MULTI-MARKET COMPETITION THEORY

A Conceptual Framework

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PROEFSCHRIFT

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CONTENTS

PREFACE

This book is an attempt at writing a scholarly work. It displays the author's understanding of what economists basically know about multi-market competition. This topic is obviously important: multinational firms and conglomerates are examples of multi-market firms. Their mutual competition is shaping the economy that others (government, employees, suppliers) act in. It is gratifying to see how much thought economists have already given to these issues. These thoughts are the subject matter that I have been grappling with for some years. In the course of this process I had help from numerous colleagues. Most of this occurred in the everyday life of an economics faculty. Let me mention some in particular, while apologising to those that I now forget. Thanks are due to my promotors Hans Maks, who tolerated my non-linear approach towards economics, and to Arjen van Witteloostuijn, who went out of his way to assist and cooperate. Lex Borghans, Hans de Graaff and Hans Peters, members of the game theory group, helped me improve my knowledge of this field. I also gratefully acknowledge comments from Hans de Graaff (throughout the book); Steven Maijoor on chapter 6; R. Cairns and Dan Kovenock on what eventually became chapter 7; and Geert Duysters and Sjef Stoop on chapter 10. I owe much to the organisers and participants of the *1991 Summer Conference on Industrial Organization, Strategic Management, and International Competitiveness* in Vancouver. Surely the most inspiring conference I ever attended, and one that changed the content of this book (especially chapters 2 and 6). And I would like to thank my parents and Ayen whose impatience was a major impetus to complete the book.

Maastricht, November 1993

PART I
INTRODUCTION

Part I contains an overview of the main themes of the book. It motivates these themes and discusses key concepts, ideas, and theories. It also introduces the structure of the book.

PART I
INTRODUCTION

1 PROLEGOMENA

Chapter 1 provides a motivation for the dissertation by pointing to the importance of some current industrial economic developments, such as globalisation of competition and business strategies. An understanding of these processes requires, I submit, building an interface between industrial economics and strategic management. This book's contribution to an interface consists of a conceptual framework.

1.1 A REAL WORLD MOTIVATION

This book is about competition among multi-market firms. These firms represent important companies such as multinational enterprises, diversified and vertically integrated firms. Three types of developments made studies such as this book relevant. Internationalisation in the world economy, globalisation, and European integration have challenged firms about where and how to compete. Various developments, such as rising wages, technological and organisational changes, and the increasing speed of imitation forced firms to identify, invest, and more fully exploit their resources (assets and 'core competences'). Improvements in internal organisation, information technology, and (airline) transportation made it possible for international firms to coordinate hitherto internationally decentralised activities. As a result, firms have reconsidered their running of multi-market activities. A firm may raise the returns to its investments by using an advantage in one market as a leverage instrument to achieve a competitive advantage in another market (Bulow *et al.*, 1985). To achieve this end, it coordinates strategic intent across its markets.

Coordination of strategic intent is a recent phenomenon. Until recently many multinational firms competed on a market-by-market basis (Hout, Porter, and Rudden, 1982; and Prahalad and Doz, 1987). Hout *et al.* (1982) distinguish international firms that compete in multidomestic and global industries. A *multidomestic* (that is, multinational) firm will coordinate finance and marketing, as well as some R&D and component production. But strategy and operations are decentralised to overseas subsidiaries: 'the company competes with other multinationals and local competitors on a market-by-market basis.' (p. 103). The *global* firm instead formulates 'strategy on an integrated, worldwide basis.' (p. 100). For instance, 'A [global] company may set prices in one country to have an intended effect in another.' (p. 103) Globalisation, therefore, refers to a firm's internal strategic decision making process rather than to the geographic extension of its sales. As an illustration, Prahalad and Doz (1987) show that in the colour television industry Philips (initially) competed with the Japanese firms on a market-by-market basis. Its Japanese competitors, however, acted from an integrated, global, perspective. The advantages derived from this strategy compensated for their initially smaller scale than Philips.

The drive toward globalisation is, therefore, a prime motive for this study.

Another motivation can be found in the '1992' European integration process. It will facilitate trade within the E.C. by taking steps that reduce transport costs and limit protectionism by national governments. The Commission of the European Community (the C.E.C.) has this to say on its motives:

> 'The intention being to encourage businesses to anticipate the overall objective and to include a European dimension from now on in their strategic planning. Together with the general worldwide economic recovery, this business reaction to 1992 is the principal reason for the revival in investment in the Community, which has now become a more attractive region for foreign investors.' (C.E.C., 1989, p. 2-3)

Including a European dimension in one's strategy can have numerous meanings, of course, but the above and other statements clearly suggest that businessmen should develop an integrated view on competing and cooperating in the E.C. Most descriptions of globalisation and European integration primarily focus on product markets. Yet they will also affect some input markets, such as the labour and capital markets.

Firms need to coordinate their actions in input markets with their competitive strategy in product markets. A very famous case where a firm failed to do this is IBM's introduction of PCs in 1981:

> 'Clones were the unintended outcome when IBM chairman John R. Opel approved a crash program to get into personal computers. He dispatched a team of 13 engineers to Boca Raton, Fla., to come up with a computer that could halt the advance of companies such as Apple, Commodore, and Tandy. (.) the team at Boca Raton was given one year to come up with an answer to the Apple II. To meet the deadline on their "Acorn" project, they broke the IBM rules. (.) [They] turned to outside suppliers for key hardware and software and signed up computer stores to sell the new machines. In the process, IBM inadvertently played kingmaker.' (*Business Week*, 12-8-91, p. 47)

The new kings, of course, were Intel and Microsoft. Potential competitors could easily clone the IBM standard by buying their key components from them, as did IBM itself. This taught IBM an important lesson, witnessing its new proprietary 'standard' OS/2: Decisions on whom to acquire inputs from can be vital for the evolving market structure. This also suggests a 'global' perspective on strategy: a rational firm needs to consider the ramifications of its strategy to *all* markets in which it participates. This refers both to interactions between input and product markets (that I will call the vertical dimension of multi-market competition), as well as to interactions among product markets (the horizontal dimension).

1.2 BRIDGING STRATEGIC MANAGEMENT AND INDUSTRIAL ECONOMICS

This book intends to contribute to an integration of several theories. In particular it sets out to build an interface between industrial economics and strategic management.

Its underlying assumption is that industrial economics and strategic management are distinctly different types of theories (or paradigms). They often cover the same research objects, *e.g.*, competition, allocation of scarce resources, strategic decision making, and satisfaction of consumer needs. As a consequence, they offer points of agreement as well as differences; and their differences should not be taken strictly. There is an ongoing integration process of both fields (to which this book hopes to contribute). Integration blurs the distinctions, and obliterates their clear-cut identities. Economists such as Caves and his colleagues Porter and Ghemawat, for instance, straddle these 'markets' in a conscious attempt to exploit analytical spillovers. Statements in this book about differences of strategic management and industrial economics do not, therefore, deny that considerable overlap exists. After clarifying the notion of integration, I will mention some differences and agreements of industrial economics and strategic management.

There are costs involved in an integrative approach. This book focuses on insights that the fields just mentioned may share, rather than on those that divide them. That is, integration is not to be understood as adding up theories A and B to get a theory C which is better because it entirely encompasses A and B. Integration instead implies a selection of elements from either side. This points to opportunity costs: selection implies a choice and a loss. For example, the book focuses on theoretical rather than empirical studies of industrial economics. It also focuses on strategic management theories of strategy content, while ignoring its analyses of the strategy process. Moreover, it has a positive rather than normative content: it is about what profit maximizing firms do, rather than about what would be socially optimal for them to do.[1]

The normative approach of industrial economics, on the one hand, is generally associated with competition policy and antitrust litigation. Questions have been raised about whether industrial economics is in a concrete way informative to antitrust litigation (Schmalensee, 1979; Spence, 1985; Porter, 1985b; and Neumann, 1988):

'Competition policy has been dominated by politics.' (Neumann, 1988, p. 155)

Strategic management has little friendliness to spare for antitrust, blaming it for creating adversary relations between government and enterprises (Willard and Savara, 1988, pp. 69-70). In the 1980s industrial economists developed rationales for a more cooperative relationship between government and business. Antitrust action directed against a 'dominant' domestic firm should avoid weakening its competition with a global competitor (Spence, 1985, p. 372; and Porter, 1985, p. 392). National welfare may benefit if the government subsidizes the domestic firm's R&D or imposes a tariff on a foreign competitor (Brander and Spencer, 1981; Spencer and Brander, 1983; Krugman, 1984; and Cheng, 1987). A government may have to impose a tariff in order to countervail another government's export subsidies (Dixit, 1984, p. 11). If research and development spill over between firms, *i.e.*, if technology diffuses, welfare may improve if firms internalise these spillovers by cooperating in R&D. Antitrust should be eased to allow such forms of cooperation

1. Business theorists might call profit maximisation a normative assumption rather than a positive one (*e.g.*, Caves, 1980, p. 77).

(Ordover and Willig, 1985; and Jorde and Teece, 1991). U.S. and European antitrust is indeed permissive of cooperative research (D'Aspremont and Jacquemin, 1988, p. 1137). Industrial economics, therefore, has come to appreciate some of the 'normal business practices' that since Adam Smith had been confused with conspiracy. This development has set the stage for industrial economics coming closer to strategic management.

Industrial economics' positive content, on the other hand, is where industrial economics and strategic management learn from each other, contribute to each other, and (try to) build bridges (Caves, 1980; De Bondt, 1985; Shapiro, 1989; Saloner, 1991; Hendrikse 1991a; and Thépot and Thiétart, 1991). Models in industrial economics have become sufficiently specific and powerful to be of use to strategic management theorists (*e.g.*, Porter, 1980 and 1985; and Ghemawat, 1991a). The large amount of modelling on capacity investments, R&D, advertising, etc., has a direct bearing on corporate strategy. Moreover, an industrial economics - strategic management interface may add realism to abstract theorising and suggest useful avenues for research. As Caves (1980, p. 88) argues:

> 'economists' preconceptions have steered them away from business strategy and organization as an area of research.'

In the 1980s economists seem to have found back the path to strategy and organisation. They have something to offer, as Caves (1980, p. 82 and 88) argues: analytical (microeconomic) rigour that seems to lack in business studies. Industrial economists are particularly meticulous on the firm's objectives. This has given rise to extensive debates on profit maximisation versus sales or growth maximisation, as well as to more recent debates on the agency costs of non-owning managers. Strategic management did not initially appreciate this point as much as it should, which led to vagueness on this issue (Caves, 1980, p. 65[n]). Microeconomic analytic *means* therefore can be used to serve strategic management research *aims*, which is the approach taken in this dissertation.

An integration of industrial economics and strategic management must come to terms with striking differences. First, there are some differences in *method*. Current industrial economics has its roots in microeconomics and game theory. Its approach is deductive: it uses first principles (*e.g.*, consumers maximise utility), with mathematical reasoning (*e.g.*, maximisation of objective functions over a convex set of constraints) to derive hypotheses and (*e.g.*, social welfare) implications. Strategic management is inductive: it tries to generalise from case studies and statistical observations. It seems to have a scavenging (integrative) approach to theoretical postulates.

The subject-object relationships in industrial economics and strategic management differ as well. Industrial economics considers firms and entrepreneurs the *objects* of its analysis. The analysis itself addresses two types of subject: the government, for the sake of antitrust and competition policy advise, and the researcher himself, whose intellectual excitement is at stake. These, at least, are the two industrial economics' objectives explicitly mentioned by Scherer and Ross (1990, p. 3). There is no presumption in this venerable handbook that entrepreneurs might learn something here. Strategic management theorists seem to place more emphasis on the interaction

with strategic management practitioners. Managers, that is, are treated as subjects rather than objects. The textbook by Hatten and Hatten (1988, p. xii), for example, addresses the reader as a manager who is going to apply the book's frameworks. This distinction goes along with (predominantly) different data that are being used. Strategic management makes intensive use of the case study method. This requires data from firms which often can be acquired only if the firms involved cooperate. A *double bind* may arise, i.e., a *quid pro quo*, where firms offer data only in return for the researcher's expertise.[2] Research is based on interaction between subject and object, therefore. Industrial economics, on the other hand, predominantly uses publicly available data.[3] No double bind arises and contact is usually established with government agencies.

Industrial economics and strategic management also differ in the weight given to research topics. On the one hand, industrial economics focuses on product markets and on strategies by firms to improve their position relative to (potential) competitors. It uses game-theoretical modelling to focus on the subtle interactions between firms, which depend on the sequence of decision making, information, and beliefs. The input side of the competition is usually curtailed by assumptions such as that firms have access to the same (or similar) production functions. On the other hand, strategic management focuses on the firm's heterogeneous, firm-specific resources, *e.g.*, its human capital, brand name, *etc.* These are sometimes called its *assets and skills* (*e.g.*, Porter, 1980, p. 348) and explain its sustainable competitive advantages. The analysis of the product market competition is relatively underdeveloped. Implicitly lurks the simple but powerful theory that sustainable competitive advantages translate over time into market share gains. This book tries to build a bridge here by means of a multi-market setting, which focuses both on product markets and resource markets.

Another difference in the relative weight of research topics is industrial economics' focus on entry deterring strategies and strategic management's focus on entry strategies. In the light of Bain's pioneering activities it does not come as a surprise that industrial economics has an overriding concern with entry deterrence strategies. Empirical evidence on whether firms do consciously deter entry is scanty (Smiley, 1988; Gilbert, 1989, p. 118; and Hall, 1990). Strategic management's concern with sustainable competitive advantages offers some support for a focus on entry deterrence.[4] Both disciplines assume that the incumbent firm brings its competitive advantage (whether a first move or ownership of resources) to bear in competition with (potential) newcomers. More than industrial economics, however, strategic management matches its interest in entry deterrence strategies with an interest in established firms' entry strategies. Diversification studies are the most

2. I owe this comment to my colleague B. van Diepen.
3. Industrial economic game theories increasingly turn to case studies as well. Boundaries between industrial economics and strategic management are diminishing, as I will argue later.
4. Hatten and Hatten (1987b, p. 341) actually equate competitive advantage to a barrier to entry.

important example.[5]

The industrial economics part of the integration effort in this study is a selection of theories. It draws from the 'old' as well as from the 'new' industrial economics. The former has as its dominating figure Joe Bain; it is verbal and empirical in nature. Mathematical models are rarely used, and most analysis is based on diagrams (*e.g.*, Modigliani, 1958). The new industrial economics is based on game theory and microeconomics. Its achievements have been exposed in such books as Tirole (1988) and the Handbook edited by Schmalensee and Willig (1989). From these two streams I make an idiosyncratic selection. Both strands made useful contributions, but these have to be identified with care.

Bain's (1956) limit price theory was an important improvement over Chamberlin's (1933) exclusive attention to *actual* entry, by focusing on incumbent firms' anticipation of *potential* competition. But Bain did not go far enough. He allowed the incumbent firm to prepare for entry deterrence, but he overlooked the possibility that the potential entrant, for its part, may prepare for entry. Both the incumbent firm and the potential entrant may be committed players. For example, Gelman and Salop (1983) explore a case where the entrant makes a commitment to small scale. The incumbent monopolist loses less by allowing this entry than by deterring entry through a low price (*judo economics*). Bain's analysis gave rise to *incumbent games* where incumbent firms deter entry by passively reacting (unsophisticated) potential entrants (De Bondt, 1985, p. 153). Innovation studies gave rise to *entry games*, where firms identify and compete for entry into new markets. Integrating these perspectives remained a 'future research issue' for a long time, witnessing De Bondt's statement in 1985:

> 'incumbent strategies [as reviewed in the paper] still view entrants as relatively unsophisticated (.) The incorporation of more symmetry in the sophistication of the strategies of all rivals, both entrants and incumbents, is probably essential for a useful bridge to business strategy analysis.' (De Bondt, 1985, p. 153) 'The sophistication of new rivals in reality is likely to go further than rational expectations as to what the industry equilibrium will evolve to.' (De Bondt, 1985, p. 154)

Multi-market analysis is such an integration: it focuses on related product markets, whose incumbent firms are potential entrants into each other's markets. The established firm in each market is committed (*e.g.*, by capacity) for a role in the game (whether as entrant or as entry deterring incumbent firm). This accords with strategic management's natural focus on existing firms in their dual role of incumbents and potential entrants.

1.3 A CONCEPTUAL FRAMEWORK

The aim of the framework in this book is, like any conceptual framework, to serve

5. For instance, Rumelt (1974), Wernerfelt (1984), Roberts and Berry (1985), Hatten and Hatten (1987), Lambkin (1988), Ramanujam and Varadarajan (1989), Clarke and Brennan (1990), and Chatterjee and Wernerfelt (1991).

as an *organising principle*. It provides a set of concepts and ideas that organise (our understanding of) a complex part of the real world. It is essentially a verbal achievement, a story to accompany the disparate modelling that has evolved on multi-market firms. The reader will find that numerous ideas (perhaps all) in this book were voiced earlier. For example, a focus on established firm entry dominates P.W.S. Andrews's work. If the language in this book seems a 'new bottle for old wine', I can only repeat others' experience that old wine is often the best.

The multi-market framework may guide research by providing concepts, intuition, and analogies. Here, the 'proof of the pudding is in the eating'. Only if the framework actually succeeds in informing research can it be said to function as such. Future research issues in the afterword may give a hint of the areas of future applied work. I admit in advance that this *reductio ad futurem* constitutes a rather informal test of the framework. But then, frameworks cannot be tested.

The conceptual framework in this book is not a figment of my imagination. It is born out of a careful study of the work of prominent economists. Specific sources of inspiration are the literature on diversification, integration, multiproduct firms, contestable markets, multinational enterprise, inter-brand competition, transaction costs and international trade. The book therefore contains surveys that go beyond reiterating economic theories. It offers an asessement of their contributions. Some economists I will refer to rather prominently are not even mentioned in the best known handbooks on industrial economics. Partly this is, I believe, an act of justice. Each 'new' view implies a reassessment of who the important forerunners were. P.W.S. Andrews and H.F. Lydall receive pride of place, while from my point of view Bain's (1956) contribution has been exaggerated (see chapter 3). The book also has critical as well as constructive aims. Critiques are required to get rid of obsolete views that deter progress (see part II).

The constructive aim of the book appears especially in part III which proposes a standardisation of terminology used by economists, and thus, may facilitate communication. Current papers in the literature usually are isolated contributions to multi-market theory. They are bound to develop related insights by means of idiosyncratic terminology. For example, what this book refers to as multi-market spillovers is also called multi-market economies (Scott, 1982, p. 369), joint economies (Bulow *et al.*, 1985, p. 509), synergy (Karnani and Wernerfelt, 1985, p. 95), spill-over effects (Ayal and Zif, 1979, p. 90), and interrelationships (Hill, 1988, p 67). In another example, multi-market collusion is also called mutual forbearance (Feinberg, 1985), spheres of influence (Scherer, 1980, pp. 340-342), and live and let live philosophy (Kantarelis and Veendorp, 1988). As a consequence, communication failures arise. For example, Calem (1988) does not refer to the paper by Bulow *et al.* (1985). This indicates the formative stage of the theory. The book might contribute towards ushering in the mature stage of the product life cycle of multi-market theory.

1.4 CONTENTS OF THE BOOK

The next chapter, chapter 2, gives a short exposition of the multi-market competition framework. Part II traces the history of the debate on established-firm entry from the 1930s up to the 1980s. Chapter 3 brings to the fore some early analyses of

established-firm entry. It also shows how for a long time the predominant concern with incumbent firms' entry deterrence pushed entry strategies into the periphery of industrial economics. Chapter 4 argues that industrial economists developed the sunk cost concept when they became aware of the importance of factor market imperfections to product market competition. Part III gives a detailed exposition of the multi-market competition framework as it evolved in the 1980s. It recognises the interaction between multiple (product and country) markets (chapter 5) as well as the interaction between product and input markets (chapter 6).

Part IV gives some explorations of the framework. It uses tools discussed in part III to explore leading theories explored in part II. Its function is heuristic and illustrative rather than conclusive. Chapter 7 contains a contribution to a debate on the theory of contestable markets. This theory begs the question who the potential entrants are, that can hit-and-run with short entry and exit lags, and without sunk entry costs. A recent debate points to established firms in related markets. This contention can fruitfully be examined in a multi-market framework. In fact, this debate gave rise to the notion of multi-market competition in this book.[6] The topic of chapter 8 is the use of capacity investments as an instrument in competition. Capacity investments have implications for product markets (that can be served by the capacity) as well as input markets (where capacity or complementary factors are traded). The incumbent firm's entry deterrence focuses on the investment's consequences either for related product markets (if the potential entrant is established in a related product market) or for an input market (if a *de novo* entrant needs yet to acquire its inputs).

Part V discusses the importance of market boundaries, and changes thereof, for multi-market competition. Chapter 9 discusses the interaction between market definition and business strategies. It suggests the contours of a dynamic markets perspective, which may be helpful in understanding cases where market boundaries fade, and firms' strategies both anticipate and respond to this. Chapter 10 illustrates the argument for the case of the computer and consumer electronics industries. Their market boundaries are fading, and they seem set to converge into a unified multimedia industry. The afterword reiterates limitations of the book which may anticipate future research issues.

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6. Van Wegberg (1990) provides a different inspiration to the present dissertation. It explores the *cross-over dynamics* in classical (Ricardian and Marxian) political economy. These dynamics imply that profit opportunities in a market call forth entry of capital from other markets. This affects the supply conditions in those markets. This induces cross-mobility of capital until a long run ('classical') equilibrium has been established.

2 A GUIDED TOUR THROUGH THE BOOK

Chapter 2 contains a summary of the multi-market competition framework which I explore in this book. Each firm is active in a setting of (horizontally and vertically) related (product and input) markets. Multi-market competition provides an industrial economic specification of Porter's *extended rivalry* framework, where a firm vies for profits with (industrial) buyers, suppliers, and (potential and actual) competitors which supply (im)perfect substitutes.

2.1 INTRODUCTION[1]

This chapter summarises the key ideas and concepts of the multi-market competition framework. It gives a feel for what the next chapters have to offer, while trading off this 'feel' for some precision. Definitions of concepts are preliminary only; see later parts for 'definitive' statements and references. First it introduces the multi-market setting in which firms coordinate their competitive moves and countermoves. Next, it discusses some of these moves. Important to multi-market competition are the firms' resources, the factor markets where they are traded, and the product market activities in which they are used.

2.2 SETTING THE STAGE: RELATED MARKETS

The economy is a chessboard of markets, as figure 2.1 may illustrate. In a very general context, it refers to value chains running from factor (input) markets to final (consumer good) markets. Point of departure in the figure is market I2, where an intermediate product is traded. In markets F1 to F3 inputs (*e.g.*, factors or other intermediate products) are supplied to industrial buyers which are suppliers in markets I1 to I3. The buyers in markets I1 to I3 are firms which cater to the customers in markets C1 to C3. Markets F4, I4, C4, *etc.*, are the associated markets of the F1, I1, C1, *etc.*, product in a different location (country or region). These are *related markets* if they are connected by links. There are three links to consider: shared participants (buyers or sellers), shared instruments (assets) in the production or consumption processes that underlie market transactions, and coordinated behaviour. There are degrees of relatedness, of course. The book will concentrate on cases where relatedness is salient, such that actions in one market will affect a firm's actions in another market.[2]

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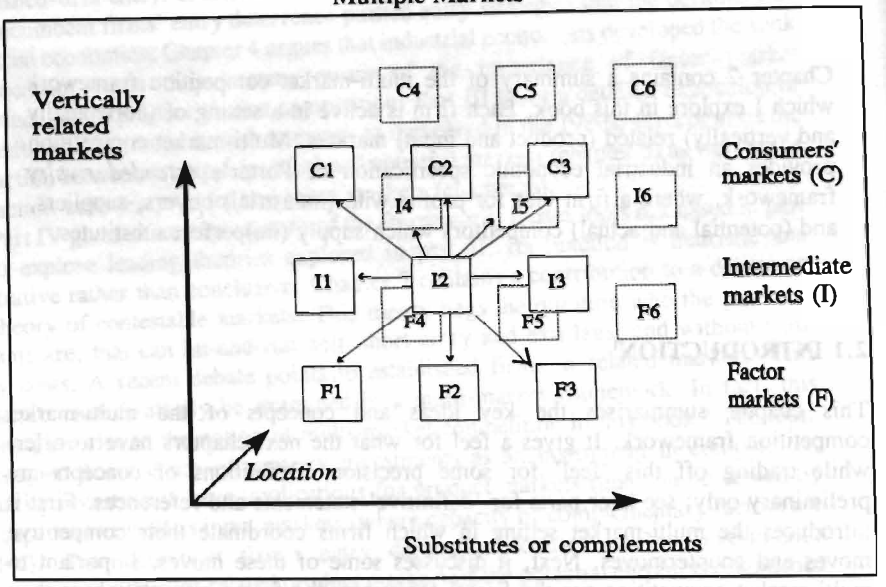
1. Parts of this chapter are based on Van Witteloostuijn (1990b), Van Wegberg and Van Witteloostuijn (1991), and Van Witteloostuijn and Van Wegberg (1992).
2. Chapter 9 will discuss the obvious implications of relatedness for market definition.

Figure 2.1
Multiple Markets



Related markets can be distinguished in *vertically related markets*, where inputs flow from one market to the other (from markets Fi through Ii to Ci, i = 1,2,3) and *horizontally related markets*, if their products are substitutes or complements in production or consumption. The latter applies to the same product traded in different locations or different products that use the same production or consumption process. This scheme may serve as a framework to encompass several types of competitive moves by an established firm. It enriches the description of (potential) competition in a market by drawing in the interaction with other product or factor markets.

The figure captures both *threats* from and *opportunities* in the environment. Opportunities arise for entry into related markets. In terms of figure 2.1, an entry move from I2 to C2 is an instance of forward integration. An entry move from I2 to F2 is an instance of backward integration. If firm 1, an incumbent supplier in I2, diversifies into market I1, it reaps the economies of scope that may exist between the production functions used to supply the I1 and I2 markets. Product cannibalization may occur if it enters market I3 that, say, trades a (highly) imperfect substitute for the I2-product. If the I2- and I3- products are complements instead, firm 1 benefits from a positive spillover that its I3-sales may have on its I2-sales. Firm 1 may enter market I5 to exploit economies of scale between the I2- and I5-market.

If the direction of the arrows is reversed, Figure 2.1 is a restatement of Porter's (1980, p. 4) *extended rivalry* scheme within a multi-market context. That is, firm 1 faces threats from the environment as entry occurs by means of backward integration (from C2), forward integration (from F2), diversification (from I1 or I3), and imports (from I5). The figure illustrates the symmetry in the

framework between the potential entrant's entry strategy and the incumbent firm's entry deterrence strategy.

The figure may also identify the firm's *stakeholders*:

> 'A stakeholder is any individual or organization whose behaviour can directly affect the firm's future but is not under the firm's control (.) there is an exchange of goods and services for money, or of approval for results, between the firm and such groups.' (Hatten and Hatten, 1988, p. 66)

Suppliers, competitors, customers, and other actors suggested by figure 2.1, are, therefore, stakeholders who are connected through exchange of goods and services. Stakeholders who 'approve' of the firm's performance are the government, unions, and other social groups. The definition implicitly assumes imperfect competition, for individual actors in perfectly competitive markets cannot affect a firm's future.[3] Stakeholders may contribute to the firm's performance, but they may also impose costs upon the firm. They too represent threats and opportunities. How do firms interact in this setting?

2.3 THE COMPETITIVE GAME IN MULTIPLE MARKETS

The topic of this book is the competitive interaction among firms across different (product and resource) markets. A parable may illustrate the interaction. How do football clubs, like Ajax and AC Milan, compete for prizes? By preparing themselves for the fight in the football stadium, one gathers. These preparations imply competition in several dimensions and 'markets'. Football clubs compete in the markets for players, sponsors, and broadcasting time. Clubs may not only prepare for battle by improving their own skill in the arena, but also by weakening their opponent through actions in the other markets. For instance, AC Milan might contract Ajax's best players. Firms exhibit the same characteristics. Consider two firms which compete in, say, output level (q_i, i = 1,2) in a homogeneous product market (a Cournot duopoly). Figure 2.2 illustrates.

The point of intersection (C) of the reaction curves (R_i, i = 1,2) gives the familiar Cournot-Nash equilibrium. Prior to the product market competition, firms may commit to actions that affect the location of these reaction curves. This prior commitment stage turns the game into a two-stage game. The resulting competition has been called strategic competition (Ulph, 1987). There are two effects (see chapter 8). The *own effect* is that a firm prepares for product market competition by reducing its marginal costs through, *e.g.*, a capacity or R&D investment (Dixit, 1980; and Brander and Spencer, 1983). If firm 1 invests to reduce its marginal costs, it shifts its own reaction curve outward. In equilibrium, this increases its output level and reduces firm 2's output level (from C to C_1). An alternative is the *cross effect*, where firm 1's strategy is to raise the other firm's marginal costs (Salop and Scheffman, 1983 and 1987; and Dixit, 1986). It thereby shifts firm 2's reaction curve inwards. This too reduces firm 2's output

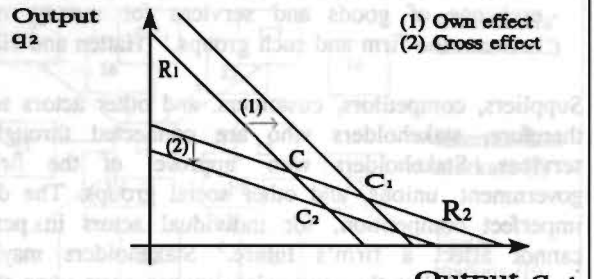
3. A more general definition would include as stakeholders actors who *collectively* affect the firm's future.

level (in equilibrium) while raising firm 1's output level (from C to C_2).

These effects require an in-depth analysis of the context in which the product market competition occurs. Strategic competition aims to exploit this context. Multi-market competition generates scenarios that may realise the cross effect as well as the own effect. These scenarios contain actions in a related market that will affect the product market competition, as the next sections suggest. Multi-market competition relates two elements that will loom large in this book: the importance of the firm's resources and the competitive interaction across product markets.

Figure 2.2

The Own and Cross Effect of Strategic Competition



2.4 RESOURCES, MULTIPLE MARKETS, AND RETURNS

Resources are the firm's (in)tangible assets, both those that are valued in the firm's annual accounts and those that are not (invisible assets). In a conventional definition of *resources* as capital, their productive services are inputs in the firm's production function. The presence of stakeholders allows a wider definition that includes relationships with stakeholders who contribute to the firm. In this book resources may, for instance, refer to consumers' trust in a firm (goodwill), reputation with suppliers, close relationships between government and the firm, *etc.* Resources have in common that they are durable (they are not completely used up while being used) and they raise the firm's value (by an amount which itself is the *value* of the resource). Many relationships with stakeholders have these characteristics. This extension of the concept of resources (or capital assets) seems to have been pioneered by Japanese firms. In the 1950s Japanese firms owned little capital in the conventional Western sense (capital goods, patents, *etc.*). To compensate this, they began to convert lasting relationships with suppliers, employees, government and consumers into alternative resources.[4] Lasting relations with suppliers led, for example, to just-in-time production. This raises the firm's value by cutting its production costs.

A 'folk theorem' in strategic management is that firms derive a sustainable competitive advantage from the ownership of efficient resources. The *resource-*

4. Womack, Jones and Roos (1990, p. 48-69) record the history of *lean production* at Toyota from the late 1940s to the late 1950s. They focus on Toyota's evolving relations with employees, suppliers and customers.

based view of the firm has sought to analyze this view (Penrose, 1959; Wernerfelt, 1984; Ghemawat, 1991b; and Grant, 1991). It argues that factors of production are often heterogeneous, that is, different between firms. Examples are locations, teams of managers and scientists. To convey a competitive advantage, the firm's resource has to be efficient relative to product market rivals. The profit derived from the resource, which equals its value minus the costs needed to attract it, is an (efficiency) *rent*. A firm faces three decision problems about its resources, which are linked, but have been treated separately by most literature. The first one is to match its efficient resources and its activities.

2.4.1 Matching Activities to the Firm's Resources

Resources that 1) generate a rent and 2) are used intensively in a market (activity) are known as *strategic factors* (Barney, 1986b). The associated policy advise is to focus on activities where the firm's efficient resources can be strategic factors. It can adjust its activities in a vertical direction (in the value chain) and in a horizontal direction (across product markets). For example, if a firm's know how is an efficient resource, it may enter a knowledge-intensive industry while undertaking only those steps in the associated production process that are knowledge-intensive. It makes an extensive use of its efficient resources if, by means of entry and exit, it adjusts its served product markets to those that use its efficient resources intensively. Given that it wants to supply a product, a firm may undertake itself those steps in the production process (or value chain) where it is efficient relative to rival suppliers. It may contract out to suppliers the other steps. The associated instruments are make-or-buy decisions, forward and backward integration, investments and divestment. The activity choice raises three related issues: which resources should the firm focus on, which activities should it undertake given its resources, and how should it exploit its resources in several product markets?

Considering the first question, firms may have numerous resources, which differ in relative efficiency. For each of the firm's resources, exploiting its potential to generate rents may require (horizontal or vertical) strategic moves in value chains and product markets. If the firm owns a variety of resources, the associated strategic moves may be contradictory. The firm may avoid conflicts by focusing on a small subset of efficient resources, that can be exploited by a consistent strategy. Such a bundle is known as a *core competence*. Prahalad and Hamel (1990, pp. 83-4) define the core competence as follows:

> 'First, a core competence provides potential access to a wide variety of markets. (.) Second, a core competence should make a significant contribution to the perceived customer benefits of the end product. (.) Finally, a core competence should be difficult for competitors to imitate.'

They add that a core competence is likely to be a team of assets rather than an individual asset, 'a complex harmonization of individual technologies and production skills' with internal coordination and learning (Prahalad and Hamel, 1990, p. 84).

The second question suggests that a firm may raise its rents from a (shared) resource or core competence by using it in several product markets. As Teece (1982, p. 45) argues,

> 'a firm's capability lies upstream from the end product -it lies in a generalizable capability which might well find a variety of final product applications.'

This leads to the important concept in strategic management of *synergy*:

> 'synergy', the economics of one business in a symbiotically beneficial relationship with those of another, is based on precisely these shared resources.' (Clarke and Brennan, 1990, p. 11).

This synergy concept (an economy of scope) is used to explain or guide diversification strategy (*e.g.*, Teece, 1982; Yip 1982a; Hatten and Hatten, 1987; and Ramanujam and Varadarajan, 1989, p. 526).

Finally, the question arises which organisational forms a firm may use to realise synergies. One particular form, internalisation, occurs if a firm makes an internal use of the shared resources by entry into a related product market, thus becoming a multi-market firm. Contracts are another form, where resource suppliers provide shared resources to independent suppliers in several markets (see subsection 4.3.2). Contracts used are selling, licensing, and leasing. Internalisation and contracting are the extreme organisation forms by which firms assure the use of shared resources in multiple product markets. Strategic alliances (*e.g.*, joint ventures) are intermediate forms. Within transaction cost theory, *internalisation theories* argue that for many firm-specific resources the best (transaction cost minimising) organisation form is for the firm to internalise the use of these resources. That is, any economies in using these resources are realised within the firm by using it in new activities (markets), rather than by selling (or licensing) the services of the resource, or parts of the resource itself, to other parties (*e.g.*, incumbent firms in those markets). This is how Rugman explains the multinational enterprise (MNE):

> 'internalization theory demonstrates that the MNE is an organization which uses its internal market to produce and distribute products in an efficient manner in situations where a regular market fails to operate. (.) There are many kinds of natural market failure associated with the pricing of knowledge, or similar firm-specific intangible advantages. These occur in the areas of technology, managerial skills, corporate organizational structures and other aspects of the internal market of the firm. The firm, in short, is an alternative to the market.' (Rugman, 1982, p. 11).

Within strategic management, the resource-based view of the firm gives the same explanation of diversification (Montgomery and Wernerfelt, 1988; Ramanujam and Varadarajan, 1989; Chatterjee and Wernerfelt, 1991; and Montgomery and Hariharan, 1991):

'The prevailing theory of diversification .. is based on excess capacity of productive factors. It argues that failure in the markets for these factors may make diversification an efficient choice, although the factors are expected to lose some efficiency in the transfer.' (Montgomery and Wernerfelt, 1988, p. 623)

Throughout most of the book, I will focus on internalisation in multi-market firms (see chapter 10 for strategic alliances in information technology industries).

2.4.2 Getting Durable Rents from Resources

The firm's second decision problem about resources is to defend their associated rents against (potential) rivals and suppliers. A rent based on a unique (or scarce) resource appears to be *sustainable* only if the resource is not (costlessly) imitable. Imitation will drive down prices, and thus reduce the value of the resource. Whether the firm realises a rent also depends on a condition of *appropriability*, *i.e.*, the firm bargains successfully over the rent with the suppliers of its resources (*e.g.*, employees) (Grant, 1991). The bargaining position of the resource supplier improves if it can threaten to sell the resource elsewhere. This will raise the resource's price, and thus determine which part of the rent the firm will realise (*i.e.*, value minus price), and which part the supplier will appropriate (*i.e.*, price minus cost). The resource's opportunity cost (the highest value of the resource to any other firm) will equal its value if the buyer firms are homogeneous. The rent will be zero as a result (chapter 6 will go into this with more detail). *Heterogeneity* is, therefore, an important determinant of rents. Among heterogeneous firms, a resource is *firm-specific* if it attains its highest value in one particular firm. The firm's bargaining position is considered strong if a resource is firm-specific, as resource suppliers cannot credibly threaten to sell their resource to someone else.

2.4.3 Competing for Resources

The core theory of the resource-based view of the firm assumes that there is a given distribution of resources across firms. But how did firms get those resource in the first place? Some important types of resources (such as experience) have been accumulated over time through the firm's activities. Others, however, have been bought in external factor markets. These resources may be subject to competitive bidding between firms. If there is imperfect competition in input markets, a rival may try to influence the quantity, quality, and price at which a rival acquires its resources. Higher resource prices have distributional effects by reducing the firm's rent, but may also affect product market competition. Salop and Scheffman (1983) argue that an incumbent firm may deter entry, induce exit, or reduce the entrant's scale by raising rivals' costs. They give several examples. A firm may try to prevent its suppliers from supplying an entrant or fringe firm. A capital-intensive dominant firm may negotiate high industry wages with the union, which hurt its labour-intensive competitors most. Also, 'exclusive dealing arrangements [with one's dealers] can raise small rivals' costs of distribution.'

(Salop and Scheffman, 1983, p. 267). Advertising and R&D raise rivals' costs if rivals have to match these outlays. And finally, a firm may lobby to have the government inflict costly regulation on its rivals as well as itself (rent-seeking).

In terms of figure 2.2, cost-raising by firm 1 shifts both its own and its rival's reaction curve inwardly. The net effect on output levels and profits can be positive as well as negative. Without further analysis one can only conclude that at least one firm has to reduce its output level. Salop and Scheffman distinguish two cases. *Cost-raising competition* (or 'predation') occurs when the dominant firm cost-raising strategy hurts its rivals. Their profits fall as the effect of a higher price on their profits is overcompensated by their higher costs. *Cost-raising collusion* occurs when the rivals stand to gain: the increase in price compensates for their higher costs. The real losers here are the consumers, who foot the bill of this collusion. Strategic competition in (external and internal) input markets thus affects both the firm's and its rivals' reaction curves in product market competition. These actions reflect a "vertical" dimension in multi-market competition.

Cost-raising competition hinges on an asymmetry between the preemptive firm and its rivals. It raises its own costs less than it raises theirs. Several asymmetries exist. For instance, if the dominant firm has a first-mover advantage, it may preempt second movers by acquiring an input (*e.g.*, a patent) which subsequently raises entry costs. It may also have differential input requirements, *e.g.*, due to its different size, complementary resources, or degree of vertical integration. As a consequence, an input price increase may raise its costs less than it raises its rivals' costs. The wage-negotiation example above is an illustration. The resource-based view argued, as noted above, that a firm may enter other product markets in order to raise the rent from a scarce and efficient resource. This, however, induces competition with other firms, whose reaction influences the firm's rents.

2.5 HORIZONTALLY RELATED MARKETS

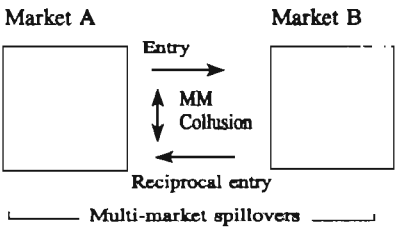
Potential entry may have several sources. The entry threat by established firms in other (country or product) markets is of a different nature than new firm entry. It therefore warrants a different response by incumbent firms. This point will emerge as a key concern in this book. In particular, how should an incumbent firm defend its stake against an established firm in a related market? The *Wall Street Journal Europe* (July 18, 1991, p. 1) nicely puts the key insight:

> 'U.S. Computer Firms Attempt an Invasion of Japan's PC Market - Success Would Keep Rivals From Using Home Turf As a Global Springboard'

A strategy to defend one's home market by challenging one's competitor's home market involves complicated interactions between these markets. These have been modelled in detail only recently. The rise of Japanese competitors, who use their safe home market as an entry platform, gave an impetus to these studies. The business interest in European integration is motivated by the desire to develop the common market into a 'global springboard'.

Entry from market A into B affects the investments in and utilisation of the firm's resources as well as product market competition. Entry raises resource utilisation, which may impose a cost upon the home market (an opportunity cost of entry). It may also, however, raise investments which may have positive (spillover) effects on the home market. Entry may also raise competitive spirits in the entry market, which may lead to reciprocal entry into one's home market. Entry may also set the stage for new, cross-market, forms of collusion. This provides four key features that drive rivalry if firms meet in multiple product markets. Figure 2.3 illustrates the framework.

Figure 2.3
Multi-market Interrelationships



(1) *Opportunity cost of entry*. Entry gives an opportunity cost, in the sense of home market profits foregone, if the entrant has a binding capacity constraint that forces it to withdraw capacity from its home market (Calem, 1988, p. 172). The opportunity cost arises whenever entry diverts a resource from the home market, *i.e.*, reduces its availability to its original use. The entry opportunity cost is zero if excess capacity is employed (Cairns and Mahabir, 1988) or if the resource has a public good character. In the latter case, the resource involved can be used in any number of activities without impairing its contribution to either:

> 'A distinctive characteristic of such [public or collective] goods is that they are not "used up" in the process of being consumed or utilized as an input in a production process.' (Oakland, 1987, p. 485). 'To be considered public a good must also be of interest to more than one consumer or firm.' (p. 485).[5]

An *inside entrant*, *i.e.*, a firm within the set of related markets (in figure 2.1), can *economise* on *entry costs* either by using non-utilised resources of a private good character (*e.g.*, excess capacity) or by using resources with a public good character (*e.g.*, R&D). This may induce spillovers.

(2) *Multi-market Spillovers*. A multi-market firm's products can be different along three dimensions: (physical) product characteristics, location, and time (of availability). Supplying multiple different products may create economies. Three notable cases are economies of scope (if the products are physically different), economies of scale (if physically identical products are traded at different

5. This is not to deny that many resources are neither strictly private goods nor public goods. The concept of club goods has been developed in order to understand intermediary cases (Oakland, 1987, p. 502).

locations), and learning-by-doing (if current production reduces the costs of goods produced later). These economies include both demand effects (*e.g.*, goodwill) and supply effects (*e.g.*, economies of scale). They are *multi-market spillovers* if a firm's actions (*e.g.*, its output level) in market A affect the (marginal) payoffs of its actions in market B and *vice versa*. That is, $\partial^2\pi/\partial S^A \partial S^B \neq 0$, where π is a firm's overall profit, and S^i is its action (*e.g.*, output level) in market i (= A,B) (Bulow, Geanakoplos and Klemperer, 1985, p. 493 and 509). Underlying these spillovers is the use of a shared resource (for example, a brand name) (Teece, 1980). These shared resources are the core competences referred to above; the associated spillovers create synergy (subsection 2.4.1). They provide an efficiency motive to the multi-market enterprise (Baumol, Panzar and Willig, 1982), such as multinational firms (Caves, 1982) and diversified firms (Teece, 1982).

(3) *One-sided and Reciprocal Entry*. Entry by an existing firm from market B into market A is one-sided if it is not reciprocated by the incumbent firm(s) from market A, and reciprocal entry if it is. Calem (1988) explicitly offers two economic rationales for one-sided entry. First, the incumbent firm's entry cost is sufficiently large to refrain from entering the potential entrant's market (Calem, 1988, p. 175). Second, legal or regulatory barriers may prevent incumbent firms from being potential entrant into the rival's market (Calem, 1988, p. 182[n]). However, one-sided entry is far from the only plausible case. Inside firms can exert a *reciprocal entry* threat (*e.g.*, Porter, 1980; Brander, 1981; Calem, 1988). Entry decisions can be interdependent if an initial act of entry induces or deters reciprocal entry (Bulow *et al.*, 1985, p. 506[n]). The initial entrant need not only take into account the entry profit per se, but also the subsequent change in its home market profits due to (induced or deterred) reciprocal entry.

Porter (1980, p. 90) summarises the strategic implications by arguing that '[m]ultiple markets provide a way in which one firm can reward another for not attacking it, or conversely, provide a way of disciplining a renegade.' Three examples illustrate reciprocal entry (threats). First, incumbent firms in the entry market may decide to enter the entrant's home market (Brander, 1981; and Calem, 1988). This strategy of counterattack is a parry to the potential entrant's entry attack (Yip, 1989). Second, Watson (1982) identifies counter-competitive strategies that anticipate and preempt the potential rivals' entry move: counter-competition entails actions (for example, entry into the potential entrants' home market) that force the potential entrant to tie resources to her home market. Third, hostage or foothold strategies can be employed to keep potential entrants in check (Caves, 1982). A foothold in the potential entrants' home market signals the ability to respond immediately to the potential entrants' entry strategy by retaliation in her home market (Karnani and Wernerfelt, 1985).

(4) *Multi-market Collusion*. Edwards (1955) proposed the hypothesis that firms meeting in several markets recognise their interdependence and therefore may decide to tune down competition. A history of multi-market competition with, for example, a series of entry and reciprocal entry moves, may well lead to a reduction in competition (Caves, 1982, pp. 103-107). The larger the number of markets where firms meet, the better they are able to communicate an intent to

collude (Feinberg, 1984). The ability to punish a firm that cheats in one market in other product markets, even if it did not cheat there, reduces the gain of cheating, which makes collusion more attractive. Multi-market collusion may have several forms. For example, firms may establish exclusive spheres-of-influence, where each firm is dominant firm or monopolist in one sphere while keeping out of other spheres (Scherer, 1980, p. 340).

With these four features, multi-market competition has an impact on product market competition (*i.e.*, the location of reaction curves). Due to a positive multi-market supply spillover (feature 2 above), production in market B may reduce marginal costs in market A, which shifts the firm's reaction curve in A outward (Bulow *et al.*, 1985). Multi-market spillovers may, therefore, underlie the own effect in figure 2.2 (from the perspective of market A). To illustrate the cross effect, consider firm 1, the incumbent firm in product market A, and firm 2, the incumbent firm in market B. Firm 1's entry in market B may reduce firm 2's profits there, thus reducing firm 2's opportunity cost of entry into market A (features 1 and 3 above). This may shift firm 2's reaction curve in market A to the left (the cross effect), which increases its output level in market A. Price falls where it most hurts firm 1, in its home market A. Anticipating this, it may decide against entry into market B (Bulow *et al.*, 1985).

The discussion of the vertical dimension (in the previous section) and the horizontal dimension (in this section) of multi-market competition has given a quick and dirty view of the main themes in this book. A recurring theme that combines both dimensions is that a firm may earn rents from scarce resources by applying them to multiple product markets. The next part of the book reviews the historical antecedents of the framework.

PART II
PRIOR HISTORY

It is a common place observation that many entrants are established firms in other markets. Yet it has taken considerable time and effort before the theoretical relevance of this observation became apparent. Two themes lurk behind much of the discussion in this part. The first one is the extent to which potential entrants are considered real players in the game. They can be active players themselves (*e.g.*, multinational firms) or passive 'players', who merely respond to an incumbent firm, who does engage in strategic behaviour. A second theme is that sunk (irrecoverable) costs have ambiguous implications for entry. Sunk costs may constitute the core of an entry barrier (Baumol, Panzar and Willig, 1982). They may also, however, refer to assets, such as a brand name or know how, that give rise to economies of scope. As such, they may stimulate entry by multinational or multiproduct firms. This gives rise to the paradox that sunk costs are both associated with entry barriers and with entry by established firms in related markets.

PART II
PRIOR HISTORY

3 ANTECEDENTS: Established-firm Entry in Industrial Economics

Chapter 3 contains a survey that traces the genesis of the multi-market competition framework from the 1930s onward. It explores how economists discovered the importance of potential competition to incumbent firms' strategies and market performance, and how they linked this to the identity of the entry threat. Joe Bain and Philip Andrews are pioneers of two alternative theories of industrial organisation. Whereas the former focuses on entry deterrence, the latter rather focuses on entry, in particular the 'easy' entry by established firms in related markets. The ease-of-entry approach is a forerunner of the theory of perfectly contestable markets.

3.1 INTRODUCTION

A digression on Chamberlin's (1962; originally 1933) book may help to set the stage for the pioneering literature. Chamberlin identified entry by firms new to the industry as the main competitive constraint upon incumbent firms. His core model is as follows. In an industry with differentiated products, each product entails an individual downward sloping demand curve. Like monopolists, incumbent firms maximise profits over their product's individual demand curve. Entry introduces 'competition' in this situation. An entrant acquires its own demand curve, while reducing demand of the incumbent firms. Incumbent firms adjust to this by reducing their level of output. Since an economy of scale exists, the contraction raises their costs, to which they respond by raising their prices. A sequence of entry occurs up to the point where an additional entrant would just fail to recover its costs. At this point, incumbent firms are supposed to earn zero profits (*i.e.*, Chamberlin's tangency solution). The resulting equilibrium contains a plethora of differentiated products, numerous firms earning zero profits, high prices, and output levels short of the cost minimising levels ('excess capacity'). This model or vision placed imperfect competition centre stage. It marked a conceptual break with the traditional Marshallian approach, which opposed perfect competition to monopoly, while treating imperfect competition with tools appropriate only to perfect competition (Samuelson, 1985, p. 347). Chamberlin's book created the intellectual context for subsequent analysis of industrial economics (as it came to be called). Shortcomings of his theory partly inspired this research, and I will mention three in particular.

Kaldor (1935, p. 40), Clark (1940, p. 246), Harrod (1952, pp. 139-157), and Bain (1956, p. 40) criticised Chamberlin's (tangency) model, arguing that established firms anticipate entry, rather than adjusting to it afterwards. By giving up some current profits incumbent firms may deter entry, which prevents a large loss of profits in the future. Bain (1956) expanded upon this theme by the limit price theory. The limit price deters (some) future entry, while being costly in the short-run as it is lower than the monopoly price. In equilibrium positive profits can be earned if the

Chamberlinian assumptions of economies of scale and product differentiation hold (two of Bain's entry barriers). Chamberlin, in contrast, concluded that incumbent firms would earn zero profits. Bain's approach shifted attention from actual entry to potential entry, and credited incumbent firms with foresight and strategic intent. It suggested the contours of a theory of strategic behaviour, where firms choose current actions to influence future decision making by rational rivals.

Chamberlin assumes each firm to supply a single product. This is evident from his *tangency solution*: the revenue from the single product has to recover all costs made by the firm, including the administrative overhead costs that are responsible for the economies of scale. By implication, the entrants are presumably new firms, for otherwise their entry would turn them into multiproduct firms. This topic, the identity of the (potential) entrants, will loom large in this dissertation. Established-firm entry implies that firms turn into multiproduct or multinational (i.e., multi-market) firms. Economists took a long time to turn their attention to multiproduct firms (*e.g.*, Coase, 1946; Clemens, 1951; and Lanzillotti, 1954). They widened the scope of firms' competitive moves to the choice of product line, the identification of entry markets, and the possibility of cross-invasion into each other's territory (*e.g.*, Lanzillotti, 1954, p. 471). Attention shifted, therefore, from incumbent firms' entry deterring strategies to potential entrants' entry strategies.

Chamberlin's 'tangency solution' (1962, p. 82) makes the heroic assumption that all firms, new and existing, have access to the same production process and product technology. He discusses factor market imperfections in a later stage of the book (1962, pp. 112, 264-5, and 303), while clearly considering them ancillary to the book's main thrust. He limited his vision of diversity, product differentiation, and imperfect competition to the product market: 'the vision of diversity and unsystematism does not extend to the resources market.' (Stigler, 1968, p. 314). I read Stigler as saying that the tangency solution assumes that input markets are perfectly and purely competitive. That is, the input market is transparent ('perfect'), inputs are freely mobile and homogeneous, and suppliers and buyers are many ('pure competition') (Eaton and Eaton, 1990, p. 384). In that case, entrants may acquire the same inputs at the same terms as incumbent firms do, *i.e.*, they have the same cost functions. If the input market is transparent, incumbent firms cannot derive an advantage from their superior knowledge of the input market. If the inputs are homogeneous, they are not a basis for differentiating production functions used by new and established firms. If incumbent firms account for a small part of the total input demand, they do not have the market power to change the terms upon which input suppliers will serve new rivals.[1] These assumptions do not usually hold in the real world, and least of all in situations where the product market is imperfectly competitive. *Factor market imperfections* may derive from factor heterogeneity, small numbers of buyers and suppliers (*e.g.*, bilateral monopoly bargaining problems), information costs, or factor immobility. Kaldor (1935, pp. 44-45), in his review of Chamberlin's book, referred to "institutional monopoly", *i.e.*,

'[a]nything (.) which imposes higher costs on one producer than another (whether

1. The latter condition is made explicitly by Chamberlin (1962, p. 85), although he does not attach much importance to it.

it is due to the possession of "unique" resources by one entrepreneur or whether it is merely due to "buyers' inertia" imposing a special "cost of entry" on new producers)'.

Due to "institutional monopoly", entrants do not have access to inputs on the same terms as incumbent firms. This 'may even be directly responsible for a large part of market imperfection' (Kaldor, 1935, p. 45). Subsequent discussions bore out Kaldor's intuition: factor market imperfections will turn out to be crucial for understanding the strategic behaviour of incumbent firms and potential entrants.

Chamberlin, therefore, arrived at interesting views within a very tight theoretical setting, which economists subsequently tried to break out of. Schematically, with modifications where appropriate, two lines of thought can be identified (with hindsight). The first one analyses entry barriers and their effect on profits (section 3.2). Joe Bain initiated a path-breaking effort to analyse potential entry. Much as Adam Smith did to his precursors and contemporaries, Bain's analysis led to the eclipse of earlier contributions, such as Kaldor's. I mention Kaldor in the next section to give a historical background to the emergence of Bain's theory. Subsequently, I turn to a predominantly British tradition, where Andrews and others pioneered the importance of potential competition, while also pointing to existing firms' entry strategies (section 3.3). This tradition denied that the entry barriers identified by Kaldor and Bain protect the incumbents' profits. According to this approach, positive profits can exist only if incumbents have cost advantages which entrants cannot duplicate due to ownership of favourable brand names, patents, natural resources, etc. This points to the importance of factor market imperfections (see the next chapter). While Bain's approach appeared to focus on barriers to *de novo* entry, Andrews' approach focused on factors that induce entry by established firms. This led to confusion, as some variables, such as economies of scale, are entry barriers in the former approach, while inducing entry according to the latter approach. To the one who brought this to the fore, I christen this the *Caves' Paradox* (section 3.4).

3.2 BARRIERS TO NEW COMPETITION

In this section I will discuss an early analysis of entry barriers by Kaldor, as well as Bain's magnum opus.

3.2.1 Nicholas Kaldor

Kaldor specified and criticised Chamberlin's analysis by exploring Hotelling's (1929) location approach to product differentiation. Rather than adjusting to actual entry, a far-sighted incumbent firm will anticipate potential competition (Kaldor, 1935, p. 40). He will charge a low price to secure his profits permanently. Kaldor's (1935) and (1938) papers recognize three sources of 'permanent' profits: economies to scale, product differentiation, and "institutional monopoly". If there are no economies to scale, entry occurs until profits are competed away. If an economy of scale exists due to an indivisibility, an entrant must enter at a large scale. But this will drive prices down and convert profits into losses. Anticipating this, incumbent

firms can afford to earn profits, while an additional entrant would suffer losses. With product differentiation, even small economies to scale suffice to protect an incumbent's profits (Kaldor, 1938, p. 521).[2] The analyses of economies of scale and product differentiation assume free entry, defined as (the possibility to offer) identical products, absence of (preferences for) trade names, and identical cost curves (p. 523). Kaldor (1938, p. 529) then suggests to use the term (institutional) monopoly for "restrictions of entry", based on a unique advantage, the possession of privileges, ownership of a patent, trade-name, or a natural resource. The concept of imperfect competition could be reserved to denote free entry cases. In sum, a foresighted incumbent can sustain profits if economies to scale, product differentiation, or restrictions to free entry exist. One will recognize these as the entry barriers later defined by Bain.

3.2.2 Joe S. Bain

The fountainhead of modern industrial economics is Joe Bain's theory of barriers to new competition. I will not attempt to summarise his work here, that has been better done elsewhere (*e.g.*, Osborne, 1964; Scherer, 1980; Gilbert, 1989; and Geroski, Gilbert, and Jacquemin, 1990). I will rather highlight some points that are salient in the context of this book. The same caveat, by the way, holds for the other theories that I will discuss. From this point of view I will discuss the limit price model, the conceptual framework of entry, the empirical tests, and the appendices to Bain's (1956) book.

Bain, it should be noted, is familiar with established-firm entry:

> 'established firms operating in other industries frequently have the least disadvantage of all potential entrants to a given industry in acquiring the requisite capital' (Bain, 1956, p. 215).

Entry may imply converting an existing plant previously used in another industry (Bain, 1956, pp. 6-7). Import competition provides examples of this type of entry. Bain's (1956, pp. 225-6) industry-specific questionnaires, from which the data in his book are largely derived, did include a question about the category of organisations that would present the most active "threat of entry." These explicitly refer to different types of related firms (in downstream and other related markets). Regrettably, he did not relate the answers he received to the question whether economies of scale are an entry barrier. The key point, therefore, is not whether Bain knew that entrants are often existing firms (they are, and he knew). The issue is whether Bain appreciates the implications of this fact for his theory. He seems to have thought, without explicit discussion, that entry by related firms could be subsumed in the same conceptual framework or (theoretical or empirical) model as

2. This intuition has been vindicated by Eaton and Lipsey (1978). If the product is homogeneous and economies of scale exist the same result holds (Nahata and Olson, 1989, p. 237). The incumbent's profits are very small, however, if their number is very large, due to weak economies of scale. In this 'large group' case, Chamberlin's proposition that entry reduces the incumbents' profits to zero is nearly correct.

new firm entry. There are reasons, however, to disagree with this view.

I begin with Bain's limit price theory as rendered more precise by Modigliani (1958). Bain (1956, p. 5) defines entry by '[a]n addition to industry capacity already in use, plus emergence of a firm new to the industry.' If entry raises the amount of capacity *in use*, total output in the market increases by definition. By how much is a moot issue. If the incumbents do not adjust their output levels (the Sylos' Postulate), the entry level raises total market output *pro tanto*. Anticipating this outcome, a potential entrant faces a *dilemma* if economies of scale exist. If it enters at a small scale, it has high unit costs, and if it enters at a large scale, it depresses market price strongly. No level of entry may exist where the post-entry price exceeds its average cost. The *limit output* is the incumbent firm's minimum output level where this dilemma forces the potential entrant to stay out of the market. The associated (pre-entry) market price is the *limit price*.

I submit that Bain's limit price theory is about *de novo* entry: the entrant starts from scratch. It can be a new firm, or the subsidiary of an unrelated conglomerate. In the limit price model, the condition of entry is evaluated by the extent to which the price exceeds the competitive long-run level of costs (Bain, 1956, pp. 3 and 6). The economy of scale is an entry barrier precisely because the entrant is forced to recover all costs associated with starting up production in the entry market (Kottke, 1962, 25ⁿ). Bain's (1956) discussion in his chapter 3 is clear about this point. The entrant enters with a new plant or with as many new plants as it takes to exploit any (plant- or firm-level) economies of scale. Distribution, product design, and sales promotion are also started from the ground up. Being aware of the above mentioned dilemma, the entrant may produce at a smaller scale than required to attain minimum average costs. But there is no allowance in the discussion that the entrant's scale of entry may help it to achieve an economy of scale based on inputs already in its use elsewhere in the economy. Moreover, it is assumed that the entrant earns no profits if it does not enter (a zero opportunity cost of entry). These characteristics entail *de novo* entry.[3] Bain's analysis of *de novo* entry is as such innovative and important.[4]

An established-firm entrant faces a different decision problem than a *de novo* entrant: many of its investments are already bygones. It enters only if it can recover the additional (marginal) costs imposed by entry. In an extreme case, no investments are required to effectuate entry. Hence entry is profitable if marginal cost is recovered (*e.g.*, Clemens, 1951). Consider a situation with an economy of scale such that marginal cost (= MC) is everywhere less than average cost (= AC).[5] No limit price exists where $AC < p < MC$, i.e., where the incumbent firm earns profits and entry is deterred. The limit price would imply negative profits to the incumbent

3. This may refer to small-scale entry by new firms (Gaskins, 1971) but is not inconsistent *per se* with large-scale entry (Modigliani, 1958) backed, *e.g.*, by a conglomerate firm's financial resources.

4. It ushered in a debate on the use of the output level vis-à-vis the capacity level in Dixit (1980), which in turn managed to integrate established-firm entry. I will discuss this at greater length in chapter 8.

5. For instance, production requires a fixed cost F and a constant marginal cost MC.

firm.[6] The economy of scale, that is, induces entry by the established firm, rather than deterring its entry (see subsection 3.4.3). This special case shows that Bain's argument, economies of scale are an entry barrier, is based on the highly specific premise of *de novo* entry.

Next, consider Bain's *conceptual framework*. It does seem potentially inclusive of established-firm entry. Bain subsumes different types of potential entrants into his framework as follows. He introduces asymmetry by assuming that entrants hit the market sequentially. He adds the assumption that a potential entrant's position in the queue depends on the limit price required to deter its entry. Potential entrants are ranked in increasing limit prices (the 'general condition of entry'). The incumbent firm needs to quote the limit price associated with the first firm in the queue (the most favoured entrant which induces the lowest limit price) in order to deter its entry (the so-called 'immediate condition of entry'). Established firm entrants may be given a prominent place in the queue, and thus are not inconsistent with this framework. I have some reservations about this view, however.

Firstly, his conceptualisation appears incomplete. The notion (implied by the example above) of a limit price with a negative profit margin is absent from Bain's conceptualisation from 'easy' to 'blockaded' entry. In this framework, the limit price guarantees at least zero profits (the easy entry case). A conceptualisation as general as Bain's should not, however, exclude the possibility of entry by superior (*e.g.*, lower cost, established) firms. In other words, Bain's specific limit price model gets in the way of his generic classification of entry games.

Secondly, Bain's 'general condition of entry' concept assumes that the incumbent firm plays the same entry deterrence game, the limit price game, with all potential entrants. It makes an assumption of *qualitative* symmetry of potential entrants. Only a single quantitative difference (statistic) remains: the limit price induced by an individual entrant. The general point has emerged, however, that different types of potential entrants require different types of entry (deterrence) game. Chapter 2 has suggested that the incumbent firm may respond to established firm entry in ways that are not available had the entrant been a new firm. In particular, reciprocal entry may be possible. Such strategic options differentiate the established firm entry game from the new firm entry (deterrence) game.

Subsequently, let's turn to his empirical work. Bain's 'general condition of entry' appears to defy operationalisation for the sake of empirical testing. The sequential entry process above allowed that entrants would face entry barriers of different magnitude. The empirical work in Bain (1956) and followers is far more restrictive. It assumes that the (average) incumbent firms' economies of scale can serve as a proxy for a potential entrant's economies of scale. This symmetry assumption implies a testable implication. In a cross-sectional regression, profits (or price-cost margins) will increase with (a measure of) the incumbent firm's economy of scale. This consequence gave Bain's theory immense popularity among empirical economists.[7]

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6. Kottke (1962, p. 43) notes the same result when an economy of scope rather than scale exists.

7. For an overview of the empirical achievements inspired by Bain's theory, see for instance Semmler (1984); Davies, Lyons, Dixon, and Geroski (1988); and Gilbert (1989).

Without knowing anything about potential entrants, the effect of their entry threat on incumbent firms' pricing can be traced. Data on incumbent firms can be used as proxies for entry barriers that explain incumbent firms' performance. This symmetry approach is inconsistent with the asymmetrical entry process noted above, which suggested that Bain's theory could accommodate diverse types of potential entrants. An obvious case where the symmetry assumption fails is the example above, where a domestic firm competes with a foreign entrant: the former should recover all fixed costs in its home market, whereas the latter only needs to recover entry set-up costs.[8] One may grant that data limitations might explain why Bain had to test a simpler (symmetry) version of his more general theory of entry. He aptly notes in the introduction to his empirical work, 'our reach exceeds our grasp' (Bain, 1956, p. 42). Sure enough, but Bain might at least have been explicit about this reduction to symmetry and its consequences.

Finally, in the appendix D on product differentiation barriers to entry, Bain provides some institutional detail on barriers and actual entry into his 20 industries. This material can fruitfully be interpreted, with hindsight, as evidence for entry by acquisition (pp. 267 and 296), strategic groups (pp. 288-290, 297-308, 309 and 310) with different entry barriers into the strategic groups (pp. 296 and 311) or similar entry barrier height (p. 290), and mobility barriers (p. 308). Some characteristic comments about established-firm entry stand out. Metal containers (tin cans) compete with glass and fibre containers. The latter give rise to a 'threat of entry' or 'expanded competition' but, on the other hand, 'cans have invaded fields primarily supplied by other containers -notably beer, coffee, and lubricating oil containers.' (p. 273). The effective "barrier to entry" is probably quite low. In the soap industry, 'the most favored category of potential entrants would be firms already distributing non-soap products through grocery and drug stores' (p. 284). This may apply to meat packers who already sell meat to grocers and have achieved parity with the big three suppliers of laundry soap and toilet-soap bars (p. 283). These comments show that, contrary to Bain's theory in the main text, product differentiation and economies to scale need not be entry barriers *per se*. Bain denotes the associated entry barrier as 'low' when entrants exist (according to answers to the questionnaires or previous experience) who can circumvent the barrier by drawing upon their investments in adjacent lines of business.

To conclude, Bain is aware of established firm entry but he keeps it out of his framework. This is not to deny Bain's merits in other respects. As I noted before, I will limit my discussion to the point relevant in this book. Moreover, my critique has the benefit of hindsight, and cannot serve to belittle Bain's contribution to the analytical landscape of his time. In contrast, however, established-firm entry is the focal point of the ease-of-entry theory proposed by Philip Andrews and Elizabeth Brunner, which is less well known than Bain's and was developed simultaneously. So let us turn to their theory.

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8. Note that in the period covered by Bain's data, circa 1951, entry by Japanese firms had not yet mounted a threat to U.S. firms. For instance, imports of cars into the U.S. accounted for less than 0.5% of total volume (Bain, 1956, p. 297). It may be added that Americans were slow to understand the significance of the Japanese threat. In this respect a focus on *de novo* entry may not be innocuous.

3.3 THE EASE-OF-ENTRY APPROACH: a Forerunner of Contestability

I will first review the pioneers' contribution before turning to other economists of the British tradition.

3.3.1 P.W.S. Andrews and E. Brunner

Andrews and Brunner developed an industrial economics which may be labelled the *ease of entry approach* (Andrews, 1949, 1964; Brunner, 1961; and Andrews and Brunner, 1975).[9] The ease of entry approach emphasises potential competition by existing firms:

> 'If the big business is important as a centre of economic power, it is also one of the sources of competition. The business world should be seen as competitive in the sense that in any market there will be a definite limit to the price which can be charged, and that any business man who exceeds this will lose his market, unless he is protected in some special way, as by legal restrictions.' (Andrews, 1949, p. 172).

The entry threat that imposes this 'limit to the price' comes from established firms in related markets:

> 'Andrews has pointed out the importance of *cross-entry competition*, i.e. firms established in other product markets who can move into this market. These may be firms in quite a different industry which are seeking diversification. It may be a firm integrating backwards to control its supply of materials, or integrating forward to control its immediate market. It may be a firm already in the same industry, but moving into a market which it was not in before.' (Brunner, in her book with Andrews, 1975, p. 39).

The key insight of the ease of entry approach is the proposition that existing firms with related assets and skills bypass entry barriers which are unsurmountable to other potential entrants. For instance, new competition from businesses already established elsewhere

> 'is likely to be not only effective but also likely to operate relatively quickly with few of the impediments on which so much stress has been laid.' (Andrews, 1964, p. 78).

Andrews (1949, p. 172) points out that existing firm entrants may economise on entry costs by using their existing overhead departments. Capital requirements may deter entry by new firms but not by existing firms eager to expand into new markets.

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9. See Robinson (1950) and Plant (1951) for critical reviews of Andrews (1949); and Edwards (1955) and Bhagwati (1970) for surveys. Cairns and Mahabir (1988) gave a sympathetic discussion that brought Andrews's theory back into the lime light. This chapter owes an obvious debt to their paper.

The latter get finance on better terms (*e.g.*, by retained earnings) than new firms (Andrews, 1949, p. 171-172). By using existing resources, an established-firm entrant can enter at a small scale without running into high average costs (Brunner, 1961). It thus escapes Bain's dilemma, that small scale entry raises costs and large scale entry reduces the market price. Entry barriers, therefore, do not deter existing firms the way they do new firms:

> 'Bain's 'barriers to entry' seem somewhat insignificant alongside the much more obvious ease of entry by existing firms. The effective entry-forestalling price has to be much lower than is suggested by the Bain criteria, because the most likely new entrants are not such as would be inhibited by those barriers.' (Brunner, 1961, p. 250).

As a result, the entry-forestalling price will not exceed unit cost by much. This may explain full cost pricing with (close to) zero economic profits ('normal profits') (Andrews, 1949, p. 174-5):

> 'The normal costing-margin will tend to be at such a level as will cover the average indirect costs in the long run, and give a normal profit, in the sense of the margin at which new businesses will enter the market.' (Andrews, 1949, p. 174)

The associated price, the normal costing price, differs from the full cost price if there is a cost difference between incumbent firms and potential entrants. That is, if C is the incumbent firm's unit cost, and E the unit entry cost, then the full cost price is $p = C$ and the normal costing price equals $p = C+E$. These different pricing policies have been labelled the priestly code and the lay code, respectively: the priestly code provides a normal level of profit; the lay code superimposes a regard for the market, including potential entry (Robinson, 1950, p. 776).

Andrews and Brunner are rather informal about what exactly constitutes their theory. The outcome they predict is similar to Bain's 'easy entry' case, where economies to scale and other barriers are small such that the limit price is not much above the long-run unit cost. It is then possible to read into their work the statement that Bain's case of 'easy entry' predominates empirically. For example, 'entry is much easier and may come more quickly than most economic analysis allows' (Andrews and Brunner, 1975, p. 41). In that case, the appropriate theory is the limit price theory, with the added notion that the firms leading the queue of potential entrants induce a limit price close to the incumbent firm's average ('full') cost. Bain, however, may conclude that in that case the incumbent firm will rather forego entry deterrence. He may quote a higher price, an 'entry-inducing price', while accepting that after an entry lag entrants will come in and cut into his profits (*e.g.*, Bain, 1956, p. 35).[10] Profits would be transitional in nature. Andrews and Brunner might retort

10. Gaskins (1971) modeled this dynamic process in the spirit of Bain (1956, p. 35). An incumbent firm may set a price (path) such that entry continuously erodes its market share and profits. As a result, the incumbent firm may earn a larger discounted profit flow than if it quotes the limit price forever.

that entry lags are sufficiently short to ignore the transitional profits. The limit price (or full cost price) would be the profit maximising option.

This interpretation captures some characteristics of Andrews's and Brunner's theory, but I propose to reject it. Austin Robinson's (1950, p. 777) interpretation of Andrews's (1949) book better captures the spirit of their work:

> 'It is clear that Mr. Andrews's account of the actions of firms makes them act as if they assume that markets will be lost if price is raised above the potential supply price of competitors.'

Andrews and Brunner believe (in now well-established industrial economic parlance) that post-entry competition is a Bertrand game in prices rather than a Cournot game in outputs:

> 'the analysis given here is in terms of an equilibrium of *price*, and not of individual *outputs*.' (Andrews, 1951, p. 166) [italics in original].

An entrant does not add his output level to the incumbent's, as in a Cournot model, but rather replaces the incumbent, as in a Bertrand model. According to Edwards (1955, p. 96), an incumbent firm should quote a 'right' price which 'is equal to the average inclusive cost of producing the product in the most efficient manner'. If he fails to do so,

> "the new entrant is thereby enabled to quote a lower price, and a price which -if the necessary scale of production can be achieved- it will be possible to maintain in the long run and still earn a 'normal' profit." (p. 97)

Note the similarity with a perfectly contestable market where full cost pricing with cost minimisation appears as a result of potential competition. In similar vein, Robinson's quote above comes close to formulating a criterium of sustainable prices. In this interpretation of Andrews and Brunner, they do present a theory substantially different from Bain. They emerge as early contestability theorists. Andrews, however, believed their theory to be compatible with risk, sunk costs, and efficiency differences between firms (Andrews, 1949, p. 270-1). This raises doubts on the validity of their theory: we know from contestable market theory that these conditions contradict perfect contestability. Moreover, Andrews made rather strong claims on the realism of his theory. Yet, in contrast to Bain, he did not develop a consistent empirical research agenda.[11] Another concern is that Andrews and Brunner analyse only half the problem, so to speak. They do not face up to the multi-market context that their theory really requires.[12] They do not analyse the effects that entry may have on the entrant's home market. Yet these feedbacks impact on the entrant's

11. Moreover, Robinson's (1950) and Plant's (1951) reviews of Andrews (1949) book criticise in particular its lack of realism.

12. Andrews and Brunner (1975, p. 25) give a very short and sketchy view of the interaction of prices between sub-markets. It does not look like a promising start of an analysis of multi-market competition.

incentives to enter another market.

To sum up, during their career Andrews and Brunner consistently developed the theme that the entry threat has to be understood in the context of a specific type of entrants (*i.e.*, existing firms). They fail, however, to conceptualise the problem in a proper theory.

3.3.2 R.F. Harrod

Andrews and Brunner were not alone in voicing early contestability views. Another proponent in the full cost pricing debate, Harrod (1952), integrated and further developed the views by Andrews and Kaldor (1935). The incumbent firm will anticipate entry, rather than adjust to actual entry as Chamberlin believed (Harrod, 1952, p. 146). Harrod gives a definition of entry barriers substantially identical to the one in Bain (1956):

> "It would seem natural to use the expression 'degree of monopoly' for the size of the impediment to the appearance of competitors to a given entrepreneur; this 'degree of monopoly' would be measured by the rate of profit that could be safely earned without provoking competition; with free entry the degree of monopoly thus defined would be zero, whatever the slope of the particular short-period demand curve." (Harrod, 1952, p. 172).

In quoting a price, the firm does not maximise short-run profits, but, rather, takes into account the effect of a high price on future entry:

> 'If a price is charged that new competitors can undercut, the loss of potential revenue due to the consequent loss of market must be subtracted from the immediate revenue yielded by the price charged.' (Harrod, 1952, p. 150-1).

If entry is (relatively) free, the incumbent will, in order to deter entry, quote a low price yielding only a normal profit, while choosing capacity to achieve lowest production costs (p. 151). A higher price than the one yielding a normal profit (*i.e.*, the full cost), is allowed for only if the incumbent firm has 'an advantage peculiar to himself'. That is, Harrod accepts only the 'institutional monopoly' or absolute cost advantages among Kaldor's and Bain's entry barriers. Harrod's exposition is inconsistent, however, as he still holds to Chamberlin's tangency solution (Harrod, 1952, p. 162). That is, in the equilibrium the firm's individual demand curve has the same slope as the average cost curve. But this must mean (given a downward-sloping demand curve) that the cost function is downward-sloping at the equilibrium output level, i.e., production costs are not minimised. Lydall (1955, p. 302) noted this inconsistency and amended the analysis.

3.3.3 H.F. Lydall

Lydall (1955) argues that if a firm chooses a price with respect to the short-run demand curve (given the number of firms), it may induce entry, which will shift the firm's short-run demand curve inward. To prevent this, it will search for a price

which covers costs, while preventing entry. This is the *no-entry ceiling price*, *i.e.*, 'the maximum price which can be charged without provoking new entry.' (p. 301). The 'ceiling' is equal to or just below the entrant's minimum average cost. If all firms have identical cost curves (Chamberlin's 'heroic' assumption), the ceiling also equals the incumbent firm's minimum average cost. A higher price would invite entry; a lower price would lead to a loss. In equilibrium the demand curve will intersect the cost curve at the point where unit cost is minimised, *i.e.*, where the cost curve is horizontal.[13,14] The relationship to contestable market theory is evident:

> 'we have the same situation as under perfect competition: price will be at a minimum, profits no more than normal and output at the optimum.' (Lydall, 1955, p. 302)

Using this framework, Lydall makes two valuable points. First, the firm's 'immediate neighbours' in terms of product substitutes will be its most likely potential entrants:

> 'If any firm raises its price above its own ceiling level it will attract the attention of a potential competitor, not so much from outside the large group, but more probably from a firm already operating in another part of the group.' (p. 305)

Second, if established and new suppliers have different cost curves, the incumbent can quote a price equal to the entrant's minimum cost and still earn a profit. Long run market power exists (or monopoly, in Lydall's words), if the incumbent firm can raise price without losing all demand to entrants. The necessary condition for this is that the incumbent raises the costs of entrants first. It can do so if

> 'the cost of launching a new product on the market depends on the policy of existing firms.' (p. 304)

The monopolist raises rival's costs by buying a patent or by advertising: 'advertising creates a barrier to new entry and as a consequence raises the price which can safely be charged without provoking new entry.' (p. 308). It occurs to Lydall that advertising also raises the firm's own cost, but 'it may still be profitable to advertise, if the price ceiling rises more rapidly than average cost.' (p. 308). This view harks back to Kaldor's 'institutional monopoly' (see section 3.1 and subsection 3.2.1), and

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13. This situation may be a fluke, although Lydall does not discuss this. Unsustainability problems arise if the demand curve cuts the cost curve elsewhere. Contestability theorists later "solved" the problem by assuming cost curves with 'flat bottoms' (Baumol, Panzar and Willig, 1982, p. 29-36).

14. Ironically, this resurrects a tangency solution. The long-run demand curve is horizontal at a price level equal to the entrants' minimum average cost. In equilibrium it is tangent to the incumbent's average cost curve where the latter is minimised (*i.e.*, at the minimum, where the cost curve is flat). This is not Chamberlin's tangency solution, featuring short-run demand curves and excess capacity, *i.e.*, excessive costs, that is the but of Harrod's and Lydall's critiques.

prefigures Salop and Scheffman's (1983) 'competition by raising rival's costs' (see chapters 6 and 8). To illustrate, call c the incumbent's minimum unit costs, E(x) the entrant's additional unit cost, x the incumbent's cost-raising investment (advertising, patenting, *etc.*), and D(.) the market demand curve. The incumbent's profits are $\pi = (p-c)D(p)-x$, if entry is deterred and the incumbent is a monopolist. The no-entry ceiling price is $p = c+E(x)$. Lydall notes that this is not a given price, but depends on the policy (here reflected by the variable x) of the established firms. Consistent with Lydall's view, the incumbent firm chooses a price p such that

(3.1) $p = c+E(x)$, $\pi = E(x)D(c+E(x))-x$, and $x = \text{argmax } \pi$.

If the entrants have an exogenous cost disadvantage of E, the incumbent may quote a price $p = c+E$. Lydall argues that the incumbent firm does not have market power (or monopoly) at this price, since if it raises price just a little above $c+E$, entry will deprive it of all forthcoming demand. Hence market power exists if and only if the incumbents can raise the entrants' costs.

> 'But under perfect market conditions existing firms have no power to influence the cost of new entry. It is this power, not the sloping demand curve as such, that marks the essential difference between monopoly and competition.' (p. 304)

Lydall, that is, distinguishes 'competition', where the entrant's cost function is exogenous ($\partial E/\partial x = 0$), from 'monopoly', where the entrant's cost function is endogenous and the incumbent firm has the ability to raise the entrant's costs ($\partial E/\partial x > 0$). Only if the incumbents monopolize some factors, *e.g.*, technical know how, can they raise the no-entry ceiling price and earn above normal profits.

Lydall's paper is clearly thought-provoking. It constitutes, in my opinion, the analytical apex of the ease-of-entry approach. His contribution encompasses both the 'horizontal' multi-market dimension, *i.e.*, firms (potentially) compete across different markets or market segments, and the 'vertical' dimension, *i.e.*, firms compete in input as well as product markets. It has taken a long time before its implications have been understood.

3.3.4 Not much of a Paradigm

Up to the 1960s, the trickle of papers on easy entry by established firms remained outside of the mainstream of industrial economics, dominated by Bain's approach. With hindsight, one can conclude that the interesting work by Andrews, Harrod, Brunner, Lydall, and others, failed to develop a paradigm or research agenda.[15] Several possible explanations can be mentioned. The authors failed to disentangle three dimensions in these debates. The first one is the identity of the entry threat.

15. When an appropriate paradigm finally appeared, in Baumol *et al.* (1982), the ancestors had been forgotten. In their book, Baumol *et al.* did not try to relate their work to these pioneers. Moreover, the book is overly formal and ignores the central motivation in Andrews. It was up to Cairns and Mahabir (1988) to trace contestability back to Andrews' work (see chapter 7 in part IV).

The authors did not develop a multi-market framework, which is the natural habitat for a theory of established-firm entry. To put it differently, they failed to integrate theories of multiproduct and multinational firms. The second one is the distinction between competition in output levels (*e.g.*, Bain), and in prices (*e.g.*, Andrews). In the latter, but not the former, the entrant can, by undercutting slightly the incumbent's price, capture a large market demand without the dramatic price reduction envisaged by Bain. This increases the urgency of the entry threat. Third, prior to the advent of game theory, economists had the greatest difficulties in coming to grips with the distinction between short-run instruments (*e.g.*, price) and long-run instruments (*e.g.*, capacity).[16,17] Progress along theoretical lines was, therefore, barred, and Bain pointed in the correct direction by providing a paradigm for empirical research. The British theorists remained predominantly oriented at the full cost pricing debate, as to which price an incumbent firm will quote, given its anticipation of quick and effective entry. Notwithstanding this orientation, they never developed the kind of tight framework introduced by Baumol and others in 1982, although Lydall came close. Theoretical giants like Kaldor and Harrod were basically interested in macroeconomic growth theory; Andrews did have a life-long commitment, but lacked the interest or ability to formalise the argument.[18] The subsequent section, however, shows that some empirical research did occur along Andrews' lines.

3.4 EMERGING EMPIRICAL IMPLICATIONS

The great strength of Bain's theory relative to Andrews's was its susceptibility to

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16. Hicks (1954) tries to complement Harrod (1952) on this point. His analysis is very muddled and overlooks two implications of this analysis. First, price is not the only instrument in competition. Capacity investments may be an instrument as well through their influence on costs or demand. Second, he assumes without question that the pre-entry price determines the scale and incidence of entry. The one point the paper is still remembered for is the distinction between *stickers* (firms with a long-run business orientation) and *snatchers* (with a short-run orientation).

17. Andrews (1949, p. 174) proposes price competition and rejects output competition, saying that firms do not choose the output level where marginal cost equals marginal revenue. His precise wording seems to have been misunderstood, however, as an attack on profit maximisation (Robinson, 1950, p. 774). This gives Andrews's work a distinctively heterodox flavour (Robinson, 1950, p. 771). Bain cannot so be misunderstood. His model of competition in outputs fits well in the Cournot tradition, where firms bring commodities to a market and a market clearing price is established. The general public (at least among economists) may have felt at home in Bain's (1956) book. In the 1950s economists did not sufficiently appreciate the point that both price and output competition are compatible with profit maximisation. For example, Modigliani (1958, p. 216[n]) does refer to Andrews (1949) but completely misses this point.

18. These arguments are only tentative. To understand more about the formation of a paradigm, one should probably move beyond the history of ideas to a history of people. I will not attempt this here.

empirical testing. Some empirical implications did emerge, however.

3.4.1 H.H. Hines: Established-firm Entrants as a Strategic Group

Hines's (1957) paper, influential after more than a decade, first derived empirical implications from Andrews's approach. It suggests what I may call *Hines' first proposition*:

> 'an established firm may be able to overcome handicaps that might effectively bar new-firm entrants' (pp. 134-135).

In explaining the advantages that established-firm entrants have, Hines casts his net wider than Andrews and Brunner did in their early formulations. According to Hines, established-firm entrants may have superior access to productive resources; for example, they may gain access to technology by trading against some of their own patents, use already-installed equipment and processes, and apply existing managerial skills. They may also have superior access to product markets by using existing facilities and brand names. Bureaucratic inertia may, however, work against the existing firm entrant.

Hines's paper is somewhat of a classic because it is a pioneering statement of what later came to be called *strategic groups* (Caves and Porter, 1977). He points out that many markets show up a competitive fringe and an oligopolistic or monopolistic core (two 'strategic groups'). He explores two consequences of this view for the entry process. He begins by noting that different types of entrants enter into different strategic groups. New firms usually enter at a small scale, and remain locked in the competitive fringe. They cannot match the dominant firms' advertising nor the width of their product line. On the other hand,

> 'established-firm entrants (because of their large size or the strength of their brand or product appeal) might more probably move at once on a large scale into the central core of the market, where they will immediately influence pricing policies.' (Hines, 1957, p. 140)

This may be called *Hines's second proposition*: when comparing actual entry by new and established firms, the latter enter at a larger scale than the former. In a parenthesis Hines then discusses what is now called the *mode of entry*, that is, the way in which a firm enters. He argues that established firms need not only enter by setting up new facilities; they may also enter by buying up an incumbent firm or some of its plants. Yip (1982b), whose book is largely dedicated to this issue, refers to this as the choice between *direct entry* and *acquisition entry*. The take-over is then a first step in the entry process; subsequently the new owner may enlarge the acquired firm by adding its own resources. Moreover, Hines claims that the new owner may support the acquired firm to leave the competitive fringe and enter the oligopolistic core of the market. From the point of view of the dominant group, this constitutes entry. Hines (1957, p. 145) here suggests an 'extension of the entry concept' which was further developed by Caves and Porter (1977) as the *mobility* concept. Hines then suggests a *third proposition*: Entry by merger tends to disrupt

local tacit collusion. That is,

> 'the change in management is likely to be peculiarly disruptive of local restrictive agreements. Administrative convenience may require the firm to set broad national or regional policies, leaving little scope for local adaptation.' (Hines, 1957, p. 44)[19]

Hines' creative paper suggests that entry barriers are specific to, and also limit mobility between, strategic groups. Moreover, there are strategic groups among potential entrants. An intuitive ex ante set of groups is as follows. One group contains new firm entrants, another established firms in related markets, and yet another one contains, for instance, unrelated (conglomerate) businesses. The analogy with strategic groups is fairly complete: it is easy to think of mobility barriers that deter a potential entrant from shifting from one group (*e.g.*, new firms) to another (*e.g.*, related entrants). Hines' paper implies a rich empirical research agenda.

3.4.2 Meanwhile at the Ottawa Bureau of Competition Policy

Some tests exist of Hines' first proposition. These show that an Andrewsian approach does have empirical implications. These came, however, long after Bain's approach had spawned a huge empirical research tradition. This may be one factor explaining Bain's popularity relative to Andrews's. Gorecki (1975), at the Ottawa Bureau of Competition Policy, studies actual entry over a short period (1958-1963) in the U.K. manufacturing sector. He distinguishes between entry by new firms ('specialists') and diversifying firms. He finds that entry by diversifying firms is not responsive to entry barriers (*i.e.*, economies of scale by average plant size and product differentiation by advertising outlay per firm), whereas entry by new firms is (p. 144). Gorecki's (1976) paper on the Canadian industry, which compares foreign and domestic entrants, reaches similar conclusions. Shapiro (1983) confirms Gorecki's (1976) results, while using a slightly different methodology and updated data on the Canadian industry. He finds, among others, that R&D intensity has a positive effect on foreign and a negative effect on domestic entry. In a study of entry by major U.S. manufacturing corporations in 1973-1977, Montgomery and Hariharan (1991, p. 84) find that 'While entry varies inversely with the size of the minimum efficient scale plant (MES), the coefficients for capital intensity (CAPI), selling intensity (SELL), and research and development intensity (RD) are not negative as traditional entry barrier theory would predict.' As Mata (1991) argues, this research tradition has not yet discovered a consistent pattern as to which explanatory variables ('entry barriers') induce entry by some and deter entry by other strategic groups of entrants. The need, however, to distinguish between strategic groups among entrants has been clearly demonstrated.

Other tests have confirmed Hines' second proposition (Hause and Du Rietz, 1984; Dunne, Roberts, and Samuelson, 1988; and Mata, 1991). Survivors among new firms tend to remain smaller than the average incumbent firm, whereas surviving diversifying entrants exceed the average size of incumbents (Dunne *et al.*,

19. This is not to say that others may not have noted this before Hines did.

1988, p. 512). This is consistent with mobility barriers that are specific to new-firm entry. Berry (1974-5) finds that large, diversifying, firms enter in direct competition with the large incumbent firms. This confirms Hines' suggestion that they enter the dominant firms' strategic group. Berry (1974-5, p. 204) concludes that

> 'the market position of leading firms does appear protected in concentrated industries from entry by other than large firms. That is the bad news. The good news is that at least some of the diversifying activity of large firms may have filled the gap.'

3.4.3 R.E. Caves: Taking Stock of the Debate

With some empirical research addressing the implications of established firm entry, it was possible to compare these results with Bain's. It was up to Caves to organise the showdown. In analysing the multinational firm, Caves (1971) harks back to Hines' ideas. First, he reiterates Bain's entry barriers. He then shows that a multinational firm can overcome these entry barriers more easily than a new domestic entrant can. In fact, the very factors which induce the multinational firm to enter foreign markets are those listed by Bain as entry barriers. Economies of scale are considered an entry barrier, yet they induce the multinational firm to enter foreign markets in order to increase its production and reduce its average costs. Product differentiation is another entry barrier; but often a firm decides to enter foreign markets in order to exploit its superior product or brand name. The same holds for absolute cost advantages imposed by the finance market on new firms or ventures. The multinational firm may have an absolute cost advantage relative to a domestic firm entrant as it can use retained earnings and may have a good credit rating (Caves, 1971, p. 13). This is *Caves' Paradox*. Yip (1982b) dramatised the Paradox by introducing the concept of 'gateways to entry' (*i.e.*, inducements to entry):

> 'the same variables giving rise to barriers can give rise to gateways to entry' (Yip, 1982b, p. 10).

Caves' Paradox epitomises the debates between Bain's approach to industrial economics and Andrews's. It revealed a fundamental ambiguity in Bain's concept of entry barriers. This is a central problem in multi-market competition, and the next chapter will show how industrial economists grappled with it in the 1980s.

4 CONTESTABLE MARKETS AND BEYOND: Sunk Costs, Factor Market Imperfections, and Transaction Costs

Chapter 4 reviews contestability theory, which has contributed greatly to the development of multi-market competition. It (over-)emphasised the salience of the entry threat, drove home the importance of economies of scope, and pointed to the importance of factor market imperfections by showing the (counterfactual) results if these are suppressed. Transaction cost economics also demonstrated the importance of factor market imperfections by showing that in their absence economies of scope would not, contrary to contestability's claim, induce firms to become multi-product in scope. The chapter leads up to a discussion of inducements to entry and barriers to entry which builds upon the conceptual and empirical theories of the 1950s to 1980s and that provides a starting point for the game theoretical analyses of multi-market competition in the 1980s and 1990s, which are discussed in part III.

4.1 INTRODUCTION

This chapter harks back to the 'Caves Paradox'. The Archimedean point in unravelling the Paradox has been the crucial role played by sunk costs. The contestable market theory is the natural point of departure for exploring this line of reasoning. It conducts a thought experiment where absence of sunk costs is necessary for absence of entry barriers. The extreme nature of the results inspired critiques which further developed the concept and significance of sunk costs. Theories of transaction cost economics and committed competition showed that sunk costs that are firm- rather than product-specific induce rather than barr entry. I will subsequently return to the Caves' paradox in the chapter's appraisal. Although this chapter can be critical at times, in similar vein as the previous one, its main aim is constructive. It tries to distil from the literature a sound conceptual basis for the analysis of entry (deterrence) games in the subsequent part.

Section 4.2 reviews the debate on perfectly contestable markets, entry barriers, sunk costs and transaction costs. Section 4.3 reviews the interaction between efficient industry structures, economies of scope, firm-specific resources, and again transaction costs. These two sections will indicate the importance of contestability theory, notwithstanding the fundamental and justified critiques levelled against it. It contributed, both directly and through the critiques which it provoked, to a clear understanding of the concepts of sunk costs, entry barriers, and firm-specific resources. These in turn provide the linchpin between the original debate on established-firm entry in the previous chapter and the modern game theories in the next part. Section 4.4 summarises the chapter.

4.2 THE THEORY OF PERFECTLY CONTESTABLE MARKETS

Bain (1956) argued that economies to scale are an entry barrier. A position directly opposite is implied by the contestable market theory.[1] It denies the existence of any entry barriers other than those based on sunk costs. It thus forced a very sharp distinction between perfect contestability, where sunk costs are absent, and imperfect contestability, when sunk costs may exist. If sunk costs are absent, incumbent firms deter entry by minimizing costs and quoting prices equal to minimum average production costs. In a sustainable industry configuration the number of firms is such that industry costs are minimised: no other number of firms can serve demand at lower prices. The number of firms is, therefore, directly derived from industry demand and cost functions (Baumol, Panzar and Willig, 1982, pp. 109 and 116-7). Sustainability requires efficiency (cost minimisation) if and only if potential entrants exist which can undercut the incumbent firm's prices otherwise, duplicate its production process, capture its market, and exit again when it responds by lowering its prices ('hit-and-run entry').

As its title might have indicated, the (1982) book contains two related theories rather than a single unified theory. Contestability is about incumbent firms which anticipate (potential) entry by quoting an entry deterring price. Potential entrants, in turn, have expectations about the post-entry situation. Call this theory I: the *theory of (im)perfectly contestable markets*. Chapter 5 in Baumol *et al.* (1982) develops a theory of the cost-minimizing industry structure, assuming only that firms are financially viable (a feasibility condition). This condition is postulated rather than derived from 'more basic postulates about the behavior of firms and of entrepreneurs' (*i.e.*, entry threats) (p. 98). That is, entry threats and sustainability are absent from this theory (they are, indeed, not mentioned in chapter 5 of the book). Call this theory II: a *theory of the cost-minimizing industry structure*. It has nothing to do with contestability. Panzar (1989) summarises this theory without, indeed, even making passing reference to contestability. Note that theory II moves beyond textbook expositions of cost and demand functions only by the elaborate analysis of multiproduct firms and economies of scope.

The authors confuse both theories when defining the concept of sustainability. Baumol *et al.* (1982, pp. 192-3) define sustainability as a vector of incumbent firm's prices and outputs such that the monopolist recovers its costs and no potential entrant can undercut the monopolist, sell a vector of quantities y^c, and recover its entry costs $E(y^c)$. In Baumol *et al.* (1983, p. 495) sustainability is defined as a vector of prices and quantities such that costs are minimised and prices just cover costs. The

1. The book by Baumol *et al.* (1982) is the canonical statement. A short summary view is in Dixit (1982). For thoughtful criticisms see Shepherd (1984). Schwartz (1986) and Farrell (1986) explore and reject the robustness of contestability to small sunk costs and exit lags. Baumol *et al.* (1983) and (1986) respond to critiques. Some extensions of the theory are Kim (1987) on the multi-product monopolist and Asheim (1992) on resource markets. Calem (1988) and Cairns and Mahabir (1988) present 'revisionist' views. For an empirical test of the airline industry, Baumol *et al.*'s favoured example, see Hurdle, Johnson, Joskow, Werden, and Williams (1989), and for a survey of the empirical results, Gilbert (1989).

definition ignores potential entrants and entry costs. The former definition is in line with theory I, the latter with theory II. If there are entry costs, a vector of prices with positive profits can be sustainable by the former definition, but is certainly unsustainable by the latter definition. The two theories should, therefore, be strictly distinguished. This interpretation of the book is consistent with Shepherd (1984, p. 572) who focuses on 'ultra-free entry' (*i.e.*, theory I), which he argues 'is largely separable from the multiproduct and sustainability analysis' (*i.e.*, theory II).

The relationship between both theories is that incumbent firms choose products, output levels, and prices so as to deter entry. In a *perfectly* contestable market (but not in an imperfectly contestable market) it is proved that the decisions must induce a cost-minimizing industry structure. The subtle differences between theories I and II become apparent, therefore, when some form or other of imperfect contestability holds.[2] Note that contestability in its single-product version does not need more than text-book analyses of cost curves. The theory of efficient industry structures makes a real contribution only in the multi-product case. So, in effect, the two theories are independent. The remainder of this section discusses theory I (on contestable markets), while the next section discusses economies of scope (from theory II). The next subsection removes two obstacles to appreciate contestability's real contributions which are discussed in subsection 4.2.2.

4.2.1 Misconceptions about Contestability Theory

First, Baumol *et al.* (1983) claim that contestability is a 'static' theory:

> 'the static equilibrium theory of perfectly contestable markets contains no assumptions whatever about the possibility of instantaneous entry or the ability of new firms to exit more quickly than an incumbent can change its prices. Such dynamic properties are best thought of as attempts to examine the plausibility and range of applicability of the static equilibrium concepts.' (Baumol *et al.*, 1983, p. 496)

Baumol *et al.* here react to Weitzman (1983) and Schwartz and Reynolds' (1983) critiques on contestability. I submit that this response is dishonest. It defends contestability (theory I) by subtly putting theory II in its place. Contestability is unalienably a theory about potential competition, and the 'hit-and-run' condition is essential to it:

> 'The crucial feature of a contestable market is its vulnerability to hit-and-run entry.' (Baumol, 1982, p. 4)

Any theory of incumbent firms that intend to deter potential entry has to face up to expectations: it is dynamic by its very subject matter. When Baumol *et al.* (1982, p. 296) propose a 'general model of entry barriers', they correctly argue,

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2. The book would have gained in clarity, therefore, if it would have presented a theory of imperfect contestability. It was up to Schwartz (1986) to present a first valiant attempt.

'Since entry must be viewed as an intertemporal process, our general model is given at least a modicum of dynamic structure.'

Conversely, theory II is predicated on given cost and demand functions, ignoring expectations, R&D, learning, *etc.* Theory I, that is, is *dynamic* and theory II is *static*. The latter two quotes differ strikingly from the first one in this subsection, as if they are about different theories. Which is, in my opinion, precisely the case. Theory II about an efficient market structure (the subject of the first quote) should not be confused with theory I about contestability (the second and third quotes).

Secondly, Baumol *et al.* (1982, pp. 13-4; and 1986, p. 339) emphasise that contestability is a *benchmark* theory. For this statement to be acceptable in a scientific context, it should be accompanied by (i) a rigorous definition of the concept, (ii) a list of conditions a theory has to pass in order to qualify as benchmark, and (iii) a proof that contestability theory indeed passes these conditions. One will look in vein for this. The authors *assert* that contestability is a benchmark. The bluntness of the assertion, its lack of proof, and the rather extreme nature of the contestability exercise has, I believe, been responsible for the unfriendly reception of contestability theory (*e.g.*, Shepherd, 1984). In the absence of any reasonable definition of benchmark in Baumol *et al.* (1982), let me assert that a benchmark theory has to submit to three conditions: (1) it has to be representative for the situations (*i.e.*, industries) that it is supposed to be benchmark for, (2) it has to be realistic, and (3) it should generalise perfect competition.[3] There are some reasons to believe that Baumol *et al.* (1982) have these conditions in mind. Condition (1) rules out a benchmark based on marginal cost prices: in industries with economies of scale this would lead to losses. Firms are thus forced to defect from marginal cost pricing - a benchmark may not abstract away from constraints that firms are forced to live with. This shows that a benchmark cannot be defined in terms of outcomes (*e.g.*, marginal cost prices) but in terms of conditions: it should allow for salient constraints that firms are subject to. Condition (2) shines through in the assertion that one should abandon the 'unrealistic standard of perfect competition as the model for market behavior' (Baumol *et al.*, 1982, p. 477). If perfect competition has to go because it is unrealistic, then realism apparently is an important condition to impose on benchmark theories. Condition (3) is consistent with the claim that perfect contestability is a 'substantive generalization of the market that is perfectly competitive.' (Baumol *et al.*, 1982, p. 271).[4]

If conditions (1) to (3) define a benchmark theory, then the theory of perfectly contestable markets cannot be claimed to be a benchmark. It seems to pass condition (1) better than perfect competition, as it allows for economies of scale and scope.

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3. Anyone who rejects this definition, is back to square one: in the absence of a rigorous definition, there is no scientific basis to Baumol *et al.*'s (1982, 1983 and 1986) claim that their theory represents a benchmark. Note that my approach to a benchmark appears similar to Clark's (1940) motivation for a theory of workable competition. He argues that concepts need to be formulated 'of the most desirable forms of competition, selected from those that are practically possible, within the limits set by conditions we cannot escape.' (Clark, 1940, p. 242).

4. A similar statement is in Baumol, Panzar and Willig (1983, p. 495).

However, it embeds these economies in two conditions that exclude all cases of interest: absence of sunk costs and an entrant's exit lag (t*) for which holds that $0 < t^* < T$, where T is the incumbent's price response lag (Baumol *et al.*, 1983, p. 493).[5] Perfect contestability, therefore, excludes most real world cases where economies of scale exist.[6] For an unanswered critique on condition 2 (realism), see Shepherd (1984), who concludes that 'ultra-free entry' seems an odd special case rather than general theory. Baumol *et al.* (1983, p. 495) defend condition (3) by arguing (a) that a perfectly competitive industry is always perfectly contestable, but (b) not the other way round. Although both (a) and (b) seem meaningful statements, (a) confuses theory I with theory II. A perfectly competitive market is always cost-minimizing (theory II). A competitive industry need not be contestable if the number of incumbent firms is sufficiently large to guarantee cost-minimisation and price-taking behaviour. In this case *actual* competition dominates *potential* competition. Competitive outcomes pertain (*i.e.*, theory II holds) even if entry barriers exclude all potential competition (*i.e.*, theory I is violated). Contestability fails to pass conditions (1) and (2), therefore, with questionable justification as far as condition (3) is concerned.

Contestability is not, therefore, a static theory of cost-minimising market structures nor a benchmark. With the authors' misconceptions out of the way, let me turn to other authors' more impartial views on contestability. Contestability is a thought experiment (Ghemawat, 1991a, p. 26) which makes counterfactual assumptions (Shepherd, 1984, p. 577; and Ghemawat, 1991b, p. 4). It throws a revealing light on the real world not by analysing conditions directly, but by analysing the outcomes when these conditions are absent. In the remainder of this book I will share this view. In this context, Baumol *et al.* did make important contributions to the understanding of entry barriers (subsection 4.2.4) and efficiency motives to entry (section 4.3).

4.2.2 An Assessment of Contestability's Contributions

The debates on contestability made two contributions which are relevant in this context. First, the contestability discussions brought established-firm entry back to the fore. Contestability theory can be seen as a formal statement of the ease-of-entry approach. It revealed its, largely implicit, critical assumptions. Moreover, it went beyond the ease-of-entry's concern for prices by exploring the consequences for market structure. The relationship of contestability to the ease-of-entry approach did not go unnoticed. The hit-and-run entry threat, which the incumbent firms fear so much, implies that entry is fast and requires few (if any) commitments. Import competition may come close to this ideal:

> 'imports have probably provided the most important form of new competition in industrial markets in advanced economies. They may offer the best chances for applying Baumol *et al.*'s approach' (Shepherd, 1984, p. 584).

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5. See subsection 4.3.2 for the discussion that revealed the latter assumption.
6. Weitzman's (1983) critique, which I will discuss later on, is that perfect contestability logically excludes *all* cases where an economy of scale exists.

Shepherd (1984, p. 581) adds, however, that 'imports have not taken large market shares swiftly.' Imports point to established-firm entry. This ushered in Cairns and Mahabir's (1988) rediscovery of the ease-of-entry approach. I will not push this point here, as chapter 7 is dedicated to this issue. Cairns and Mahabir (1988), moreover, suggest that established-firm entry is the linchpin between salient (perhaps hit-and-run) entry threats (in contestability theory) and economies of scope (in efficient industry theory). Another type of entry that may come close to hit-and-run entry is entry by a firm established in a nearby strategic group, as Hines (1957) argued. Hatten and Hatten (1987b) give some examples of this. They argue that strategic groups with low mobility barriers inhabit niches that are (almost) contestable to competitors in other strategic groups:

> 'the competitively more effective firms can enter and exit the weaker firms' markets at will, and with very limited incremental investment given their total resources. Such intra-industry studies of competition appear to be more apt sites to research contestability than are the usual industrial organization multi-industry studies.' (Hatten and Hatten, 1987b, p. 330)

Second, a perfectly contestable market is predicated on the absence of factor market imperfections. Baumol *et al.* (1982, p. 299) prove that if sunk costs are absent and there is otherwise (*ex ante*) symmetry between incumbent firm and potential entrant, then an entry barrier does not exist. If anything (*e.g.*, economies to scale) is to be an entry barrier, it has to involve sunk costs, therefore.

4.2.3 Sunk Costs

Consider their definition:

> **Definition 4.1 Sunk costs**: 'Let C(y,w,s) represent the short-run cost function, applicable to plans for the flow of production, that occurs s units of time (years) in the future. Then K(w,s) are the costs sunk for at least s years, if C(y,w,s) = K(w,s)+G(y,w,s), G(0,w,s) = 0.' (Baumol *et al.*, 1982, p. 280)

Here y and w are the vectors of output quantities and input prices. If s increases to infinity, K decreases to zero: in the long run all costs are variable (Baumol *et al.*, 1982, p. 281). K(w,s) is the irreducible cost that remains if the firm decides now (t = 0) that it will suspend production s periods from now (*i.e.*, $y_t > 0$ if $t < s$ and $y_t = 0$ for $t \geq s$). The intuition of this rather formal definition is that K(w,s) is the loss incurred when selling the firm's resources at period s. A resource is sunk by this definition if its resale value in the used factor market, the opportunity cost, is less than its value to the firm (Gilbert, 1989, p. 521).

Baumol *et al.* (1982) do not derive the sunk cost function from underlying economic data. From a microeconomic point of view, this is unsatisfactory. The important dimension is *tradability* of a factor. In a perfect factor market, a factor can be traded without costs, delay, or loss of value. Imperfection of a factor market is a denial of one or more *perfection* criteria, which were listed in section 3.1 as transparency of the market, freely mobile and homogeneous inputs, and many

suppliers and buyers.

Transparency has a time and information dimension. Tentatively, the time dependence of the sunk cost can be explained as follows. In a non-transparent market, a firm faces a trade-off when liquidating its investment. If it liquidates instantaneously, it is unlikely to find a trade partner willing to pay the asset's original value. That is, a resale or exit loss occurs: the sunk cost. If the firm takes more time to gather information on trading partners and prices, it may get a higher price for its asset. Thus its loss, the sunk cost, decreases. If the liquidation (or exit) lag is infinite, the sunk cost may (but need not) be zero. There is thus a trade-off between sunk cost and exit lag (Baumol *et al.*, 1982, p. 281; Shepherd, 1984, p. 577; and Schwartz, 1986, p. 41). The function K(w,s) represents the factor market imperfection: the more the factor market approaches the perfect (Chamberlinian) ideal, the smaller *K* will be for any period *s*.

Transparency is also violated if a factor is similar to an experience good in marketing theory, *i.e.*, if its quality cannot be observed prior to purchase. Lemons may exist, that is, machines (or other factors or durable goods) can be 'good' or 'bad' (*i.e.*, a lemon). A firm's attempt to sell a used machine may imply that it is 'bad', which reduces its sales price (p_o) below the new factor price p_n, such that $p_b \leq p_o < p_n \leq p_g$, where p_b (p_g) is the price of a machine which is known to be bad (good). If $p_b = p_o$, no trade may occur at all: 'The cost of dishonesty, therefore, lies not only in the amount by which the purchaser is cheated; the cost also must include the loss incurred from driving legitimate business out of existence.' (Akerlof, 1970, p. 62). Tradability of (good) durable goods is impeded, therefore, which provides an explanation of sunk costs: a factor which is 'good' entails a sunk cost of p_n-p_o as it fails to distinguish itself from a 'bad' one.

Factor heterogeneity may give rise to a specific tradability problem, *i.e.*, *product-specificity*. The more product-specific a factor is, the less appropriate it is to an alternative use. The smaller, therefore, is the opportunity cost *ex post* compared to the factor price *ex ante*. This is a specific example of sunk costs. A factor may have a price p_n (*ex ante*), but if it is completely product-specific, *ex post* it has no alternative use at all (*i.e.*, $p_o = 0$). Factor heterogeneity may also exacerbate imperfections, such as transparency and small numbers. Small numbers themselves may lead to bargaining problems.

As a result, factor market imperfections came to be understood as essential to sustainable prices with positive profits (Ghemawat, 1991a, p. 26-41). This is a counterfactual contribution by contestability, as the theory of contestable markets is predicated on an assumption of perfectly competitive factor markets, *i.e.*, factor prices are parametric. The concept of sunk costs ushered in a deeper understanding of the meaning of barriers and inducements (efficiency motives) to entry. I will discuss these extensively in the next two (sub)sections.

4.2.4 Entry Barriers

Several definitions exist of entry barriers (see Davies *et al.*, 1988, and Gilbert, 1989, for useful surveys). Following Bain, some definitions associate entry barriers with the incumbent firm's performance. Bain (1956, p. 3) defines the condition of entry as

> 'the advantages of established sellers in an industry over potential entrant sellers, these advantages being reflected in the extent to which established sellers can persistently raise their prices above a competitive level without attracting new firms to enter the industry.'

Similarly, Gilbert (1989, p. 478) 'takes the view that a barrier to entry is a rent that is derived from incumbency.' This type of definition of entry barriers can be very misleading (De Bondt, 1985, p. 144). Any definition that this or that factor constitutes an entry barrier implies that there is an unambiguous (if stochastic) causal link from that factor (*e.g.*, economies of scale) to incumbent firms' profits. Such links of causation probably do not exist. Whether an incumbent firm stands to gain from say, economies of scale, depends on the entire context of the competitive game. No individual aspect of the game can be singled out as an 'entry barrier'. This holds especially in a multi-market context. Here, entry barriers in one market do not have a one-to-one link to performance in that market. The outcome of an entry game depends upon the conditions in both the entry market and the entrant's home market. Prices differ when the game is one-sided entry or reciprocal entry. Performance, therefore, depends on more factors than entry barriers that 'surround' a market. Moreover, the effect of entry barriers on performance depends on which kind of potential entrant confronts the incumbent firm. Barriers which deter new firms need not deter established firms, as Andrews and others argued. Lack of awareness of this fact created several paradoxes. Caves' Paradox is only one of them. Semmler (1984, p. 124) notes that in a cross-section, an industry's entry barriers may explain high profits; exit barriers may explain low profits due to overcapacity in slumps. Since entry and exit barriers are almost identical ('sunk costs'), this makes the concept of entry barrier ambiguous. I suggest, therefore, to use a concept of entry barrier that is not a priori related to performance.

An alternative definition of entry barriers is based on entry costs (Baumol *et al.*, 1982, p. 282). The classic statement is Stigler's (1968, p. 67):

> 'A barrier to entry may be defined as a cost of producing (at some or every rate of output) which must be borne by a firm which seeks to enter an industry but is not borne by firms already in the industry.'

This definition is not without ambiguities. Say, *ex ante* the incumbent firm and the potential entrant have the same (opportunity) costs and production function. Before entry occurs, however, the incumbent firm sinks costs by an up-front investment. This reduces its opportunity cost and thus creates a cost difference (*ex post*) with the potential entrant (Gilbert, 1989, p. 491). An entry barrier arises in the *ex post*, but not in the *ex ante* interpretation of costs in Stigler's definition. Stigler's original discussion (1968, pp. 67-70) ignores the issue of sunk costs, *i.e.*, of timing; current use of his definition leans towards an *ex post* interpretation (Gilbert, 1989, p. 491, seems a dissenter). Stigler's definition can be specified to

Definition 4.2 An **entry barrier** is an entry set-up cost, that is, a cost that (1) has to be incurred prior to or during entry, (2) is a bygone to a going process or concern, (3) cannot be recovered upon exit, and (4) the associated assets are

specific to the entry market.

Ideally, one should abandon the concept of *entry barriers* for the neutral *entry costs*. It is by no means clear in every case which costs constitute entry costs. In the real world, as opposed to models, it is not clear when the entry process is completed and the firm has established itself (Bain, 1956, pp. 10-1). Preliminary, one may define the *entry process* as over when the firm has achieved an equilibrium *vis-à-vis* its competitors. *Entry costs* are the set-up costs required during this process. They pertain to transaction-specific inputs, *i.e.*, inputs that are specific to the location, if a firm enters a new country, and to the product, if a firm enters a new product market. These inputs have no perfect alternative use within or outside the firm, and are sunk (see conditions (3) and (4)). They introduce a cost asymmetry with the incumbent firm. The incumbent's set-up costs are no longer part of its opportunity cost, as they are sunk costs, but entry costs are part of the potential entrant's opportunity costs.

Bain recognised the importance of entry costs. He traced the absolute cost advantages of incumbents to factor markets. Absolute cost advantages arise if (1) entry raises factor prices, (2) incumbents secure factors at lower prices than entrants, or (3) established firms have access to better factors than entrants (Bain, 1956, pp. 14-6); (2) and (3) imply factor market imperfections. Bain considered this entry barrier as separate from the other ones. The limit price model, moreover, centred attention on the economy of scale entry barrier. The ease-of-entry approach, however, insisted on imperfect factor markets as the only source of advantages for incumbent firms. One may recall Kaldor's 'institutional monopoly' and the incumbent's 'advantages peculiar to himself' in Harrod. Lydall (1955) finally traced the incumbent firm's profits exclusively to its ability to raise the entrant's cost curve.[7] These authors made this barrier topical by flatly denying the relevance of any other entry barrier, referring to established-firm entry for an explanation of this. Their intuition seems to have been vindicated by the 1980s debates. The contestable market theory likewise denied the existence of any entry barrier, such as economies of scale, other than those based on factor market imperfections (giving rise to sunk costs).

A shortcoming of previous definitions of entry barriers is their suggestion that potential entrants are at a disadvantage relative to the incumbent firms. This presumption is erroneous, as the advent of Japanese competition has established beyond any doubt. The advantage of definition 4.2 is that it makes no such claim. Obviously, even the most efficient entrant requires some entry set-up costs. But the

7. Baumol *et al.* (1982, pp. 293-296) analyse a similar situation as Lydall. They focus on welfare consequences. Like Andrews before him, Lydall believes that the contestability outcome is consistent with sunk investments costs (x). A combination of (perfect) contestability with sunk (own cost reducing) investments has been called a *barrier market* (Van Witteloostuijn, 1990a and b). Baumol *et al.* express some doubts on the consistency of their model when sunk costs exist that erect entry barriers. They point out that recent literature has shown that such sunk costs can 'be capable of producing various ancillary effects on the incumbent's incentives with respect to price and output decisions.' (Baumol *et al.*, 1982, p. 294[n]).

existence of entry barriers does not guarantee higher unit costs to the entrant or excess profits to the incumbent. There is, therefore, no basis for a claim, as made by Bain and Andrews, for instance, that entry barriers determine (or are identical with) the incumbent firm's profit margin or (limit) price. I reiterate, therefore, that entry barriers should not be defined in terms of (their effects on) performance.

This discussion is not to deny that in the context of different research questions other definitions of barriers to entry may be more appropriate. Davies *et al.* (1988, p. 26-27) are almost unique in being careful to point this out. They rightly argue that the research questions posed by Bain and Stigler differ markedly, which explains the differences in their definitions. The same holds for the definitions in this chapter: they have to be evaluated in terms of the concomitant research interest.This discussion of entry barriers, therefore, leads to a recognition of the importance of product- and location-specific (entry) costs, pertaining to inputs with an imperfect alternative use in or outside of the firm. I shall now turn to inputs which do have some alternative use.

4.3 MULTIPRODUCT FIRMS AND FIRM-SPECIFIC RESOURCES

The book by Baumol *et al.* (1982) did not only contribute to a better understanding of entry barriers by the introduction of contestable markets (theory I). It also explored efficiency motives for entry by multiproduct firms in its theory of efficient industry structures (theory II). These are based on economies of scope. This inspired a discussion between contestability and transaction cost economics about the connection between economies of scope or scale and firms' entry, exit, and merger strategies.

4.3.1 Economies of Scope

Multiproduct firms derive cost advantages from economies of scope.[8] In a two-product case with products A,B, economies of scope exist if and only if $C(q_A,q_B) < C(q_A,0)+C(0,q_B)$: joint production is cheaper than separate production. For the formal definition, consider a set S of n products, with a partition P of k ($1 < k \leq n$) non-overlapping sub-sets $T_i \subset S$ ($i = 1,..,k$). Assume that each sub-set T_i contains at least one product, and that $S = \cup_i T_i$ and $q_S = \Sigma_i q_{Ti}$, where q_S (q_{Ti}) is the output vector for the product set S (T_i). Total costs are C(q). Then:

8. These are also called economies of jointness. They have been explored in the context of perfect competition theory (*e.g.*, Samuelson, 1966; Burmeister and Turnovsky, 1971; Hirota and Kuga, 1971; Hall, 1973; and Laitinen, 1980). The aim of this work is to devise criteria that allow econometric tests to characterise technology (*e.g.*, economies of scale, and scope etc.) on data about costs and quantities. These models assume perfect competition in factor and product markets, thus excluding the imperfections which loomed large in the previous section. The models are static, *i.e.*, all inputs are treated as if they are acquired simultaneously. These assumptions are orthogonal to the ones made in this book, and I will not, therefore, pay attention to this literature.

Definition 4.3 A **(dis)economy of scope** exists at q_S with respect to the partition P if and only if $C(q_S) < (>) \Sigma_i^k C(q_{Ti})$ (Baumol *et al.*, 1982, p. 72).

The next chapter will feature a more detailed as well as a more general description, which also embraces products which are complementary in consumption. For the time being, the importance of economies of scope resides in the conditions they originate from and in the implications they have for entry.

Baumol *et al.* (1982, pp. 75-79) argue that the public good nature of factors is the source of economies of scope. Say there are n products (i = 1,..,n) to be produced in quantities q_i, which requires capital (or capital services) k_i. If a factor (k) is used in the production process of product i and j, the less production of i reduces the factor's availability to product j, the more it is a public good. They distinguish two extreme cases. Economies can be due to 'some factors of production [which] are public inputs in the sense that, once they are acquired for use in producing one good, they are available costlessly for use in the production of others.' (op. cit., p. 76). The classic special case is joint production, where cattle is slaughtered for meat, and rests are 'costlessly' (with respect to meat production) available for leather and glue production. An economy of scope may also follow from quasipublic inputs, *i.e.*, inputs which when used in the production for one product are not completely lost to the production of another product: 'Often, this results because of indivisibilities or lumpiness in the plant of the productive enterprise.' (op. cit., p. 77). Examples are overhead and idle capacity. Unlike pure public goods, they have some congestion if using k_i units of capital for product i reduces the amount of capital available to product i, but by less than k_i. In the extreme case of complete congestion, capital is a *pure private good*: each product consumes k_i, and total capital required is $k^* = \Sigma_i k_i$. A similar explanation of a diseconomy of scope might refer to public 'bads', such as pollution or exhausting natural reserves.

Caves (1971) argued that these (quasi-)public inputs induce the multinational firm's entry into other countries. A multinational firm may, *e.g.*, benefit from using know how in several markets (De Bondt, Sleuwaegen and Veugelers, 1988; and Veugelers and Vanden Houte, 1990). If the inputs induce entry, and if they also give rise to economies of scale (*e.g.*, a plant) or product differentiation (*e.g.*, a brand name), they refute Bain's proposition that they are entry barriers, and support Hines's claim to the contrary. This raises the question how entry relates to economies of scope. The analysis in perfectly contestable market theory unleashed a debate to be discussed subsequently. Transaction cost theory also developed theories on firm's strategies and economies of scope, as the next two subsections show. Yet another perspective, game theoretical industrial economics, is deferred to the next part.

4.3.2 Multiproduct Firms and Transaction Costs

The basic insight relating economies of scope and the efficient industry theory is:

Proposition 4.1 An economy of scope 'is a necessary and sufficient condition for the existence of multi-product firms in perfectly contestable markets.' (Baumol *et*

al., 1982, p. 71)

This proposition implies that economies of scope (and similar with economies of scale) induce entry into related markets (or merger across markets) up to the point where costs are minimised. The theories of contestable markets and efficient industry structure introduce a dichotomy: sunk costs are entry barriers (definition 4.2), and fixed costs that underlie economies of scale or scope induce entry. Caves' Paradox is avoided by asserting that the fixed costs are not sunk (in a perfectly contestable market). This dichotomy has, however, been challenged: costs are fixed only if they are sunk as well. Moreover, firms exist to minimise transaction costs (Coase, 1937). Critics of contestability theory extended the argument to multiproduct firms.

Teece (1980 and 1982) and Weitzman (1983) raise the question whether an economy of scope or scale is realised within the firm -an internalisation solution- or between firms by means of market transactions. In the former case, the firm internalises the economy by entry into related markets. In the latter, it sells the services of the resources which give rise to the economies in a factor market. The latter solution, but not the first, incurs transaction costs. The authors find that if factor markets are perfect, and by implication transaction costs absent,

> 'market arrangements and internal organization are perfect substitutes.' (Teece, 1982, p. 41)

That is, there is no compelling reason for a firm to internalise any economies by entry if there are no transaction costs to save by excluding the factor market. Weitzman and Teece explore the cases of single-product and multi-product firms, respectively. I will summarise their findings in a conjecture:

Conjecture 4.1 If, in a perfectly contestable market, technology exhibits increasing returns to scope (scale), then individual firms' cost functions exhibit constant returns to scope (scale), if the associated (quasi-)public productive assets or their services can be traded without (a) sunk costs and (b) transaction costs.

This is a conjecture, not a theorem. In the absence of a formal proof it is not yet possible to be precise about the necessary and sufficient conditions. One may argue, for instance, that conditions (a) and (b) are identical. The existence of transaction costs explains why an investment is sunk: its liquidation entails a loss due to the transaction costs. Moreover, a sunk cost is apparent only if the asset is traded and, hence, can be treated as a transaction cost. The conjecture holds that sunk costs are a necessary condition for the existence of increasing returns to scope (scale). The conjecture is inconsistent with the 'sufficient' part of proposition 4.1. By implication, contestability theorists face a dilemma. Either they grant that (quasi-) public resources are sunk, in which case sunk costs underlie both the entry barriers and the cost-minimizing inducements to entry (*i.e.*, Caves' Paradox rears its head). Or, the (quasi-) public resources are tradeable in perfect factor markets, in which case economies of scope or scale do not give rise to multi-product firms.

To demonstrate the conjecture, first consider a single-product, perfectly contestable market with economies of scale. Contestable market theory dissociates

fixed costs, which give rise to economies of scale, from sunk costs, which give rise to exit barriers. Weitzman (1983) challenges this by arguing that without sunk costs there can be no fixed costs. His proof is based on the assumption that factors can be acquired without lags: facilities can be hired in a rental market for arbitrarily short periods of time without either set-up or set-down lags or costs. Transaction costs are absent, therefore, factor markets are perfect (in Chamberlin's sense), investments are immediately and costlessly reversible, and sunk costs are absent.[9] An example may illustrate his condensed proof. Say, the technically lowest-cost production level is y' *per period* (*e.g.*, 100,000 units per year). A small firm that supplies y units (*e.g.*, 1,000 units per year) is conventionally thought to produce at a flow of y per period, at higher unit costs than y' because of the economy of scale. However, Weitzman adds a clever twist by focusing on the time dimension. Production is a flow. The small firm can hire the production facilities from a factor market for a y/y' period of time. It produces at the optimal *flow*, y', if only during a shorter period. It has to pay a rent to the factor market which is calculated on the basis of it producing the optimal flow y'. As a result any firm, however small, has to pay the same rental rate per unit of output. The individual firm, therefore, experiences constant returns to scale. Weitzman does not ignore that an economy of scale exists, technically. The economy is rather a Marshallian external economy at the level of the product market: a higher market output reduces unit costs.

In their rejoinder to Weitzman, Baumol, Panzar and Willig (1983) deny that the assumption of instantaneous access to factors holds in a perfectly contestable market. They introduce in perfectly contestable market theory the *ad hoc* assumption that lags exist which rule out Weitzman's scenario without impairing the hit-and-run entry threat. There must be a minimum time t* during which a firm must rent a production factor. That is, they impose a specific form upon the sunk cost function: $K(w,s) = 0$, if $s \geq t^*$, and $K(w,s) >> 0$, otherwise. Hit-and-run entry is still possible, provided that $t^* \leq T$, where T is the incumbent firm's price response lag. They argue that 'successful entry may require commitment of assets to a particular market for a nontrivial interval of time' which does not 'imply the presence of costs which are sunk in any economically significant sense.' (Baumol *et al.*, 1983, p. 493). Their response amounts to the admission that economies of scale exist *only if* entry requires a (temporary) commitment.[10] Because of the commitment period (t*), investment decisions are not immediately and costlessly irreversible, *i.e.*, there are sunk costs (Baumol *et al.*, 1982, p. 280; Shepherd, 1984, p. 577; Schwartz, 1986, p. 41; and Tirole, 1988, p. 307-308). Weitzman's rebuttal, therefore, holds: internalisation of the economy of scale will not occur if the rental market is a perfect substitute for internal organisation.

Second, consider a multi-product setting where an economy of scope stems from a common (*e.g.*, physical) input. Teece (1980, p. 226) states:

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9. In terms of Baumol *et al.* (1982, p. 280): $K(w,s) = 0$, even if $s = 0$, *i.e.*, for all $s \geq 0$.

10. Where a *commitment* appears to be defined as (the combination of) a period during which a decision cannot be reversed or a cost incurred when reverting a decision.

> 'I submit that the facility with which the common input or its services can be traded across markets will determine whether economies of scope will require the enterprise to be multiproduct in its scope.'

He argues that

> 'In the absence of transactional difficulties, there is nothing to prevent one individual or firm from procuring the physical asset in the requisite size to realize the economies in question and contracting to supply the services of this asset to other individuals or firms. All parties could be independent, yet scope economies could be fully realized.' (Teece, 1980, p. 231-2)

Market transactions are an efficient way to make the services of a common input available to other firms if (1) the input is homogeneous rather than highly specialised, (2) there are 'many' buyers and sellers, such that bilateral monopoly problems are absent, and (3) there are no transaction costs which impede a transaction which otherwise would be to the mutual benefit of both parties (Teece, 1980, pp. 227 and 232). In the ideal case of a purely and perfectly competitive input market, an individual firm cannot improve upon a transacted outcome by internalizing the use of the resource, *e.g.*, by means of entry into a related market. In Teece's example, a shepherd and an orchardist can jointly exploit a plot of land, without the need to merge into a multi-product firm. The shepherd cannot improve upon the outcome by entry into the orchardist's market. As in Weitzman's model, at the level of the market there is a Marshallian external economy, whereas at the level of the firm there are constant returns to scope. If economies of scale or scope are to induce entry, one has to turn to a world where transaction costs do exist.

The upshot of this discussion is that if a link exists between economies of scope (scale) and firm's entry and exit decisions, one has to leave the context of perfectly contestable markets. Instead, one has to focus on resources which are imperfectly tradeable, that is, on firm-specific resources:

Definition 4.4 A **firm-specific resource** is an asset that (i) has an alternative use within the firm and thus is not completely product- and location-specific, and (ii) it or its services are traded, if at all, in imperfect factor markets.

The next part explores the interaction among firm-specific resources, economies of scope, and firm's strategies from the perspective of game theoretical industrial economics.

4.4 APPRAISAL

The chapter demonstrates the fundamental nature of Caves' Paradox, which joins together a stream of literature within the mainstream of industrial economics (Bain) and outside (*e.g.*, Andrews). The internalisation argument shows that if a resource has an alternative use within the firm, rather than outside of it, it may induce entry. Contestability demonstrated that if a resource has no alternative use either within or outside the firm, it is an entry barrier. Scale economies and product differentiation

(*e.g.*, brand names) can thus be entry barriers, as Bain argued, or inducements to entry, as Andrews and others argued. The Caves paradox dug up an underlying real world problem: where do incumbent firms derive a sustainable competitive advantage from, relative to potential entrants?

For a start, a firm can rank its factors along three dimensions (tradability, product-specificity, and publicness). A factor's ranking along these dimensions may have to be intuitive, and, moreover, these rankings are closely related. A higher extent of product-specificity reduces the possibilities for an alternative use of the factor, and thus reduces the number of buyers, which is one type of factor market imperfection. Ranking factors along these lines may help management to 'zoom in' on those factors which are specifically important to its entry decisions. The key factors to focus on in entry (deterrence) strategies are imperfectly tradable. They constitute commitments, and the associated investments are irreversible.[11] Within this class, the extent of product-specificity helps to distinguish firm-specific resources (which are somewhat specific) from entry costs (which are completely specific). Within the group of firm-specific resources, 'publicness' determines the extent to which a factor's use in an entry market imposes an opportunity cost upon the home market. These preliminary steps may help to identify factors that can serve as commitments to particular decisions.

The chapter arrives at a symmetry between incumbent firms and potential entrants: both players have commitments at stake in the competitive game. Entry barriers point to incumbent firms' commitment to their product market, as their original entry set-up costs are bygones. Firm-specific resources constitute the potential entrants' commitment to entry into related product markets. This view brings us one more step beyond Chamberlin's original vision. Bain and others made the first step: they introduced incumbent firms with foresight and strategic intent. The subsequent debate in the 1980s on firm-specific resources introduced entrants (*e.g.*, multinational firms) with similar foresight and strategic intent. It remained up to the modern, game theoretical, industrial economics to formalise this idea rigorously (chapter 5). Moreover, the debate on perfect contestability clearly pointed to imperfect factor markets as the source of the (incumbents' and potential entrants') commitments. Firms, whether incumbent firms or potential entrants, are wise to nourish imperfect factor markets. Again, the 1980s ushered in a game-theoretical approach that formalised this idea (chapter 6).

11. Ghemawat (1991a) makes this insight the cornerstone of his theory of strategic management.

PART III
A CONCEPTUAL FRAMEWORK

This part discusses the key concepts and ideas of multi-market competition. It expands the brief discussion in chapter 2. Its two chapters focus on two dimensions of multi-market competition: the 'horizontal' dimension of competition in multiple product markets (chapter 5) and the 'vertical' dimension of competition in factor markets and product markets (chapter 6).

Although a strict dividing line cannot be drawn between the multi-market framework in this part and the pioneers in the previous part, it may be useful to point to their different shades of grey. The pioneering literature appears to share three characteristics. First, competition centres on the product market instruments: price and output level. Second, if incumbent firms anticipate entry at all, their expectations are simple. Entrants expect the incumbent firms to maintain either their pre-entry output or price level. The incumbent firms expect entrants to behave as if they believe this. Third, analysis focuses on the links between market structure (*e.g.*, concentration, entry barriers) and market performance (*i.e.*, market price and profit margin). The organising principle of these theories is the structuralist interpretation of the Structure-Conduct-Performance paradigm (Scherer, 1980, p. 6).

These characteristics point to an underlying inability to deal with time and dynamics (Kreps and Spence, 1985). In a dynamic setting, structure is endogenous as mergers, entry, and exit change market structure, and firms erect entry barriers by investing in R&D and advertising. Feedback effects from irreversible conduct to structure should be central (rather than ancillary) in an analysis of strategic behaviour by firms. Game theory recognised this point.

The game-theoretical framework in this part is an instance of what has been labelled *strategic competition* (Ulph, 1987; and Shapiro, 1989) or *committed competition* (Caves, 1984). Thomas Schelling defined a *strategic move* as an action 'that influences the other person's choice, in a manner favourable to one's self, by affecting the other person's expectations on how one's self will behave' (quoted in Lyons, 1987, p. 63). A strategic move implies making a *commitment*: a not immediately and costlessly reversible decision. A firm's irreversible move narrows its future choice set and thus affects other actors' expectations of how it will act in the future. *Today's irreversible decisions create tomorrow's structures. Tactic competition* instead involves reversible decisions, that adjust to new information fast and easy (Shapiro, 1989). Strategic competition games entail both commitments (*e.g.*, an investment) and tactic competition (*e.g.*, by price setting). In these games, firms anticipate that today's irreversible decisions set the stage

(*i.e.*, form the structural setting) for tomorrow's decisions of themselves and of their (potential) rivals. This does, of course, require complex systems of expectation formation (*e.g.*, Selten's perfect equilibrium concept). With sophisticated expectations, game theory overcame the simple expectations in pioneering industrial economics.

Since the 1970s, industrial economics has explored the commitment value of numerous kinds of investments.[1] Irreversibility derives from the difficulty to sell used factors, their services, or one's part of the contract through which they were made available. A contract (*e.g.*, a delivery contract with a consumer) is irreversible if the parties are unable to renegotiate it. In the case of factor markets, the important dimension is *tradeability* of a factor, its services, or contract (see chapter 4). Since non-tradeability is an important feature of entry costs and firm-specific resources, these can be analyzed as examples of commitments.

The pioneers in industrial economics confused the issues (for lack of appropriate analytical tools) by discussing strategic competition (*e.g.*, entry deterrence) in terms of tactical decision instruments (price or output). As parts III and IV will demonstrate, this has numerous implications for multi-market competition. At this point I would like to note that my intention is to integrate new insights while retaining some of our existing, much older, concepts from the 'Weltanschauung' that we have been brought up with. I do not intend, therefore, to rid us of either Bain or Chamberlin. But further work along their frameworks does seem to run into decreasing returns. A striking difference between the early pioneers and the recent flurry of game-theoretical industrial economics is the change in method from conceptual and empirical to mathematical. Throughout part III, I will follow the pioneers by offering a conceptual discussion. This is in line with the dissertation's aim to present a conceptual framework of multi-market competition. A mathematical treatment of some issues is deferred to appendices and to part IV.

Chapter 5 (on horizontally related markets) and chapter 6 (on vertically related markets) both focus on the shared, firm-specific resources whose importance section 4.3 emphasised. Chapter 5 explores how a firm derives value from these resources by applying them to a number of product markets. For example, the use of a common input in the supply of different products leads to

1. Some recommended textbooks on industrial economics and game theory are Scherer (1980), Davies, Lyons, Dixon and Geroski (1988), Tirole (1988), the *Handbook of Industrial Organization* edited by Schmalensee and Willig (1989), and Carlton and Perloff (1990). Some essays that attempt an overview of this field are Caves (1984), De Bondt (1985), Kreps and Spence (1985), Geroski, Phlips and Ulph (1985), Ulph (1987), Schmalensee (1988), Gilbert (1989), Shapiro (1989), and Hendrikse (1991b). Papers that attempt to integrate the field are Salop (1979), Fudenberg and Tirole (1984), Bulow, Geanakoplos and Klemperer (1985), and Dixit (1986). Spence (1985), Porter (1985), and Neumann (1988) evaluate policy recommendations to be derived from industrial organisation.

economies of scope. The associated expected profits induce firms to invest in these shared resources. Chapter 6 shows that a firm may also raise the value which it produces with a resource by combining it with complementary factors that it may uniquely own. Either way, the more value a resource adds to a firm, the higher the firm's incentive to acquire the shared resource. If (natural or human) resources are scarce, rivals will bid for them. If the Coase theorem holds in our world with transaction costs, resources will end up being used by the firm that produces most value thereby. Multi-market firms may have an advantage in this respect over single-market (domestic) firms or multinational firms that invest on a market-by-market basis. A common element in both chapters is the importance of complementarities: chapter 5 discusses complementary outputs, where the associated products are complementary in a production process or in their consumers' consumption process, and chapter 6 discusses complementary inputs (*i.e.*, production in teams). In management literature, both complementarities are known as *synergy*.

5 HORIZONTALLY RELATED MARKETS

The 'horizontal' dimension of competition in multiple product markets in this chapter shows that entrants can be committed to entry as much as incumbents to entry deterrence. This may hold in particular for entrants that are established firms whose commitments are based on shared resources that can be applied in several product markets. The chapter ranks groups of markets in terms of an increasing degree of relatedness from segmented markets, via joined markets and other intermediate forms, to integrated markets.

5.1 INTRODUCTION

Chapter 2 defined related markets as markets that are connected by any of three links: shared participants (buyers or sellers), shared instruments, that is, shared assets in production or consumption processes, and coordinated behaviour. Venables (1990a) argues that the *degree of relatedness* increases if firms (are able to) take more decisions from a global perspective (taking into account the entire set of markets served) rather than from a local (single-product) perspective. Economists usually relate the degree of relatedness to the familiar cross-elasticities of supply and demand. Market relatedness can thus be defined in terms of basic conditions (cross-elasticities and shared instruments), structures (shared participants) or conduct (coordinated behaviour or global perspective of decision making). This chapter uses Venables' behavioural approach as organising principle to tie in the other elements (except cross-elasticities, which are deferred to chapter 9). Figure 5.1 illustrates the setting.

At the lowest level of relatedness, short of unrelated markets, are segmented markets. On the demand side, these imply independent market demand functions due to the absence of arbitrage trade, and prices that can differ among markets. On the supply side, the necessary condition for segmentation is constant returns to scale: sales in one market do not affect (marginal) costs in another market. To these structural conditions Venables (1990a, p. 23) adds behavioural

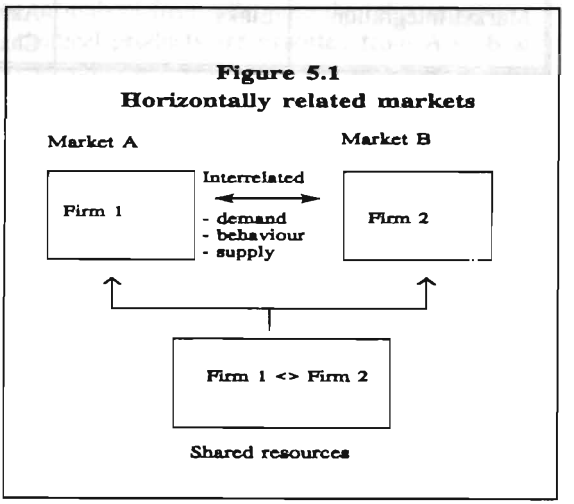

Figure 5.1
Horizontally related markets

conditions: segmented markets have common suppliers who decide about product market variables (*e.g.*, output levels) on an 'unrelated', market-by-market basis. Venables (1990a, p. 23) distinguishes the segmented markets from the *integrated market* hypothesis where, respectively,

> 'firms are permitted to select strategies for each national market, or merely to choose a strategy at the world level. (.) Integration implies that producers set a single quantity (or price) at the world level, and let arbitrageurs determine the distribution of sales to national markets (.) At the other extreme, segmented market behaviour, when combined with constant marginal costs, implies that the game played between firms in one country is completely separate from the game that the firms are playing in other countries'.

Venables (1990a) also distinguishes an intermediate case, which I propose to call *joined markets* where

> 'some of the firms' decisions are taken on an integrated, or worldwide, basis, and others on a segmented market basis. The most natural variable in the former category is firms' capacity choice, since a unit of capacity can be used to supply any country. In the latter category, we may wish to leave some of firms' market decisions (price or sales) to be taken on a national basis.'

Integration of decision making can refer to investment decisions other than capacity as well. A table summarises the proceedings of the chapter, while harking back to figure 5.1.

Table 5.1
A Taxonomy of Related Markets

Market integration	Links	Associated Characteristics	Section
Segmented markets	Common suppliers	Cross-hauling	5.2
Joined markets	Shared resources	Multi-market spillovers	5.3 and 5.4
Coordinated markets	Integrated strategic intent	Multi-market collusion	5.5
Spheres-of-influence			
Integrated markets	Trade arbitrage	Global price level	5.6

The chapter discusses markets in increasing relatedness, to begin with segmented markets (section 5.2). In joined markets investments in shared resources create links that will be formalised as multi-market spillovers, which build upon the concept of economy of scope (in sections 5.3 and 5.4). Firms integrate strategic intent across these markets if they respond in one market to actions undertaken by a rival in another market. This may lead to coordinated behaviour across markets

(in *coordinated markets*) or to a coordinated withdrawal of each firm to a home market (*spheres-of-influence*) (see section 5.5). The chapter reviews integrated markets in section 5.6. An appraisal concludes the chapter. The 'links' in the table are necessary conditions to achieve a particular degree of relatedness. They are also necessary for the 'associated characteristics'. As a result, degrees of market relatedness tend to go together with these characteristics.

5.2 SEGMENTED MARKETS

Segmented markets exhibit the lowest degree of relatedness:

Definition 5.1 *Segmented markets* are defined by (1) the presence of some common suppliers, (2) who have constant returns to scale; (3) independent pricing is possible due to absence of arbitrage and due to localized demand.

In international trade, segmented markets are regional or country markets linked by exporters. Brander (1981) and the sequel in Brander and Krugman (1983) develop the paradigm model of segmented markets. It can be summarised as follows. There are two countries, A and B, and two firms, 1 and 2. There is symmetry across markets and between firms. Firm 1 is the incumbent firm in market A (*i.e.*, located in A), and likewise firm 2 in B. In each market, products are homogeneous, and firms compete in outputs (Cournot duopoly). The demand functions are independent. Marginal costs of production, c, are constant. Exporting to the other market requires a constant unit transport cost or tariff, t. Each firm chooses home and foreign sales, taking the rival's home and foreign sales as given. Profit maximisation leads to straightforward results. In each market, the incumbent firm has lower marginal costs (c) than the importer (c+t). If the incumbent's monopoly price (p^m) is less than the importer's unit cost (c+t), the import level is zero, and the incumbent firm is monopolist. Otherwise, a Cournot duopoly exists where the incumbent firm sells more than the importer.

The result is *cross-hauling*: identical products are exported from A to B and imported from B into A. This is an important real world phenomenon in world trade. The model suggests that this aspect of trade can best be understood in terms of imperfect competition. It subsequently became the basis of new international trade theories.[1] In a symmetric equilibrium, the model shows that the prices in both countries will be equal. Each firm will, therefore, have a higher profit margin in its home market than in its export market (where it incurs transport costs). This result has been called *reciprocal dumping*, if dumping is defined as an f.o.b. price for exports below the domestic price (Brander and Krugman, 1983, p. 316). This result critically depends on imperfect competition: only then can different prices (net of transport cost, f.o.b.) exist while marginal revenues (f.o.b.) in both markets are equal (as both are equal to the marginal cost c). In perfect competition, a price taker will not sell in two markets simultaneously if one market offers a higher price (f.o.b.) than the other.

1. See Helpman and Krugman (1989) for references and a survey of the implications for trade policy.

Some characteristics of the model stand out. First, a demand shock in one market will not affect another market. The assumptions of independent market demand functions (no arbitrage) and constant marginal costs see to that.[2] Second, it exhibits a prisoner's dilemma. Exporting to the foreign market is each firm's dominant strategy (if $p^m > c+t$). Yet both firms would benefit it both decided not to export: they would gain monopoly profits at home while losing export profits. The net gain will be positive as the monopoly outcome saves on transport costs and prevents erosion of profits by duopoly competition. Third, it is a one-stage, one-shot game. It has been extended to two-stage games (section 5.3), which explicitly introduce investment decisions and increasing returns to scale or scope. The associated markets are called joined markets. The segmented markets game has also been extended to repeated games (section 5.5), which show how collusion may overcome the prisoner's dilemma. Collusion also leads to associated market forms (coordinated markets and spheres-of-influence).

The natural interpretation of the reciprocal dumping model is to view markets A and B as countries. However, they can also be different product markets. Entry, that is, is associated with either adjustment cost in production, if the entry market good is a technical substitute, or transport cost or tariffs, if the product is exported. Entry is *easy* if these entry costs are low (Calem, 1988, p. 171). These adjustment or export costs can be asymmetrical from markets A to B, and *vice versa*. If we allow some asymmetry, the model may be used to introduce two extreme cases. Say, unit transport costs differ per firm: $t_i \leq t_2$ (for firm i = 1,2). No entry at all occurs if $p^m-c \leq t_i$: each firm is monopolist in its home market. If $t_i < p^m-c \leq t_2$, *one-sided entry* occurs: firm 1 exports to market B, while firm 2 does not export to A (Calem, 1988, p. 175). If $(t_i \leq) t_2 < p^m-c$, *reciprocal entry* occurs: each firm exports to the other firm's home market (Calem, 1988, p. 178). This is the cross-hauling case of international trade theory.

The occurrence of one-sided or reciprocal entry raises the question what triggers the existing firms' entry move(s)? A reduction in transport costs or tariffs may induce entry (*e.g.*, consider a decrease in t_2 from a level above p^m-c to one below p^m-c). European integration exhibits examples of this situation. Investments in firm-specific resources that can be used in several country markets may give rise to established-firm entry (see chapter 4 and the next section). If firms collude to stay away from each other's home market, the breakdown of collusion may induce reciprocal entry (section 5.5). If firms expand their market definition from countries to continents or beyond, they may enter markets previously beyond their intellectual horizon (chapter 9). Although it is unlikely that this change occurs on conceptual grounds alone, it does mean that changes in business strategy can lead to reciprocal entry. Privatisation of state monopolies with liberalisation of their monopoly markets may induce reciprocal entry by the former monopolists into their once protected national markets.[3]

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2. Subsection 5.3.6 discusses a borderline case with joined markets where sales in one market do affect costs or revenues in another market.

3. *e.g.*, 'Cross-Channel Rivalry Highlights Opening Of EC Phone Industry' (*The Wall Street Journal Europe*, 1-8-92, p. 1 and 4).

5.3 JOINED MARKETS

Joined markets represent a higher state of relatedness than segmented markets:

Definition 5.2 A pair of *joined markets* exists if (1) suppliers use shared resources in both (all) markets, and (2) they invest in these resources while anticipating this common use. (3) Arbitrage among these markets does not occur such that prices may differ from one market to the next.

Condition (3) holds in segmented markets as well. The distinction between segmented and joined markets is blurred since condition (1) is implicit in segmented markets, where the common suppliers may use shared production capacity for both home and entry markets. Moreover, condition (2) ignores cases where shared resources do not reflect anticipation of multi-market use (see subsection 5.3.6). Conditions (1) and (2) may give rise to multi-market spillovers (or joint economies).[4] The current section begins with defining multi-market spillovers and subsequently explores why multi-market spillover effects exist at all. It will appear that multi-market spillovers are not so much important in their own right; instead they are fingerprints pointing to the real *dramatis personae* of this section: shared resources. The link to these resources will also suggest a taxonomy of multi-market spillovers. Finally, multi-market spillovers do play a role in decision making: they identify the impact of a firm's position in one market on its decisions in another market.

5.3.1 Definitions of Multi-market Spillovers

In the Brander (1981) model, a demand change in one market, say A, will not affect either cost or demand in market B. In joined markets this does not hold because of multi-market spillover effects. This concept intends to generalise the (dis)economy of scale or scope. It comes in a marginal and in a 'total' condition.

Definition 5.3 The marginal condition for a *multi-market spillover* is

$$\frac{\partial^2 \pi}{\partial S^A \partial S^B} \neq 0;$$

where π is the firm's total profits in markets A and B, S^j is its decision instrument (*e.g.*, the output level) in market j (= A,B), and $\partial\pi/\partial S^B$ is the marginal profitability of the decision S in market B (Bulow, Geanakoplos and Klemperer, 1985, p. 493).

If the inequality condition holds, the action S^A in market A affects the marginal profitability ($\partial\pi/\partial S^B$) of action S^B in market B. The marginal profitability in turn affects the choice of S^B: the profit maximising firm raises S^B up to the point

4. This explains the name joined markets. The meaning is similar to Shakun's (1956) concept of *coupled markets*, which are markets connected by advertising campaigns for brand names. See subsection 5.4.4.

where it no longer raises its profits (*i.e.*, where $\partial\pi/\partial S^B = 0$). A change in market A, *e.g.*, a demand shock, affects not only S^A but also, via S^A's impact on $\partial\pi/\partial S^B$, the choice of S^B in market B.

In the special case where two markets are completely independent from each other except in the cost curves of its firms, Bulow *et al.* (1985, p. 493) equate the multi-market spillover to $\partial^2 C/\partial q^A \partial q^B$, where C is a firm's total costs and q^j is the output level in market j (= A,B). If negative there is a weak cost complementarity (Baumol, Panzar and Willig, 1982, p. 74). The next definition generalises their related concept of economy of scope (definition 4.3 in the previous chapter) to include complementary products in consumption:

Definition 5.4 The 'total' condition for a positive (negative) *multi-market spillover* at the pair of variables (S^A,S^B) is $\pi(S^A,S^B) > (<) \pi(S^A,0)+\pi(0,S^B)$.

Appendix 5.A compares these cost concepts in Baumol *et al.* (1982). The next subsection traces these spillovers back to assets that are public goods.

5.3.2 Spillovers and Public Goods

Baumol *et al.* (1982) explain economies of scope from (quasi)public goods (see subsection 4.3.1). Their analysis pertains to factors of production. It can be extended to any capital asset that raises a firm's profits (gross of capital service costs). The appendices 5.B and 5.C demonstrate this. They recount and generalise their proofs that public goods lead to multi-market spillovers.

Six factors need to be taken into account for public goods to lead to spillovers. The first one is product-specificity. If a capital good is completely product-specific, it has no alternative use. It is then without meaning to ask how alternative use would affect its current availability, that is, whether it is a private good or a public good with respect to other products. Imperfect product-specificity (also called firm-specificity) is thus a necessary condition for a meaningful distinction between private and public goods. Moreover, if an investment is completely product-specific, it does not influence the (marginal) profitability in another market, and thus generates no multi-market spillover.

A second factor important for spillovers is a property called non-exclusion. Public goods satisfy certain conditions (*e.g.*, Atkinson and Stiglitz, 1987, pp. 483-4). First, it should be costly to exclude non-contributors from benefiting from the resource (the *exclusion principle*). This relates in particular to know how and experience. These (intangible) assets spread (intentionally) within the firm but may also leak (unintentionally) to other firms, thus making them more competitive. The firm faces an appropriability problem: it does not recoup all returns to its own investments in, for example, R&D. Solutions can be to cooperate or merge with the rival firms (*e.g.*, De Bondt and Veugelers, 1991). Second, the resource should be made available to other product (markets) at little or no opportunity costs. If investment k_j for product j has an externality upon product i, it raises the *effective capital* K_i from the dedicated investment k_i to $K_i = k_i+\alpha\Sigma_{j\neq i}k_j$ (i,j = 1..n; where $\alpha \neq 0$ is the externality). Appendix 5.C ranks investments from private good to purely public good when the externality

increases from zero to unity. An externality is an opportunity to the firm: it may exploit its resource in other markets without giving up its home market. This aspect of public goods is the focus in this book. Appendix 5.C, however, demonstrates that an externality leads to a multi-market spillover only in two special cases. Both cases express the condition that exclusion must hold. The economic content of this condition is centralisation: either there is a firm-specific investment in public goods ($\alpha = 1$ and $K_i = K_j$ for all i,j) or investments are limited to some products, and other products free-ride on them (for example, product i has $k_i = 0$ and $K_i = \alpha\Sigma_{j \neq i} k_j$).

Three, spillovers may occur through two avenues. One, a (demand) shock in market A may affect the investment decision in a shared resource, which in turn affects the profitability in market B. This generates the spillover in definition 5.3. The variables S^A and S^B in the definitions above then refer to the firm's output levels; the firm controls only one (global) investment decision (see appendix 5.C for the reason of this assumption). Two, a shock in market A may affect the utilisation of the (private or quasipublic) resource, which affects the profitability in market B. Consider the former avenue. The implicit assumption is that the size of the investment is endogenous. If investments are exogenous, *e.g.*, a fixed plant size, developments in market A cannot influence the size of the investment, and thus do not transmit to market B. There is no spillover effect on the margin in the other market, *i.e.*, no spillover as measured by definition 5.3. Developments in market A may influence the lumpy decision whether to invest at all, and this may affect market B. Hence, a spillover as measured by definition 5.4 may exist. The distinction of two avenues is also useful to understand the impact of imperfect information.

Since imperfect information will affect both size and utilisation of an investment, it too may affect the size of a spillover. Table 5.2 illustrates the argument.

Table 5.2
Multi-market spillovers and shared resources

Spillover		Demand Shock	
		Anticipated	Unanticipated
Shared Resource	Private	Zero	Negative
	Quasipublic	Positive	Zero/Negative
	Public	Positive	Zero

Say firm 1 is active in markets A and B. Consider, on the one hand, a change (increase) of demand in market A which the firm is able to anticipate when it takes its investment decision. The firm will increase its investments in R&D, advertising or capacity. Positive spillovers occur to market B if the resource is a (quasi)public good. Higher advertisements, for example, may raise its sales in market B as well. Anticipative investments in capacity (or another private good)

for market A prevent a capacity constraint on product B, such that no capacity-induced spillover occurs. On the other hand, a change in A's demand curve may also be unanticipated. Being unanticipated, it did not induce a larger investment in the shared resource. The shock now affects the utilisation of the shared resource. If the resource, *e.g.*, advertising, is a pure public good, no spillover occurs to market B. Higher sales in market A, given the unchanged level of advertising, do not affect sales in market B. If the resource is a quasipublic or private good, *e.g.*, capacity, the firm's increase of production of A raises its marginal costs in market B. This example implies a negative spillover. Baumol *et al.* (1982) analyze the former case (see appendix 5.B). The table complements their results with the case of unanticipated shocks. Section 8.6 and subsection 9.8.4 explore the case of a private good (capacity).

The capital good market also affects spillovers. Pecuniary economies of scope are absent if factor markets are perfect. When imperfect competition on the demand side of the factor market is allowed, an increasing demand for capital good k_i for product i (*e.g.*, because demand for i increases) affects capital good prices and thus may affect investments k_j for product j, and thus j's marginal costs. A multi-market (multiproduct) spillover may result. This holds even if the capital goods themselves are purely private goods or product-specific.

Finally, strategic competition affects investment motives and thus the size of spillover effects. Baumol *et al.* (1982) do not explore the strategic implications of irreversible investments in shared resources. Instead they explore the cost-minimising investments for given output levels. In a game with irreversible investments, however, firms choose profit-maximising investments levels, and then choose product market variables (output levels) given those investments. They may invest in shared resources for the sake of making a commitment to entry (deterrence) rather than to exploit a joint economy (spillover). In terms of the latter (cost minimisation) objective, the commitment motive may lead firms to over- or underinvest (see subsection 6.4.6). This reflects the setting of joined markets in, among others, Venables (1990a). See subsection 5.3.5 and section 5.4.

5.3.3 A Taxonomy of Multi-market Spillovers

The identity of the shared resource that underlies a multi-market spillover effect may give rise to a taxonomy of spillovers. Shared resources may represent three basic types of economic data: technology, consumer preferences, and information.

Multi-market Supply Spillovers

Supply spillovers occur if production processes use shared factors of production or if the output of one process is an input in another process. A positive (negative) multi-market supply spillover exists if the output in market B reduces (raises) the (marginal or average) costs of producing for market A (*i.e.*, economies of scale or scope). Given the discussion above and in the previous chapter, let me just note that markets A and B are vertically related if definitions 5.3 or 5.4 indicate an integration (dis)economy.

Multi-market Demand Spillovers

Demand spillovers occur if the consumer's utility from consuming one product depends on his (or someone else's) consumption of another good. A multi-market demand spillover

> 'is positive if a firm's demand in one market is complementary to its demand in the second ... and would be negative if selling more in one market hurts prospects in the other' (Bulow *et al.*, 1985, p. 509).

Products A and B are complements (substitutes) in consumption, if the consumer's marginal utility of product A increases (decreases) in his consumption of product B. They are strict (or perfect) complements, if one product is useless without the other (*e.g.*, the left shoe and the right shoe in a pair of shoes). Consumers are indifferent between perfect substitutes. When a firm starts selling in another market, a demand spillover from its entry market makes itself felt as a shift in its home market demand curve. That is, the demand functions are interrelated (Coase, 1946).

Close substitutes in demand such as coffee and tea may have to be included in one market; distant substitutes create a negative spillover across markets.[5] Complementarity in consumption exists between such 'systemic' products as cameras and films, computers and software, CD players and CDs. The complementarity here reflects a technical need, which requires compatibility between, *e.g.*, a particular camera and film. That is, compatibility can be seen as a requirement or specific case of (strict) complementarity in consumption or use. Partly overlapping with these examples is the case of network externalities. Products may be related by a joint network (*e.g.*, telephone lines are also used for fax machines), such that increasing demand for or diffusion of one product increases the usefulness of the other. Distribution, advertising, and after sales service may link demand of otherwise different products, if consumers prefer widely distributed, advertised, or serviced products. Similar to the economies of scope, therefore, a firm-specific resource may be the source of a demand spillover.[6] If the shared resource is (product) information, a specific type of spillovers can be mentioned, which cuts across the distinction between supply and demand spillovers.

Multi-market Information Spillovers

Actions in one market may signal an inalienable characteristic of a multi-market firm that makes itself felt in all its markets. The signal may be received by

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5. Chapter 9 further discusses market definition problems.

6. Consumers may derive utility U(.) not directly from a good, but from a service, z(.), derived from using that good in conjunction with another good. For example, $U_i(z_1(q_i^A,q_i^P),z_2(q_i^B,q_i^P),..)$, where i is the consumer, A, B and P are commodities, and z_j (j =1,2,..) are service functions. The good P is a public good (*e.g.*, a cable or phone network, advertising, *etc.*) that raises the utility derived from consuming the A and B goods. Through P, consumer utility and demand for A and B are related.

consumers, (potential) competitors, or by suppliers. Their response to the signal may change the firm's marginal cost or revenue in a related market (hence a multi-market spillover).

Consumer signalling is relevant for experience goods, *i.e.*, goods whose quality consumers cannot ascertain prior to purchase. Consumers may buy on the basis of supplier's goodwill, *e.g.*, a reputation for quality, which in turn reflects the consumers' past experience with the firm's products. A firm may use the goodwill which it has developed in one market to facilitate the introduction of a new product. By selling the new product under its own brand name it signals its quality. This is called *umbrella branding* (*e.g.*, Wernerfelt, 1988). Consumers may also react to information about each other's behaviour. This may occur with fashion or lifestyle goods. Consumers in one country may follow demand in a lead market, a *bandwagon* effect, or they may be appalled (and their utility may be reduced) by a product's increasing popularity elsewhere, a *snob* effect. The bandwagon (snob) effect is formally similar to a (dis)economy of scope in demand, which can be derived from consumer utility functions (Kesteloot, 1990, p. 171-4).

Predatory behaviour by an incumbent firm against entrants in one market may generate a reputation for predatory behaviour in its other markets (Selten, 1978; Kreps and Wilson, 1982; Milgrom and Roberts, 1982; Phlips, 1988; and Levy, 1989). A monopolist may build up a reputation by exploiting the potential entrants' uncertainty about its response to entry. It does so by price cutting upon (early) entry *as if* in all its markets price cutting is profitable (Kreps and Wilson, 1982) or as if it (has a small chance to) display(s) an aggressive reaction whether profitable or not (Milgrom and Roberts, 1982). Reputation may deter entry in later markets, such that the firm enjoys monopoly profits there, which outweigh the costs of price wars in its early markets. Similarly, a firm might develop goodwill or a reputation for toughness with suppliers (*e.g.*, employees) in one market, with a view to using this reputation in other markets. The next two subsections show that spillovers may influence decision making.

5.3.4 Multi-market Spillovers and Decision Making

Multi-market spillovers play a role in decision making both about product market variables (production levels or prices) as well as about pre-competitive investment levels (such as production capacity). This subsection centres on production levels; the next one discusses investment decisions. Multi-market spillovers may affect a 'lumpy' decision, such as whether to enter a market. They may also affect an incremental or marginal decision to adjust the output level to a small shock. These two cases show when one will use either of the two definitions of multi-market spillovers. Consider both cases in turn.

A lumpy decision such as entry can take several forms. In international trade, entry may imply local investments (by a multinational enterprise) or local sales (by an exporter). A multi-market firm may also come about by a merger of firms in related markets. In all cases, the firm may realise a spillover by using a shared resource in its new and existing markets. If the resource is not a pure public good, entry into market j reduces its availability to activity (or market) i. The

latter loss imposes an *opportunity cost of entry* into market j (see chapters 2 and 7). Consider for example a monopoly firm in market A which enters market B. It enters if $\pi(A,B)-F > \pi(A,0)$, where $\pi(i,j)$ is the maximum profit from activities in markets i and j, and F is the (given, fixed) entry cost into market B. There are two ways to decompose this decision problem. First, imagine for the sake of the argument (which will be difficult in practice) that $\pi(A,B)$ can be decomposed into local profits $\pi^A(A,B)+\pi^B(A,B)$. Then, entry is profitable if:

(5.1) $\pi^B(A,B)-F > \pi(A,0)-\pi^A(A,B)$.

That is, the entry profit should exceed the opportunity cost of entry, where the latter entails the loss of profits in market A due to entry into market B. The opportunity cost of entry will be zero (the usual case in industrial economics models) if the resources used in market B are either purely public or (in the case of private goods) were not used in market A prior to entry (*e.g.*, excess capacity). A negative opportunity cost exists if entry into B actually raises profits in market A. To introduce spillovers, decompose the entry decision problem alternatively into

(5.2) $\pi(A,B)-[\pi(A,0)+\pi(0,B)] + \pi(0,B)-F > 0$.

That is, the established-firm's entry decision can be decomposed into the multi-market spillover effect (definition 5.4) plus the *de novo* entry profits. This suggests a two-stage analysis for an entrant: first explore the entry profits *as if* the new activity is independent, and then study the contribution the parent company can make to the new activity by leveraging its spillovers.[7] Equation (5.2) provides the necessary condition for entry by acquisition: the established firm in market A may acquire a local firm in market B (with a value of $\pi(0,B)-F$) and then enhance its competitiveness by means of the spillover (see section 3.4.1).

A marginal output decision is called for when a small shock occurs in say, market A. Increasing demand in A may induce the firm to raise its output level in that market. Should it also adjust its output level in a related market, B? When addressing this question, Bulow *et al.* (1985) discovered the importance of the marginal multi-market spillovers in definition 5.3. The same analysis also ushered in their concepts of strategic substitutes and complements, which received greater attention by economists than the multi-market spillovers did. Appendix 5.D recapitulates their analysis. Suffice it to say that if in response to a shock in market A the firm increases its production level in that market, it will, if there is a positive (negative) multi-market spillover, raise (reduce) its output level in market B.

The following subsection explicitly links entry decisions to investment decisions. Its special case of multinational firms demonstrates that both cost minimisation motives (joint economies) as well as commitment motives determine a firm's investment decision in shared resources.

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7. The decomposition breaks down if the incumbent firm in market B responds differently to *de novo* entry than to established-firm entry (see subsection 6.7.2).

5.3.5 Spillovers and Investment Decisions by Multinational Enterprises

Theories of the multinational enterprise (MNE) distinguish three types of costs: unit tariff and transport costs (t), firm-specific fixed costs (F), and plant-specific fixed costs (G). This set-up reflects the dichotomy, discussed in chapter 4, between firm-specific resources (F) that may induce entry, and product-specific factors whose costs (G, t) serve as entry barriers. This subsection focuses on models which assume these costs to be of given (exogenous) size (Horstmann and Markusen, 1987, 1989 and 1992; and Veugelers, 1990).[8] Moreover, it assumes that the firm-specific resource, *e.g.*, know how, can be used without any costs in all (both) markets served by the MNE. The firm-specific resource F combined with constant marginal production costs gives a global economy of scale or scope (see definition 5.4). A firm can prefer to serve its home market only, in which case it is a domestic firm and incurs fixed costs F+G. If it serves the foreign market as well, it may export, incurring transport costs or tariffs tX (if X is the level of exports). It may also become an MNE by setting up a plant in the foreign market. Compared to an exporter, the MNE incurs fixed costs G, while saving on transport costs tX. An MNE's cost advantage over domestic firms is that two domestic (single-market) firms incur fixed costs 2F+2G whereas the MNE incurs F+2G. The higher F, the more likely that an MNE replaces domestic firms. Moreover, if entry and exit is allowed, the higher F, the smaller the number of firms sustained by given country demand curves.

Two specific cases have been explored. One, consider the case when consumer needs across countries and products are homogeneous. Two firms, located in different countries, may compete in the two markets (reciprocal entry). First, however, they choose an entry mode, *i.e.*, whether to export from the home country or to invest in the host market, thus becoming an MNE. Call this the MNE-MNE game (Dei, 1990; and Rowthorn, 1992). Dei focuses on the prisoner's dilemma in the game. Becoming an MNE can be a dominant strategy as the MNE's local production reduces its marginal costs in the foreign market, and thus raises its gross profits.[9] If both choose to become an MNE, however, each may lose more in its home market, by the other's incursion, than it gains in the foreign market. Rowthorn (1992) shows that, depending on the size of, on the one hand, the transport costs and tariffs, and, on the other hand, the plant-specific costs, several outcomes are possible. Cross-hauling may occur (when both firms export), cross-investments (when both firms become an MNE), as well as intermediary cases.

Two, if consumer needs are heterogeneous, local firms may cater to local consumers' specific needs (Ghemawat and Spence, 1986; and Veugelers, 1989). Lets call this one-sided entry case the MNE-DOMESTIC game. The domestic firm's differentiated product may give it an edge relative to the MNE's cost-

8. Krugman (1983) and Dei (1990) are similar models of the MNE, but they ignore the plant-specific fixed cost. Rowthorn (1992) ignores the firm-specific fixed cost.

9. In Dei (1990) this also raises the MNE's *net* profits as plant-specific fixed costs are ignored.

efficiency derived from its firm-specific resource:

> 'global competitors try to exploit the similarities across countries, while country-centered producers tend to be more responsive to the differences among them.' (Ghemawat and Spence, 1986, p. 63)

Veugelers (1990) cuts across the MNE-MNE and the MNE-DOMESTIC games. In her model, both firms in the game can choose to become either an MNE, by investing in R&D to acquire a firm-specific asset, or to be a domestic, non-exporting firm.[10] Apart from the prisoner's dilemma referred to above, she shows that a chicken dilemma exists when the size of the R&D outlay excludes more than one MNE in equilibrium. The other firm chooses for the role of domestic firm. Each firm prefers to be the MNE, but if the other firm chooses for the MNE role, it is better to seek a niche and be a domestic firm.

Competition by MNEs shows that firm-specific resources have two conceptually distinct effects in a multiple market context. First, they may represent a joint economy relative to the situation where domestic firms invest only in their home market. For instance,

> 'This jointness or public goods property [of firm-specific assets] gives rise to the existence of multi-plant economies of scale in which one two-plant firm has a cost advantage over two independently owned plants.' (Horstmann and Markusen, 1989, pp. 46-7)

This is an efficiency-argument to multi-market firms. Second, firm-specific resources represent a commitment that may improve the firm's competitive position. That is, an MNE may buy resources to deter entry by potential domestic firms. By buying a local plant it reduces its marginal costs by t (the exporter's transport costs). This allows it to reduce price upon entry in its host market, which deters entry, such that high prices may result:

> 'The problem that arises is that, while the MNE is technically efficient, it often possesses considerable market power.' (Horstmann and Markusen, 1989, p. 47)

A firm may thus become an MNE even if exporting would give lower total costs (if $tX < G$) but exporting would induce entry by a local firm.

These models made important contributions to the analysis of MNEs. However, something is missing. Decisions by a firm to become an MNE or an exporter have no repercussions in its home market. The assumptions of exogenous investment levels (F, G), constant marginal costs, and segmented markets (on the

10. This is called an assignment game. In Horstmann and Markusen (1987), by contrast, roles are exogenous. One firm is allowed to choose between export to a host market and becoming an MNE by investing in the host market. In the host market, a potential firm is constrained to become a (single-market) domestic firm if it enters.

demand side) rule out feedback effects. Technically, these assumptions pertain to segmented markets. These models underestimate the extent to which multinational firms create linkages among national economies. The assumption of exogenous firm-specific resources has the merit of being a simplifying modelling assumption. There are, however, two reasons to think that investment outlays are rarely exogenous. The number of inputs that make up an investment are usually variable. If the inputs are complementary, more of one input (*e.g.*, R&D engineers) raises the contribution by other inputs. Second, in cases where the number of inputs is fixed, *e.g.*, a favourable location or natural resource, the outlay on them rarely is fixed. Firms bid for scarce natural resources. As the next chapter shows, the bid price depends on the value that the resource will have for business users.

5.3.6 Segmented versus Joined Markets

The models about MNEs reveal that the boundaries between segmented and joined markets are blurred. Both have common suppliers who use shared resources, although these are implicit in segmented market models. The reason for blurred boundaries is that definitions 5.1 and 5.2 have two loopholes. One loophole is that if the use of a shared resource was not anticipated by the firms at the time of their investment decisions, the markets are not joined by definition 5.2. I will refer to these markets as segmented. Note, however, that in this case events in one market may affect the other market. Multi-market spillovers appear if exports are so profitable that exporters ration sales to their home market in order to relax capacity or other constraints on their exports (a negative multi-market spillover by table 5.2). This modifies definition 5.1 by allowing for resource constraints. Hence positive or negative (zero) spillovers cannot be used to define joined (segmented) markets.[11] If transport costs decrease and trade levels increase, segmented markets can be classified in four types: they may exhibit no trade if transport costs are sufficiently high (a case that overlaps with unrelated markets), one-sided trade, or two-sided trade; finally resource constraints and spillovers arise if trade levels have further risen due to falling transport costs (the case that overlaps with joined markets). In the latter case, firms may adjust their investment levels to their sales in multiple markets, and markets become joined.

Another loophole appears if the size of investments in firm-specific resources is exogenous, as was assumed by the models above. In this case, the only decision firms can take is whether to invest at all. The markets are still joined if firms decide about these investments from a global point of view, that is, a new firm is created and F+G are incurred with an MNE's view to entry profits as well as home market profits. Markets are to be classified as segmented, however, if the decision to invest is a bygone and the number of firms is given exogenously: condition (2) of definition 5.2 then fails to hold. The next section

11. Another reason for not distinguishing segmented and joined markets on the basis of multi-market spillovers is that there are two definitions of these spillovers (see their different implications in appendix 5.A) and the size of spillovers is ambiguous as it depends on whether shocks are anticipated (table 5.2).

explores strategic resources with an endogenous size, where the choice of investment size creates a feedback effect between markets.

5.4 FIRM-SPECIFIC RESOURCES IN JOINED MARKETS

This section will discuss a wide variety of shared, firm-specific resources (see definition 4.4 in subsection 4.3.2). It does not aspire to be exhaustive (*e.g.*, Grant, 1991, p. 119). These resources may account for multi-market spillovers or, as it has been understood within strategic management, synergy (see subsection 2.4.1). They underlie the firm's choice of product markets. They are what Barney (1986b, 1232) calls *strategic factors*, being the resources that are necessary for implementing a strategy. Since they provide potential access to a wide variety of markets, they are *core competences*, if they also qualify Prahalad and Hamel's (1990, pp. 83-4) other conditions (see subsection 2.4.1).

5.4.1 Capacity

Capacity can be a firm-specific resource. First, it is *ex post* difficult to trade, as it is often indivisible and immobile. Second, although it may be designed to produce a specific product, it often can be used (or adapted) for distinct products. It may be used to supply the same product to different countries, while incurring transport costs, or it may be used to produce technically different products, while incurring some adjustment costs. As Clemens (1951, p. 2) argued, in a path-breaking article:

> 'What the firm has to sell is not a product, or even a line of products, but rather its capacity to produce.'

Clemens explores the situation where the products are perfect substitutes in production: producing one unit of A reduces capacity for B by one unit. In this case, capacity is a private good. If the capacity constraint is binding, a product's opportunity cost is no longer the direct marginal cost but the earnings foregone by reducing capacity for other products.[12] Firms may first invest in capacity and then, given capacity, serve both country or product markets (Calem, 1988; Anderson and Fischer, 1989; and Venables, 1990a) (see chapters 7 and 8).

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12. Andrews (1951) seems to have missed this point. He argues that Marshall used a broad market definition based on technical and demand substitutes (Andrews, 1951, p. 143-4). All products within the broad industry can be aggregated to a cost-based standard commodity [*i.e.*, all products are perfect substitutes in production]. This would have allowed Marshall to analyze the industry in a homogeneous good context. This conclusion misses the point that opportunity costs change. This argument may explain Andrews' exclusive focus on single-product firms, whereas real world firms are multi-product firms. Robinson (1950, p. 774-5[n]) criticised Andrews on this point.

5.4.2 Experience

Learning by doing gives rise to experience, which is a firm-specific asset, as rivals may benefit only little from each other's experience (Dasgupta and Stiglitz, 1988). Experience is a sunk cost as there are numerous transaction costs in the market for experience (Teece, 1982). Although it is usually considered to be product-specific, it can be a public input in the production of a similar product across countries. To exploit its experience the firm may sell its product in numerous country markets. This has led to complicated trade issues (Dasgupta and Stiglitz, 1988; Gruenspecht, 1988; and Dick, 1991). Learning by doing implies that the production process jointly produces both commodities and (an increase in) experience. New knowledge is a by-product of a production process. The new knowledge, in turn, reduces the production costs of future production. This implies that current production costs differ from economic costs: the latter but not the former take the future cost-reductions into account (Spence, 1981). This may induce the firm to quote a price below current production costs: by increasing its current output it speeds up its learning process and thus increases future profits.

In an international trade context, however, pricing below cost may be picked up as dumping. Hence the controversies in numerous industries, such as semiconductors. Gruenspecht (1988) and Dick (1991) argue that the dumping allegation against Japanese semiconductor producers was misdirected. They define dumping as a foreign producer's export price below its current production cost ('cost-of-production dumping'). They then show that if a learning curve exists as steep as in the semiconductor industry, it may indeed be profitable in early stages of the learning curve to quote a price below current production costs. This practice thus need not have anything to do with a conscious attempt by Japanese firms to drive their U.S. competitors out of business. Yet this has been the motivation underlying dumping allegations.[13]

5.4.3 R&D

Know how is usually treated as a pure public good: its use in one market does not reduce its availability in another market. This, however, is an abstraction as transferring knowledge from product A to B does involve resource costs (Teece, 1977). That is, engineers must be involved in transferring their own know how to market B. This implies that they are temporarily unavailable to market A: the know how in producing market A has (temporarily) decreased. Know how qualifies as a firm-specific resource. One explanation for this is that it is often tacit (non-formalised), personal, and tied to routines (ways of doing things)

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13. Berck and Perloff (1990) model a case where a foreign ('Japanese') firm does quote prices so as to induce domestic ('U.S.') firms to contract. Learning does not play a role here, however. Regretfully, the authors assume a leadership role for the 'Japanese' firms, rather than deriving this from underlying data. It might be, for instance, that 'Japanese' firms use their learning skill to acquire a leadership role.

(Nelson and Winter, 1982). Because of this, it is difficult to trade and the associated factor market is imperfect (*e.g.*, Teece, 1977 and 1980). Knowledge is rarely completely product-specific. This holds obviously for basic research, but much applied research has the same characteristic. Tentatively, one may say that know how becomes increasingly product-specific as one moves from basic research through applied research to product development. Firms may invest in process innovation (or imitation) in order to reduce marginal costs. This case is formally similar to investments in capacity (Brander and Spencer, 1983). Product innovations raise demand for the product, which is similar to brand advertising.[14]

Competition, again, can be a two-stage game: first the firms decide on R&D levels and, next, they decide on their output levels. The latter product market stage can be modeled as in Brander (1981). This set-up has been particularly explored by the Leuven school (De Bondt, Sleuwaegen and Veugelers, 1988; Veugelers, 1989a and 1990; and Veugelers and Vanden Houte, 1990). They are careful to distinguish one-sided entry, where a foreign MNE enters a domestic firm's home market, and reciprocal entry, where two firms develop into MNEs and enter each other's home market.

R&D differs from capacity investments because of its inter-firm spillover effects: one firm's R&D may support another firm's R&D (*e.g.*, by diffusion of the know how) or may hamper it (*e.g.*, by patenting). This has several ramifications for competition. A firm's R&D investments may encourage or discourage its rival's R&D: R&D can be a strategic substitute or complement (Bulow *et al.*, 1985). This may either increase or reduce the incentives to commit R&D. An inter-firm spillover may give firms an incentive to cooperate in R&D, even if they (continue to) compete in the product (or country) markets. In a single-market setting, four cases exist where the duopoly cooperate or compete in R&D, and where they cooperate or compete in the product market. Cooperation in R&D allows the firms to internalise the R&D spillovers, which raises their incentive to do R&D. Cooperation in the product market raises price and thus the return to R&D, but also reduces the output levels, which reduces the investment motives. It appears that full cooperation (or merger) induces the highest R&D levels, but the combination of R&D cooperation and subsequent product market competition induces the highest consumer welfare (*e.g.*, D'Aspremont and Jacquemin, 1988). This raises thorny competition policy issues (*e.g.*, Ordover and Willig, 1985; De Bondt and Veugelers, 1989; and Jorde and Teece, 1991).

De Bondt, Sleuwaegen and Veugelers (1988) study one-sided entry by a multinational firm in a market with a domestic firm. Entry by the multinational reduces the domestic firm's output level and thus its R&D motive. On the other hand, the spillover from the multinational firm's R&D on the domestic firm may restore the domestic firm's costs, output level, and even R&D motive. They also show that a cooperative R&D choice may either raise or reduce R&D levels. Cooperation in the product market will raise R&D. Hence the investments in a public good, such as R&D, depend both on the degree of spillovers (within the

14. Moreover, with linear demand and cost curves the analysis of cost reducing and demand increasing R&D is formally identical (De Bondt and Veugelers, 1991, p. 347).

multinational firm among its markets and among the two rivals), and on competition in the two decision stages of R&D and the product markets.

R&D that raises product quality has an economy of scale effect, such that a global firm may have both higher quality and lower average costs than a domestic firm. This is a 'paradox' encountered by (domestic) western firms competing with (global) Japanese firms. Japanese firms confront their western rivals with decreasing costs and steep learning curves (Pascale and Rohlen, 1983; Wernerfelt, 1984; Gruenspecht, 1988; Lieberman, 1989; Womack, Jones and Roos, 1990; and Dick, 1991), increasing product quality and brand loyalty (Mannering and Winston, 1991), and a global (investment in, *e.g.*, R&D) strategy (Ronstadt and Kramer, 1982; Levitt, 1983; Prahalad and Doz, 1987; and Willard and Savara, 1988).

Since R&D affects the firm's marginal cost or revenue worldwide, it will affect trade patterns, as Brander's (1981) model would predict. The government may give R&D subsidies with this outcome in mind (Spencer and Brander, 1983; and Cheng, 1987). Given that both the domestic and the foreign firm earn positive (quasi-)rents in the home market, the local government has a rent-shifting rationale. It aims to shift rents from the foreign firm to the domestic firm. The prospect of an R&D subsidy provides the domestic firm with a commitment to raise R&D. This reduces the foreign firm's R&D (if R&D outlays are strategic substitutes) and raises its marginal costs. That in turn raises the domestic firm's profit and thus domestic welfare (if the loss in consumer surplus is not too big). In the case of policy rivalry, both governments subsidise R&D, which reflects a prisoner's dilemma in the policy game. 'The jointly optimal policy is to tax R&D so as just to offset the negative effect of own R&D on the other firm's profit.' (Spencer and Brander, 1983, p. 715). So far, I have discussed examples of multi-market supply spillovers. The next case shows how a demand spillover arises.

5.4.4 Advertising, Goodwill, and Brand Names

Firms advertise to introduce products, to inform consumers of availability and prices, and to improve brand name recognition. A brand name can be a (quasi)public good if it is used for promoting different products. Advertising clearly creates sunk costs, as the market for brand names is imperfect: brands are heterogeneous, buyers and sellers are few, and numerous transaction costs exist. Advertising can be product-specific, especially if it is informative of prices, *etc.*, but it can also be firm-specific, if it relates to brand names. In the latter case, it develops a firm-specific resource (goodwill). The outcome can be similar to R&D competition.

Many economists, however, explicitly focus on the fact that advertising and brand names disseminate 'information'. Shakun (1965, p. 42) noted, and went on to model, 'a situation in which the markets for different products are coupled in the sense that advertising dollars spent in generating sales for one product have an influence on the sales of another product.' Advertising campaigns may be complementary, thus increasing their effectiveness. Shakun did not try to explain the complementarity. This is what the theory of umbrella branding tries to achieve (Wernerfelt, 1988). The starting point is that consumers are imperfectly informed

of, *e.g.*, product quality (in the case of experience goods). If consumers buy one of the firm's products, they can infer from it the quality of the firm's other products. This is what the common brand name, the umbrella, invites them to do. Hence sales of one (high-quality) product may raise demand for another product using the same brand name: umbrella branding suggests 'reputational economies of scope' (Wernerfelt, 1988, p. 463). A firm's reputation for quality may be based on its underlying technology, manufacturing capability, or other skills. Even if the quality levels are technically independent, and consumers pool their information of products carrying the same brand name, it is in the firm's interest not to dilute a 'good' brand name by introducing a 'bad' product (Wernerfelt, 1988). This result, in turn, sustains the consumers' pooling of information. A positive multi-market demand spillover is apparent, therefore.

An umbrella may backfire, as Sullivan (1990) has shown: an event (*e.g.*, an accident) that reduces one product's quality image, reduces demand for all products associated by consumers with its brand. This implies that transferring the brand name from an old (successful) product to a new one entails costs if the new product may backfire on the old one. The brand name is, in this case, a quasipublic good exhibiting some congestion, rather than a pure public good. If the feedback from the new product to the old one is uncertain, it can be positive (a *halo effect*) or negative (a *black-eye effect*) (Jensen, 1992, p. 198-9). The introduction of a successful (failing) new product may give the innovator a good (bad) reputation among consumers. Moreover, an inter-firm spillover arises if a successful (failing) new product induces consumers to substitute (away from) the innovator's old product for (to) its rival's old product (Jensen, 1992).[15]

5.4.5 Reputation

Reputation, like consumers' goodwill, is an incomplete information phenomenon: a person's reputation is what others *think* he is, rather than what he actually is - which is different if the others' information is incomplete. Several cases of informational multi-market spillovers have been explored (Dranove and Tan, 1990; Green and Laffont, 1990; Srinivasan, 1991; and Rotemberg and Saloner, 1991). A particular case is a multi-market firm's reputation for aggressiveness (see subsection 5.3.2 for references). Here (and also in Green and Laffont, 1990, and Srinivasan, 1991), the established firm itself is fully informed of both its own costs and the potential entrants' costs. The established firm fools others, not itself. The reputation problem is one-sided: new firms have no reputation as their costs are known with certainty. This assumption is decidedly odd. How is the incumbent firm going to acquire certainty about firms not yet in business,

15. Most other models of umbrella branding focus on a multi-product monopolist. Montgomery and Wernerfelt (1992) do model competition between multi-product firms. They model these as firms that supply 'different' products in subsequent sub-periods within 'the period'. This does not strike me as a very convincing analysis of what being multi-product is about, and moreover, the authors admit that the assumption does not change the model's equilibrium 'structure' relative to the single-product case.

whereas the latter are not completely informed about the incumbent firm, which may have in been in business for decades?

If the entrant is a multi-market firm it too has a reputation to defend. Kreps and Wilson (1982) explore the case where an incumbent firm tries to deter entry into its N markets by an entrant, which enters these markets one by one. Uncertainty is two-sided: both are uncertain about the other's payoffs. The monopolist initially fights entry in order to build a reputation that fighting entry is simply more profitable for it than accommodating entry. The entrant, in turn, initially enters markets in order to build a reputation that entry is profitable for it even if the monopolist fights. If, in fact, the monopolist's optimal response to actual entry would be to acquiesce, it may give in after a while. If the entrant's optimal response to a monopolist that fights is not to enter, it will after a while give up entry. So both firms are involved in a game of chicken, where both behave aggressively (*i.e.*, the monopolist fights and the entrant enters) until one of them gives up. If this is the monopolist, the entrant will enter all subsequent markets, and the monopolist will accept this; if it is the entrant, the monopolist has successfully defended its remaining markets. Reputation, therefore, is worthwhile. It represents an investment in early play (where neither firm is profitable due to their aggressive behaviour), which is recovered in later play.

In joined markets, the integrated (global) perspective is limited to investment decisions. I now turn to markets where product market decisions are coordinated across markets. First, I discuss cases where firms (collusively) decide to coordinate product market decisions. The associated theories do not yet include (shared) investment decisions. Next, I discuss integrated markets, where structural conditions (arbitrage) enforce integration of product market decisions.

5.5 MULTI-MARKET COLLUSION

The one-shot Brander (1981) model exhibits a prisoner's dilemma: each firm raises its profits by entry into the other firm's market, but, since both do this, both destroy each other's monopoly profits (subsection 5.2). It seems obvious that firms may try to solve the dilemma by tacit collusion. The theory of repeated games has shown that if firms compete on a regular basis, they can sustain cooperation by a credible threat to punish defection now by reverting (after an observation lag) to a (temporary or infinite) punishment phase (*e.g.*, Friedman, 1986). This argument does indeed apply to multi-market firms (Pinto, 1986; Harrington, 1987; Bernheim and Whinston, 1990; Kesteloot, 1990; and Fung, 1991). These models are part of a broader literature. I will first discuss the history of the debate, and then the salient theories.

5.5.1 Live and Let Live

Edwards (1955, p. 335) ushered in the multi-market collusion theory:

> 'The interests of great enterprises are likely to touch at many points, and it would be possible for each to mobilise at any one of these points a considerable aggregate of resources. The anticipated gain to such a concern

> from unmitigated competitive attack upon another large enterprise at one point of contact is likely to be slight as compared with the possible loss from retaliatory action by that enterprise at many other points of contact. There is an awareness that if competition against the large rival goes so far as to be seriously troublesome, the logic of the situation may call for conversion of the warfare into total war. Hence there is an incentive to *live and let live*, to cultivate a cooperative spirit, and to recognize priorities of interest in the hope of reciprocal recognition.' [italics added]

It is, ironically, the great competitive strength of conglomerate (large and diversified) firms, plus their awareness of this, which prompts tacit collusion. Multi-market collusion may thus be widespread; it is not related to market share in individual product markets, but to corporate size ('bigness'). These views received attention in the United States especially because of their consequences for antitrust policy (Solomon, 1970; Adams, 1974; and Areeda and Turner, 1979). A conglomerate merger between banks located in different (regional) banking markets should be opposed if they increase multi-market contact, even if the merger does not *per se* change market power in a local market (Solomon, 1970, pp. 333-334).

Strategic management also recognises that even if markets are otherwise unrelated, rivals may retaliate to one another's moves across the markets where they meet. For example, a cross-parry occurs

> 'When one firm initiates a move in one area and a competitor responds in a different area with one that affects the initiating firm .. This situation occurs not infrequently when firms compete in different geographic areas or have multiple product lines that do not completely overlap.' (Porter, 1980, p. 84).

The analyses below will show that retaliation is justly expected from profit maximising firms involved in tacit multi-market collusion. Implicitly, then, (strategic management) theorists who analyze retaliation strategies assume that firms try to restore collusion (*e.g.*, Caves, 1982, p. 107; and Cowling, 1982, p. 39). Two types of analysis of multi-market collusion have been developed: where firms behave routinely, and where they explicitly maximise an objective function. I discuss these in turn.

5.5.2 Mutual Forbearance

If a firm changes its output level, its rivals may respond by changing theirs as well, in a fixed proportion of the former's action: firms may use conjectural variations. If the firms meet in different markets, they may have cross-market conjectural variations: firm j's output level in market B reacts to firm i's output level in market A. The reaction is given by the variation $R^{ji}_{BA} = dq_j^B/dq_i^A$ (Feinberg, 1984). This assumes that firms respond to each deviation (*e.g.*, $dq_i^A > 0$ and $dq_i^B > 0$) separately, which is rather myopic. If a firm defects from a collusive outcome, it will do so in all its markets (Bernheim and Whinston, 1990) as, indeed, a conjectural variation model will predict. The size of the response

(the variations R) is given rather than the result of a maximising calculus, but, given these variations, firms do adjust their output levels optimally to them. Collusive results occur if the cross-market variations are positive: if one firm increases its output level in market A, other firms 'retaliate' by likewise increasing theirs in market B. This induces firms to limit their output levels: they exhibit *mutual forbearance* (Feinberg, 1984, p. 244). Feinberg (1984, p. 248) derives some useful hypotheses from his model:

> 'the effect of mutual forbearance in restraining output should increase with increased multi-market contacts between firms, as either the number of firms per market (m) increases or the number of markets involved (n) expands.'

Empirical tests are based on this model (*e.g.*, Feinberg, 1985; Alexander, 1985; Gelfand and Spiller, 1987; and the experiment in Feinberg and Sherman, 1988). They have been able to find cases where multi-market collusion seems to occur, *i.e.*, where the cross-market conjectural variations are significant and positive or where the number of multi-market contacts restrains output, as predicted.

5.5.3 Repeated Games

Unlike the previous theories, repeated games explore conditions where cooperation, defection, and punishment are explicitly maximising actions. Multi-market collusion may occur in the case of reciprocal entry (*e.g.*, cross-hauling). Multi-market collusion requires a global perspective: firms cooperate, defect, or punish (if that) in *all* markets. Consider the case where there are no links between markets other than shared suppliers. In the case of complete symmetry between markets and firms, multi-market collusion has no effect relative to single-market collusion (Bernheim and Whinston, 1990, p. 5). Collusion in multiple markets simply multiplies identical costs and benefits of cooperation, defection, and punishment with the number of identical markets. Hence the outcome is identical to collusion in each market for itself. For multi-market collusion to have an effect, markets should be asymmetric. Two cases present themselves.

5.5.4 Coordinated Markets

One asymmetry case is that multi-market firms use the potential to achieve collusion in one market to sustain collusion in another market, which does not sustain collusion by itself (Harrington, 1987; Tirole, 1988; and Bernheim and Whinston, 1990). Say, punishment of a defector hits sufficiently hard to deter defection in market A but not in market B. Separately, market A will show collusion and market B will not. If some incumbents are active in both markets, they may react to defection in market B by a punishment in both markets. This may be sufficient to deter defection in market B. Formally, say profits from cooperation are π^i_C, from unilateral defection π^i_D, and from punishment π^i_P (i = A,B). A prisoner's dilemma exists if $\pi^i_P < \pi^i_C < \pi^i_D$. The time horizon is infinite. Collusion yields profits of $\pi^A_C+\pi^B_C$ from t=0 to infinite; defection at t=0 gives $\pi^A_D+\pi^B_D$ now and $\pi^A_P+\pi^B_P$ from t=1 to infinite. Multi-market

collusion is feasible if and only if

(5.3) $((1+i)/i)(\pi^A_C+\pi^B_C) > (\pi^A_D+\pi^B_D) + (1/i)(\pi^A_P+\pi^B_P)$,

where i is the interest rate. This is consistent with a situation where $((1+i)/i)\pi^A_C > \pi^A_D + (1/i)\pi^A_P$ (*i.e.*, collusion is feasible in market A), and $((1+i)/i)\pi^B_C < \pi^B_D + (1/i)\pi^B_P$ (*i.e.*, collusion is not feasible in market B).[16] By pooling this constraint across markets A and B, the slack collusion enforcement power in market A is transferred to market B (Bernheim and Whinston, 1990, p. 8; and Srinivasan, 1991, p. 1547). These results underlie

Definition 5.5 *Coordinated markets* are (1) otherwise segmented markets, which (2) are asymmetric as some sustain collusion by themselves and others do not, and where (3) collusion is interdependent as collusion in at least one market is sustainable only by the participants' threat to retaliate defection by suspending collusion elsewhere.

In coordinated markets product market decisions are taken from an integrated, global perspective.

5.5.5 Spheres-of-influence

Another asymmetry case occurs if each firm is most efficient in one market. Suppose each of two firms is incumbent firm in one and entrant (exporter) to the other market (Scherer, 1980; Pinto, 1986; Bernheim and Whinston, 1990; and Fung, 1991). Because of transport costs, in each market the incumbent firm has lower costs than the exporter. Otherwise, symmetry exists between the firms and the markets. In isolation, markets A and B may each realise *collusive market sharing agreements*. In the case of multi-market contact, the firms may achieve a *spheres-of-influence* arrangement where each firm withdraws to its home market. If a firm defects from a spheres-of-influence arrangement by one-sided entry into the other player's 'sphere', the other will retaliate after a lag by reciprocal entry into the defector's 'sphere' (Pinto, 1986).[17]

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16. The asymmetry may have several causes. For example, one market may have Cournot competition, whereas an other market may have Bertrand competition. Another example is where one market may have multiple equilibria whereas another has only one (Harrington, 1987). Also, one market may exhibit more suppliers than the other one (see appendix 5.E), markets may have different growth rates or fluctuating demand levels that are not perfectly correlated, and defection may take longer to be detected in market B than in market A, thus having a larger gain (Bernheim and Whinston, 1990).

17. Pinto's punishment strategy implies a reversal to the one-shot Nash equilibrium in the Brander (1981) Cournot model with cross-hauling. If instead firms compete in prices (Bertrand), they will pre-empt reciprocal entry as each (low-cost) incumbent firm reduces its price to the importer's higher cost level (Bernheim and Whinston, 1990, p. 11-12).

Definition 5.6 *Spheres-of-influence* are (1) otherwise segmented markets, where (2) each firm selectively pulls out (partially or completely) from some markets relative to the outcome in segmented markets, while (3) defending its own allotted market(s) by a threat to invade or raise sales in a defector's 'sphere'.

The advantages of spheres-of-influence are that the home firm gains market power and that lower exports save on transport costs.

Firms can divide their markets into spheres-of-influence along three dimensions. In the geographical dimension, transport costs and tariffs create a cost wedge between domestic firms and foreign rivals. The same holds for adjustment costs imposed on foreign entrants if national product standards (*e.g.*, about safety) differ. Firms may also delineate spheres along product market lines. The asymmetry may again be based on adjustment costs. In a paper on the information technology industry, Stoop (1992) suggests time as a third dimension. Innovators and imitators may divide the product life cycle between them. In the introduction and growth stage, the innovator earns a monopoly profit. As the product matures, imitators enter the market. They reduce prices and destroy the innovator's profits. The innovator may evacuate the market to the imitators, and switch to new products. This allows the imitators to realise some profits. If the imitation lag is sufficiently long, innovators recover their R&D outlays in the initial stages of the product life cycle. In the mature stage of the product cycle, imitators have lower earnings, but they also incur lower costs. By avoiding competition between them both groups create temporal spheres-of-influence.

Pinto's (1986) model of spheres-of-influence is instructive. The setting is as in Brander (1981). Say, firm 1, the home firm in market A, incurs a transport cost t into market B. The reverse holds for firm 2, the home firm in market B. There is symmetry of the firms and markets otherwise. In the case of collusion, each firm is monopolist in its home market, produces the monopoly output level, $x_i^{j,m}$, and earns the monopoly profit, $\pi^{j,m}{}_C$ (i = 1, 2; and j = A, B). If, *e.g*, firm 1 defects, it enters market B with an output level that maximises its profit, given firm 2's unsuspecting choice of the monopoly output level $x_2^{B,m}$. Pinto calls the associated entry profit ϕ. The other firm retaliates in the next period. In the case of a grim trigger strategy, the reversal will be forever.[18] Each firm then earns duopoly profits; call their sum over both markets π^d. Firm 1's discounted profit flow from collusion is $((1+i)/i)\pi^{A,m}{}_C$, where i is the interest rate. Its profits from defection are $\pi^{A,m}{}_C+\phi+(1/i)\pi^d$. It follows that collusion will occur if

$$(5.4)\quad i < R/\phi,$$

where $R \equiv \pi^{A,m}{}_C-\pi^d$. In the case of linear demand, Pinto shows that transport costs raise R/ϕ, and thus facilitate collusion (see appendix 9.A for a qualification). This appears the most important conclusion of this research. Transport costs raise the gains, R, of collusion (which saves transport costs) relative to competition and reduce the one-shot gain of defection, ϕ. A reduction of transport costs (*e.g.*, due

18. Pinto (1986) studies a variety, where firms revert to collusion after a while. The results are similar.

to innovations) or tariffs (*e.g.*, European integration) may, by the same argument, weaken or even destroy the cartel.[19]

5.5.6 Interaction between Collusion and Relatedness

The two cases of coordinated markets and spheres-of-influence have a common inspiration (collusion), but very different implications for relatedness of product markets. Consider the implications of first demand shocks and next spillover effects.

In the case of coordinated markets, common suppliers continue to serve both markets. Subtle developments in one market may affect decision making in the other market. For example, an increase in demand in one market may raise price in the own market as well as in the other market (Bernheim and Whinston, 1990, p. 8). The markets may behave as if they are integrated, therefore. In the case of exclusive spheres-of-influence, trade ceases to occur among the markets. The markets appear less related than in the case of segmented markets, where they share (some) suppliers and reciprocal entry occurs. Firms act *as if* transport costs are too high to warrant trade. Developments in one market will have no implication at all in the other market provided that collusion remains intact. Multi-market collusion among otherwise segmented markets may thus lead to behaviour that mimics any of the other types of markets, ranging from unrelated to integrated markets.

Multi-market spillovers may affect spheres-of-influence and coordinated markets differently. If positive multi-market spillovers exist, the spheres-of-influence arrangement may collapse. Due to the spillover, it will hold that $\pi^{A+B}_i > \pi^A_i+\pi^B_i$ (i = P,D), where π^{A+B}_i refers to joint and $\pi^A_i+\pi^B_i$ to separate production (or firms) in markets A and B (definition 5.4). It is now possible that

(5.5) $((1+i)/i)\pi^A_C < \pi^{A+B}_D+(1/i)\pi^{A+B}_P$.

Firms will cross-invade markets A and B if the efficiency advantage (the spillover effect) outweighs the monopoly profits of a sphere-of-influence.

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19. Bernheim and Whinston (1990, p. 13) have a different model, where firms compete in prices (a Bertrand duopoly). They show that for an interest rate *i* less than 100% multi-market collusion is always feasible, regardless of the transport cost. In the absence of multi-market collusion, both firms collude in each market separately. A price is chosen which grants the high-cost exporter a positive profit and market share. Multi-market collusion *reduces* price relative to single-market collusion, as it excludes the high-cost exporter from the market. If $i > 100\%$ (which suggests long lags), transport costs do raise the price level that an incumbent firm may quote for its sphere-of-influence without inducing defection. In the absence of multi-market collusion, no trade occurs either, as each firm quotes an entry deterring price (Bernheim and Whinston, 1990, p. 12). Both results (for $i < 100\%$ and $i > 100\%$) are paradoxical. Trade never occurs, whatever the transport cost. It appears that Pinto's model has the more intuitive results.

Spillovers may strengthen rather than weaken collusion in coordinated markets. Kesteloot (1990) shows that if spillovers exist, multi-market collusion has an effect relative to single-market collusion even if complete symmetry exists. She has a two-market duopoly model with differentiated products, where each firm chooses two prices, one for each product market. Multi-market collusion implies a set of (2x2) prices that maximises the firms' joint profits. Snob and bandwagon effects create international multi-market demand spillovers (see subsection 5.3.2). Due to these spillovers, it is not optimal for firms to establish exclusive spheres-of-influence, *i.e.*, condition (5.5) holds.[20] Negative spillovers (*i.e.*, a cross-market consumers' snob effect) increase the gains to cooperation, defection, and punishment (Kesteloot, 1990, p. 191). The reason is that cooperation raises prices, which reduces demand in one market and thus, by the snob effect, raises demand in the other market. Paradoxically, collusion becomes harder to maintain even though the gains to collusion increase, as the snob effect raises the gains to defection even more. The opposite holds for positive spillovers (*i.e.*, a cross-market bandwagon effect): they facilitate collusion by reducing the gains to defection even more than the gains to cooperation. This suggests that positive multi-market spillovers may facilitate collusion in coordinated markets while reducing the associated profit levels.

5.6 INTEGRATED MARKETS

The previous sections explored cases where arbitrage trade is absent. Hence, prices of the same good may differ across markets. This allows firms to develop local market power. The highest degree of integration is attained in integrated markets. Following Venables' (1990a, p. 23) definition, these reflect cases where firms only control decisions on a global level. The firm does not control local sales or prices due to arbitrage:

Definition 5.8 Markets are *integrated* if arbitrageurs reduce price differentials between markets until they are at most equal to the (arbitrageurs') unit arbitrage costs. That is, $p^A_i - t \leq p^B_i \leq p^A_i + t$, for the prices of firm i's product in market A (home market), B (foreign market), and a transport cost, tariff or adjustment cost, t.

Theoretical literature (*e.g.*, Venables, 1990a, p. 27), simulations (Smith and Venables, 1988), and empirical literature (*e.g.*, Spiller and Huang, 1986) may use a narrower definition where markets are integrated if the constraints are binding, such that $p^A_1 + t = p^B_1$, when firm 1 trades from market A to B. Being subject to arbitrage, the firm may choose a single (home) price, with arbitrageurs marking this up with transport costs in the export market (the Bertrand model). Alternatively, the producer may choose its total output level, with arbitrageurs allocating these to local markets, until price differences are evened out (the

20. Her analysis differs from the ones in section 5.4 as she does not identify a shared resource. Instead, demand functions are interrelated, that is, the segmented markets assumption is dropped.

Cournot model). Relative to segmented or joined markets, the firm loses degrees of freedom: instead of a price or output level for each market, it now controls only the global price or output level. Moreover, the firm loses its local market power. In the case of segmented markets its profit margin at home (p^A_i-c) exceeds the profit margin abroad (p^B_i-c-t), if markets are similar and $p^A_i = p^B_i$. With binding arbitrage, however, $p^B_i = p^A_i$+t, such that its profit margin abroad equals p^A_i-c. In other words, its ability to 'dump' abroad is destroyed. This leads to a reduction of prices, relative to a segmented markets setting (Smith and Venables, 1988, p. 1522).

5.6.1 Interaction between Arbitrage and Relatedness

Integration will affect the two types of relatedness discussed in the previous sections: collusion and shared resources. Firstly, integration enhances competition as spheres-of-influence can no longer be formed. This illustrates that the ability to prevent arbitrage trade is an important ingredient of a spheres-of-influence arrangement. If European integration, for instance, transforms segmented or joined markets into a single, integrated market, it will destroy spheres-of-influence, raise competition, and reduce prices (as predicted).[21] The effect of integration on coordinated markets is difficult to judge, as coordinated markets are asymmetric. It is difficult to see how integration affects asymmetric markets prior to collusion. The unified market after integration may allow for collusion (like the coordinated markets prior to integration), but collusion may also break down. Considering the asymmetries in coordinated markets (*e.g.*, number of firms, growth rates, cyclical demand, and defection lags), any outcome is possible. Appendix 5.E shows that arbitrage may reduce prices without dissolving multi-market collusion.

Secondly, integration may affect the incentives to invest in firm-specific resources, *i.e.*, the size of the multi-market spillovers. Venables (1990a, p. 35) shows that an integrated market gives rise to smaller capacity investments than a segmented market, provided that the demand function is convex. The opposite result holds if demand is concave. In the absence of information on real world demand functions this is not, regrettably, an intuitive result.

5.7 APPRAISAL

Established firms need to assess their environment by ranking their (home and potential entry) markets in terms of degree of relatedness or integration. To complicate matters, this dimension is multi-faceted. Integration increases if basic conditions change (such as arbitrage), structures (such as when common suppliers emerge with spillovers), or conduct (for instance, collusion). Global firms that *integrate strategic intent* across markets (Prahalad and Doz, 1987) may do so to exploit spillovers, to safeguard collusion, or to accommodate to arbitrage.

The chapter has discussed numerous aspects that impact on a firm's decision to enter multiple product markets. Positive multi-market spillovers and firm-

21. I owe this comment to R. Veugelers.

specific resources (synergy) as well as low transport and tariff costs induce entry. Negative multi-market spillovers, multi-market collusion of the spheres-of-influence type, and high entry costs, on the other hand, are impediments to entry. Entry costs arise due to product-specific resources, which need to be acquired in factor markets which may be imperfect and, as the next chapter will show, may have been rigged by the incumbent firm. Reciprocal entry may occur if the inducements gain importance (*e.g.*, by cost reductions due to innovations in transport or communication media), or if the impediments lose significance (*e.g.*, if spheres-of-influence break down).

This chapter may contribute to an understanding of the concept of the degree of integration, and its implications for business behaviour. Impediments to application of this framework are many. First, most models explore a two-firm, two-market context. Real world cases exhibit, however, numerous firms in, say five or six markets, whose activity patterns do not completely overlap: one firm may be active in markets A, B, and C, another one in markets B, C, and E, etc (Porter, 1985, p. 354). Secondly, the current modelling assumes that each public input underlying a spillover can be studied separately. This is approximately correct if each industry is dominated by a single public input (*e.g.*, R&D or advertising) (Ghemawat, 1991a, p. 28). But cases do exist where firms draw on different public inputs (Porter, 1985, p. 355). Moreover, cases where firms invest in public resources may coincide with forms of collusion. "Horizontal" and "vertical" dimensions (in the next chapter) may likewise coincide. Decision makers operate in fuzzy contexts, rather than the sharply delineated contexts in game theory (Kreps and Spence, 1985, p. 353; and Saloner, 1991, p. 125). Chapter 9 will explore one type of fuzziness in particular: the market definition problem. Notwithstanding these caveats, strategic management may benefit from a generous reading of these theories, as I hope to have shown.

I would like to end with the caveat that the statements in this chapter are subject to the usual *ceteris paribus* condition. It remains to be seen how firms respond to particular configurations of related markets, competition, sequence of moves, information, *etc.* Part IV gives some game theoretic discussions to illustrate this point. The conceptual framework in this chapter readily shows that numerous configurations have not yet been thoroughly explored. More needs to be done on the interaction between multi-market spillovers and collusion. Economists have just begun to scratch the surface of the interaction between the 'integration' dimension of product markets and the product-specificity dimension of factors. Part V will tentatively explore the dynamic process which underlies the ranking of segmented, joined, and integrated markets. This gives rise to a dynamic markets perspective, that may be applied to globalisation, convergence of the computer and consumer electronics industries, and European integration.

APPENDICES

Appendix 5.A. Multiproduct cost concepts

This appendix reviews a family tree of cost concepts from Baumol *et al.* (1982) used in subsection 5.3.1. A concept which is more general than the economy of scope is that of *strict subadditivity* which holds if in definition 4.3 the assumption is dropped that the sub-sets T_i must be non-overlapping (Baumol *et al.*, 1982, pp. 17 and 71; see section 4.3.1). Given that subadditivity is at the root of the family tree, economies of scale are in another branch. By dropping the 'non-overlapping' condition, strict subadditivity may include economies of scale in a single-product setting. If the product sets S and T_i are allowed to completely overlap, *i.e.*, $S = T_1 = .. = T_k$, it is possible for S to be a single product 'set'. Strict subadditivity follows if there are global economies of scale (Baumol *et al.*, 1982, p. 22).

Family Tree

$T_i \subset S$, $S = \cup_i T_i$, and $q_s = \Sigma_i q_{Ti}$

↓

Strict subadditivity:
$C(q_S) < \Sigma_i C(q_{Ti})$

↓

↓	↓
Ecs. of scale	Ecs. of scope
$n = 1$	$n > 1$
$T_i = S \ \forall i$	$T_i \cap T_j = \varnothing$, $i \neq j$
[= decreasing average cost]	[→weak cost complementarity]

A different multiproduct cost concept is a *weak cost complementarity*, defined as $\partial^2 C(q)/\partial q_A \partial q_B \leq 0$, where q is a vector of outputs containing (at least) the scalar quantities q_A and q_B (Baumol *et al.*, 1982, p. 75 and 89). The upshot of this concept is that if q_B (weakly) reduces the marginal costs of product A ($\partial C/\partial q_A$), products A and B are (weakly) complementary in production. Baumol *et al.* (1982, p. 75) show some relationships between economies of scope and weak cost complementarities that carry over to the relationship between definitions 5.3 and 5.4. For example, analogous to their argument, if the profit function is twice-differentiable, then a positive (negative) spillover by definition 5.3 is a sufficient condition for a positive (negative) spillover by definition 5.4. Barring this special case, the two definitions can lead to different results. Consider the cost function $C(q_A,q_B) = F(A,B)+c(q_A+q_B)-dq_Aq_B$, where F(S) is the fixed cost, which varies with the product set S (A,B,A+B), c is the constant marginal cost, and $d \geq 0$. There is an economy of scope without cost complementarity if $F(A,B) < F(A)+F(B)$ and $d = 0$. That is, an economy of scope exists, as $F(A,B)+cq_A+cq_B < F(A)+cq_A+F(B)+cq_B$, but a (strict) cost complementarity does not exist, as $\partial C/\partial q_A = c$ and $\partial^2 C/\partial q_A \partial q_B = 0$. A cost complementarity without an economy of scope exists if a diseconomy of developing two products in one firm, $F(A,B) > F(A)+F(B)$, exceeds a (slight) cost complementarity ($\partial^2 C/\partial q_A \partial q_B = -d < 0$), such that $C(q_A,q_B) > \Sigma_i(F(i,0)+cq_i)$ (i = A,B). Which of these cost concepts is salient depends on the context. See subsection 5.3.4 and appendix 5.D.

Appendix 5.B. A pure public good and a multi-market spillover

This appendix accompanies subsection 5.3.2 and prepares the ground for appendix 5.C. It reiterates how Baumol *et al.* (1982, pp. 90-1) trace the multi-market spillover in definition 5.3 back to public goods.

Proposition 5.B1. A pure public good leads to a positive multi-market spillover by definition 5.3.

Proof. Consider a pure public good k such that

(5.B1) $\Pi(y) \equiv \max_k[\Sigma_i\pi^i(y_i,k)-\psi(k)] \equiv \Sigma_i\pi^i(y_i,k^*(y))-\psi(k^*(y))$.

The first-order and second-order conditions for optimality are:

(5.B2) $\Sigma_i\pi^i_k-\psi(k)_k = 0$; and

(5.B3) $\Sigma_i\pi^i_{kk}-\psi_{kk} < 0$;

where i = 1,..,n; and the subscripts k, i and j refer to first-order derivatives (to k and y_i and y_j, respectively) and kk, ik and ij refer to second-order derivatives. If there are economies to scale in the production of capital goods, or pecuniary economies in buying them, then $\psi_{kk} < 0$. Inequality (5.B3) implies that these economies should be small or absent. From equation (5.B1) follows with the envelope theorem that

(5.B4) $\Pi_i \equiv \partial\Pi(y)/\partial y_i = \pi^i_i$; and

(5.B5) $\Pi_{ij} \equiv \partial^2\Pi(y)/\partial y_i\partial y_j = \pi^i_{ik}k^*_j$ $(i \neq j)$;

where $\pi^i_i \equiv \partial\pi^i/\partial y_i$; $\pi^i_{ik} \equiv \partial^2\pi^i/\partial y_i\partial k$; and $k^*_j \equiv \partial k^*/\partial y_j$. We now need the assumption that

(5.B6) $\pi^i_{ik} \equiv \partial^2\pi^i/\partial y_i\partial k > 0$;

that is, capital raises marginal profits. To sign k^*_j, partially differentiate the first-order optimality condition (5.B2) with respect to y_j:

(5.B7) $\partial^2\pi^i/\partial k\partial y^j + \Sigma_i\pi^i_{kk}\partial k/\partial y_j-\psi_{kk}\partial k/\partial y_j = 0$.

This gives

$$(5.B8)\quad \frac{\delta k}{\delta y_j} = -\frac{\dfrac{\delta^2\pi^j}{\delta k\delta y_j}}{\sum_i \pi^i_{kk}-\psi_{kk}}.$$

This expression is positive as $\pi^i_{kj} \equiv \partial^2\pi^i/\partial k\partial y^j > 0$ and $\Sigma_i\pi^i_{kk}-\psi_{kk} < 0$ (the

second-order condition in inequality 5.B3). The conclusion is that $\Pi_{ij} > 0$, which is definition 5.3 of a positive multi-market spillover. *QED*

Appendix 5.C. Quasipublic goods and a multi-market spillover

This appendix also accompanies subsection 5.3.2 and expands upon the previous appendix. It shows that quasipublic capital goods lead to spillovers only if the non-exclusion property holds. This result will give economic content to non-exclusion. Modify the above approach as follows:

(5.C1) $\Pi(y) \equiv \max_{k1..kn}[\sum_i^n \pi^i(y_i,K_i)-\psi(\sum_i^n k_i)]$, where $K_i \equiv k_i+\alpha\sum_{j\neq i}k_j$.

Call K_i the *effective capital* invested in product i (with terminology due to Shakun, 1965), and call $f(k_1..k_n:y_1..y_n) \equiv \sum_i^n \pi^i(y_i,K_i)-\psi(\sum_i^n k_i)$. If $\alpha = 1$, $K_i = \sum_i^n k_i$, and equation (5.C1) reduces to one variable, k, as in appendix 5.B. The individual k_i are arbitrary. Hence, capital is a pure public good, and a positive spillover exists. A spillover also arises if an investment k_j affects the investment *outlay* of investments k_i, that is, if the capital cost function ψ exhibits pecuniary (dis)economies of scale. In order to focus on the externality α, I henceforth assume a constant unit capital goods price. Thus $\psi_k \equiv \partial\psi/\partial k_i$ is constant, and $\psi_{kk} = 0$. Now derive the interior optimum of (5.C1) from the first-order optimality conditions:

(5.C2) $\partial f/\partial k_i = 0 = \partial\pi^i/\partial k_i+\sum_{j\neq i}\alpha\partial\pi^j/\partial k_j-\psi_k$; $i = 1..n$.

This gives n equations in $\partial\pi^i/\partial k_i$. Subtract two equations $\partial f/\partial k_i-\partial f/\partial k_j$ to get $\partial\pi^i/\partial k_i(1-\alpha)+\partial\pi^j/\partial k_j(\alpha-1) = 0$, from which follows that $\partial\pi^i/\partial k_i = \partial\pi^j/\partial k_j$ (for all $i,j = 1..n$). Substitute this result in (5.C2) to find:

(5.C3) $\partial\pi^i/\partial k_i = \psi_k/(1+(n-1)\alpha)$.

Since $\partial\pi^i/\partial k_i$ is a function of y_i and K_i, equation (5.C3) determines the n capital levels K_i for given y_i. This gives n equations

(5.C4) $k_i+\alpha\sum_{j\neq i}k_j = K_i$,

from which the k_i ($i = 1..n$) are solved.

If $\alpha = 0$, each good i gets the profit maximising capital investment k_i without any spillover to another product j. If $\alpha < 1$, an externality arises from k_j on K_i ($dK_i = \alpha dk_j$). It is tempting to think that for α in (0,1) capital is a quasipublic good with a positive spillover. This is not, however, the case:

Proposition 5.C1. In the case of an interior solution (where all $k_i > 0$) and an incomplete externality ($0 < \alpha < 1$), a small increase in output of product j induces no spillover on product i ($\Pi_{ij} = 0$).

Proof. Introduce spillovers as follows. Imagine that the output of one product j,

y_j, increases. A spillover exists if this raises $\partial\pi^i/\partial y_i$ for some or all products i ($\neq$ j), that is, $\Pi_{ij} \equiv \partial^2\Pi(y)/\partial y_i\partial y_j > 0$. Recall that (5.C3) gives n equations in y_i and K_i. Differentiate these equations to y_j, taking all other y_i as given and the $K_{i,j}$ as variables:

$$(5.C5) \qquad \frac{\partial^2\pi^j}{\partial k_j\partial y_j}dy_j + \frac{\partial^2\pi^j}{\partial k_j^2}dK_j = 0;$$

$$(5.C6) \qquad \frac{\partial^2\pi^l}{\partial k_l\partial y_j}dy_j + \frac{\partial^2\pi^l}{\partial k_l^2}dK_l = 0.$$

From equation (5.C5) follows that

$$(5.C7) \qquad dK_j = -\frac{\dfrac{\partial^2\pi^j}{\partial k_j\partial y_j}}{\dfrac{\partial^2\pi^j}{\partial k_j^2}}dy_j;$$

which is positive since $\pi^j_{kjyj} \equiv \partial^2\pi^j/\partial k_j\partial y_j > 0$, which is equivalent to assumption (5.B6), and $\pi^j_{kjkj} \equiv \partial^2\pi^j/\partial k_j^2 < 0$, which underlies the second-order condition (5.B3) with $\psi_{kk} = 0$. Since $\partial^2\pi^i/\partial k_i\partial y_j = 0$, equation (5.C6) gives

$$(5.C8) \quad dK_i = 0.$$

Hence, if y_j increases, the firm raises K_j and keeps all K_i ($i \neq j$) constant. Therefore, the marginal profitability of product i is unaffected. There is no spillover from product j on product i. *QED*

In order to prepare the ground for the next hypothesis where the externality does lead to a spillover, the following lemma shows how the firm uses its instruments k_i ($i = 1,..,n$) in order to raise K_j and leave all other K_i unchanged.

Lemma. To raise K_j and leave all other K_i unchanged, upon an increasing y_j, the firm raises k_j and reduces all other k_i.

Proof. Since K_j changes and all K_i remain constant, differentiate the n equations in (5.C4) to K_j:

$$(5.C9) \qquad \frac{\partial k_i}{\partial K_j} + \alpha\sum_{p\neq i}\frac{\partial k_p}{\partial K_j} = 0; \ (\forall\ i \neq j)$$

$$(5.C10) \qquad \frac{\partial k_j}{\partial K_j} + \alpha\sum_{p\neq j}\frac{\partial k_p}{\partial K_j} = 1.$$

Take any i,l ($\neq$ j) and deduct l's equation in (5.C9) from i's equation there, to see

that $(\partial k_i/\partial K_j - \partial k_i/\partial K_j) + \alpha(\partial k_i/\partial K_j - \partial k_i/\partial K_j) = 0$, that is, $\partial k_i/\partial K_j = \partial k_i/\partial K_j$ $(\forall\ i,1 \neq j)$ if $\alpha \neq 1$. Substitute this in equations (5.C9) and (5.C10) to get

$$(5.C11)\quad \frac{\partial k_i}{\partial K_j}(1+(n-2)\alpha) + \alpha\frac{\partial k_j}{\partial K_j} = 0;\ (\forall\ i \neq j)$$

$$(5.C12)\quad \frac{\partial k_j}{\partial K_j} + (n-1)\alpha\frac{\partial k_i}{\partial K_j} = 1.$$

Solve this to get

$$(5.C13)\quad \frac{\partial k_i}{\partial K_j} = \frac{-\alpha}{1+(n-2)\alpha-\alpha^2(n-1)}.$$

$$(5.C14)\quad \frac{\partial k_j}{\partial K_j} = \frac{1+(n-2)\alpha}{1+(n-2)\alpha-\alpha^2(n-1)}.$$

For any $n > 1$ and $0 \leq \alpha < 1$, the denominator is positive. Hence, the firm raises k_j and reduces all k_i. *QED*

There is a knife-edge between an externality α in (0,1), where no spillover arises, and $\alpha = 1$, where appendix 5.B shows that a positive spillover does arise. This proposition applies for example to a symmetry case where all investment levels are equal and positive: no multi-market (or multiproduct) spillover arises.

So we have a paradox: capital is a quasipublic good with an externality α, but without a multi-market spillover. The reason is that each product gets the amount of effective capital K_i where marginal costs equals marginal revenue. The effect of the externality α is to reduce the marginal cost of K_i from ψ_k (the marginal cost of a unit of capital k_i) to $\psi_k/(1+(n-1)\alpha)$. This marginal cost falls as either α increases (the externality) or n-1 (the number of products an individual product derives externalities from). Moreover, a higher α or n-1 raise the effective capital K_i invested in product i. This follows from equation (5.C3) and the assumption that $\partial^2\pi^i/\partial k_i^2 < 0$, *i.e.*, $\partial\pi^i/\partial k_i$ is downward sloping in K_i for a given y_i. But each good pays for its own capital, K_i. Hence, there is no public-ness involved here.[22]

A defining characteristic of a public good is the failure of exclusion (the *exclusion principle*): capital is a public good if, when investing in K_j, one cannot prevent product i from benefiting as well. There are two routes to build non-exclusion into the model above. First, if $\alpha = 1$ then all K_i (i = 1..n) are identical $(= \Sigma_i k_i)$: hence the increase of one capital stock K_j (to accommodate an increasing output level y_j) raises the other capital stocks as well. Second, for $\alpha <$

22. In similar vein, Arrow (1985, pp. 510-1) shows that externalities can be treated as separate commodities with their own price. They are therefore consistent with a competitive equilibrium, and need not imply a market failure. He then proposes two conditions which may account for any market failure; one of them is the exclusion principle.

1, we need the additional constraints that $k_i \geq 0$, for all i = 1..n. A spillover arises by the following intuitive argument. Imagine that y_j changes. The firm intends to adjust its investments by raising k_j and reducing all k_i ($i \neq j$) such that K_j increases and all K_i remain constant (see the lemma). However, this may require reducing some k_i below zero. This is obviously impossible. Hence, if k_i drops to zero, the increase in k_j raises K_i by $\alpha dk_j - k_i$. The increase in K_i raises the marginal profitability of product i, and a positive spillover occurs. Hence the positive spillover occurs not only because of the externality ($\alpha > 0$) but also because of non-exclusion: product j cannot prevent product i from free-riding upon its investment k_j. This argument restores the idea that a higher externality α raises the spillover effect (Π_{ij}). A spillover occurs if $dK_i = \alpha dk_j - k_i > 0$, that is, if $dk_j/k_i > 1/\alpha$. The higher α, the smaller $1/\alpha$, the sooner this condition will be met, and thus the more often a positive spillover will occur.

Hypothesis 5.C1. In an asymmetric setting, where some products i are produced without product-specific capital ($y_i > 0$ and $k_i = 0$) and another product j has $y_j > 0$ and $k_j > 0$, a small increase of output j will have a positive spillover on product i.

I will sketch a proof. Consider the problem:

(5.C15) $\Pi(y) \equiv \max_{k1..kn}[\sum_i \pi^i(y_i, k_i + \alpha \sum_{j \neq i} k_j) - \psi(\sum_i {}^n k_i)]$, subject to $k_i \geq 0$, i = 1..n.

Solve this using Kuhn-Tucker. The solution will have some $k_i^* = 0$, and some $k_i^* > 0$. Reorder the sequence of products such that $k_i^* = 0$ for i = 1..m, and $k_i^* > 0$ for i = m+1..n. If m = 0, an interior solution exists and proposition 5.C1 shows that no spillover exists. Assume that m > 0. Consider now a new problem, which imposes upon (5.C15) the additional constraints $g_i(k) = k_i = 0$, for i = 1..m. The solution to (5.C15) still applies, and so the maximum value does not change but the function $\Pi(y)$ does change. We now have the 'constrained' problem:

(5.C16) $\Pi^c(y) \equiv \max_{k1..kn}[\sum_i {}^n \pi^i(y_i, k_i + \alpha \sum_{j \neq i} k_j) - \psi(\sum_i {}^n k_i)]$, subject to $k_i = 0$, i = 1..m, and $k_i \geq 0$, i = m+1..n.

The envelope theorem applied to this problem gives equation (5.B4), which now gives the spillover effect

(5.C17) $\Pi^c_{ij} \equiv \partial^2 \Pi^c(y)/\partial y_i \partial y_j = \pi^i_{yiKi} K_{ij}$; where $\pi^i_{yiKi} \equiv \partial^2 \pi^i / \partial y_i \partial K_i$ and $K_{ij} \equiv \partial K_i / \partial y_j$
$= \partial k_i / \partial y_j + \alpha \sum_{p \neq i} \partial k_p / \partial y_j$ ($i \neq j$).

Since $k_i = 0$ for i = 1..m, it also holds that

(5.C18) $\partial k_i / \partial y_j = 0$, for i = 1..m, and j = 1..n.

Now assume for convenience that n = 2. Consider the special case where m =

1, such that $k_1 = 0$.[23] By equation (5.C18) $\partial k_1/\partial y_j = 0$, for $j = 1, 2$. Write the Lagrange function to (5.C16):

(5.C19) $L(k_1,k_2,\lambda:y_1,y_2) = \pi^1(y_1,k_1+\alpha k_2)+\pi^2(y_2,k_2+\alpha k_1)-\psi(k_1+k_2)+\lambda k_1$.

The first-order condition of the Lagrange to k_2 is

(5.C20) $\partial L/\partial k_2 = 0 = \alpha\partial\pi^1/\partial k_1+\partial\pi^2/\partial k_2-\psi$.

Differentiate this condition to y_2 (a parameter in this equation):

$$(5.C21)\quad \alpha\frac{\partial^2\pi^1}{\partial k_1^2}\left(\frac{\partial k_1}{\partial y_2}+\frac{\alpha\partial k_2}{\partial y_2}\right)+\frac{\partial^2\pi^2}{\partial k_2\partial y_2}+\frac{\partial^2\pi^2}{\partial k_2^2}\left(\frac{\partial k_2}{\partial y_2}+\frac{\alpha\partial k_1}{\partial y_2}\right)=0.$$

Since $\partial k_1/\partial y_2 = 0$ by equation (5.C18), equation (5.C21) gives

$$(5.C22)\quad \frac{\partial k_2}{\partial y_2} = \frac{-\dfrac{\partial^2\pi^2}{\partial y_2\partial k_2}}{\alpha^2\dfrac{\partial^2\pi^1}{\partial k_1^2}+\dfrac{\partial^2\pi^2}{\partial k_2^2}}.$$

Also, $K_{12} \equiv \partial K_1/\partial y_2 = \partial k_1/\partial y_2+\alpha(\partial k_2/\partial y_2) = \alpha(\partial k_2/\partial y_2)$. Substitute this in (5.C17) to get

$$(5.C23)\quad \frac{\partial^2\Pi^C}{\partial y_1\partial y_2} = \frac{\partial^2\pi^1}{\partial y_1\partial k_1}\frac{\partial^2\pi^2}{\partial y_2\partial k_2}\frac{-\alpha}{\alpha^2\dfrac{\partial^2\pi^1}{\partial k_1^2}+\dfrac{\partial^2\pi^2}{\partial k_2^2}}.$$

Thus, if $\alpha = 0$, the spillover effect is zero, and if $\alpha > 0$, there is a positive spillover. This substantiates to some extent that as α increases, the spillover increases (which is not to say that the expression in 5.C23 increases monotonically in α). A thorny problem, however, is how $\partial^2\Pi^C/\partial y_1\partial y_2$ relates to $\partial^2\Pi/\partial y_1\partial y_2$ from the unconstrained (original) problem in equation (5.C4). The generalised envelope theorem (Beavis and Dobbs, 1990, p. 113) shows that $\partial^2\Pi^C/\partial y_i^2 < \partial^2\Pi/\partial y_i^2$ $(i = 1,2)$. So the solution to the 'constrained' problem may be representative for the 'unconstrained' problem.

To conclude appendix 5.C. A higher externality α and more products n-1 to get externalities from raise the amount of effective capital K_i invested in any product i. This raises the (marginal) profitability of each associated product. Furthermore, this need not entail increasing capital outlays: if α increases, an increase of K_i is consistent with a decrease of k_i for every product i and thus decreasing capital outlays $\psi(\Sigma_i k_i)$. A multi-market spillover arises by definition 5.3 only if an

23. Cases where $m = 0$ or $m = 2$ are trivial (in both cases there are no spillovers).

investment in K_j cannot possibly exclude product i from benefiting, that is, if either capital is a pure public good (where $K_j \equiv K_i$) or if some products have no product-specific investment ($k_i = 0$, for at least one product). Both conditions point to centralisation: either all investments are firm-specific rather than product-specific (if $\alpha = 1$) or investments are limited to some products, and other products free-ride on them (where $K_i = \alpha\Sigma_{j \neq i} k_j$). This book studies throughout the former case where the firm controls a single firm-specific investment decision. For the latter case with quasipublic capital goods, a positive spillover occurs only if the products are asymmetric, which is a far more difficult situation to study. Only in this case does a higher externality appear to some extent to raise the multi-market spillover.

Appendix 5.D. A multi-market spillover and output decisions

This appendix accompanies subsection 5.3.4 and recounts the analysis of multi-market spillovers by Bulow *et al.* (1985). Spillovers provide information about the question: (how) does a shock in market A affect decision making about market B? Bulow *et al.* explore this by tracing the consequences of a shock in one market. Say, there are two markets m,n = A,B and two firms i,j = 1,2. Aggregate profits of firm i are $\pi^i(q_i^A, q_i^B : Z^A, q_j^A, q_j^B)$, where q_i^m is the output level (or another decision instrument) in market m and Z^A is a shock in market A. The expected value of Z^A equals zero. The four first-order optimality conditions are:

(5.D1) $\partial\pi^i/\partial q_i^m = 0$, i = 1,2 and m = A,B.

A shock dZ^A occurs, which raises the marginal profitability in market A by unity: $\partial^2\pi^i/\partial q_i^A \partial Z^A = 1$. Totally differentiate the four equations (5.D1) to get, *e.g.*, for $\partial\pi^i/\partial q_i^A = 0$:

$$\text{(5.D2)} \quad \frac{\partial^2\pi^i}{\partial q_i^{A2}} dq_i^A + \frac{\partial^2\pi^i}{\partial q_i^A \partial q_i^B} dq_i^B + \frac{\partial^2\pi^i}{\partial q_i^A \partial Z^A} dZ^A + \frac{\partial^2\pi^i}{\partial q_i^A \partial q_j^A} dq_j^A + \frac{\partial^2\pi^i}{\partial q_i^A \partial q_j^B} dq_j^B = 0.$$

This gives the system

$$(5.D3)\qquad \begin{bmatrix} \frac{\partial^2\pi^1}{\partial q_1^{A^2}} & \frac{\partial^2\pi^1}{\partial q_1^A \partial q_1^B} & \frac{\partial^2\pi^1}{\partial q_1^A \partial q_2^A} & \frac{\partial^2\pi^1}{\partial q_1^A \partial q_2^B} \\ \frac{\partial^2\pi^1}{\partial q_1^B \partial q_1^A} & \frac{\partial^2\pi^1}{\partial q_1^{B^2}} & \frac{\partial^2\pi^1}{\partial q_1^B \partial q_2^A} & \frac{\partial^2\pi^1}{\partial q_1^B \partial q_2^B} \\ \frac{\partial^2\pi^2}{\partial q_2^A \partial q_1^A} & \frac{\partial^2\pi^2}{\partial q_2^A \partial q_1^B} & \frac{\partial^2\pi^2}{\partial q_2^{A^2}} & \frac{\partial^2\pi^2}{\partial q_2^A \partial q_2^B} \\ \frac{\partial^2\pi^2}{\partial q_2^B \partial q_1^A} & \frac{\partial^2\pi^2}{\partial q_2^B \partial q_1^B} & \frac{\partial^2\pi^2}{\partial q_2^B \partial q_2^A} & \frac{\partial^2\pi^2}{\partial q_2^{B^2}} \end{bmatrix} \begin{pmatrix} dq_1^A \\ dq_1^B \\ dq_2^A \\ dq_2^B \end{pmatrix} = -dZ^A \begin{pmatrix} 1 \\ 0 \\ 1 \\ 0 \end{pmatrix}.$$

The matrix P in (5.D3) is negative definite, which is the second-order condition to (5.D1). Hence the determinant of P is positive. The matrix P has four types of elements, with the following economic interpretation:

The elements $\partial^2\pi^i/\partial q_i^{m2}$ are negative as a consequence of P being negative definite; this expresses decreasing returns.

The elements $\partial^2\pi^i/\partial q_i^A \partial q_i^B$ are the multi-market spillover effects.

There are also two competition effects in P. The elements $\partial^2\pi^i/\partial q_i^m \partial q_j^m$ ($i \neq j$; $m = A,B$) imply that an expansion of q_j^m raises (if > 0) or reduces (if < 0) the marginal profitability of q_i^m ($\partial\pi^i/\partial q_i^m$). The decision variables q are called strategic substitutes if the sign of $\partial^2\pi^i/\partial q_i^m \partial q_j^m$ is negative, and strategic complements if the sign is positive. Bulow *et al.* (1985) are mainly famous for their analysis of strategic complements and substitutes.

The elements $\partial^2\pi^i/\partial q_i^m \partial q_j^n$ ($i \neq j$; $m \neq n$) are inter-firm multi-market spillover effects: sales by firm j in market n affect the (marginal) profitability of firm i in market m. An analysis of inter-firm spillovers can be found in R&D literature, where one firm's R&D leaks to other firms, who may use this knowledge in another product market (*e.g.*, De Bondt, Sleuwaegen and Veugelers, 1988). Also, sales in one market may affect consumer preferences in another market through bandwagon and snob effects (Kesteloot, 1990).

For a result some structure has to be imposed upon the problem. First consider the special case where there are no multi-market spillovers: $\partial^2\pi^i/\partial q_i^A \partial q_i^B = \partial^2\pi^i/\partial q_i^m \partial q_j^n$ ($i \neq j$; $m \neq n$) $= 0$. Cramer's rule then gives that $dq_1^B = 0$ and, by symmetry, $dq_2^B = 0$. If there are no multi-market spillovers, a shock in one market will not affect another market. This is an obvious and meaningful result.

Secondly, in order to focus on the (intra-firm) multi-market spillovers, equate the competition effects to zero. This gives, using Cramer's rule

$$(5.D4)\quad dq_1^A = -dZ^A \frac{1}{|P|} \frac{\partial^2\pi^1}{\partial q_1^{B^2}} \begin{vmatrix} \frac{\partial^2\pi^2}{\partial q_2^{A^2}} & \frac{\partial^2\pi^2}{\partial q_2^A \partial q_2^B} \\ \frac{\partial^2\pi^2}{\partial q_2^B \partial q_2^A} & \frac{\partial^2\pi^2}{\partial q_2^{B^2}} \end{vmatrix}.$$

The second-order conditions imply that the determinant of P as well as the 2x2 matrix in (5.D4) are of positive sign and $\partial^2\pi^1/\partial q_1^{B2} < 0$. A positive shock translates therefore into an expansion of q_1^A.

$$(5.D5)\quad dq_1^B = dZ^A \frac{1}{|P|} \frac{\partial^2\pi^1}{\partial q_1^B \partial q_1^A} \begin{vmatrix} \frac{\partial^2\pi^2}{\partial q_2^{A^2}} & \frac{\partial^2\pi^2}{\partial q_2^A \partial q_2^B} \\ \frac{\partial^2\pi^2}{\partial q_2^B \partial q_2^A} & \frac{\partial^2\pi^2}{\partial q_2^{B^2}} \end{vmatrix}.$$

The sign of dq_1^B equals the sign of $\partial^2\pi^1/\partial q_1^A \partial q_1^B$. A multi-market spillover implies that a shock which changes q_1^A also has an effect in market B. With a positive spillover, q_1^B changes in the same direction as q_1^A.

Appendix 5.E. Coordinated markets with and without arbitrage trade

This appendix accompanies subsection 5.5.4. It extends the analysis by Bernheim and Whinston (1990) of coordinated markets to a case where arbitrage occurs between these markets.

Bernheim and Whinston (1990, pp. 7-8) explore a type of coordinated markets where the asymmetry required is based on different number of incumbent firms. In market A there are two firms (i = 1,2); in market B there are the same two firms as well as some domestic firms (i = 3,..,N). In isolation, collusion is sustainable in market A but unsustainable in B where the large number of firms encourages defection. Firms 1 and 2 transfer their ability to encourage collusion in A to B by reducing their market share in B until collusion becomes sustainable there for both the two multi-market firms as well as for the N-2 domestic firms. This appendix shows that arbitrage can make a difference to this result. I will first reiterate the analysis in Bernheim and Whinston, and then add arbitrage.

Coordinated markets without arbitrage

Both markets have Bertrand competition. Marginal costs are c in both markets; there are no capacity constraints. The demand functions are $Q^j(p)$ (j = A,B). Collusion in market A implies that both firms quote the monopoly price p^A_m with aggregate profits Π^A_m. Each firm earns $0.5\Pi^A_m$, and the flow of profits gives a present value $0.5\Pi^A_m/(1-\partial)$. If firm i (=1,2) defects by a price just short of p^A_m, it takes the entire market, its sales are $Q^A(p^A_m)$, and its profits are approximately Π^A_m. The other firm punishes by shifting for ever to Bertrand pricing, with zero profits (a so-called grim trigger strategy). Collusion is sustainable if $\Pi^A_m <$

$0.5\Pi^{A}_{m}/(1-\partial)$, that is, if $0.5 \leq \partial$. In market B, the same situation implies that collusion is sustainable if $\Pi^{A}_{m} < (\Pi^{A}_{m}/N)(1/(1-\partial))$, that is, if $N(1-\partial) < 1$. If $0.5 \leq \partial$ and $N(1-\partial) > 1$, collusion is sustainable in A but not in B:

(5.E1) $0.5 \leq \partial$;

(5.E2) $N(1-\partial) > 1$.

Proposition 5.E1. Multi-market collusion exists if

(5.E3) $(N-2)(1-\partial) < 1$.

Proof (Bernheim and Whinston, 1990, pp. 7-8). Say, collusion in B gives a price p^{B} and aggregate profits Π^{B}. The N-2 domestic firms agree on a market share λ_i, and the two multi-market firms agree on a market share λ_C. The domestic firms collude if $\Pi^{B} \leq \lambda_i \Pi^{B}(1/(1-\partial))$, that is, if

(5.E4) $\lambda_i \geq 1-\partial$.

The two multi-market firms can guarantee that the N-2 firms agree on collusion by giving them market shares of $1-\partial$. Thus the aggregate market share of the N-2 domestic firms is $(N-2)(1-\partial)$, and the two multi-market firms reserve for themselves $1-(N-2)(1-\partial)$. Each multi-market firm takes a market share $\lambda_C = [1-(N-2)(1-\partial)]/2$. This is positive by (5.E3), but less than $1-\partial$, as $N(1-\partial)$ exceeds unity by assumption (5.E2). The multi-market firms reduce their market shares relative to domestic firms. Both now have a motive to defect, as by (5.E4), defection occurs if $\lambda_i < 1-\partial$. The multi-market firms make collusion sustainable, however, by drawing in market A: each will punish defection in B by the other multi-market firm by punishing in both markets. The loss of defection in both markets is

(5.E5) $\Pi^{A}_{m}(1- 0.5/(1-\partial)) + \Pi^{B}(1-\lambda_C/(1-\partial)) \leq 0$.

Given p^{A}_{m} and Π^{A}_{m}, the firms raise p^{B} and Π^{B} until equality holds in (5.E5). Since $(1- 0.5/(1-\partial)) < 0$ by (5.E1) and $(1-\lambda_i/(1-\partial)) > 0$ as $\lambda_C < 1-\partial$, Π^{B} should be positive. (See Bernheim and Whinston, 1990, p. 8, for the case when the implicit constraint $\Pi^{B} \leq \Pi^{B}_{m}$ becomes binding.) The multi-market firms continue to earn monopoly profits in A and now also earn some profits in B. *QED*

The multi-market firms do earn less in B than the domestic firms, who free-ride on the formers' ability to punish each others' defection in A.

Coordinated markets with arbitrage

Arbitrage implies that constraints are imposed upon prices:

(5.E6) $p^{A}-t \leq p^{B} \leq p^{A}+t$.

Proposition 5.E2 Arbitrage does not destroy multi-market collusion, but does change prices.

Proof. If arbitrage exists from market B to A, Bertrand prices $p^B = c$ in market B imply that the maximum price in A equals c+t, where t is the arbitrageurs' constant marginal transport or adjustment cost. Collusion in A is still possible, by (5.E1), so the market price in A is indeed c+t. Given that, prices in B can increase up to c+2t without invoking arbitrage from A to B. Given that, prices can increase in A up to c+3t without invoking arbitrage from B to A, *etc.* This entails that equation (5.E5) has to be rewritten into

(5.E7) $(p^A\text{-}c)Q^A(p^A)(1- 0.5/(1-\partial)) + (p^B\text{-}c)Q^B(p^B)(1-\lambda_c/(1-\partial)) = 0;$

with the additional constraints that $p^j \leq p^j_m$ (j = A,B), and $p^A\text{-}t \leq p^B \leq p^A+t$. Equation (5.E7) gives p^B as an implicit function of p^A; this is an increasing function for $p^j \leq p^j_m$ (j = A,B) if the profit functions are single-peaked. For profit maximisation, the firms seek the highest prices p^j (along the implicit function) until one or more constraints become binding. If one or both of the constraints $p^j \leq p^j_m$ (j = A,B) are binding, the result is the same as in the non-arbitrage case. If, however, $p^A\text{-}t \leq p^B \leq p^A+t$ is binding, prices result such that $p^A < p^A_m$ and $p^A+t = p^B$ or $p^A\text{-}t = p^B$. In this case, arbitrage has an effect: it does not dissolve collusion, but it does reduce prices. Arbitrage trade is not inconsistent with coordinated markets, but does reduce prices (as expected). *QED*

6 VERTICALLY RELATED MARKETS

This chapter discusses competition in vertically related markets. These are markets linked by firms that are buyers in one market (the input market) and suppliers in the other (a product market). Actions in (imperfectly competitive) input markets may provide instruments in product market competition. A firm may make an irreversible acquisition of inputs in order to raise costs of rivals, thus indirectly raising its own revenues even if the acquisition itself is costly. The chapter explores the relationship between the industrial economic theory of competition by raising rivals' costs and the resource-based view of the firm within strategic management. Both approaches indicate that a firm derives a competitive advantage from a team of complementary resources. This may be an instrument in entry deterrence. The chapter explores both *de novo* entry and established-firm entry, thus offering a synthesis with the previous chapter.

6.1 INTRODUCTION

A large class of competitive games has the following form: an incumbent firm makes moves in its (external or internal) factor market which affect a (potential) competitor's *subsequent* moves in its product market. Figure 6.1 illustrates this idea. If inputs are acquired before production takes place, the purchase or contracting of inputs may be used as an instrument in order to affect the subsequent product market competition. Two conditions determine the role which moves in factor markets can play in competition.

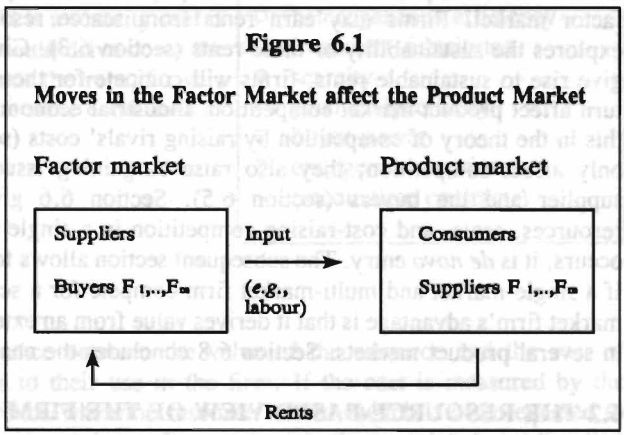

Figure 6.1

First, the setting in figure 6.1 implies more than a time sequence. It assumes that the purchase or contract is irreversible. If it is reversible, the firm effectively postpones its decision until (after) the product market decision (*e.g.*, output or price). Two types of games have explored how an irreversible move in a factor market can be a strategic move. In *commitment games*, a firm's move influences competitors to its advantage only because it is irreversible. For example, an incumbent firm's product-specific inputs raise exit barriers, such that rivals know that it will remain in the market even if it is no longer earning enough to recover its original investment

outlays. This may keep rivals out of the market, which is favourable to the incumbent firm. In *signalling games*, a firm's actions in a factor market may reveal information that has an effect upon the subsequent product market competition. It signals its information (*e.g.*, that its cost level is 'low') by making moves which would not be profitable if its information would be different (*e.g.*, if it had high rather than low costs).

Secondly, if the factor market exhibits imperfect competition on the demand side, the buyers of the factors are interdependent. The conditions (price, availability, quality) under which one firm may purchase factors become dependent upon the transactions by its product market rival. Since cost functions are based on these conditions, each firm's cost function depends upon decisions by the other firm. Firms may not only compete in the product market, but in a factor market as well.

The importance of irreversibility and interdependence can be demonstrated in a counterfactual way by studying the effects when they are absent. The perfectly contestable market is predicated on the assumptions that all investments are reversible without costs or delays (they should adjust faster than prices), and that factor markets are perfectly competitive with price-taking buyers and sellers. These assumptions destroy the possibility for incumbent firms to deter entry while earning positive profits. Chapter 4 was careful to point out that, justified critiques notwithstanding, contestability's importance is its demonstration that the absence of at least one of both conditions is necessary for profits. The case usually explored by industrial economics is when investments are irreversible (*e.g.*, because of imperfect used factor markets). The remainder of the chapter studies the situation with an imperfectly competitive new factor market where moves are irreversible.

The chapter develops an integrated approach which draws upon theories from strategic management and industrial economics. The foundation is the strategic management approach of the resource-based view of the firm (section 6.2). This is a 'vertical' variety of multi-market competition with imperfect competition in the factor market. Firms may earn rents from scarce resources. The next section explores the sustainability of these rents (section 6.3). Given that scarce resources give rise to sustainable rents, firms will compete for these resources. This may in turn affect product market competition. Industrial economics has sought to explore this in the theory of competition by raising rivals' costs (section 6.4). Rents do not only affect competition; they also raise bargaining issues between the resource supplier and the buyers (section 6.5). Section 6.6 gives examples of scarce resources, rents, and cost-raising competition in a single product market. If entry occurs, it is *de novo* entry. The subsequent section allows for established-firm entry. If a single-market and multi-market firm compete for a scarce resource, the multi-market firm's advantage is that it derives value from an extensive use of the resource in several product markets. Section 6.8 concludes the chapter.

6.2 THE RESOURCE-BASED VIEW OF THE FIRM

The resource-based view of the firm argues that if a firm owns superior assets (compared to product market rivals) it will earn economic profits or rents. Rents can

be defined as income in excess of costs needed to attract the factors of production.[1] By implication, inter-firm profitability differences are partly explained by heterogeneous factor endowments. Barney (1986b) calls the factors that are central to a firm's competitive strategy and profitability *strategic factors*. These are, for example, tangible assets such as production capacity and intangible assets such as R&D (Chatterjee and Wernerfelt, 1991), the management team (Penrose, 1959), and organisation culture (Barney, 1986a). Reviews of this new approach are Wernerfelt (1984), Grant (1991), Ghemawat (1991b) and Peteraf (1993).[2]

The origin of the resource-based view is Ricardo's (1973) theory of rents in agriculture. Corn is a homogeneous commodity, and the suppliers of corn (capitalist-farmers) are price takers. They use land of different qualities. On marginal least-quality land the unit production cost of corn equals the market price. Higher quality lands have lower production costs. The difference between market price and production cost on these (infra-marginal) lands is a rent. Competition between farmers for a lease of good land drives up the lease price they are willing to pay up to the point where the landlord who owns the good land appropriates the entire rent. This theory combines the basic features of the resource-based view of the firm: the product market is competitive, factors are heterogeneous, good factors are scarce and generate a rent; bargaining between the supplier and the user (firm) of the resource divides the rents between supplier income and user profits.

The resource-based view extends Ricardo's theory. It moves beyond land to all factors that satisfy certain conditions (what these conditions are will become apparent in the next sections). It also raises new issues: the sustainability of rent and the endogenous size of the rent. A firm may increase rents by, first, forming a team to combine a scarce resource with complementary resources, or, second, by diversifying in order to use a shared resource in multiple product markets.

The first condition that rent-generating factors must satisfy follows immediately from Ricardian theory. A profit is a scarcity rent if and only if competition would drive down the market price and wipe out the rent if rivals could buy resources in the same conditions as

Factor Market Imperfections:
- heterogeneous efficiency
- imperfect substitutes
- scarcity
- product-specificity
- buyer power
- endogenous service (incomplete contracts)

1. The rent is the difference between the value of the resource and the cost of contracting the resources to their use in the firm. If the cost is measured by the opportunity cost (the revenue when the resource is sold, which is often equated to the highest value of the resource in an alternative use), the associated rent is called quasi-rent (Milgrom and Roberts, 1992, p. 269). The rent is positive if the resource is used where it has the highest contribution (marginal product). This is an example of the Coase theorem (Raiffa, 1982, p. 107).

2. Related insights can be found in Lippman and Rumelt (1982), Barney (1986b), Aaker (1989), Reed and DeFilippi (1990), and Schoemaker (1990).

the incumbent firm or first mover did.[3] Rents arise, therefore, if competitors cannot buy the resources required. For example, no factor market exists for them, the factor market is imperfect, resources may be scarce or closely held, and no substitutes are available. Factor market imperfections are therefore a necessary condition for firms earning scarcity rents.

The resource-based view raises the following three topics, which the next sections will discuss: the sustainability of rent, the effect of competition for scarce resources on product market competition, and bargaining with the resource supplier about the distribution of the rent.

6.3 SUSTAINABLE RENTS

Rents are sustainable if the scarcity upon which they are based continues after the rent-generating potential of the resource has become apparent. Processes such as substitution and imitation reduce the scarcity. Impediments to imitation and substitution in turn defend the sustainability of the rent. These impediments are sometimes called *resource-position barriers* (Wernerfelt, 1984) or, due to Richard Rumelt, *isolating mechanisms* (Teece, 1984). Important examples of these impediments are barriers to imitation and government regulation.

6.3.1 Barriers to Imitation

Barriers to imitation are usually related to limited information. First, imitation is difficult if know how is tacit and personal. Second, it may be difficult to identify which resources among the many used by a firm are responsible for its competitive success. *Complexity* (of the team-like interaction between resources required for the firm's success) and *non-transparency* (as to which resource is responsible for a particular aspect of performance) give rise to the *uncertain imitability* problem, where potential entrants stay out of the market for fear of buying the wrong (combination of) resources (Lippman and Rumelt, 1982). Third, it may take time and experience to build a team out of separate resources. Each firm is a unique combination of complementary resources. Penrose, who initiated this idea, focused on the management team with experience in working together: 'such management cannot be hired in the market-place' (Penrose, 1959, p. 46). These impediments act as an entry barrier such that incumbent firms continue to earn rents.

Imperfect information may improve sustainability of rents also in another way. Rents may be protected by a contract between the resource supplier (*e.g.*, a union) and the user (*e.g.*, a firm). Contracts can be reversible if the parties renegotiate or voluntarily dissolve the contract. Rents based on a contract are sustainable only if second movers are unable to create conditions where the initial parties consent in renegotiation or dissolution. If one party suggests the dissolution of a contract, the other may fear to be ripped off. (This is why a contract is signed to begin with.) If

3. If rivals can buy resources in the same conditions as the incumbent firm or first mover did, *i.e.*, if there is no interdependence in the factor market, then any non-transitory profit should result from irreversible (*e.g.*, commitment or signalling) moves.

uncertainty exists, it may be difficult for the other to distinguish a renegotiation which is mutually beneficial from one which is not. This may prevent the renegotiation, which in turn buttresses its commitment value (Dewatripont, 1987).

The impediments that buttress a resource's continued scarcity may naturally follow from its identity, as in the cases above. However, a scarcity of rents may also be deliberately created or sustained. Government actions may have the desired (and perhaps intended) effect of creating scarce, rent-generating, resources.

6.3.2 Regulation and Rent-seeking

Incumbent economic actors may lobby with the government to impose regulation that prevents or limits entry, thus turning the status and regulatory approval of an incumbent firm into a scarce resource. For instance, Carr and Mathewson (1988) discuss cases in Scottish banking (1795-1882) and U.S. lawyers' firms where some incumbent firms had a limited liability charter. Unlimited liability is to the advantage of creditors who in the case of the firm's bankruptcy can safeguard their loans by appropriating the shareholders' personal property. This effect reduces the costs of debt. However, to avoid loss of their property, owners of an unlimited liability firm will both monitor management (to reduce the risk of bankruptcy) as well as each other (to see to it that each is able to bear part of the costs of eventual bankruptcy). The net effect of low interest rates and high monitoring costs seems to be to reduce the value of unlimited liability to shareholders (see Jensen and Meckling, 1976, p. 331). In the Scottish example, incumbent banks with a limited liability charter had succeeded in convincing the government of the need to impose unlimited liability upon entrants. The lower marginal revenue of equity in unlimited liability (due to the monitoring costs) reduces the provision of deposits. This prevents the interest rate on deposits from falling. As a result, owners of a scarce limited liability charter realise a sustainable rent (Carr and Mathewson, 1988, p. 772).

Maijoor and Van Witteloostuijn (1993) have an empirical study of the Dutch audit market. Government regulation initiated between 1967 and 1983 had increased demand for accounting while allowing the organisation of accountants to self-regulate the registration of new accountants. Accountants and their organisations had actively participated in the political process that led to these regulations. Incomes of partners of accounting firms, which had increased before 1967 at lower rates than those of other professionals, began to catch up after 1967. This suggests that regulation turned accounting services into a scarce factor, while partners of the accounting firms appropriated some of these rents.

6.3.3 Tariffs and Quota

If international trade exhibits symmetry between two countries and firms, the firms may attempt to escape reciprocal dumping (see section 5.3) by means of *collusion by raising rivals' costs*. Each firm will lobby with its local government to impose an import tariff. One may think of tariffs and quota as scarce resources traded in a political market. This raises the foreign rival's costs, and shifts some of its rent to the home government. National welfare may increase therefore, by Brander and Spencer's (1981) rent-shifting motive. If both firms do this, this may change their

situation. Previously, they may have been involved in cross-hauling. After the tariffs, however, the extent of cross-hauling decreases. Firms may now revert to a spheres-of-influence arrangement.[4] They certainly gain from this, as duopoly gives way to monopoly, and tariffs are avoided in the absence of trade. It remains to be seen how governments react if they lose tariff revenues.

These subsections give some examples where conditions tend to keep a resource scarce. Given that a scarce resource exists, firms bid for them, which may have an effect on product market competition. Industrial economics explored this presumption in a theory called *competition by raising rivals' costs*.

6.4 COMPETITION BY RAISING RIVALS' COSTS

As Lydall (1955, p. 304) stated, 'the [entrant's] cost of launching a new product on the market depends on the policy of existing firms.' (see subsection 3.3.3). Firms may deter entry by raising their (potential) rivals' costs. The main instrument is to buy up scarce resources that rivals need to expand or enter. For instance, an incumbent firm may acquire a (sleeping) patent. By doing so, it raises the costs to a second mover. This may induce the latter to contract its output level or to stay out of the market altogether. The rival may also try to buy the resource, however. This raises the question which advantage the incumbent firm has, such that it can profitably outbid its rivals. Four types of heterogeneity among rivals exist that may help some to raise the costs of rivals without reducing their own profits. The associated theories are different and, I suggest, complementary.

6.4.1 Cost-raising by a First-mover

Salop and Scheffman (1987) discuss three models which have in common that one firm (*e.g.*, an incumbent firm) moves ahead of other firm(s) (*e.g.*, a potential entrant). The first model assumes that the incumbent firm determines a parameter α (*e.g.*, an industry wage rate) that affects both its own and the entrant's costs. It chooses α to deter entry or reduce the scale of a competitive fringe. An example is that a capital-intensive dominant firm may negotiate high industry wages with the union, which hurt its labour-intensive competitors most (see subsection 8.7.3). In the second model both firms acquire inputs a that are competitively supplied at price α with an upward sloping supply curve $A(\alpha)$. The incumbent firm may acquire excessive amounts of a (an 'over-buying' strategy) in order to raise its price α to the entrant. This may raise the market price although it also increases the incumbent firm's costs. A third model explores vertical integration: the incumbent may 'over-buy' inputs in an external input market, even if it is cheaper to produce them internally. This may raise the price of the external input, with similar effects as in their second model.

Appendix 6.A has a modified version of the second, over-buying model (see also subsections 8.7.1 and 8.7.2). It brings out some important features of competition by raising rivals' costs. First, it is not imperative that the preemptive (cost-raising)

4. Remember that higher transport costs or tariffs facilitate a spheres-of-influence arrangement, as Pinto (1986) shows (see subsection 5.5.5 and appendix 9.A).

firm 1 has market power in the product market. It does raise the market price, but indirectly through its impact on its rivals' unit costs and thus market price. Second, there is a scarce resource a: because a is scarce, a greater demand for a by firm 1 raises the input price. Scarcity is implicit in the upward slope of the supply curve $A(\alpha)$. Third, firm 1 is a first-mover and a price setter in the input market.

In this approach the first mover preempts second movers by changing the factor market conditions that they will face. In the next cases, two firms move simultaneously in the factor market. They simultaneously bid for a scarce resource, such as a distribution network, an ore deposit, a patent, or a contract with consumers. Say firm 1 and firm 2 compete (or bid) for the resource. Call V_i the value of the resource for firm i (= 1,2), which represents the difference in profit between winning and losing the bid. In the case of complete information, the supplier can auction its resource. If $V_1 > V_2$, the firms will bid up until the bid equals V_2, where firm 2 drops out, and firm 1 wins. Firm 1 appropriates a rent V_1-V_2 and pays V_2 to the resource supplier. This line of argument exists in three varieties, with different explanations of the valuations V_i.

6.4.2 Cost-raising by a Firm with Market Power in the Product Market

Call profits $\pi_i(1,0)$ for firm i (= 1, 2) if firm 1 wins the bid and $\pi_i(0,1)$ if firm 2 wins the bid. A bid B_1 is profitable to firm 1 if and only if $\pi_1(1,0)-B_1 > \pi_1(0,1)$, that is, the profits minus the bid (if it wins) exceed its profits if the other firm wins. Its maximum bid equals $V_1 \equiv \pi_1(1,0)-\pi_1(0,1)$. Firm 2 bids B_2 such that $\pi_2(0,1)-B_2 \geq \pi_2(1,0)$, that is, $\pi_2(0,1)-\pi_2(1,0) \equiv V_2 \geq B_2$. Firm 1 is able to win if $\pi_1(1,0)-\pi_1(0,1) = V_1 > V_2 = \pi_2(0,1)-\pi_2(1,0)$, that is,

(6.1) $\pi_1(1,0)+\pi_2(1,0) > \pi_1(0,1)+\pi_2(0,1)$.

Firm 1 wins if industry profits when it wins are greater than the industry profits if firm 2 wins the bid. The winner, therefore, is the one who induces the highest industry profits. This result does not *per se* extend beyond two firms, as we will see.

A special case is where firm 1 is the incumbent firm and firm 2 is a potential entrant. Assume that firm 2 is unable to enter if it does not win the bid for the scarce resource, that is, $\pi_2(1,0) = 0$. In this case, equation (6.1) says that firm 1 wins the bid if the monopoly profit (when the incumbent firm wins the bid) exceeds the total duopoly profits (when the entrant wins). Intuition suggests that the condition will hold: the duopoly competes away some of the monopoly profits. The incumbent firm wins the bid and pays the entrant's highest price ($V = \pi_2(0,1)$). The condition

(6.1a) $\pi_1(1,0) > \pi_1(0,1)+\pi_2(0,1)$,

is called the *efficiency effect* and is, according to Tirole (1988, p. 348), the basis for the persistence of monopoly. An implicit assumption is, however, that the incumbent firm does not exit after loosing the bid. If it does, the entrant earns the monopoly profit, and the inequality will not hold. That is, some exit barriers exist, such that the entrant does not produce if the incumbent wins, but the incumbent does produce if the entrant wins.

To introduce more than two firms, consider a market where all incumbent firms are equal. Each firm's profit is $\pi(n)$, where n is the number of active firms. Each firm requires a natural resource, *e.g.*, a mineral well. There are actually $n+1$ of these wells. Both an established firm and a new firm bid for the $(n+1)$th well. The incumbent firm will not use the second well (one well is enough for any output level); it only bids for it to prevent entry. The incumbent firm's maximum bid is $\pi(n)-\pi(n+1)$; the entrant's maximum bid is $\pi(n+1)$. The incumbent firm wins, and entry is deterred, only if

(6.1b) $\pi(n) > 2\pi(n+1)$.

In a symmetric Cournot model with linear demand, this condition holds only for $n = 1$, that is, only for the case in equation (6.1a) (see Carlton and Perloff, 1990, p. 271). In non-monopolised markets, each individual incumbent firm does not gain enough from entry deterrence to be able to outbid a potential entrant. The incumbent firm loses although it does (weakly) induce the largest industry profits: the efficiency effect extended to n equal firms implies that $n\pi(n) > (n+1)\pi(n+1)$. The winner is the one who has most to gain by winning the bid: it need not hold that the industry as a whole also stands to gain.

Cases with more than two firms can still be allowed by introducing side-payments. Call industry profits Π^i where i (= 1..n) is the identity of the firm that wins the bid. Rank a number of firms 1,2,..n, such that $\Pi^1 \geq \Pi^2 \geq ..\geq \Pi^n$. Then firm 1 wins the bid and acquires the scarce resource as it can compensate both its rivals and the resource supplier. Hence equation (6.1) readily generalises to any number of firms. However, if side-payments are not allowed, it need not hold that the winner is the one who induces the highest industry profits. In this approach, a firm realises a higher rent or producer surplus, V_1-V_2, than a rival because it has more market power. Having market power, it has most to lose and is thus most willing to win the bid. The next subsection gives an alternative explanation of rent.

6.4.3 Cost-raising by Combining Complementary Resources

A firm may achieve greater value in using the factor than its rivals if it owns scarce resources itself that complement that factor (Gilbert, 1989, p. 521-522). As a result, it may earn rents from using the factor in team with its complementary factors. Alchian and Demsetz (1972, p. 770) define *team production* as follows:

Definition 6.1 Team production: the output level $x = F(f_1,..,f_n)$ is team produced by inputs f_i and f_j if $\partial^2F/\partial f_i\partial f_j > 0$ $(i \neq j)$,

that is, a quantity f_j of factor j raises the marginal productivity $\partial F/\partial f_i$ of factor i.[5] The specific case Alchian and Demsetz (1972, p. 779) have in mind is a team of employees, where '[t]here exist production techniques in which the Z obtained is greater than if Xi and Xj had produced separable Z' (where Z is the output level and

5. If $\partial^2F/\partial f_i\partial f_j < 0$, inputs i and j are in congestion, and I prefer not to call them a team.

X are labour inputs). Another example of a team of inputs is referred to by Frumau (1992, p. 98) as *interlinkage of technology areas*, that is, several knowledge inputs are required to develop a new product. For instance, Philips required competence in electronics, mechanics and optics to develop and produce the compact disc. Intuitively, team production requires complementary inputs, and I will assume when speaking of complementary inputs that definition 6.1 holds.[6]

In order to explore the link between team production and rents, assume that the production function (suppressing other factors) is F(r,f), with $\partial^2F/\partial f\partial r > 0$. Each firm *i* owns a given stock of firm-specific resources r_i as well as f_i. Firms 1 and 2 are price takers in the product market (with price p). An additional unit of factor *f* comes for sale. Each firm's highest bid equals its marginal revenue from a unit of *f*: $V_i = p(\partial F/\partial f)$. If the firms are price takers in the factor market with price p_f, then $V_i = p(\partial F/\partial f) = p_f$. Now assume an imperfect factor market. Using Taylor expansion, assuming small differences and a smooth production function, the rent V_1-V_2 can be rewritten into $p(r_1-r_2)\partial(\partial F/\partial f)/\partial r$ plus a 'small' term, *i.e.*,

(6.2) $V_1-V_2 \approx p(r_1-r_2)\partial^2F/\partial f\partial r$.[7]

Thus endowments $r_1-r_2 > 0$ lead to $V_1-V_2 > 0$ if $\partial^2F/\partial f\partial r > 0$. If, therefore, a firm has developed unique skills (the factor r_1), it is able to drive a hard bargain with the suppliers of a complementary resource (*i.e.*, the marginal unit of f): the latter earn V_2 (which is firm 1's winning bid), and firm 1 earns V_1-V_2. Condition (6.2) refers to differences in production endowments. In analogy with the three varieties of the multi-market spillovers in chapter 5, a valuation difference may also result from demand side effects, *e.g.*, different brand name recognition, or from asymmetric information. In this case, the approach is widened to allow for imperfect competition in the product market.

6.4.4 Cost-raising by a Multi-market Firm

A firm may also derive greater value from a resource than others if it can apply the resource to activities in multiple markets (see sections 5.3 and 5.4). If, for example,

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6. To check this, define factors i and j as *gross substitutes (complements)* if the firm will increase (reduce) the use of the ith factor when the relative price of the jth factor increases, taking into account that output may reduce upon an input price increase (Henderson and Quandt, 1980, pp. 32 and 81). In the special case of a profit maximizing, price-taking firm with two inputs and one output, inputs i and j are gross complements if and only if they are team producing ($\partial^2F/\partial f_i\partial f_j > 0$), and gross substitutes if $\partial^2F/\partial f_i\partial f_j < 0$ (Henderson and Quandt, 1980, p. 81). Conversely, Laitinen (1980, pp. 42 and 48-9) shows for the multiproduct firm, that if the production function is additively separable in inputs rather than team producing ($\partial^2F/\partial f_i\partial f_j = 0$), no input is a specific substitute or complement (where *specific* refers to the assumption that output is taken to be given, rather than variable as with gross substitutes).

7. If r_1-r_2 is large, the expression is $(V_1-V_2)/p = \int_{r2}^{r1}(\partial^2F/\partial x\partial f)dx$ (see Baumol, Panzar and Willig, 1982, p. 89, for the mathematics).

a shared resource allows a firm to realise a multi-market spillover, it may earn $\pi(q^A,q^B)$, while if it fails to acquire the resource, it may earn $\pi(q^A,0)+\pi(0,q^B)$, where q^j is the output level in market j (= A, B). The spillover effect,

$$\pi(q^A,q^B)-[\pi(q^A,0)+\pi(0,q^B)]$$

(see definition 5.4.), equals the value which the firm derives from the resource. This leads to a competitive advantage against rivals whose activities are limited to fewer or smaller product markets. An extreme example is offered by one-sided entry from a multi-market entrant against a domestic firm (see section 5.2 and subsection 5.3.4). A rent may thus follow from the combination of a shared resource and a unique access to (or incumbency in) many or large product markets. Since this case integrates elements from horizontally and vertically related markets, I defer further treatment to section 6.7.

6.4.5 Comparing the Four Types of Cost-raising Competition

Table 6.1 may serve as guideline in the comparison.

Table 6.1
Cost-raising Competition

Source of Buyers' heterogeneity	Factor market: Supplier(s)	Buyers' product market
First-mover advantage	Perfect competition	(Im)perfect competition
Market power in product market	Monopoly	Imperfect competition
Complementary resources	Monopoly	(Im)perfect competition
Multi-market firm	Monopoly	(Im)perfect competition

All varieties of the buyer heterogeneity in cost-raising competition can be traced back to a first-mover advantage. In Salop and Scheffman's models, the incumbent's advantage is the timing advantage that it acquires its factors before the entrant does. In the other varieties, the incumbent firm and entrant may bid simultaneously. The incumbent's advantage is that it owns firms-specific resources that either constitute an exit barrier to its imperfectly competitive product market (condition 6.1), or complements in production with the scarce resources (condition 6.2). A multi-market firm may own product-specific resources that prevent entry into its home market, thus forcing an asymmetry upon rivals (one-sided entry). In all cases the incumbent firm has acquired at least some specific resources prior to entry.

In actual cases, competitors may exhibit a combination of these heterogeneity (first move) conditions. A firm which has a market power disadvantage may yet win a bidding auction if it has enough complementary resources to be able to generate more value with the scarce resource than the dominant firm. Consider an example

where two firms, potential entrant 1 and incumbent firm 2, in market B vie for a scarce resource (*e.g.*, a distribution network). Only if firm 1 wins the bid does it enter B. As condition (6.1) shows, the winner of the bid is the one who induces the largest industry profits. The market power advantage of the incumbent firm 2 is the efficiency effect. However, entry raises industry profits if the potential entrant's marginal cost is sufficiently lower than firm 2's, *e.g.*, due to learning in its home market A.[8] The entrant, firm 1, will win the bid and enter the market. This reflects a possible lesson from the entry by Japanese firms into the world market: having a dominant market position is not enough if new rivals succeed in making more value out of scarce resources.

Preemptive ownership of the scarce resource has different implications for the incumbent firm in the cases above. In the case with condition 6.1, the resource may not have an intrinsic use to the incumbent firm (*e.g.*, a sleeping patent). The firm buys the resource simply to prevent the entrant's entry, *i.e.*, to protect its market power. In the case of condition 6.2, the incumbent firm tries to appropriate the scarce resource in order to reduce its costs which, given perfect competition in the product market, translates directly into higher producer surplus. It clearly intends to use the resource, and will win the bidding only if it generates a higher surplus using the resource than would a rival. In agreement with Ricardo's rent theory and the resource-based view of the firm, a competitive product market can exhibit rents. Buying scarce resources preemptively creates profits (subsection 6.4.1) and by assembling a team of complementary resources a firm can outbid rivals for scarce complementary resources (subsection 6.4.3).

6.4.6 Cost-raising versus Other Competition Instruments

Three different games discussed in this section and in the introduction (competition by commitment, signalling, or cost-raising) all imply that a firm acquires factors for reasons additional to the technical reason that outputs require inputs. A distinction arises between cost-minimising firms, which acquire inputs in order to minimise costs given an output level, and profit-maximising firms, which exploit the strategic potential that moves in factor markets may have relative to competitors. A profit maximiser may over- or under-invest in factors relative to cost-minimisation.[9]

There is a difference between commitment and signalling strategies on the one hand, and cost-raising strategies on the other. Commitment and signalling strategies

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8. Say, products are homogeneous and the linear industry demand curve is $p(X) = A-BX$ with industry output X. The duopolists' constant marginal costs are c_i ($i = 1,2$). The Cournot industry profits Π^B are $[(A+c_1-2c_2)^2+(A+c_2-2c_1)^2]/9B$. Firm 2's monopoly profit if firm 1 does not enter is $\Pi_2^B = (A-c_2)^2/4B$. Then $\Pi^B > \Pi_2^B$ iff $c_1 < c_2-(A-c_2)/10$. Recall that the monopoly price equals $(A+c_2)/2$ and the monopoly profit margin is $(A-c_2)/2$. In order to win the bid, firm 1 should have a cost difference, c_2-c_1, of more than 20% of firm 2's monopoly profit margin.

9. Fudenberg and Tirole (1984) and Bulow, Geanakoplos and Klemperer (1985) propose alternative benchmarks relative to which firms can be said to over- or underinvest. These are not necessarily inconsistent (Klemperer, 1987, p. 104[n]). This book uses both benchmarks, choosing for each case the one most appropriate.

(usually) share the condition that the incumbent firm and the entrant are not interdependent in the factor market. They may have different factor markets, or the input market may be perfectly competitive. The crucial assumption is that the move in the factor market is irreversible, *e.g.*, because the *used* factor market is imperfect. Cost-raising strategies, instead, imply that both firms are interdependent in a factor market. The crucial assumption is that the *new* factor market is imperfectly competitive on, at least, the demand side. A move by one firm (*e.g.*, its demand for intermediate inputs) affects the factor market conditions found by the other firm. Competition by raising rivals' costs, therefore, is a case where (expected) product market competition has an effect on the factor market (see figure 6.1). This represents a higher degree of interdependence than on the basis of irreversibility alone, where there is a unilateral influence from factor markets on the product market. The next table summarises.

		Used factor market perfectly competitive?	
		Yes	No
New factor market perfectly competitive on demand side?	Yes	Perfect contestability	Commitment, signalling
	No	(-)	Cost-raising competition

The sections above discussed one party that influences a firm's rents: its rivals. I now turn to the suppliers of the associated rents. Industrial economics and strategic management share some insights about bargaining between firms and their inputs suppliers.

6.5 BARGAINING FOR RENTS WITH RESOURCE SUPPLIERS

Competition or bidding for scarce resources may pass over most of the rents to the resource suppliers.[10] Union bargaining, for instance, diverts a large part of monopoly rents to employees (Schmalensee, 1988, p. 669-70; and Veugelers, 1989). A bargaining process determines the distribution of the rents between the supplier(s) of the resource and the firm with the winning bid. We need to distinguish two types of resources: those whose service to the firm is exogenous, and those whose service (or effort) is endogenous.

6.5.1 Resources with Exogenous Effort or Service

If the effort or service is exogenous, firms derive given values V_i from the resource.

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10. Ricardo's theory is the extreme case where the suppliers appropriate all rents. The reason is that the farmers who compete for land are identical. Thus, from (6.2), V_1-V_2 = 0, and farmers do not earn rents. If, however, some farmers would own complementary factors (such as skill in working on fertile land), they would appropriate part of the rent. This argument ushered in the emphasis on teams of complementary resources.

Several models predict the bargaining outcome. In the bargaining model used above, an ascending outcry auction, firm 1 bids up to V_2 (the next highest bid) and earns V_1-V_2 (Raiffa, 1982, p. 96). In the alternative case of cooperative Nash bargaining, the resource supplier gets more than V_2. The supplier's outside option is V_2 and firm 1's outside option equals 0. In the Nash bargaining solution, the joint rent V_1 is distributed in w for the resource supplier and π for the firm such that $V_1 = w+\pi$, and w and π maximise the expression $(w-V_2)(\pi-0)$ (Rasmusen, 1989, p. 231). The supplier gets $w = (V_1+V_2)/2$, which exceeds V_2. The buyer firm, of course, loses by the same amount.

Both outcomes show that a firm appropriates a larger part of the rent when there is more buyer asymmetry (*i.e.*, the higher V_1-V_2). They also indicate the importance to the resource supplier of having an outside option (V_2). The more product-specific the resource, the lower its outside option. High mobility raises the outside option. This explains the argument in Alchian and Demsetz (1972) that the monitor of the team (the entrepreneur) will be the team's residual claimant. A residual exists precisely because individual team members cannot earn as much outside of the team as they can (marginally) produce inside. Theories have made it intuitive that the firm appropriates a larger part of the employees' rents if success is based on team effort rather than individual skill, if the individual employee's contribution is difficult to identify by outside employers, or if skills are firm-specific (Grant, 1991, p. 129).

6.5.2 Resources with Endogenous Effort

The bargaining process above assumes that the price of the resource *w* does not affect V_1, the contribution of the resource to the firm's value. For some resources, however, V_i depends on effort which in turn depends on the rewards *w* (Raiffa, 1982, p. 96-7). Examples of a resource with an endogenous effort are an employee, manager, or another firm. The service or effort of these resources cannot be contracted for and hence is not given in advance. It is an old point (going back to Marx) that firms cannot buy labour; instead they buy labour power. A labour market does not literally exist, therefore, which is a fairly extreme factor market imperfection. In modern language: the labour contract is incomplete (does not specify in advance the labour effort or service expected). Incentives or coercion are required to assure that the service does come forth.

To focus on bargaining, ignore for now the presence of a product market rival who bids against the incumbent firm. Principal-agent models analyze the situation when the firm bargains with a resource supplier. Of particular interest is the property rights view of the firm (Grossman and Hart, 1986; Hart and Moore, 1990; and Moore, 1992). It explores the firm as being the result of a vertical merger. The reasoning assumes that the managers of two firms independently make investment decisions in complementary factors (*e.g.*, their own human capital). Each firm's revenue depends on its own and on the other firm's investment. It appropriates part of the income generated by the other firm's investment. This hold-up induces each firm to underinvest. To avoid this, one firm acquires the other. The acquiring firm has higher incentives to invest as it appropriates the entire income from its investment. The manager of the acquired firm, however, loses his share in the income; his incentives to invest decrease:

'a firm that purchases its supplier, thereby removing residual rights of control from the manager of the supplying company, can distort the manager's incentives sufficiently to make common ownership harmful.' (Grossman and Hart, 1986, p. 692)

This implies the policy recommendation that ownership should go the manager whose investment decision has the greatest impact on the joint income.

The property rights view focuses on (investment or effort) incentives of firms with complementary resources. The analysis can be extended to the case where a firm acquires a complementary resource with endogenous effort. Rotemberg and Saloner (1991) explore a case where a contract that gives incentives to a newly acquired resource (an employee) may reduce the incentives of the established employees. This creates an advantage of being narrow, *i.e.*, of turning down a profitable opportunity because 'entering a new activity worsens performance on existing activities.' (Rotemberg and Saloner, 1991, p. 6). They specifically centre on R&D. Say activity *a* is the firm's core business and *b* a new opportunity. Their workers, A and B respectively, may develop a useful idea, which requires them to exert effort *e*, with a probability of success *P*. Effort is non-contractible, *e.g.*, because it cannot be observed by outsiders. Enforceability of the contract is assumed to rest on implementation of the innovation, rather than on the innovation (idea) itself. If B's idea is implemented to the detriment of A's idea, A gets no reward (a one-sided spillover). If A anticipates this, A may not exert the effort. This is an inefficiency.

'By choosing to be narrow, and focusing only on activity a, the firm commits itself not to research innovations that could jeopardize the effort of its innovative employee in activity a.' (Rotemberg and Saloner, 1991, p. 4)

This is a very specific story, but it points the way to a better understanding of why mergers and multiproduct firms run into incentive problems. If product market activities undermine the incentives of each other's employees, they are substitutes in production, and the firm faces a (managerial) diseconomy of scope.

Strategic management explored the same bargaining problem as an exercise in power (Mintzberg, 1983). The power of A is his ability to influence the behaviour (*e.g.*, effort) of another person B. Firm A will have power if B depends on a resource owned by A (the dependency view of power). If firm A owns resources complementary to those of an employee or firm B, A may have the power upon acquiring B (or his factors) to induce him to provide effort or services. Agent B will depend on A if A's resources are essential to B, concentrated in A's hands, and nonsubstitutable (Mintzberg, 1983, p. 24). These conditions are consistent with those mentioned earlier as giving rise to rents. Unlike the property rights view of the firm, this approach also mentions non-economic incentives to induce B to spend effort in ensuring the value of the acquisition (called V_1 above). Firm A should have the will and the skill in using power to actually influence behaviour by B. Power may also imply the charisma that makes followers willing to be led. These non-economic factors may substitute for economic incentives. What remains yet to be done is to integrate economic and non-economic incentives with competitive bidding for scarce

resources.

6.5.3 A Synthesis of Cost-raising Competition and the Resource-based View of the Firm

The cost-raising theory and the resource-based view show that the gap between industrial economics and strategic management is closing. Their theories can fruitfully be considered as complementary. The vision that emerges from these theories is as follows. Firms can derive a competitive advantage (*i.e.*, an excess profit or rent) from a first move in a resource market (see subsection 6.4.1), in a product market (subsection 6.4.2), in a complementary resource (subsection 6.4.3), or in a related product market (subsection 6.4.4). This must be an *irreversible* move that changes the structural conditions which rivals face in input markets. This refers to *imperfect (new or used) factor markets*. Two additional characteristics single out strategic resources that can be targeted for a cost-raising strategy. The first one is that they must be *scarce*. By buying these resources the first mover either completely preempts second movers (as in subsections 6.4.2 and 6.4.3), or it raises the price of resources to second movers (see the first move model in 6.4.1). Secondly, the second movers make an *intensive use* of these resources. Appendix 6.A shows that the first mover's ability to raise price is directly proportional to the intensity of the second movers' use of the resource (equation 6.A2). The other varieties feature cases where the scarce resource raises the owner's profits and may be necessary for entry. Furthermore, the distribution of the rent depends on bargaining with the resource suppliers. A firm derives a bargaining advantage from being a *first mover* or from the *higher value* which it generates from the resource than do its rivals (due to market power, team production, or multi-market scale).

The resource-based research in strategic management suggests that management's main task may be to create teams of complementary resources. The importance to the firm of having a team of resources is, first, that teams raise the value generated with a complementary resource, second, the complexity of teams raises the costs of imitation ('uncertain imitability') and enhances sustainability of the rent, and third, the firm has a better bargaining position relative to individual resources if their skill is specific to a team than if each resource has a transferable skill with its own productivity. Strategic management theorists focus on these teams, and implicitly have condition (6.2) in mind. Note that, as the next section will show, condition (6.1) dominates in industrial economics. With some exaggeration, therefore, the argument about condition (6.1) may be called the *economic variety*, and the one about condition (6.2), the *managerial variety*. Building teams of complementary resources may be a successful strategy that breaks through conventional entry barriers. As the previous chapter argued, building on shared resources in the home market (leading to multi-market spillovers) is also a possibly successful entry strategy. Diversification, for example, allows a firm to raise the amount of rents earned with a resource. Section 6.7 takes up the task of relating these insights. First I discuss examples of scarce resources, rents, and cost-raising strategies.

6.6 CASES OF SCARCE RESOURCES AND PRODUCT MARKET COMPETITION

This section discusses several examples. Resources are not limited to factors of production, but they include all contributions that the firms' stakeholders make to a firm's activities (see section 2.2). Stakeholders include consumers, suppliers, the government, unions, *etc.* The scarce resource can be tangible (*e.g.*, a natural resource) or intangible (*e.g.*, a patent or contract). It may be strictly unique (*e.g.*, a patent), or there may be imperfect substitutes or multiple suppliers with decreasing returns to scale. The examples focus on a single product market. Interactions with other product markets are ignored, which implies *de novo* entry threats.

6.6.1 Capacity

Ghemawat (1990) explores a case where the supply of new durable, product-specific, productive assets is limited. Two incumbent firms of unequal size bid for these assets. If the large firm wins (state 1,0), the concentration ratio (CR) will be higher than if the small firm wins (state 0,1):

(6.3a) $CR(1,0) > CR(0,1)$.

At least in the special case of Bertrand competition with binding capacity constraints, industry profits Π increase in the concentration ratio:

(6.3b) $\partial\Pi/\partial CR > 0$.

Together the conditions imply that equation (6.1) holds, and the larger firm wins the bid. This raises the concentration ratio, a result which Ghemawat calls the *snowball effect* (see subsection 8.7.2). He illustrates this with the U.S. market of titanium dioxide, where Du Pont was the dominant supplier. In 1975 Du Pont considered two strategies: maintain its share of U.S. industry capacity at 43% or grow to 55%. It expected the growth strategy to lead to *higher* prices in the long run than the maintain strategy. This illustrates that Du Pont increased its capacity in order to raise its market power over smaller rivals. Another example, where indeed an auction occurred, is given by Lieberman (1987, p. 623). In 1957 the U.S. government auctioned a large low-cost magnesium plant. Prior to the auction, Dow Chemical [the dominant supplier] stockpiled magnesium ingot. By 1957 the stock was up to approximately two years of U.S. domestic consumption. Dow proved the sole bidder of the auction and bought it for less than the original construction cost. Subsequently, it closed the plant for four years in order to run down the stockpile.

6.6.2 Labour

Both collective as well as individual labour contracts can be instruments in cost-raising. Consider both cases in turn. Williamson (1968) studies a case where a wage agreement in the U.S. bituminous coal industry may have had the rationale of raising the costs of entrants and fringe mines (see subsection 8.7.3). The upshot is that

capital-intensive mines could afford to raise the industry-wage rate to the detriment of small, labour-intensive mines.

Good employees are scarce and may be subject to 'poaching' by rival firms. The difficulty for employers is that anti-slavery laws deter the writing of contracts that prevent labour mobility to rivals. Instead, employers use incentives ('golden ties') and ancillary contractual restrictions. Mori (1991) studies incentives when labour is an experience good. He assumes that the incumbent employer knows his employees' quality levels, but an entrant does not. The incumbent's job assignment can be observed, and is a signal of employee quality. Assuming costless labour mobility, an entrant might hire the incumbent's workers and give them the same assignment. To distort the signal, the employer chooses an inefficient matching of worker quality and job assignment. The misassignment reduces the incumbent's productivity, but would reduce the entrant's productivity even more, provided the workers' skill is somewhat firm-specific.[11] The latter effect reduces the wage which the entrant is willing to pay to the incumbent's workers. Since these offers are the workers' reservation wages in bargaining with the incumbent firm, the incumbent earns a rent, called by Mori an *informational surplus*.

A special case in the labour market are R&D engineers. Pakes and Nitzan (1983) explore a situation where an entrepreneur hires a scientist to develop a marketable product. Once the product or its technology is developed, the scientist may leave the firm to exploit the idea himself in a rival enterprise. The semiconductor industry has seen numerous examples where individual scientists or teams defected to form their own enterprise. The entrepreneur faces the problem of developing an incentive scheme for the scientist that prevents this defection. The solution is to make it costly to switch to (or create) a rival firm by forfeiting a bonus. The wage contract implies a low initial wage rate prior to the invention, and a high bonus paid when the time is past that the scientist could defect. Due to condition (6.1), the monopolist can pay a bonus which exceeds the bonus paid by a rival firm, or the profit earned by the scientist in his own firm. The bonus raises the entry costs, therefore, and prevents defection.[12]

6.6.3 Intermediate Inputs

The traditional result of vertical integration in intermediate price theory is that price falls and welfare is enhanced (*e.g.*, Davies, 1987, p. 89-92). This reasoning assumes bilateral monopoly or (tight) oligopoly. Bilateral monopoly occasions the double marginalisation problem, where the upstream firm adds a markup on its marginal

11. The incumbent firm may use the labour contract to raise the firm-specificity of the employee's skills, *e.g.*, by a provision that employees shall not transfer the firm's customers or other relations to a new employer.

12. The discussion about equations (6.1a) and (6.1b) also showed that monopoly is the only situation where the innovator has higher profits than two rivals combined. In non-monopolised markets, the innovating incumbent needs other bases than market power to make the most attractive bid for the scientist. Alternatively, the firm may write contracts to prevent (and use litigation in the case of) the scientist's use of its knowledge (if identifiable) in another firm.

cost, and the successive downstream monopolist treats the resulting price as its marginal cost, and adds its markup on top of it. A vertical merger between the bilateral monopolists gives rise to an integrated firm. It chooses a downstream price on the basis of the correct upstream marginal production cost, which is lower than the one above, where the input price included a markup. Hence it chooses a lower price than the unintegrated downstream firm. This raises both its own profits and consumer welfare: vertical integration is efficient (Scherer, 1980, p. 300-3). Several exceptions and counterarguments to this idea are based on cost-raising competition.

First, consider the situation where the dominant firm's product market rivals acquire their inputs from the firm itself. The dominant firm raises the input price to the rivals, while reducing the product market price through competing with them in the product market (its own marginal costs are given). This entails a price squeeze (Perry, 1989). Second, if an upstream and downstream firm merge, the merged firm may cease to participate in the market for the intermediate (upstream) product. This may raise the intermediate product price and thus raise the costs to unintegrated downstream firms (Salinger, 1988; Ordover, Saloner and Salop, 1990; and Bolton and Whinston, 1991). This may in turn raise the final good price. The merged firm's increased efficiency may outweigh the rival's cost-raising effect, however, such that industry price falls (Greenhut and Ohta, 1979; and Nahata and Olson, 1989).

Next, consider a situation where the dominant firm's product market rivals can turn to unintegrated input suppliers. The dominant firm's decision not to buy from these suppliers reduces the scale at which they operate (an 'under-buying' strategy, Salop and Scheffman, 1987). If these suppliers face (external or internal) economies of scale, the dominant firm's 'under-buying' will raise the input costs. It will, thereby, raise the prices at which the dominant firm's (potential) rivals acquire inputs. Entry costs are raised. For example, by setting up internal procurement (supply) and allocation (demand) of inputs, an established firm (partially or completely) excludes the external input market. If the firm involved is large or innovative, the use of an internal market may actually prevent an external input market from coming into existence. This may (prohibitively) raise entry costs. The existence of (im)perfect input markets can thus be *endogenous* to firm's strategies. An example where a firm did not sufficiently appreciate this point is IBM's choice of an operating system for its PCs (see chapter 1). By acquiring its operating system from the upstart firm Microsoft, IBM inadvertently facilitated entry by new rivals which could likewise buy MS-DOS rather than developing their own costly operating system.

6.6.4 Product Promotion

Product promotion can be an instrument to raise the costs of introducing new products (which is Lydall's, 1955, original example of cost-raising competition). It is convenient to think of the input associated with this as the consumer's effort or costs to experiment with a new product. Consider an experience good whose product quality v (indicating the maximum price consumers would be willing to pay) consumers can only ascertain *ex post*. Say a pioneering brand name has a quality v_p and price p_p (Schmalensee, 1982). Since the product is now well-known, consumers know v_p with certainty. A new brand by an entrant has an expected quality $(1-\tau)v_n$

and a price p_n, where τ reflects the costs of trying a new brand; *e.g.*, with a probability $\tau < 1$ the new product is useless with a quality $v=0$. The consumer surplus is v-p, which consumers try to maximise. Consumers will try the new brand name if it provides a larger consumer surplus than the pioneering product, *i.e.*, if $(1-\tau)v_n-p_n > v_p-p_p$, or

(6.4) $(v-p)_p+\tau v_n < (v-p)_n$.

To prevent consumers from trying the new brand, the pioneer may raise the consumer surplus, $(v-p)_p$, by raising its quality or reducing its price. More interesting, perhaps, are attempts to raise τv_n. The cost τv_n is a special case of a consumer's *switching cost*. Airlines, *e.g.*, have frequent flyer programs, which give rewards or discounts to travellers (frequent flyers) who have flown more than a certain number of miles with the airline. If a customer switches to a rival airline, she discontinues building up mileage with the airline's frequent flyer program. She thus forfeits the program's advantages. In similar vein, supermarkets provide stamps or coupons to customers, which, when accumulated to a certain amount, give right to a discount. These actions, therefore, impose switching costs upon consumers. Consumers, in turn, will switch only if the entrant compensates these costs by offering 'value for money'. This raises entry costs. This may have a counter-intuitive effect on entry. Klemperer (1987) showed that switching costs tie consumers to the incumbent firm as well as the other way round. In order to exploit its customers, which it can because of the switching costs, the incumbent will quote a high price, which induces new consumers to turn to entrants. This facilitates entry if new consumers appear in the market.[13]

Contracts may also lead to consumer switching costs. Aghion and Bolton (1987) explore a delivery contract between an incumbent firm and a consumer that specifies for a future date a price and a fine (liquidated damages) if the consumer breaks the contract. The fine is a kind of switching cost. The consumer switches to an entrant only if the latter compensates her for the fine. This implies that the incumbent's fine raises the entrant's costs. The potential entrant enters only if it is very efficient. In that case, the incumbent firm sells nothing but does earn the fine. Hence the contract does not *per se* deter entry, but it does shift surplus from the entrant to the incumbent, who shares part of it with the consumer. The price, that is, is lower than in the absence of an entry threat. The relevant 'factor' in this example is the possibility to write a contract with a consumer.

If products are incompatible, consumers face switching costs when moving from one to the other. Examples are 'systems', such as computer hardware and software, video players and cassettes, *etc.* The supplier of a new, improved, system, may choose whether to be (in)compatible with older technology. Incompatibility locks out the supplier(s) of the older technology, and thus reduces competition. It also forces costs upon either consumers of the old technology, if they switch, or their suppliers,

13. This partly seems to explain why PC market leaders such as IBM continued for such a long time to quote high prices in the face of massive entry. IBM may have banked on the switching costs of its corporate clients, thereby losing new firms and home users to its new rivals.

if they choose to develop adapters to make their technology compatible with the new technology (*e.g.*, Katz and Shapiro, 1985 and 1986).

6.6.5 Intra-market Mergers and Acquisitions

There is a twist to the argument about condition (6.1b) when merger is possible. Say the entrant happens to own the (n+1)th well. An incumbent firm might now bid for the entrant itself for a merger or takeover. Again, however, the same problem appears. An incumbent firm gains $\pi(n)-\pi(n+1)$, if by winning the bid and merging it reduces the number of independent firms from n+1 to n. Any alternative bid will be less than or equal to $\pi(n+1)$ (the entrant's profit). The profitability of a merger, therefore, depends on exactly the same condition as the cost-raising condition (6.1b)! A firm is itself a scarce resource that other firms can bid for. Potential entrants, *e.g.*, may effectuate entry by buying up a local incumbent firm. The market for corporate control may, therefore, be a battlefield for (potential) product market rivals.

Merger does not pay in a Cournot model if there are more than two firms around (see subsection 6.4.2). The competitors of the merger are its only beneficiaries, as the merged firms contract their output level, which raises the market price, to which rivals respond by increasing their output level. This result reflects a difficult problem in economics. Although mergers are not profitable by this argument, mergers do occur, and rivals routinely protest against them, although they would benefit (Boyer, 1992). Moreover, mergers are indeed, *ex post*, often not as profitable as expected, if at all, and they do reduce market shares (Scherer and Ross, 1990, p. 172-3).

Is there a case for profit-increasing mergers? Ghemawat's snowball effect (subsection 6.6.1) shows that if a merger creates a dominant firm, it may allow the firm to preempt rivals in acquiring additional capacity. By imposing a capacity constraint on its rivals, the (merged) firm prevents that they expand their output in order to free ride on its attempt to raise price. This invalidates the Cournot argument against mergers (when $n > 2$). However, this merger is anticompetitive. Management usually gives a procompetitive efficiency defense of mergers. A merger of firms that supply complementary outputs may facilitate economies of scope (see definition 4.3). A related argument centres on firms which merge in order to pool complementary factors.[14] A merger may also enhance efficiency if it takes the form of a multidivisional enterprise with an internal capital market, as was proposed by Williamson (1975).

The argument that merger reduces the merging firms' aggregate profits cannot be ruled out. It can be turned into the opposite direction to explain why a firm might split itself up in several independent, competing divisions (Vickers, 1985). Divisionalisation pays off exactly in those situations (where $2\pi(n+1) > \pi(n)$) where cost-raising competition against a new entrant would not be feasible. Managerial motives such as a preference for growth go some way to explain non-profit motivated mergers (Mueller, 1977).

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14. This argument also explains (research) joint ventures. See Kay (1991) for why firms might prefer a merger or takeover to a joint venture with an otherwise independent partner.

6.7 COST-RAISING COMPETITION WITH MULTIPLE PRODUCT MARKETS

The cases studied in the previous section assumed *de novo* entry and a single-market incumbent firm. Although the source and size of the rents that firms earn may differ (due to first moves, market power, or team production), all firms did have in common that they apply the resource only to one product market. A multi-market firm, however, uses a shared resource in many markets. This raises the value of the resource, and thus raises the bid the firm is willing to make for it. A positive multi-market spillover facilitates entry if it breaks the conditions (6.1) and (6.2) which underlie the incumbent firm's entry deterrence by a cost-raising strategy.

In exploring this idea, numerous cases present themselves. First, cost-raising competition can be used in the case of reciprocal entry between markets, as well as in the case of one-sided entry. Second, the scarce resource may be a shared resource or a product-specific resource. While shared resources stimulate established-firm entry (they induce a multi-market spillover), the need to buy product-specific complementary factors raises entry costs (an entry barrier) (see definitions 4.2 and 4.4). This suggests two paths towards entry deterrence. An incumbent firm may buy up a scarce shared resource in order to forestall the entry that is bound to occur when a rival buys it and tries to realise the associated multi-market spillover by entry. Alternatively, the incumbent may buy a complementary product-specific resource in order to raise entry costs. Third, the basis of cost-raising competition may be any of the three types identified in section 6.4. The next subsections explore two cases. Both focus on one-sided entry, but differ in the other respects. Subsection 6.7.1 combines bidding for a shared resource with condition (6.2); and subsection 6.7.2 combines a product-specific resource with condition (6.1).

6.7.1 Bidding for a Shared Resource: Team Production versus Multi-market Spillovers

Consider a case where a new shared resource comes available that can be applied in two markets. The introduction of the resource implies a process innovation. The model in appendix 6.B shows that if the innovation is 'drastic' (in a sense to be made clear), a new firm will win the bid rather than an established firm. The resource has the given size K, it is unique and indivisible (*e.g.*, an entrepreneur, entertainer, or scientist, who wants to be employed in one firm only). The size of K may reflect the labour hours offered.[15] The supplier of K (*e.g.*, the scientist himself) sells K to the highest bidder. There are three potential bidders: a single-market incumbent firm, an established multi-market firm, and a new firm. Each firm has a maximum bid V_i. The winner gets the resource and pays a price equal to the next-highest bid; he prevents its rival bidders from reducing their costs. The product market is competitive and all candidate buyers bid simultaneously for the resource. The firms derive value from K by combining it with complementary resources; hence the basis

15. The firm may treat the resource as a variable input k subject to the constraint that $k \leq K$. I assume that any firm that wins the bid for K will use it to the full, *i.e.*, $k = K$.

of cost-raising is condition (6.2).

Firm 1 is an incumbent firm in the product market (market A) and in an identical market B. It can use K in both markets; K is its only shared resource. It buys all other inputs for one activity (market) only. In the absence of K there is no technical reason why firm 1 should be a multi-market firm: it may result from two single-market incumbent firms that merge in order to use K. This is an example where an innovation creates a spillover effect that may induce a cross-market merger. Firm 2 is a new firm. It enters the market only if it wins K, as prior to the introduction of K the market was in equilibrium and entry was not profitable. Firm 2 enters only market A: some lags exist that rule out that it enters two markets at the same time. Firm 3 is an incumbent firm that will use K only in market A. Due to symmetry, it is the representative incumbent firm in that market. Each firm earns a profit on K that equals its maximum bid for K as in the absence of K each firm earns zero profits.

The advantage of firm 1 is that it realises an economy of scope by using K in two markets: it always outbids the single-market incumbent firm 3. The advantage of firm 2 is that it has no previous commitments: it is able to buy inputs that are team producing with K so as to draw maximum benefit from K. Condition (6.2) is essential in this respect. The established firms, firms 1 and 3, do not have this advantage. Being established, at least some of their inputs are inflexible. They may be stuck with some inputs that may substitute for K rather than complement it. Their inertia prevents them from making full advantage of K. Appendix 6.B assumes that they cannot adjust their factors at all. Although this is extreme, it does highlight some of the advantages and disadvantages of incumbent firms: while the incumbent firm is 'large' in that it can be active in multiple markets, the new firm is more flexible in the choice of its inputs. The appendix shows that the multi-market incumbent firm will win the bidding for K if its economy of scope advantage outweighs the inertia disadvantage. Moreover, it shows that inertia is the flip-size of the new firm's ability to create a team of complementary resources.

6.7.2 Bidding for a Specific Resource: Market Power versus Multi-market Spillovers

I now consider a case where a single-market incumbent firm and an established firm potential entrant compete for a scarce resource. The resource is product-specific and is necessary to realise entry. It may, for example, refer to a local distribution network. The incumbent firm bids for it for the sole purpose of deterring entry. Its bid is based on its domestic monopoly power, which it loses if entry occurs. Condition (6.1) is now essential. The entrant bids for the resource since entry will allow it to realise an economy of scope. There is a conflict between entry deterrence based on cost-raising competition (condition 6.1) and entry based on a multi-market spillover (definition 5.4). It can tentatively be explored as follows.

Say, firm 1 is an incumbent firm in market A, which considers entry into firm 2's home market, B. Due to *one-sided entry*, the domestic firm 2 has no access to market A (its output level q_2 thus refers to market B). Profit levels are $\pi^i(q_1^A, q_1^B, q_2)$, where $i = 1,2$. Two pairs of outcomes are to be compared: the case with *de novo* entry where firm 1 consists of independent divisions in both markets (or is a new

firm not active in market A), and established-firm entry, where firm 1 exploits a multi-market spillover. Denote the former case by lower-case symbols (q) and the latter by upper-case symbols (Q). Firm 1 experiences a positive multi-market spillover if $\pi_1(Q_1^A,Q_1^B,Q_2) > \pi_1(Q_1^A,0,Q_2)+\pi_1(0,Q_1^B,Q_2)$, for some relevant output levels by firm 2 (see definition 5.4). Firm 2, in turn, may try to defend its home market by means of cost-raising competition. I will leave implicit which particular cost-raising instrument firm 2 can use; it may, *e.g.*, acquire a distribution network. It can deter *de novo* entry (where $q_1^A = 0$) if condition (6.1) holds: $\pi_2(0,0,q_2^m) > \pi_1(0,q_1^B,q_2)+\pi_2(0,q_1^B,q_2)$ with a monopoly (duopoly) output level, q_2^m (q_2). Note that $\pi_2(0,0,q_2^m)$ equals $\pi_2(q_1^A,0,q_2^m)$, if we assume that firm 1's production in market A has no direct influence on firm 2's profits in B.

Firm 1 earns $\pi_1(Q_1^A,Q_1^B,Q_2)$, if it wins the bid, and $\pi_1(q_1^A,0,q_2^m)$, if it loses the bid, so its valuation is $V_1 = \pi_1(Q_1^A,Q_1^B,Q_2)-\pi_1(q_1^A,0,q_2^m)$. If firm 2 wins, it earns $\pi_2(q_1^A,0,q_2^m)$. If it loses, its profit is $\pi_2(Q_1^A,Q_1^B,Q_2)$. Its valuation is $V_2 = \pi_2(q_1^A,0,q_2^m)-\pi_2(Q_1^A,Q_1^B,Q_2)$. Firm 1 wins the bid if $V_1-V_2 > 0$. This amounts to the condition that entry should raise total profits in both industries:

(6.1c) $\pi_1(Q_1^A,Q_1^B,Q_2)+\pi_2(Q_1^A,Q_1^B,Q_2) > \pi_1(q_1^A,0,q_2^m)+\pi_2(q_1^A,0,q_2^m)$.

This is a two-market restatement of condition (6.1) that the firm that raises industry profits most wins the bid. Rewrite this into:

(6.5) $V_1-V_2 = A+B+C+D$;

where:

A = $\pi_1(Q_1^A,Q_1^B,Q_2)-[\pi_1(Q_1^A,0,Q_2)+\pi_1(0,Q_1^B,Q_2)]$, the multi-market spillover (definition 5.4);

B = $\pi_1(0,q_1^B,q_2)+\pi_2(0,q_1^B,q_2)-\pi_2(q_1^A,0,q_2^m)$, where -B reflects condition 6.1 in market B;

C = $\pi_1(Q_1^A,0,Q_2)+\pi_1(0,Q_1^B,Q_2)]-[\pi_1(q_1^A,0,q_2^m)+\pi_1(0,q_1^B,q_2)]$;

D = $\pi_2(Q_1^A,Q_1^B,Q_2)-\pi_2(0,q_1^B,q_2)$, firm 2's loss if the entrant is a multi- rather than single- market firm.

If firm 1 has a positive multi-market spillover, $A > 0$. If firm 2 has a cost-raising advantage (the efficiency effect), $B < 0$. The signs of C and D are undetermined and depend on the game-theoretic interaction between both firms. It will hold that $D < 0$, if established-firm entry poses a greater threat to firm 2 than one-sided entry.[16]

Established-firm entry is feasible if $A+B+C+D > 0$. In the case of *de novo* entry into market B, the entrant's net profit if it wins the bid is $\pi_1(0,q_1^B,q_2)$ minus the incumbent firm 2's bid, $\pi_2(0,0,q_2^m)-\pi_2(0,q_1^B,q_2)$, *i.e.*, B (remember that $\pi_2(q_1^A,0,q_2^m) = \pi_2(0,0,q_2^m)$). Thus *de novo* entry is feasible if $B > 0$. If both an

16. Due to the spillover and $Q_1^A > 0$, it may hold that $Q_1^B > q_1^B$. If the product market B is characterised by strategic substitutes, *e.g.* with Cournot competition, the increase of firm 1's output in market B will reduce firm 2's outputs and profits, *i.e.*, $Q_2 < q_2$ and $D < 0$.

established-firm entrant and a *de novo* entrant appear, the former would win the bidding between them if $V_1 = \pi_1(Q_1^A, Q_1^B, Q_2) - \pi_1(q_1^A, 0, q_2^m)$ exceeds $\pi_1(0, q_1^B, q_2)$, *i.e.*, if $A+C > 0$. The table shows the following cases.

Table 6.2
Entry into market B with cost-raising competition

De novo entry feasible	Established-entry (from market A) feasible	
	Yes ($A+B+C+D > 0$)	No ($A+B+C+D < 0$)
Yes ($B > 0$)	Established-firm entry ($A+C > 0$); *De novo* entry ($A+C < 0$)	*De novo* entry
No ($B < 0$)	Established-firm entry	Entry deterred

A possible outcome is that an established-firm enters a market inaccessible to a new firm (if $A+B+C+D > 0$ and $B < 0$). It is also possible that a *de novo* entrant enters the market even though an established-firm entrant has a positive multi-market spillover (if $A > 0$ and $B > 0$, and either $A+B+C+D > 0$ and $A+C < 0$ or $A+B+C+D < 0$). A multi-market spillover, on the one hand, raises firm 1's profit and its willingness to make a bid ($A > 0$), but, on the other hand, both raises its output levels (such that $C < 0$ is possible) and hurts firm 2, thus raising its incentives to deter entry (if $D < 0$). To put it differently, 'weak' *(de novo)* entry may arouse less resistance and may, therefore, be accommodated by the domestic firm 2. This is similar to judo economics (Gelman and Salop, 1983).[17] To sum up: the fact of a positive spillover ($A > 0$) does not guarantee success in entry against a single-market incumbent firm. The established-firm's entry may fail either because of the domestic firm's market power (if $A+B+C+D < 0$) or because of a new firm's entry threat (if $A+B+C+D > 0$, $B > 0$, and $A+C < 0$). The next subsections give examples of cost-raising competition with multiple product markets.

6.7.3 Multi-media Industries

Economies of scope based on the joint use of information inspire firms such as Sony to develop into multi-media firms (see chapter 10 for more information). These firms undertake entertainment activities in order to support new media, such as new musical media (Sony's MiniDisc), new electronic media (Sony's Electronic Book), or new computers (*e.g.*, Microsoft's Multimedia PCs with Windows). This implies a quest for individuals with both the skill and the imagination to explore the potential of new technologies. These people are scarce resources. Several types of firms vie for their services: traditional entertainment firms (such as Walt Disney), consumer electronics firms (*e.g.*, Sony), and computer firms (such as Microsoft). Apart from

17. Closely related is Judd's (1985) two-market model, where the incumbent firm accommodates single-market entry (by exit from the entered market), but resists two-market entry (by cutting price across the board).

established firms also new firms manage to attract talent. Each firm offers both material rewards (salaries) as well as immaterial ones (success, challenging ideas, team work). The above analysis assumes that the firm that derives highest value from these stars is able to offer them the best terms. The established entertainment firms derive an advantage from the efficiency effect (condition 6.1). New firms with a small, dedicated, and enthusiastic team benefit from complementarity (condition 6.2; see appendix 6.B). The emerging information conglomerates such as Sony benefit from combining multiple complementary products such as hardware and software (condition 6.1c). For the latter firms, the costs of acquiring complementary factors to, say entertainment stars, constitute entry costs (or mobility barriers) into the emerging multi-media product market. For example, when Sony acquired Columbia Pictures Entertainment, it induced Columbia's two top managers to stay with the firm. It payed them higher salaries than all its incumbent senior managers in Japan put together (Milgrom and Roberts, 1992, p. 280). This sent shock waves through Sony's Japanese organisation.

6.7.4 Cross-market Mergers and Acquisitions

Entry by acquisition is a case where a merger may hurt rivals (Hines, 1957) (see subsection 6.6.5 where rivals benefit from a merger). If an existing firm in a related market acquires an incumbent firm, the merger may pool its factors in order to increase the firm's market share. According to Hines, this will have a procompetitive effect. Rivals might complain in this case. The government may be susceptible to complaints if the acquiror is a foreign firm. Yet consumers might benefit from more competition and lower prices. Entry by established firms may also, however, increase concentration by putting out of business small incumbent firms. Berry (1974-5) confirmed that the procompetitive effect dominates. He finds that the higher the market's initial concentration, the more entry by large firms reduces concentration. The argument in subsection 6.7.2 underlines this effect (see table 6.2). Even if an incumbent firm is able to deter entry by a new firm, it may not be able to deter one-sided entry by a (foreign) established-firm (if $B < 0$ and $A+B+C+D > 0$). By, for example, merging with a domestic firm, the established-firm entrant facilitates its entry into the local market. The argument also showed, however, that if the procompetitive effect is 'too large', the established-firm entry will be deterred. That is, established-firm entry appeared to be feasible only if industry profits (aggregated over the two markets) would increase (condition 6.1c). Thus the procompetitive effect of established-firm entry should not be exaggerated: it can be 'second best' at most, in line with Berry's (1974-5, p. 204) conclusion that:

> 'the market position of leading firms does appear protected in concentrated industries from entry by other than large firms. That is the bad news. The good news is that at least some of the diversifying activity of large firms may have filled the gap.'

6.7.5 International Trade

A one-sided entrant may raise the incumbent's costs in the special case where trade

occurs both in intermediate products (*e.g.*, DRAM chips) and in final products (*e.g.*, computers). Spencer and Jones (1992) explore this case. They assume that a 'foreign' (*e.g.*, Japanese) firm exports both an intermediate product and a final product to the 'home' market (*e.g.*, the U.S.). The 'home' supplier of the final good can produce its intermediate products itself; it can also buy them from the foreign firm. The foreign firm has lower marginal production costs of the intermediate good than the home firm (which appears to be the case with semiconductors). The intermediate product exhibits, therefore, one-sided entry from the foreign country into the home country. Thus the rivals in the final good market partake to some extent in the same factor market, *i.e.*, the foreign firm's internal production of the intermediate product. If the foreign firm raises the export price of the intermediate good, it reduces its sales (exports), but also raises the costs of the home supplier, and thereby raises the market price of the final good.[18] It may then expand its exports of the final good. The home firm's government may mitigate this problem (a price squeeze) by raising an import subsidy on the intermediate good, or an import tariff on the final good.

6.8 COMPETITIVE MOVES IN FACTOR MARKETS APPRAISED

Factor markets offer instruments which incumbent firms may use to deter entry. This chapter may have shown that the resource-based view of the firm in conjunction with cost-raising competition offer an integrated framework to understand numerous types of competition. Firms compete with each other in all markets where they meet, whether in input or product markets. Porter's (1980, p. 6) *extended rivalry* concept comes to mind. *Multi-market competition should include both a horizontal and a vertical dimension*, which is the central message of this part of the book.

The framework integrates current research while suggesting some future research issues. Vertical and horizontal multi-market competition may need further integration. The success of entry, internationalisation, and mergers (a horizontal development) may depend in large measure on the incentives of the employees (the vertical dimension). The failure of many mergers to create value may be attributable to internal incentive problems. Incentive schemes may also create inflexibility in competition (which is the downside of their use as a commitment instrument). Since many incentive schemes are dynamic (promising future promotions for current effort), the need to realise these rewards makes the firm inflexible.

The framework can also be extended from factor markets to include the firm's wider environment. Firms operate in social infrastructures: local education, transport, services, government taxation and legislation, *etc.* These bestow externalities upon the firm: they provide it with inputs or they impose costs upon it. Firms may try to deny each other access to these inputs or they may use their access to impose costs upon each other. In the political arena, for instance, a firm, as we have seen, may lobby with its government in order for it to impose costs upon (foreign) rivals. The institutional context may be a threat to firms as well as an opportunity. Pressure groups (*e.g.*, consumer groups) may significantly affect the terms of product market competition (*e.g.*, product quality, safety standards, and

18. Notice that this widens the policy menu: one may now accuse the Japanese firms of raising prices, as well as of dumping!

environmental concerns), which may affect some firms more than others. An important institutional difference between countries is the ability of incumbent managers to protect themselves against hostile takeovers. Research along these lines could, perhaps, be integrated in a multi-market framework.

Another future research issue is the strategic factor problem: which strategic factors should a firm focus on? Economists usually view the commitment instrument as determined by industry, with industries being different as to whether R&D, product promotion, or capacity is the main instrument (Ghemawat, 1991a, p. 28). The commitment instrument, however, often reflects choices made by firms. Firms choose whether to make irreversible steps. They invest or lease factors; they make or buy; they can hire employees for indefinite periods or on short-term contracts. Entrepreneurial firms may use this freedom to change the dominant competition instrument in the industry. In the end of the 1980s and beginning of the 1990s, competition in the PC industry appeared to shift from innovation to distribution. A resource of increasing importance is information (see chapter 10). The next part of the book delves deeper in some of the issues raised in this part. It may illustrate the richness and usefulness of the multi-market competition framework.

APPENDICES

Appendix 6.A. Cost-raising competition by competitive firms

The 'over-buying' model in Salop and Scheffman (1987) is illustrative for their theory (see subsection 6.4.1). It can be restated as follows, where I assume a competitive product market, whereas Salop and Scheffman, 1987, use a dominant firm product market. A competitive product market brings out more clearly the importance of imperfect competition on the (demand side of the) *factor* market. Moreover, it substantiates the three claims made in the associated subsection 6.4.1.

There are two firms, 1 and 2, both incumbent firms, where firm 1 is the first mover and firm 2 represents m (> 1) homogeneous perfectly competitive firms in the product market. All firms use an input *a* and inputs z_i (i = 1..n). The input market of *a* is perfectly competitive on the supply side. The price of input *a*, α, determines the competitive supply $A(\alpha)$. Due to decreasing returns in the supply of *a* it holds that $A_\alpha \equiv \partial A/\partial\alpha > 0$ (a subscript to a function value will denote a first-order derivative). Moreover, assume that $A_{\alpha\alpha} \equiv \partial^2 A/\partial\alpha^2 < 0$ (where two subscripts imply a second-order derivative). All firms are price takers in the markets of the z inputs. The game involves two stages. Firm 1 is the first mover in the market of input *a*. It buys K units of *a*. Next firm 2 buys A^2 units of input *a* as well as inputs z_i^2 (i = 1..n). Market clearing in the input market implies that $A(\alpha) = K+A^2$.[19] When taking its investment decision firm 1 anticipates on this market clearing condition: it is price setter in the input market, while firm 2 is price taker in the input market. Firm 2 produces y quantities of output, where $y = f^2(z^2,A^2)$. It minimizes costs and earns zero profits. The product price *p* equals its minimum average cost.

In the second stage of the game, given the input prices r_i and α, firm 2 solves the problem:

(6.A1) $p = \min_{z2,A2}(\sum_i r_i z^2_i+\alpha A^2)/y$, where $y = f^2(z^2,A^2)$.

This gives solutions $z^2_i(\alpha)$ (i = 1..n), $A^2(\alpha)$, $y(\alpha)$, and $p(\alpha)$. The envelope theorem gives

(6.A2) $p_\alpha \equiv \partial p/\partial\alpha = A^2/y > 0$.

This substantiates cost-raising competition: a higher input price α raises the product price. Some additional assumptions must be made. First, $A^2_\alpha < 0$ (because of substitution) and $A^2_{\alpha\alpha} > 0$ (substitution becomes more difficult at higher levels of α, when the use of *a* has already been diminished strongly).[20]

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19. This equation ignores for convenience the existence of multiple fringe firms. With *m* symmetrical fringe firms, where *m* can be very large, it would be more appropriate to write $A(\alpha) = K+mA^2$.

20. It can be shown that $p_{\alpha\alpha} < 0$ if $A^2_\alpha < 0 < \partial z_i/\partial\alpha$ (*i.e.*, if the *a* and *z* inputs are gross substitutes). That is, the ability to raise p through raising costs α decreases when α is already high. As equation (6.A2) shows, the ideal cost-raising instrument

The purchases of input *a* by firms 1 and 2 determine the input price α. From the input market clearing condition $A(\alpha)-A^2(\alpha)-K = 0$ follows

(6.A3) $\alpha_K \equiv \partial\alpha/\partial K = 1/(A_\alpha - A^2{}_\alpha)$,

Since $A_\alpha > 0$ and $A^2{}_\alpha < 0$, it holds that $\alpha_K > 0$. If $A_{\alpha\alpha}-A^2{}_{\alpha\alpha} < 0$ (*e.g.*, $A_{\alpha\alpha} \leq 0$ and $A^2{}_{\alpha\alpha} > 0$), it can also be shown to hold that $\alpha_{KK} \equiv \partial^2\alpha/\partial K^2 > 0$.

Anticipating these outcomes in the first stage, firm 1 solves the following problem: $\max_{x,z,K} \Pi^1 = px-\sum_i r_i z^1_i-\alpha K$, where there are i (=1..n) inputs z_i, and $x = f^1(z^1,K)$, that is,

(6.A4) $\max_{z,K} \Pi^1 = p(\alpha)f^1(z^1,K)-\sum_i r_i z^1_i-\alpha K$.

The first-order conditions are

(6.A5) $\partial\Pi^1/\partial z^1_i = pf^1_{zi}-r_i = 0$ (i = 1..n), and

(6.A6) $\partial\Pi^1/\partial K = (p_\alpha f^1-K)\alpha_K+pf^1{}_K-\alpha = 0$.

Does firm 1 'over-buy' K, that is, does it over-invest? Two benchmarks may be used relative to which firm 1 over- or under-invests.[21] First, consider the case where firm 1 ignores its influence on the product price.

Proposition 6.A1. Firm 1 over-invests relative to a cost-minimizing firm that is a price setter in the factor market.

Proof. If firm 1 ignores its influence on the product price, it takes $p_\alpha = 0$, and equation (6.A6) changes into

(6.A7) $pf^1{}_K-\alpha - K\alpha_K = 0$.

This benchmark implies that firm 1 minimizes cost by equating marginal revenue of a unit of *a*, $pf^1{}_K$, to the marginal cost, $\partial(\alpha K)/\partial K$ $(= \alpha+K\alpha_K)$. Since $p_\alpha > 0$ by equation (6.A2), equation (6.A6) implies that $pf^1{}_K-\alpha - K\alpha_K < 0$. Note that $f^1{}_K$ decreases in K (due to diminishing returns in the production function), and α and $K\alpha_K$ increase in K (since $\alpha_K > 0$ and $\alpha_{KK} > 0$). Hence the function $pf^1{}_K-\alpha - K\alpha_K$ decreases in K. Since $pf^1{}_K-\alpha - K\alpha_K = 0$ in the non-strategic case and $pf^1{}_K-\alpha - K\alpha_K < 0$ in the strategic case, it follows that firm 1 strategically over-invests in K in order to raise firm 2's costs and thus raise the product price p. *QED*

Second, consider the benchmark where firm 1 ignores both its influence on the product price as well as its influence on the input price.

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is one which is used intensively by the rivals. Raising α will reduce the *a*-intensity of production.

21. In both cases the benchmark is the investment level that minimises total costs given the output level that the strategic interaction leads to (Bulow *et al.*, 1985a).

Proposition 6.A2. Firm 1 over-invests, relative to a firm that ignores both its influence on the product price as well as its influence on the input price, if and only if it uses the input *a* less intensively than firm 2 does.

Proof. The cost-minimizing price-taking firm chooses K such that $pf^1{}_K-\alpha = 0$. Compared with this benchmark, a cost-raising firm 1 may over-invest to raise p, but it may also under-invest to prevent its investment from raising the input price α. The sign of $pf^1{}_K-\alpha$ in (6.A6) depends on the sign of $p_\alpha f^1-K$ since $\alpha_K > 0$. Remember that $p_\alpha = A^2/y$ (equation 6.A2), $K = A^1$, and $f^1 = x$. Then, $p_\alpha f^1-K = (A^2/y-A^1/x)x$. If firm 1 uses the input *a* less intensively than firm 2 does, *i.e.*, $A^1/x < A^2/y$, then $p_\alpha f^1-K > 0$, and by equation (6.A6), $pf^1{}_K-\alpha < 0$. Taking into account that $f^1{}_K$ and $-\alpha$ decrease in K, firm 1 over-invests relative to the price-taking, cost-minimizing benchmark, where $pf^1{}_K-\alpha = 0$. If firm 1 is relatively *a*-extensive, it will raise the price of *a* to raise the costs of rivals that are *a*-intensive. This result is similar to Williamson (1968), where a capital-intensive mine dominates the labour market in the coal industry. It raises industry wages in order to raise the costs of labour-intensive mines, which in turn raises coal prices.[22] *QED*

Appendix 6.B. Competition for a scarce resource in two competitive product markets

This appendix accompanies subsection 6.7.1. It studies the rents which different firms may derive from the appearance of a new factor of production. The new factor is a shared resource, and firms earn rents from the team effect (see subsection 6.4.3). Consider a market with pure competition. The market price is p, there are m suppliers with an identical production function $f(z_1..z_n)$, with n inputs z_j that are traded in perfect factor markets at given factor prices r_j ($j = 1..n$). Decreasing returns in the production function warrant finite (small) production levels. Moreover, we take the special case where the incumbents' profits are zero. A new resource appears in the market. It entails an innovation that induces a new production function $F(K,z_1..z_n)$. Assume that $F(0,z_1..z_n) \equiv f(z_1..z_n)$. The function F has constant returns when K is treated as a variable and thus has decreasing returns in the z_i while taking K as fixed (Varian, 1984, p. 20). Thus both $F(0,z_1..z_n)$ ($= f(z_1..z_n)$) and $F(K,z_1..z_n)$ have decreasing returns in the z_j.

The ensuing model assumes that the introduction of K will not affect the market price: the winner of the bid for K remains sufficiently small not to affect p.[23] The advantage of firm 1 relative to firm 3 is that firm 1 will earn a rent twice as large: $\pi_1 = 2\pi_3$, due to symmetry of product markets A and B. The advantage of firm 2 is that it buys inputs z_i in quantities that are optimal in terms of the production function $F(K,z_1..z_n)$. To highlight this advantage, assume that the incumbent firms 1 and 3 are unable (at least in the short run) to adjust their input levels. Hence their

22. In Williamson's model, the difference in capital-intensities is exogenous. Subsection 8.7.3 discusses a variety of his argument with imperfect competition in the product market and an endogenous capital-intensity for identical technology.
23. None of the firms, therefore, tries to win the bidding for the *purpose* of raising rivals' costs (although they have this effect). See appendix 6.A for the cost-raising motive in perfect competition.

AFTERWORD

What I hope this book has achieved is an integration of different perspectives, theories, and models within industrial economics and strategic management. Its content derives largely from industrial economics, while its research aim is predominately inspired by strategic management, in particular Porter's (1980) extended rivalry framework. It draws insights from contestability, transaction cost theory, committed competition, competition by raising rivals' costs, and the resource-based view of the firm, to mention its most important sources. Integration also means that theories have been discussed not so much from the perspective of their developers as from the central perspective in this book. This may give the book its critical overtones here and there. The integrated framework consists of two dimensions (the horizontal and vertical one). These are related in terms of the institutional setting (chapter 2), through the common importance of shared resources (section 4.3), by exploring interaction effects (section 6.7), and in a basic model (section 8.3).

There are obvious limits to what a conceptual framework can contribute. It focuses on links between theories rather than on further development of any particular hypothesis. It is not testable in a clearly defined, empirical or logical way. Its aim is to be useful in guiding research on multi-market firms. As is often the case, the proof of the pudding is in the eating. Current research is usually characterised by streams focusing on specific topics, in particular, vertical integration, multinationals, and diversified firms. Research also tends to occur in rivalrous approaches (or paradigms), such as contestability, game theory, and transaction cost economics. This book contains a plea to explore a specific topic by drawing inspiration, ideas, and hypotheses from any of these topical streams and paradigms. Synergies, that is, may exist in theory as well as in fact. The framework's contribution may be to support synergies by facilitating communication among different theories and theorists. I will next mention some sources of the framework; a short summary reiterates some results, and a section on future research closes off the book.

Sources

The contribution made by the source theories can be summarised as follows. Transaction cost economics contributed especially to the analysis of shared resources (*e.g.*, internalisation theory). It showed that shared resources give an efficiency rationale to the multi-market enterprise only if transaction costs exist in the market(s) of these resources. Its emphasis on bounded rationality shines through in the chapter on market definition, which argued that bounded rationality has an effect on firms' decision making. Contestability contributed to the analysis of shared resources (economies of scope) and established-firm entry (to explain hit-and-run entry). Industrial economics contributed to multi-market modelling (international trade models), committed competition (game theory), and cost-raising competition. Theories on vertical integration contributed to the latter topic as well. Theories of diversification and multinational firms brought the importance of shared resources to the fore, as well as established-firm entry. Theories on multinational firms also emphasised market definition (global versus multidomestic firms). Strategic management contributed indirectly, to

(6.B6) $\pi_2 = pF(K,z_1..z_n)-\Sigma_j r_j z_j$.

The first-order conditions are

(6.B7) $pF_{zj}(K,z_1..z_n) = r_j$ (j = 1..n).

Insert equations (6.B7) in (6.B6) to get:

(6.B8) $\pi_2 = p[F(K,z_1..z_n)-\Sigma_j\{F_{zj}(K,z_1..z_n)\}z_j]$.

Since F(.) has constant returns in all factors, the Euler theorem applies, which gives $F(K,z_1..z_n) = F_K(K,z_1..z_n)K+\Sigma_j F_{zj}(K,z_1..z_n)z_j$. Substitute this in (6.B8) to get

(6.B9) $\pi_2 = pF_K(K,z_1..z_n)K$.

We can now make comparisons between the firms. First, consider firms 2 and 3. Firm 2 wins the bidding for the scarce resource K if the following expression is positive:

(6.B10) $\pi_2-\pi_3 = p[F_K(K,z_1..z_n)K-\{F(K,z_1^*..z_n^*)-F(0,z_1^*..z_n^*)\}]$.

Proposition 6.B1: Firm 2 wins, *i.e.*, $\pi_2-\pi_3 > 0$, if firm 3's input vector $(z_1^*..z_n^*)$ contains 'large' quantities of inputs, relative to firm 2's unconstrained choice of $(z_1..z_n)$, that are substitutes to K, and 'small' quantities of inputs that are complementary to K.

Proof. Again use the Euler theorem on F() to replace the $F(k,z_1^*..z_n^*)$ (with k = 0, K) in equation (6.B10) by $F_K(k,z_1^*..z_n^*)k+\Sigma_j F_{zj}(k,z_1^*..z_n^*)z_j^*$. Rearrange the result to get

(6.B11) $\pi_2-\pi_3 = p[AK-B]$,

where $A = F_K(K,z_1..z_n)-F_K(K,z_1^*..z_n^*)$ and $B = \Sigma_j\{F_{zj}(K,z_1^*..z_n^*)-F_{zj}(0,z_1^*..z_n^*\}z_j^*$. First, explain A by using the mean value theorem for vectors (Salas and Hille, 1990, p. 875).[25] The mean value theorem implies that there is an input vector $c \in \mathbb{R}^{n+1}$ in between $(K,z_1^*..z_n^*)$ and $(K,z_1..z_n)$ such that (i) $c = (1-\lambda)(K,z_1^*..z_n^*)+\lambda(K,z_1..z_n)$ with $\lambda \in (0,1)$, and (ii) the number $F_K(K,z_1..z_n)-F_K(K,z_1^*..z_n^*)$ equals the dot product $(F_{KK}(c),F_{Kz1}(c),..,F_{Kzn}(c))\cdot(K-K,z_1-z_1^*,..,z_n-z_n^*)'$. That is,

(6.B12) $A \equiv F_K(K,z_1..z_n)-F_K(K,z_1^*..z_n^*) = \Sigma_j F_{Kzj}(c)(z_j-z_j^*)$.

Thus part A of $\pi_2-\pi_3$ is positive if firm 2 raises demand relative to firm 3 (*i.e.*, $z_j-z_j^* > 0$) for those inputs where $F_{Kzj}(c) > 0$, that is, that are team producing with K. The same holds if firm 2 reduces demand (*i.e.*, $z_j-z_j^* < 0$) for inputs where $F_{Kzj}(c)$

25. The theorem says that there always is a vector c in between any vectors a and b such that $f(b)-f(a) = \nabla f(c)(b-a)$, where $\nabla f(c)$ is the gradient of f in the point c.

< 0. The expression A indicates the inertia disadvantage of firm 3 or firm 2's flexibility advantage.

Use integration to explore B: $F_{z_j}(K,z_1^*..z_n^*)-F_{z_j}(0,z_1^*..z_n^*) = \int_0^K F_{z_jK}(k,z_1^*..z_n^*)dk$. Hence

$$(6.B13) \quad B \equiv \Sigma_j\{F_{z_j}(K,z_1^*..z_n^*)-F_{z_j}(0,z_1^*..z_n^*\}z_j^* = \Sigma_j\{\int_0^K F_{z_jK}(k,z_1^*..z_n^*)dk\}z_j^*.$$

Expression B indicates to what extent firm 3 is able to generate value from K using its existing lineup of inputs z^*. $\Sigma_j\{\int_0^K F_{z_jK}(k,z_1^*..z_n^*)dk\}z_j^*$ contains negative contributions by z_j^* that are substitutes of K such that $F_{z_jK} < 0$. There are positive contributions from those inputs with $F_{z_jK} > 0$, *i.e.*, that are complements to K. If K implies a drastic innovation it may require a complete realignment of the input vector: raising the use of some inputs and reducing the use of others. Firm 3, however, is unable to make this adjustment. In such cases it is likely that B is small or negative. *QED*

Both A and B in equation (6.B11) therefore tell the same story. They illustrate the disadvantage of commitment: it may saddle the firm with fixed factors (if only in a short run) that are inappropriate *ex post* when team production with K is called for.

Turning to firm 1, I have

Proposition 6.B2. The multi-market firm wins the bidding from firm 2 if its economy of scope advantage outweighs the inertia disadvantage.

Proof. Compare firm 1's highest bid to firm 2's bid: $\pi_1-\pi_2 = 2\pi_3-\pi_2 = \pi_3-(\pi_2-\pi_3)$. It follows from equation 6.B9 and 6.B11 that $\pi_3 = p[F_K(K,z_1^*..z_n^*)K+B]$. Substitute equation (6.B11) to get

$$(6.B14) \quad \pi_1-\pi_2 = p[F_K(K,z_1^*..z_n^*)K+2B-AK].$$

Firm 1 benefits from a multi-market spillover (economy of scope) in that it uses K in two markets, thus earning $2\pi_3$. It suffers from the same inertia problem as firm 3 does. That is, its rent depends on $B = \Sigma_j\{\int_0^K F_{z_jK}(k,z_1^*..z_n^*)dk\}z_j^*$, which may be negative. If $B < 0$, it is possible that $\pi_3 < 0$. In this case, neither firm 1 nor firm 3 are motivated to engage in a bid for K. Even if $B > 0$, firm 1 still suffers from firm 2's flexibility advantage A. If $2\pi_3 > \pi_2 > \pi_3 > 0$, firm 1 wins the bid in a case where a single-market incumbent firm loses against the new firm.[26] *QED*

26. An interesting problem is to simulate a series of identical innovations K that hits the market. Does the market price p decrease, and will this affect the identity of the winner (firm 1 or 2)? Moreover, does the winner of a bid have the highest chance of winning the next bid, that is, does Ghemawat's (1990) snowball effect hold?

PART IV
SOME EXPLORATIONS IN THE FRAMEWORK

Part IV explores two competition instruments: price (chapter 7) and capacity investments (chapter 8). It provides examples of the horizontal and vertical dimension of multi-market competition, while further exploring Andrews' and Bain's theories in a formal multi-market context. Both chapters concentrate on production capacity as a shared resource. They differ in that capacity is exogenous in chapter 7 and endogenous in chapter 8. Chapter 7 models a situation described by Baumol, Panzar and Willig (1982), where firms enter a newly profitable market using capacity which they did not install for this purpose. This situation refers to segmented markets. If entry imposes a capacity constraint on the home market, the markets are more tightly linked than in the original segmented markets model in Brander (1981) (see section 5.3.6). Chapter 8 explores numerous situations where a firm invests in production capacity with a view to improving its situation in product markets. This points to joined markets.

PART IV

SOME EXPLORATIONS IN THE FRAMEWORK

7 RECIPROCAL ENTRY THREATS IN CONTESTABLE MARKETS

Chapter 7 focuses on the horizontal dimension of multi-market competition. It explores reciprocal entry between two contestable (product or country) markets. Each market's incumbent firm acts as potential entrant into the other market. Since the firms use existing capacity, no sunk costs are (assumed to be) required for entry, which seems the most likely context for a hit-and-run entry threat. The chapter explores the claim by Andrews (see chapter 3) and contestability theory (see chapter 4) that an (established-firm) entry threat inspires incumbent firms to deter entry by means of low (zero-profit) prices. The model formalises and refutes this claim. It also has the heuristic function of illustrating how entry decisions become interdependent: each firm's entry decision depends upon an opportunity cost of entry which is endogenous to the other firm's (simultaneous) entry decision.

7.1 INTRODUCTION[1]

Potential competition is an elusive concept in contestable market theory. It drives decision making by incumbent firms. Yet if a 'feasible' and 'sustainable' market outcome exists, incumbent firms will successfully deter entry, and the entry threat will not materialise. This may explain the almost complete absence of potential entrants in Baumol, Panzar and Willig (1982). Shepherd (1984) and Cairns and Mahabir (1988) question the existence of the hit-and-run entry threat: Do potential entrants exist who are alert to enter almost instantaneously, and if so, do they have sufficient capacity to replace the incumbent firm completely? Moreover, if such firms exist, are they motivated to hit-and-run? By raising such questions these authors shift emphasis from the incumbent firm to the potential entrant. They argue that existing firms in related markets approach the hit-and-run ideal more closely than either new firm entrants or unrelated existing firms such as conglomerates. Since a related firm has already invested in capacity, it needs less time and (sunk) entry costs than a completely new firm or unrelated conglomerate. The salience of the entry threat may depend upon the source of entry (Hines, 1957, pp. 132-133; Brunner, 1961, p. 250; and Scherer, 1980, pp. 248-250). These ideas gain cogency in the context of the multi-market framework.

This chapter continues the work by Cairns and Mahabir (1988) and Calem (1988) in developing a multi-market restatement of contestability theory. It introduces a conceptual and formal middle ground that recognises the comments by Shepherd (1984) and Cairns and Mahabir (1988), while staying close to the contestable market theory. The model establishes the Bertrand analogue to Calem's (1988) two-market Cournot model for the symmetric duopoly case. It

1. This chapter is largely based on Van Wegberg and Van Witteloostuijn (1993).

will appear that the capacity constraints are crucial for determining the outcomes of the game. Particularly, perfect contestability results occur only if *both* firms face sufficient excess capacity: both firms should be able to serve *total* demand in both markets simultaneously. Moreover, *neither* firm chooses an entry deterring strategy if entry cost is sufficiently small and capacity restrictions are binding (over both markets). A model offers a rationale for an *un*sustainable pricing strategy. On the one hand, entry diminishes home market profits of the incumbent firm. On the other hand, entry imposes excess capacity upon the incumbent firm and diminishes the entrant's capacity to meet demand in her home market. The latter two effects may create a profitable reciprocal entry opportunity into the entrant's home market. The net effect may be that allowing entry raises profits.

The chapter is organised as follows. The following section reviews the discussion of potential entrants and contestability. The next section gives an illustration: the airline industry. The subsequent section introduces a model that captures essential elements of the current debate on contestability. It is followed by an appraisal. The final section concludes the argument.

7.2 CREDIBLE ENTRY THREATS

Chapter 3 gave an extensive review of the ease-of-entry approach (Andrews and others). This approach argues that established-firm entry is sufficiently fast and large-scale to capture the incumbent's market if the latter gives occasion by setting a high price. To deter entry, the incumbent firm quotes a 'normal costing price' that provides for normal profits (in an accounting sense) or zero profits (in an economic sense). Formally, this proposition has been explored by and come to be identified with the theory of perfectly contestable markets. Contestable market theory is based upon a condition of free entry and costless exit (Baumol *et al.*, 1982, p. 349). That is, there are no entry setup costs. Moreover, entry lags are short. Any positive profit of incumbent firms attracts full-scale hit-and-run entry before the incumbent can reply. As a consequence, price-cutting entrants snatch away even temporary profit opportunities. Shepherd (1984) and Cairns and Mahabir (1988) inquire into the source of a credible hit-and-run entry threat. If potential entrants are new firms, they need time and sunk entry costs to build up capacity. Presumably then, potential hit-and-run entrants are existing firms transferring goods to, rather than investing in, the entry market (Shepherd, 1984, p. 584). For example, import competition constitutes a major threat against market shares of dominant firms (Scherer, 1980, pp. 241 and 249-250).

Cairns and Mahabir (1988) question the entry motive of an existing firm (denoted by 'she' for convenience). Suppose she really devotes resources to hit-and-run entry. By shipping goods to an entry market, she withdraws these goods from her home market if she faces binding capacity constraints. This induces excess demand in her home market, which in turn invites further entry by entrants from other markets, provided any entry barriers are surmountable. These entrants capture consumers deserted by the initial entrant. When she returns from her hit-and-run activity, she may discover that she no longer has a home market (Cairns and Mahabir, 1988, p. 271). Thus entry has an opportunity cost, consisting of home market profits foregone, the size of which depends on the

entrant's capacity constraint. An anticipative firm with a binding capacity constraint will not give in to temporary entry opportunities.

This argument points to excess capacity as a source of credible entry threats. If firms have excess capacity, they can hit-and-run while continuing to serve their home market. Costly excess capacities are not sustainable in a contestable market, however (Cairns and Mahabir, 1988, p. 271). If excess capacity involves a cost, a lower-cost firm with capacity just right will prey upon a high-cost firm with excess capacity. In similar vein as Penrose (1959), Cairns and Mahabir (1988, p. 273) point to sustainable sources of overcapacity. For example, excess capacity may be due to indivisible equipment, in which case it does not impose avoidable costs on the firm. This suggests that the presence in nearby markets of incumbent firms with sustainable excess capacity is a necessary condition for hit-and-run entry. I will substantiate this in a multi-market framework.

7.3 AN EXAMPLE: THE AIRLINE INDUSTRY

In Baumol *et al.* (1982) the airline industry is the darling example of a contestable market:

> because airline equipment (virtually "capital on wings") is so very freely mobile, entry into the market can be fully reversible. In principle, faced with a profitable opportunity in such a market, an entrant need merely fly his airplane into the airport, undercut the incumbent's price, and fly the route profitably. Then, should the incumbent respond with a sufficient price reduction, the entrepreneur need only fly his airplane away to take advantage of some other lucrative option -even if he only returns his rented aircraft or resells it in the well-functioning secondary aircraft market. Thus, it is highly plausible that air travel provides real examples of contestable markets.' (Baumol *et al.*, 1982, p. 7).

The authors add that empirical work lends support to this view. The basic argument is that

> 'In an industry whose firms use only capital on wheels (or wings), some or all of that capital may be fixed, but it is not sunk.' (*op. cit.*, p. 292)

Airplanes and locomotives are mobile between routes, which implies that hit-and-run entry is possible from one market (that is, route) to another. Because of this, these assets represent fixed but not sunk costs.

The argument pertains to the deregulated U.S. airline industry. The airlines responded to deregulation by developing hub-and-spoke networks. They replaced direct long-haul routes by routes to the airline's hub and from there to the final destination (perhaps through other hubs). Economies to scale can be realised by transporting passengers with different ultimate destinations in the same plane (Berry, 1992). These networks also, however, led to airport dominance: each airline tries to dominate the airport that is its hub. Market power was further developed by frequent-flyer programs (FFP). Travellers are promised a discount

or gift if they have flown a number of miles with the airline. This is especially attractive for business travellers with a large mileage. In order not to forfeit their FFP gift, frequent flyers are tempted to make their journeys with the same airline. Travellers who are interested in an FFP, may prefer the airline whose hub is at the nearest airport: it has most routes to offer for the traveller (Borenstein, 1991).

Most empirical research follows contestability in defining each city-pair route as a relevant market. Berry (1992; p. 906) has a sample of entry events into 1219 U.S. city-pair routes. He records 4 cases of entry into a city-pair route by an airline that did not yet serve any of the two cities; 45 cases of entry by an airline that already flew on one city, and 232 cases where the entrant already flew on both cities (but did not yet serve the route between them). This supports the realism of the point of view in Baumol *et al.* (1982) that the hit-and-run entrants are established airlines in related (tangent) markets (city-pair routes). Consistent with contestability, after deregulation, the announcement of a merger that will raise concentration does not raise the returns to shareholders of bidding and targeted airlines (Slovin, Sushka and Hudson, 1991). Before deregulation, a merger would create excess returns to shareholders, which is consistent with the view that concentration did raise prices. The results of some other tests are inconsistent with contestability, however. Airport dominance (measured as overall market share of flights from the hub) raises the airline's market share on any route originating at its hub. Price differences with other airlines weaken but do not destroy this effect (Borenstein, 1991). Hurdle, Johnson, Joskow, Werden and Williams (1989) show that measures of concentration and the number of potential entrants have a significant influence on fares, which is inconsistent with perfect contestability.[2]

More recent events further lend support to the argument that the airline industry is not contestable. Many airlines and the industry as a whole suffer losses. Industry spokesmen even claim that the airline industry made a cumulative loss over its entire history since the Wright brothers. Losses are inconsistent with perfect contestability, where a firm exits the market as soon as price no longer covers average costs. If deregulated airlines do not exhibit contestability, what is wrong about the argument in Baumol *et al.* (1982)? Most explanations are that airlines grafted forms of market power (by hub-and-spoke networks, computer reservation systems and FFPs) on a market structure which is otherwise contestable. This argument is useful, but computer reservation systems and the like are not the most immediate explanations of huge worldwide losses. Instead, overcapacity is mentioned in the press. Following through this argument, I would rather like to challenge the basic assumption that aircraft represent costs that are fixed but not sunk. The "capital on wings" argument mistakes mobility for fungibility. Airplanes are mobile between routes, but they have no alternative use outside the airline industry (they are not fungible). Consider what happens if *global* demand for airline transportation falls. Firms will be unable to move airplanes outside the industry and overcapacity will occur. Prices fall; they may

2. See Shepherd (1984) and Gilbert (1989, p. 121-123) for surveys which indicate that empirical research is largely unfavourable to contestability.

still cover variable costs but not fixed costs. Firms may earn positive gross profits but negative net profits (net of fixed costs). The fixed costs, that is, are sunk. Note that neither a secondary aircraft market nor a rental market are of help here. If demand declines globally, demand for secondary aircraft is likely to fall as well. Moreover, who will run a rental market if airlines collectively return their rented aircraft?![3] The next section introduces a model with 'capital on wings' that will appear to be sunk (and thus immobile) nevertheless. It explores a duopoly's use of capital that is mobile between two product markets (where some transport costs are allowed), but that has no alternative use outside the two markets.

7.4 HIT-AND-RUN ENTRY BETWEEN TWO MARKETS

The contestability model assumes that firms control prices only. This is a critical and controversial assumption.[4] The problem is that a profit maximising rationing rule instead chooses *quantities* (scales of entry) such that marginal revenue minus marginal cost is equated across markets (Clemens, 1951). Models where firms control quantities do exist (see subsection 5.4.1 and the next chapter). In these two-stage games firms first choose total capacity and subsequently choose output levels for each market. Prices are determined in the product market, rather than being quoted by the firms. A fully specified model would have firms choose output (or capacity) levels as well as prices.[5] This chapter goes halfway by analysing a model where (i) firms select quantities *and* prices in home and entry markets for (ii) different levels of productive *capacity*. The model focuses on two dimensions: excess capacity and ease of entry (indicated by entry costs) of the existing firm entrant. The amount of excess capacity required is a telling indicator of the realism of the (multi-market interpretation of the) contestable market theory.

Symmetric duopoly. A and B are two identical (country) markets of the same tradeable consumer good. There are two firms. Firm 1 is the incumbent firm in market A and likewise firm 2 in market B. Both have constant and identical unit

3. Baumol *et al.* (1982, p. 281) note that a rental market does not eliminate the commitment [or sunk cost] of the aircraft's user, but rather shifts the commitment to the supplier in the rental market.

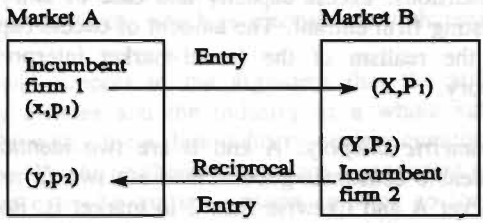
4. But this is also a time-honoured assumption. Consider Andrews (1949, p. 174): 'At that normal costing price, the business man will be prepared to supply whatever his market will take, ignoring any extra-ordinary rise in his costs, so far as his equipment and labour-force will let him.' Perry (1984) shows that if a monopolist controls price and quantity simultaneously, in a setting otherwise identical to a perfectly contestable market, he may choose a price-quantity schedule such that he deters entry while earning positive profits.

5. Venables (1990a) explores several multi-market models. One comes close to the one in this chapter by using Bertrand competition. However, it explores differentiated products, since this allows demand to be continuous in the firm's own price. The case of homogenous products seems, as yet, not to have been explored.

production costs C (≥ 0) and unit transport or entry costs E (≥ 0). The markets will be *perfectly contestable* if entry cost is zero and price equals average production cost (E = 0 and p = C), and *imperfectly contestable*, if the entry cost is positive (but can be arbitrarily small) and price is set to deter entry (E > 0 and p = C+E).[6] In each market the demand function D(p) is downward sloping in the price, p, and bounded between 0, for $p \geq R$, and $D(0) < \infty$, for p = 0. The profit functions (p-C)D(p) and (p-C-E)D(p) are single-peaked: that is, there is a unique p^m which maximises net revenue, and for $p < p^m$ net revenue increases in p. This entails that (p-C)D'(p)+D(p) is downward sloping: that is, (p-C)D"(p)+2D'(p) < 0 (similar for unit costs C+E). Primes (' and '') refer to (first-order and second-order) derivatives. Linear (D" = 0) and concave demand (D" < 0) are sufficient conditions. To give each firm an incentive to consider prices in excess of C+E, I assume that C+E falls short of the monopoly price, p^m, which maximises the profit (p-C)D(p): $E \leq p^m - C$. Capacities of both firms are equal to K. For the sake of convenience, I assume that $K > D^i(C+E)$ (i = A,B): that is, capacity restrictions are *non-binding* if only *one* market is served against the entrant's unit cost. To keep notation tractable, I use lower and upper case letters to refer to markets A and B, respectively. Call x and X firm 1's supply in markets A and B, and, likewise, y and Y for firm 2. Prices are p_i in market A and P_i in market B (i = 1,2). Figure 7.1 summarises the crucial symbols.

Figure 7.1

Two-market Model



Simultaneous markets. The game evolves in three subgames. The firms decide on home market prices, p_1 and P_2 (subgame 1), entry market prices P_1 and p_2 (subgame 2), and quantities x, X, y, and Y (subgame 3). In subgame 3 the firms allocate their capacity to the two markets and consumers decide which firm to buy from.[7] Payoffs (profits) accrue as a result. The *simultaneous markets* assumption implies that in each subgame the firms decide simultaneously (Bulow, Geanakoplos and Klemperer, 1985a, pp. 489-490). The markets are *segmented*: that is, prices may differ

6. The price p = C may be considered identical to the full cost price, if 'C' includes the cost of capital and the reward for the entrepreneur. The price p = C+E may be equated with Andrews' 'normal costing price', which does allow for a positive profit (if E > 0) as it expresses a 'regard for the market', *i.e.*, the salience of the entry threat if the firm raises its price (Robinson, 1950, p. 776).

7. One can think of two chain stores, which publish their new week's prices on saturday, and which stock their shops on monday morning. Consumers buy from the incumbent store unless the entrant's store is lower-priced. The model assumes centralised pricing: that is, the chain store, rather than local managers, sets prices in both markets. This is one area where chain stores have different strategies.

between markets as there is no arbitrage trade (Brander and Krugman, 1983, p. 314; see subsection 5.3.6). Following the theory of contestable markets, in each market the incumbent decides first. Hit-and-run entry occurs if an entrant undercuts the incumbent's price (subgame 2) and captures his sales (subgame 3). In an (im)perfectly contestable market hit-and-run does not actually occur. It rather is a response to unsustainable pricing (out-of-equilibrium behaviour) by the incumbent firm. A perfect equilibrium is the natural device for enquiring whether the threat is effectuated when called for.

Demand rationing. Given the prices in a market, consumers buy from the lowest-priced supplier up to his/her capacity. If any residual demand arises, they turn to the other supplier. The literature has developed several *demand rationing schemes*. I adopt the one in Levitan and Shubik (1972), which is, admittedly, the easiest to use.[8] In this scheme, if the lowest-priced supplier i sells q_i units, residual demand for the highest-priced supplier j with price p_j is $D(p_j)-q_i$. I use the tie-breaking rule that if two firms quote the same price, all consumers turn to the incumbent firm. Predation therefore requires that the entrant strictly underprices the incumbent firm. This resembles the Bertrand assumption in contestability theory. The firm, for instance firm 1, anticipates individual demand levels $d^i(.)$ $(i = A,B)$ by the rule that

$$(7.1)\quad d^A(p_1) = \begin{cases} D^A(p_1) \text{ if } p_1 \le p_2, \text{ and} \\ \max\{D^A(p_1)-y,0\} \text{ if } p_1 > p_2, \end{cases}$$

where y is firm 2's sales level in market A.

Supply rationing. The firms may meet more demand in both markets than they can satisfy, given their capacity constraints (K). I use the following *supply rationing rule*. The firm will fully serve demand in its most profitable market. It will then operate its residual capacity to supply the other market. The most profitable market to firm 1 is its home market A if $p_1-C \ge P_1-E-C$. In the case of a tie (if $p_1-C = P_1-C-E$) it prefers to sell in its home market. Thus the profit-maximising supply schedule for, say, firm 1 is

$$(7.2)\quad x = \begin{cases} \min\{K_1,d^A(p_1)\} \text{ if } p_1 \ge P_1-E, \text{ and} \\ \min\{K_1-X,d^A(p_1)\} \text{ if } p_1 < P_1-E, \end{cases}$$

and similar for X in market B. Moreover, $x = 0$ if $p_1 < C$, and $X = 0$ if $P_1 \le C+E$. Thus the firm serves his most profitable market first, respects his capacity

8. This rule is also used by Kreps and Scheinkman (1983) and Gelman and Salop (1983). Dixon (1987, p. 289) offers a number of rationales for this rationing rule, including the unique connection between the Levitan and Shubik rationing rule and the Cournot model. Davidson and Deneckere (1986) present a comparison with another often employed scheme.

constraint ($x+X \leq K_1$), and avoids producing unsold goods ($x \leq d^A(p_1)$).

An equilibrium outcome of the game is $(p_1,P_2,P_1,p_2,x,X,y,Y)$. The question to be answered is whether the entry-deterring prices in settings with perfect contestability (C) and imperfect contestability (C+E) constitute equilibria in this two-market game. An (im)perfectly contestable market equilibrium is associated with $p_1 = P_2 = C+E$ (where E may be zero), while the entrant's prices are not below the incumbent's ($P_1 \geq P_2$: that is, $P_1 = P_2+\Delta_2$ with $\Delta_2 \geq 0$). This gives

Definition 7.1. A contestable market equilibrium is defined as $(C+E,C+E,C+E+\Delta_1,C+E+\Delta_2, D(C+E),0,0,D(C+E))$ $(\Delta_i \geq 0, i = 1, 2)$.

I will identify values of E and K where neither firm will unilaterally defect from this contestability equilibrium. If both firms quote a price equal to C+E in the first stage, they will not underbid each other in the entry market game, since doing so would entail a loss. In the third subgame each firm therefore faces home market demand D(C+E). Thus any defection from the proposed equilibrium must occur in the first subgame.[9]

Firm 1's profits are as follows. In the proposed equilibrium, each firm's profit margin equals E, with profits of ED(C+E). If firm 1 unilaterally defects in the first stage by quoting a $p_1 > C+E$, firm 2 may prey upon firm 1 in the second stage. Firm 2's supply in market A depends on relative profitability: that is, upon whether $p_2 > P_2+E$ $(= C+2E)$ or $p_2 \leq P_2+E$. If, on the one hand, $(p_2 <)$ $p_1 \leq P_2+E = C+2E$, firm 2 will serve her home market first and use her excess capacity (K-D(C+E)), which is positive by assumption, for entry into market A. This may be called *partial entry*: firm 1 loses part of his home market sales. Firm 2's profits are $ED(C+E)+(p_2-C-E)(K-D(C+E))$, where firm 2 just underbids firm 1 ($p_2 = p_1-\varepsilon$ with ε arbitrarily close to zero). This payoff exceeds his profit for the strategy where firm 2 does not prey upon firm 1 $(= ED(C+E))$. Firm 1 satisfies residual demand in his home market demand, $(D(p_1)-(K-D(C+E))$, with a profit equal to $(p_1-C)(D(p_1)+D(C+E)-K)$. Anticipating this in the first stage, firm 1 sets a price p_1 that maximises his profit, subject to the constraints that $C+E < p_1 \leq P_2+E$ $(= C+2E)$. If, on the other hand, p_1 $(> p_2)$ $> P_2+E$, firm 2 will first enter market A, serve all demand $D(p_2)$, and satisfy her home market B by deploying her excess capacity $(K-D(p_2))$, where $p_2 = p_1-\varepsilon$. This may be called *total entry*: firm 1 loses all home market sales. Firm 1 will satisfy residual demand in his entry market B. His profit equals $(P_1-C-E)(D(P_1)+D(p_1-\varepsilon)-K)$, which is maximised by an appropriate choice of p_1 in the first and P_1 in the second stage. Obviously, firm 1 is interested in keeping p_1 as low as possible in order to induce firm 2 to deploy as much of her capacity as possible in market A. Thus $p_1 = P_2+E+\varepsilon = C+2E+\varepsilon$. This implies a profit of $(P_1-C-E)(D(P_1)+D(C+2E)-K)$, which firm 1 maximises by an appropriate choice of P_1. Firm 1's profits π^1 then equal

9. Subgame perfection implies that if firm 1 unilaterally defects in the first subgame, firm 2 defects from the proposed equilibrium in the second and third subgames.

$$(7.3)\ \pi^1 = \begin{cases} \text{A) } ED(C+E) \text{ if } p_1 = C+E \text{ [entry deterrence],} \\ \text{B) } \max_{p_1}(p_1-C)(D(p_1)+D(C+E)-K) \text{ if } C+E < p_1 \leq C+2E \text{ [partial entry],} \\ \text{C) } \max_{P_1}(P_1-C-E)(D(P_1)+D(C+2E)-K) \text{ if } p_1 = C+2E+\varepsilon \text{ [total entry].} \end{cases}$$

This induces a proposition.

Proposition (7.i). If entry costs are zero ($E = 0$), the proposed perfectly contestable market equilibrium ($p_1 = P_2 = C$) holds if, and only if, each firm's capacity exceeds demand in *both* markets: that is, $K \geq 2D(C)$. *(7.ii)* If entry costs are positive ($E > 0$), the proposed imperfectly contestable equilibrium ($p_1 = P_2 = C+E$) holds if, and only if, 'sufficient' excess capacity exists.

Proof. (7.i) The first option (7.3A) entails zero profits with sales of D(C). The second option (7.3B) refers to an empty set ($C < p_1 \leq C$). The third option (7.3C) entails positive profit and sales if, and only if, $K < 2D(C)$. Thus, if $K \geq 2D(C)$, the first option has zero profits and is the only one with positive sales. If $K < 2D(C)$, the third option is the only one with strictly positive profits. *Q.E.D.*

Proof. (7.ii) The profit levels in Equation (7.3) are functions of E and K. Call these functions $G_i(E,K)$, with $i = 1,2,3$: for example, $G_1(E,K) = ED(C+E)$. Firms defect from the contestable market outcome if at least one i ($= 2,3$) exists such that $G_i(E,K) > G_1(E,K)$. The *sustainability frontier*, $S\{(E,K)\}$, contains the (E,K)-values where each firm is just indifferent between obeying and defecting from the contestable market outcome: $S\{(E,K)\} = \{(E,K) \mid \exists\ i\ G_i(E,K) = G_1(E,K)$ and $\forall j\ (\neq i)\ G_j(E,K) < G_1(E,K),\ i,j = 2,3\}$. The frontier falls between the curves $K = D(C+E)$ and $K = 2D(C+E)$. If $K = D(C+E)$, then $G_1(E,K) < G_2(E,K)$, provided that the profit function $(p-C)D(p)$ is single-peaked at p^m. That is, since $C+E < p_1 \leq C+2E$, it follows that $G_1(E,K) = ED(C+E) < (p_1-C)D(p_1) \leq G_2(E,K)$. Thus firm 1 defects from the proposed equilibrium: the curve determined by $K = D(C+E)$ is inward of the sustainability frontier. If $K = 2D(C+E)$, then $0 = G_i(E,K) < G_1(E,K)$ for $E > 0$ and $0 = G_i(E,K) = G_1(E,K)$ with $E = 0$ for $i = 2,3$. Thus this curve is outward of the sustainability frontier. *Q.E.D.*

So, 'sufficient' excess capacity is required to sustain an imperfectly contestable market equilibrium. The intuition can be clarified by choosing a specific functional form of demand. Figure 7.2 illustrates the result for an example with linear demand: $D(p) = R-bp$, where $R,b > 0$ (Appendix 7.A).

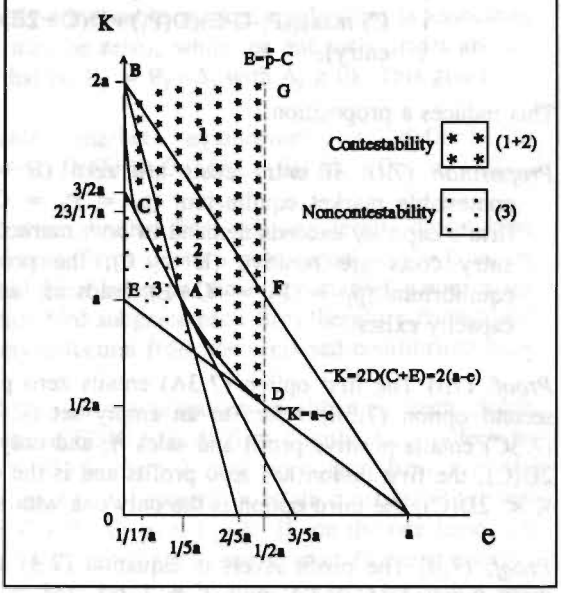
For the sake of convenience, call $a := R-bC$ and $e := bE$. In the (K,e)-space, the assumptions delineate an *admissible region* (contained by points BEDFG) enclosed by the lines $E = p^m-C$ (where $e = \frac{1}{2}a$) and $K = D(C+E)$ (where $K = a-e$). The curve BCAD is the sustainability frontier. On the line BF holds: $K =$

2D(C+E) (= 2(a-e)). In areas 1 and 2 the contestable market equilibrium is reached.

In area 3 firms defect from this proposed equilibrium notwithstanding excess capacity (D(C+E) < K). Along the curve BC in area 3, firm 1 defects by inducing total entry by firm 2, and along CA and AD firm 1 induces partial entry by firm 2. The non-emptiness of area 2 in this example illustrates an interesting point. In contestable market theory the entry threat is driven by the potential entrant's ability to completely duplicate the incumbent firm (total entry). This suggests an excess capacity for each entrant equal to demand in the incumbent's market evaluated at the unit cost C+E: that is, K > 2D(C+E). Area 2 shows that if excess capacity is below this level, the entrant may still induce the incumbent to deter entry by a unit entry cost price (= C+E). Furthermore, the figure shows that for given capacity an increase in unit entry cost may bring the firms from area 3 to area 1 or 2: that is, an *increase* in unit entry cost may facilitate entry deterrence with unit cost prices (= C+E).

Figure 7.2

Perfect and Imperfect Contestability



The proposition does not establish which prices firms will quote in area 3. While being short of conclusive proof, I suggest that firms resort to a mixed equilibrium. I first need a

Lemma. In area 3, a symmetric pure equilibrium does not exist. If a pure equilibrium exists it must be asymmetric.

Proof. (see Appendix 7.B).

In a symmetric game each asymmetric equilibrium has its mirror image: that is, there are pairs of these equilibria. If an equilibrium offers payoffs (V,W) to firms 1 and 2, its mirror image equilibrium offers payoffs (W,V): that is, the roles of both firms are simply changed. If V > W, it is impossible for both firms to prefer the same equilibrium: firm 1 prefers the former and firm 2 the latter equilibrium. This rules out the possibility that the firms have a compelling reason to coordinate on a Pareto-optimal equilibrium. The outcome of the noncooperative game is thus random. This is in striking contrast to the (im)perfectly contestable

market outcome. Whether the randomised outcome is a (mixed) equilibrium is another matter. A folk theorem among game theorists suggests that the number of equilibria is uneven: that is, if there are two pure asymmetric equilibria, there must be a third mixed equilibrium. I cannot, regrettably, prove this conjecture.[10]

7.5 APPRAISAL

What drives these results is that the firms' entry decisions in a multi-market context are interdependent by an *endogenous opportunity cost* (Calem, 1988, p. 172). Entry causes a loss of home market sales due to the reduction of home market capacity (a direct effect) and the triggering of reciprocal entry (an indirect effect). The indirect effect implies an endogenous opportunity cost of entry as it makes firm 1's opportunity cost of entry dependent upon firm 2's reciprocal entry decision. For instance, firm 1's scale of entry into market B, X, has two effects upon his home market profits. Firstly, there is the *direct opportunity cost* that the entry sales, X, reduce the residual capacity left to serve home market demand, K_1-X. The direct opportunity cost is the loss of profits, $(p_1\text{-}C)(d^A(p_1)\text{-}x)$ if sales x fall short of demand $d^A(p_1)$, provided that without entry firm 1 would have been able to serve all forthcoming demand. Secondly, there is the *indirect opportunity cost*. The entry level, X, reduces firm 2's residual home market demand, $d^B(P_2)$, and sales, Y, which raises firm 2's residual capacity, K_2-Y, to serve her entry market A. This in turn raises firm 2's scale of reciprocal entry, y, which reduces firm 1's home market demand $d^A(p_1)$.[11]

This chapter assumes symmetric ease of entry: that is, reciprocal entry. Real world cases often show one-sided entry, however. For instance, entrants may have protected home markets, as illustrated by Japanese firms. Indeed, models on the multinational enterprise often assume that the multinational has a secure home market (for example, Horstmann and Markusen, 1989). In the U.S., incursions by protected entrants have induced pressures towards a strategic trade policy which issues a demand for reciprocal access to the entrant's home market, while threatening with protectionism otherwise (Yoffie and Milner, 1989, p. 113). In terms of this model, contestable market outcomes pertain if the entrant (say, firm 2) has sufficient capacity to serve both her own protected home market B at the profit-maximising price P^m *as well as* the entry market A for a price equal to or above the unit cost (C+E). Anticipating this, the incumbent in market A quotes

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10. I do not apply Dasgupta and Maskin's (1986) existence proofs of mixed equilibria for I read their theorems as applying to open-loop Nash equilibria rather than closed-loop perfect equilibria.

11. This confirms Kaldor's (1935, p. 48) visionary statement on excess capacity-induced entry by existing firms: 'Let us suppose that one of them finds it profitable to produce another commodity, highly competitive with the products of some other producers. These latter producers will now find the demand for their products reduced; and *this* may make it profitable for them to engage in the production of a second, or even a third, commodity -even if it was not profitable before.' Kaldor (1935, pp. 48-49) observes that (in my terms) an endogenous opportunity cost drives this process.

the entry-deterring price (= C+E). This results holds if $D(C+E)+D(P^m) \leq K$. The contestable market outcome pertains, but only for the entry market A. Thus contestability does not arise as a general (benchmark) case for *both* markets.

7.6 CONCLUSION

This chapter supports in a formal context Cairns and Mahabir's (1988) critique on contestability. (Im)perfect contestability requires sufficient excess capacity. Otherwise, the possibility of hit-and-run entry does not force the incumbent to quote a sustainable (zero entry profit) price. In the (plausible) case that established firms do have excess capacity, but insufficiently to (almost totally) replace one another, the claims by Andrews and by contestability theory that entry-deterring (zero-profit) prices result, are rejected. It also rejects the presumption that a (plausible) entry threat from established firms leads to the hit-and-run result that the entrant replaces the incumbent firm. Rather than *total entry* where one entrant replaces the incumbent firm entirely, there is *partial entry* where one entrant replaces only one product in the product line offered by an incumbent firm.

Future research in this area can deal with several technical issues such as different consumer rationing schemes, endogenous capacity choice, and fixed rather than variable entry costs. Furthermore, it may be of interest to tie in other aspects of multi-market competition. For instance, a positive multi-market spillover can induce a firm to enter another market (Bulow *et al.*, 1985a). If firms meet in several markets, they may try to extend collusion from one market to all markets where they meet (Pinto, 1986; and Bernheim and Whinston, 1990). Multi-market contact may increase the incidence of tacit collusion by facilitating implicit transfer of signals through price cutting, output reduction and the like. Future research may, for example, identify the capacity level necessary to prevent multi-market collusion.

APPENDICES

Appendix 7.A. Proposition (7.ii) illustrated for linear demand

Equation (7.3) implies that each firm compares the contestable market equilibrium payoff $ED(C+E)$ with prices (p_1) equal to $C+E$ to the defection payoffs $\max_{p_1}(p_1\text{-}C)(D(p_1)+D(C+E)\text{-}K)$ if $C+E < p_1 \leq C+2E$ and $\max_{P_1}(P_1\text{-}C\text{-}E)(D(P_1)+D(C+2E)\text{-}K)$ if $p_1 = C+2E+\varepsilon$ ($\varepsilon > 0$). I will solve these constrained maximisation programs, called program I and II respectively, and then specialise by assuming a linear demand function, $D(p) = R\text{-}bP$ ($b > 0$). Assume that $E > 0$ (the proposition (7.i) gives the results when $E = 0$).

Program I. $\max_{p1}\ (p_1\text{-}C)(D(p_1)+D(C+E)\text{-}K)$ if $C+E < p_1 \leq C+2E$ [Equation (7.3B)].

Rewrite this problem into $\max_p\ (p\text{-}C)(D(p)+D(C+E)\text{-}K)$ subject to (i) $p\text{-}(C+E) \geq 0$, (ii) $C+2E\text{-}p \geq 0$ and (iii) $D(p)+D(C+E)\text{-}K \geq 0$. For the sake of convenience, the strong inequality restriction $p > C+E$ is transformed into the weak inequality constraint $p \geq C+E$, which does not affect the results. The Lagrange function is

(7.A1) $L(p,\lambda_1,\lambda_2,\lambda_3) = (p\text{-}C)(D(p)+D(C+E)\text{-}K)+\lambda_1(p\text{-}C\text{-}E)+\lambda_2(C+2E\text{-}p)+\lambda_3(D(p)+D(C+E)\text{-}K)$.

The Kuhn-Tucker conditions are, given that the objective and the constraints are concave functions (Beavis and Dobbs, 1990, p. 54),

(7.A2) $\partial L/\partial p = (p\text{-}C)D'(p)+D(p)+D(C+E)\text{-}K+\lambda_1\text{-}\lambda_2+\lambda_3D'(p) = 0$,
$p\text{-}C\text{-}E \geq 0$,
$C+2E\text{-}p \geq 0$,
$D(p)+D(C+E)\text{-}K \geq 0$,
$\lambda_1(p\text{-}C\text{-}E) = 0$,
$\lambda_2(C+2E\text{-}p) = 0$,
$\lambda_3(D(p)+D(C+E)\text{-}K) = 0$, and
$\lambda_i \geq 0$ ($i = 1,2,3$).

Case 1: $\lambda_1 > 0$, $\lambda_2 > 0$ and $\lambda_3 = 0$.
$\lambda_1 > 0 \Rightarrow p\text{-}C\text{-}E = 0$ and $\lambda_2 > 0 \Rightarrow C+2E\text{-}p = 0$, which gives a contradiction if $E > 0$.

Case 2: $\lambda_1 > 0$, $\lambda_2 = 0$ and $\lambda_3 = 0$.
$\lambda_1 > 0 \Rightarrow p = C+E \Rightarrow \pi = E(2D(C+E)\text{-}K)$. Moreover, $\partial L/\partial p = ED'(C+E)+2D(C+E)\text{-}K+\lambda_1 = 0 \Rightarrow \lambda_1 = K\text{-}2D(C+E)\text{-}ED'(C+E) > 0 \Rightarrow K > 2D(C+E)+ED'(C+E)$. Call this area A in (E,K)-space. With linear demand, $D(p) = R\text{-}bp$, the frontier equals $K = 2D(C+E)+ED'(C+E) = 2(R\text{-}bC\text{-}bE)\text{-}bE = 2(R\text{-}bC)\text{-}3bE = 2a\text{-}3e$, where $a := R\text{-}bC$ and $e := bE$. Hence, area A equals $\{e,K;\ K > 2a\text{-}3e\}$.

Case 3: $\lambda_1 = 0$, $\lambda_2 > 0$ and $\lambda_3 = 0$.
$\lambda_2 > 0 \Rightarrow p = C+2E \Rightarrow \pi = 2E(D(C+2E)+D(C+E)-K)$. Moreover,
$\partial L/\partial p = 2ED'(C+2E)+D(C+2E)+D(C+E)-K-\lambda_2 = 0 \Rightarrow$
$\lambda_2 = 2ED'(C+2E)+D(C+2E)+D(C+E)-K > 0 \Rightarrow$
$K < 2ED'(C+2E)+D(C+2E)+D(C+E)$.
Call this area *C* in (E,K)-space. With linear demand this amounts to the frontier $K = 2(R-bC)-5bE = 2a-5e$, which defines *C* as the set $\{e,K;\ K \leq 2a-5e\}$.

Case 4: $\lambda_1 = 0$, $\lambda_2 = 0$ and $\lambda_3 = 0$.
$\lambda_1 = 0 \Rightarrow p \geq C+E$, $\lambda_2 = 0 \Rightarrow C+2E \geq p$ and $\partial L/\partial p = (p-C)D'(p)+D(p)+D(C+E)-K = 0$, from which price and payoff follow. Note that an internal solution must exist within the constraints. That is, $\partial L/\partial p(C+E) > 0 = \partial L/\partial p(p) > \partial L/\partial p(C+2E)$, knowing that $\partial L/\partial p(p)$ is a downward-sloping curve: $\partial^2 L/\partial p^2 = (p-C)D''(p)+2D'(p) < 0$, by the assumption of single-peakedness. The constraints then imply that
$ED'(C+E)+2D(C+E)-K > 0 > 2ED'(C+2E)+D(C+2E)+D(C+E)-K$, or
$2ED'(C+2E)+D(C+2E)+D(C+E) < K < ED'(C+E)+2D(C+E)$.
Call this area *B* in (E,K)-space. With linear demand *B* is defined as $\{e,K;\ 2a-5e < K < 2a-3e\}$.

Case 5: $\lambda_1 > 0$, $\lambda_2 > 0$ and $\lambda_3 > 0$.
$\lambda_1 > 0 \Rightarrow p-C-E = 0$ and $\lambda_2 > 0 \Rightarrow C+2E-p = 0$, which gives a contradiction if $E > 0$.

Case 6: $\lambda_1 > 0$, $\lambda_2 = 0$ and $\lambda_3 > 0$.
$\lambda_1 > 0 \Rightarrow p = C+E$. With $\lambda_3 > 0$ this means that $2D(C+E)-K = 0 \Rightarrow \pi = 0$. Moreover,
$\partial L/\partial p = ED'(C+E)+2D(C+E)-K+\lambda_1+\lambda_3 D'(C+E) = 0 \Rightarrow$
$ED'(C+E)+\lambda_1+\lambda_3 D'(C+E) = 0 \Rightarrow (E+\lambda_3)D'(C+E)+\lambda_1 = 0$.
Noting that $\lambda_3 > 0$ and $D'(C+E) < 0$ this means that $\lambda_1 = -(E+\lambda_3)D'(C+E) > 0$, which is consistent.

Case 7: $\lambda_1 = 0$, $\lambda_2 > 0$ and $\lambda_3 > 0$.
$\lambda_2 > 0 \Rightarrow p = C+2E$. With $\lambda_3 > 0$ this means that $D(C+2E)+D(C+E)-K = 0$. Moreover,
$\partial L/\partial p = 2ED'(C+2E)+D(C+2E)+D(C+E)-K+\lambda_2+\lambda_3 D'(C+2E) = 0 \Rightarrow$
$\lambda_2 = (\lambda_3+2E)D'(C+2E)$.
With $E > 0$, $\lambda_3 > 0$ and $D'(C+2E) < 0$ this gives $\lambda_2 < 0$, a contradiction.

Case 8: $\lambda_1 = 0$, $\lambda_2 = 0$ and $\lambda_3 > 0$.
$\lambda_3 > 0 \Rightarrow D(p)+D(C+E)-K = 0$.
$\lambda_1 = 0 \Rightarrow p \geq C+E$, $\lambda_2 = 0 \Rightarrow C+2E \geq p$ and $\partial L/\partial p = (p-C)D'(p)+D(p)+D(C+E)-K+\lambda_3 D'(p) = 0 \Rightarrow \lambda_3 = -(p-C)$. With $p \geq C+E$, and so $p > C$, this means $\lambda_3 < 0$, which gives a contradiction.

Program II. $\max_{P_1}$ $(P_1\text{-}C\text{-}E)(D(P_1)+D(C+2E)\text{-}K)$ if $p_1 > C+2E$ [Equation (7.3C)].

Rewrite the program into $\max_p$ $(p\text{-}C\text{-}E)(D(p)+D(C+2E)\text{-}K)$ subject to (i) $p\text{-}C\text{-}E \geq 0$ and (ii) $D(p)+D(C+2E)\text{-}K \geq 0$. The Lagrange is

(7.A3) $L(p,\lambda_1,\lambda_2) =$
$(p\text{-}C\text{-}E)(D(p)+D(C+2E)\text{-}K)+\lambda_1(p\text{-}C\text{-}E)+\lambda_2(D(p)+D(C+2E)\text{-}K)$,

with the Kuhn-Tucker conditions that

(7.A4) $\partial L/\partial p = (p\text{-}C\text{-}E)D'(p)+D(p)+D(C+2E)\text{-}K+\lambda_1+\lambda_2 D'(p) = 0$,
$p\text{-}C\text{-}E \geq 0$,
$D(p)+D(C+2E)\text{-}K \geq 0$,
$\lambda_1(p\text{-}C\text{-}E) = 0$,
$\lambda_2(D(p)+D(C+2E)\text{-}K) = 0$, and
$\lambda_i \geq 0$ $(i = 1,2)$.

Case 1: $\lambda_1 = 0$ and $\lambda_2 > 0$.
$\lambda_1 = 0 \Rightarrow p\text{-}C\text{-}E \geq 0$ and $\lambda_2 > 0 \Rightarrow D(p)+D(C+2E)\text{-}K = 0$. Moreover, $\partial L/\partial p = (p\text{-}C\text{-}E)D'(p)+\lambda_2 D'(p) = 0 \Rightarrow \lambda_2 = -(p\text{-}C\text{-}E) \leq 0$, which gives a contradiction.

Case 2: $\lambda_1 > 0$ and $\lambda_2 = 0$.
$\lambda_1 > 0 \Rightarrow p = C+E$ and $\lambda_2 = 0 \Rightarrow D(C+E)+D(C+2E)\text{-}K \geq 0$. Moreover, $\partial L/\partial p = D(C+E)+D(C+2E)\text{-}K+\lambda_1 = 0 \Rightarrow 0 < \lambda_1 = K\text{-}D(C+E)\text{-}D(C+2E)$, which is a contradiction.

Case 3: $\lambda_1 > 0$ and $\lambda_2 > 0$.
$\lambda_1 > 0 \Rightarrow p = C+E$ and $\lambda_2 > 0 \Rightarrow D(C+E)+D(C+2E)\text{-}K = 0 \Rightarrow K = D(C+E)+D(C+2E) \Rightarrow \pi = 0$. Moreover, $\partial L/\partial p = \lambda_1+\lambda_2 D'(p) = 0$. So, $\lambda_1/\lambda_2 = -D'(C+E) > 0$, which is consistent.

Case 4: $\lambda_1 = 0$ and $\lambda_2 = 0$.
$\lambda_1 = 0 \Rightarrow p \geq C+E$ and $\lambda_2 = 0 \Rightarrow D(p)+D(C+2E)\text{-}K \geq 0$. Moreover, $\partial L/\partial p = (p\text{-}C\text{-}E)D'(p)+D(p)+D(C+2E)\text{-}K = 0$. The associated payoff is the interior maximum. By assumption $(p\text{-}C\text{-}E)D'(p)+D(p)$, and therefore $\partial L/\partial p$, is downward sloping. At $p = C+E$ it must hold that $0 < \partial L/\partial p$. Therefore, $0 < D(C+E)+D(C+2E)\text{-}K$: that is, $K < D(C+E)+D(C+2E)$. With linear demand the frontier is $K = 2(R\text{-}bC)\text{-}3bE = 2a\text{-}3e$, which gives area *D* equal to $\{e,K;\ K < 2a\text{-}3e\}$. This includes both areas *B* and *C* of program I.

To sum up, the payoff of program II equals zero unless $K < D(C+E)+D(C+2E)$, which is area *D*. That is, solution of program I and II shows that in the linear demand case three areas of interest exist: areas *A*, *B*, and *C*. Defection is profitable if, and only if, the payoff of program I and/or II exceeds the payoff $ED(C+E)$ $(= E(R\text{-}bC\text{-}bE))$ with $p_1 = C+E$. I now proceed with the linear demand case: $D(p) = R\text{-}bP$. The assumption $D(C+E) < K$ can be

rewritten as a-e < K, and the assumption E < p^m-C can be reformulated as e < ½a. This defines the *admissible* region {(e,K); e < ½a and a-e < K}. Noting that E = e/b and C = (R-a)/b the following equilibrium strategies per area can be determined.

Area A: {e,K; 2a-3e < K}.
Firm 1 (and, along similar lines, firm 2) faces three options. Option 1: p_1 = C+E with profits π^1 = ED(C+E) = e(a-e)/b. Option 2: p_1 = C+E+ε < C+2E (program I above) with profits π^2 = E(2D(C+E)-K) = e(2(a-e)-K)/b. Option 3: p_1 > C+2E (program II above) which does not lead to positive profits. Firm 1 then faces the question: does π^2 exceed π^1? π^2-π^1 = e(a-e-K)/b. By assumption a-e = D(C+E) < K: therefore, π^2-π^1 < 0. Firm 1 will not defect from the contestable market equilibrium.

Area B: {e,K; 2a-5e < K < 2a-3e}.
Firm 1 (and, for that matter, firm 2) faces three options (as above). Option 1: identical to option 1 in area *A*. Option 2: π^2 = (2(R-bC)-bE-K)²/4b = (2a-e-K)²/4b. Option 3: π^3 = (2(R-bC)-3bE-K)²/4b = (2a-3e-K)²/4b. π^2 > π^3 as 0 < 2a-3e-K < 2a-e-K (if e > 0). Firm 1's problem is to choose option 1 or 2. Define Δ:= 4b(π^2-π^1) = (2a-e-K)²-4e(a-e) = K²+K(2e-4a)+5e²-8ae+4a². Δ = 0 if, and only if, $K_{1,2}$ = 2a-e±2√e(a-e). Since K < 2a-3e < 2a-e ≤ 2a-e+2√e(a-e) = K_2, K_2 falls out of range. Thus firm 1 is indifferent between obeying to or defecting from the equilibrium if, and only if, K = K_1 = 2a-e-2√e(a-e); he defects if, and only if, K < K_1 (within the set *B*). K_1 intersects *B*'s lower bound K = 2a-5e at (0,2a) and point A = (a/5,a). K_1 intersects *B*'s upperbound K = 2a-3e at (0,2a) and point D = (½a,½a). In the admissible region (where e < ½a) K_1 is downward sloping as $\partial K_1/\partial e$ = -1-(a-2e)/√e(a-e) < 0. At point A the slope is -5/2 and at point D the slope is -1.

Area C: {e,K; K ≤ 2a-5e}.
Firm 1 (and, similar, firm 2) faces the three options as above. As for profits, π^1 in area *C* is identical to π^1 in area *A*, π^2 = 2e(2a-3e-K)/b and area *C*'s π^3 is identical to area *B*'s π^3. Firm 1 faces two problems. (i) Call Δ = π^2-π^1 = e(3a-5e-2K)/b. Firm 1 is indifferent (Δ = 0) if K = (3a-5e)/2. Firm 1 defects if [but not only if, see (ii)] K < (3a-5e)/2. (ii) Call Δ = 4b(π^3-π^1) = (2a-3e-K)²-4e(a-e) = K²+K(6e-4a)+13e²-16ae+4a². Δ = 0 if, and only if, $K_{1,2}$ = 2a-3e±2√e(a-e). K ≤ 2a-5e < 2a-3e ≤ 2a-3e+2√e(a-e) = K_2: therefore, K_2 is out of range. Firm 1 is indifferent in problem (ii) if, and only if, K = K_1 = 2a-3e-2√e(a-e); he defects if, and only if, K < 2a-3e-2√e(a-e). Problems (i) and (ii) imply that firm 1 defects if, and only if, K < max{(3a-5e)/2,2a-3e-2√e(a-e)}. To find the maximum of the two upper bound frontiers it is instructive to know that K_1(0) = 2a, K_1(a/5) = 3a/5 and K_1(a) = -a. So, $\partial K_1/\partial e$ = -3-(a-2e)/√e(a-e), and thus $\partial K_1/\partial e$(0) = -∞. If e < a/2, then $\partial K_1/\partial e$ < 0: that is, the frontier is decreasing in e. The frontier is convex as $\partial^2 K_1/\partial e^2$ = {2e(a-e)+½(a-2e)²}/e(a-e)^{3/2} > 0. K_1 intersects area *C*'s upper boundary K = 2a-5e at the points B = (0,2a) and H = (½a,-½a). K_1 intersects the line K = (3a-5e)/2 at point C = (a/17,a23/17) and (a,-a). The line K = (3a-5e)/2

intersects *C*'s upper boundary line K = 2a-5e at point A = (a/5,a).

So, the areas *A*, *B* and *C* in (e,K)-space give the critical points A = (a/5,a), B = (0,2a), C = (a/17,a23/17), D = (½a,½a), E = (0,a), F = (½a,a) and G = (½a,2a). Points B and C are on the curve K = 2a-3e-2√e(a-e) (where program II is the alternative to sustainable pricing: that is, $\pi^1 = \pi^3 > \pi^2$). Points C and A are on the line K = (3a-5e)/2 (where program I is the alternative to sustainable pricing: that is, $\pi^1 = \pi^2 > \pi^3$). Points A and D are on the curve K = 2a-e-2√e(a-e) (where program I is the alternative to sustainable pricing: that is, $\pi^1 = \pi^2 > \pi^3$). Points D, F and G are on the line e = ½a and points E and D are on the line K = a-e (both lines delimit the admissible region). The results are summarised in figure 7.2 in the text. I conclude that within the admissible region firm 1 defects for (e,K) values in the area 3, enclosed by points BCADE. He does not defect from the contestable market equilibrium in area 2, enclosed by points BCADF, and area 1, enclosed by points BFG.

Appendix 7.B. Proof of the lemma

Proof. Call the symmetric pure equilibrium (p,p,r,r,q,z,z,q). Home market prices *p* will exceed the 'contestable' level of C+E (firms deviate from pricing equal to C+E only if they can do better). Distinguish two cases.

Case (1a) $r \leq C+E < p$ and (1b) $C+E < p \leq r$. In both cases, neither firm sells in her entry market: it is not profitable (case 1a) or price is too high (case 1b). As a result, home market sales q = D(p), entry market sales z = 0, and profits are (p-C)D(p). This cannot be an equilibrium, for each firm will defect in the second stage by underbidding the other firm. In both cases, firm 1 will quote a P_1 in entry market B such that $C+E < P_1 < p$. He continues to be the only (case 1a) or the lowest-priced (case 1b) supplier in his home market A (assuming that firm 2 does not defect). In the third subgame the firm can choose to serve the home market first, with sales D(p) and entry sales X = min{D(P_1),K-D(p)}, or to serve the entry market first, with entry sales X = D(P_1) and home market sales x = min{D(p),K-D(P_1)}. Profits are equal to max{(p-C)D(p)+(P_1-C-E)min{D(P_1),K-D(p)}, (p-C)min{D(p),K-D(P_1)} +(P_1-C-E)D(P_1)}. This exceeds the equilibrium profit (p-C)D(p) as K-D(p) is strictly positive (this follows from D(p) < D(C+E) < K). Firm 1 thus defects.

Case (2) $C+E < r < p$. Each firm is lowest-priced supplier in her entry market. First use the demand rationing rule (7.1). Since r < p, consumer first turn to the entrant and next to the incumbent firm:

$d_1^A(p) = \max\{D^A(p)-y,0\}$;
$d_2^A(r) = D^A(r)$;
$d_1^B(r) = D^B(r)$;
$d_2^B(p) = \max\{D^B(p)-X,0\}$.

Secondly, use the supply rationing rule (7.2). Since r-E < r < p, each firm first serves its home market and then its entry market:

$x = \min\{K,d_1^A(p)\}$;
$X = \min\{K-x,d_1^B(r)\}$;
$Y = \min\{K,d_2^B(p)$;

$y = \min\{K-Y, d_2^{\wedge}(r)\}$.
A lengthy development gives that entry market sales are $z = D(r)$, home market sales are $q = 0$, and equilibrium profits are $\pi^e = (r-C-E)D(r)$. In the case of unilateral defection by firm 1, however, firm 1 may quote a price $p_1 = C+E$, while firm 2 continues to quote $P_2 = p$. In the second stage, firm 2 cannot profitably underbid firm 1, $p_1 = C+E < p_2$, and firm 1 will underbid firm 2 in his home market, $C+E < P_1 < p$. Being lowest-priced supplier in both markets, in the third stage firm 1 may either serve his home market or his entry market first. He realises a (defection) profit $\pi^d = \max\{E D(C+E) + (P_1-C-E)\min\{K-D(C+E), D(P_1)\}, E\min\{D(C+E), K-D(P_1)\} + (P_1-C-E)D(P_1)\}$, subject to $P_1 < p$. Since $D(P_1) < D(C+E) < K$, π^d strictly exceeds the (constrained optimal) profit level $\pi^c := \max_P (P-C-E)D(P)$ subject to $P < p$. This in turn weakly exceeds the equilibrium profit $\pi^e = (r-C-E)D(r)$ for $r < p$: as a default, firm 1 may choose $P_1 = r$, such that $\pi^e = \pi^e$. Thus $\pi^d > \pi^e \geq \pi^e$. Firm 1 will again defect. Both cases together imply that if $C+E < p$, no price r exists which induces a unique pure equilibrium. *Q.E.D.*

8 CAPACITY AS A COMMITMENT INSTRUMENT IN MULTI-MARKET COMPETITION[1]

Chapter 8 contains a discussion on capacity investments that acknowledges both horizontal and vertical dimensions of multi-market competition. One of its contributions is to integrate both dimensions in a unified reaction curve format. The argument that capacity is an instrument in entry deterrence is a development of (or critique on) Bain's limit price theory, which assumed that the incumbent's *output* level is an instrument in entry deterrence. The chapter explores models which formally introduced into this discussion the notion that potential entrants can be established firms in related markets. As chapter 3 argued, this cannot be incorporated into the limit price theory. In particular, established-firm entry undermines the incumbent's ability to deter entry. An established firm in a related market may use its existing (excess) capacity for (potential) entry (the 'horizontal' multi-market dimension). An incumbent firm may deter (new firm) entry by exploiting a first-mover advantage in an input market (the 'vertical' dimension).

8.1 INTRODUCTION

Industrial economists have argued that firms may use capacity investments as an instrument in entry deterrence. Dixit (1980) summarised this argument in an enticingly simple reaction curve format. A capacity investment transforms variable costs into sunk costs, and thus reduces marginal costs. This makes the firm more aggressive in product market competition with an entrant, that is, the incumbent firm's reaction curve shifts outward. With these results in mind, the incumbent firm may over- or under-invest in capacity relative to the case where cost minimisation is its objective. These capacity-commitment models have shown to be a rich framework to study potential entry by different types of entrants and different entry deterrence strategies. This chapter gives an integrated treatment of several games that have been developed in the literature. Economists explored the horizontal multi-market setting where firms use capacity in multiple product or country markets (*e.g.*, Calem, 1988). Separately, they also explored the vertical multi-market context where firms compete in a capital good market as well as in the product market (*e.g.*, Salop and Scheffman, 1983). The chapter will allow an appraisal of the usefulness of capacity investments to entry deterrence in several competition settings.

Section 8.2 discusses why capacity can be a competition instrument in the first place. Section 8.3 introduces the basic capacity-commitment model using a multi-market framework. It goes without saying that for cases where capacity is the prevailing commitment instrument, one has to turn to capital-intensive industries.

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1. This chapter is based on Van Wegberg (1993).

Section 8.4 illustrates the usefulness of a multi-market framework for the U.S. steel industry. The subsequent sections build on the basic model while exploring different competition settings. Section 8.5 focuses on *de novo* entry. Section 8.6 focuses on existing firm entrants, *e.g.*, importers, which implies a horizontal multi-market setting. Section 8.7 discusses cases where incumbent and entrant compete in an input as well as in the product market, which implies a vertical multi-market setting. A firm's investment not only affects its product market competitiveness, but may also affect the input price faced by a second mover or *de novo* entrant. Section 8.8 summarises these insights, appraises empirical evidence, and returns to the steel industry example.

8.2 CAPACITY INVESTMENTS AS IRREVERSIBLE MOVES

Bain (1962) argued that a firm's output level is its instrument in competition. His limit price model is based upon the Sylos' postulate that a potential entrant believes that upon entry the incumbent firm will stick to its pre-entry output level. Anticipating this belief, the incumbent firm may choose a pre-entry output level so as to deter entry. If one rejects the Sylos' postulate, the output level becomes an ambiguous instrument in entry deterrence.[2] As Dixit (1980) puts it:

> 'First, faced with an irrevocable fact of entry, the established firm will usually find it best to make an accommodating output reduction. On the other hand, it would like to threaten to respond to entry with a predatory increase in output. Its problem is to make the latter threat credible given the prospective entrant's knowledge of the former fact.' (p. 95)

The pre-entry output level does not deter entry, therefore, because the entrant expects that upon entry the incumbent firm will adjust its output level.[3,4] Unlike

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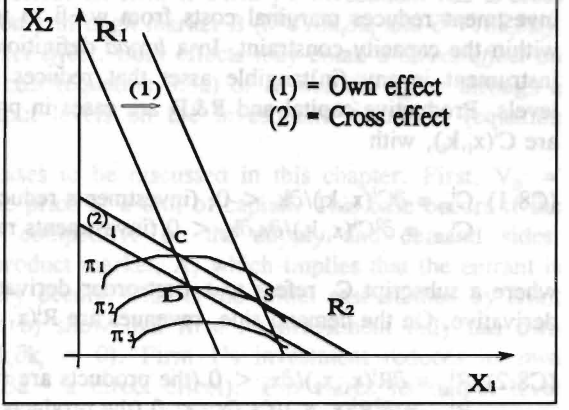
2. This is not to say that Bain really believed in the Sylos' Postulate as applying to actual entrants. It merely represents a simplifying assumption which he needed for his analysis.

3. Notwithstanding this critique, the Sylos' Postulate still appears occasionally. Basu and Singh (1990) split up the entry decision into an 'entry' decision and a 'production start-up' decision. Prior to the 'entry' decision, the incumbent firm chooses capacity. In between these decisions, the incumbent firm chooses its output level. The entrant holds the Sylos' postulate (now dubbed a Stackelberg assumption) that the incumbent firm does not revise its output level after the entrant's 'start-up' decision. If the potential entrant decides to 'enter', the incumbent firm chooses an output level which deters the entrant from actually starting up production. In this setting the authors support the use of excess capacity. A similar Stackelberg argument accounts for Spulber's (1981) result of entry deterrence by excess capacity. These papers defy the Spence (1979) lesson that a Stackelberg leadership position cannot be assumed. It has to be derived in a perfect equilibrium from asymmetries in the competing firms' capacity investment processes (a leader has a head start or can expand its capacity faster than a follower). Leadership has to be credible.

output levels, (pre-entry) capacity investments do constitute an irreversible decision. Investments are irreversible if capacity is firm-specific, that is, has no (perfect) alternative use outside the firm. In the extreme case of complete specificity, the opportunity cost of capacity is zero. This argument led to a shift in the entry deterrence argument from the output level in Bain's theory, to capacity investments and pre-commitments in the game-theoretical literature.

To see what a strategic move may achieve, consider a duopoly with firms 1 and firm 2. Figure 8.1 illustrates. Firm i's output level is x_i and its reaction curve is R_i (i = 1,2). The Cournot equilibrium is the intersection C of the reaction curves. The curves π^j (j = 1,2,3) are some of firm 1's iso-profit curves. The lower the iso-profit curve, the higher firm 1's profit level, as they are associated with lower output levels of firm 2. Given that firm 2 reacts to an output choice by firm 1 by locating along its reaction curve R_2, firm 1 would prefer to locate at the Stackelberg equilibrium S, which is on firm 1's lowest iso-profit curve still tangent to R_2. If firm 1 chooses its output level before firm 2, it might choose the level associated with point S. This carries no weight, however, because of Dixit's argument above. A strategic move that intends to induce rivals to accept outcome S rather than C has to be irreversible.

Figure 8.1
Strategic Moves in Duopoly Competition



The figure suggests two types of strategic move. The capacity-commitment model exploits the idea that firm 1's investment reduces its marginal costs, thereby shifting its reaction curve R_1 outward to R_1', say. As a result, the Cournot equilibrium shifts along R_2 towards the point S. This is the *own effect*. Firm 1 may also try to shift firm 2's reaction curve downward, to R_2', say. This shifts the Cournot equilibrium along R_1 towards point D, which is located at the same iso-profit curve (π_2) as point S. Firm 1 may, as we will see, achieve this if its investments have effects in another (product or factor) market, which in turn affect firm 2 to the effect that (given an output level for firm 1) its marginal costs or revenue change. Firm 1's investment thus has a *cross effect*. The argument does not explain which instruments firm 1 has for a cross-effect. To know this, more information is required about the context in which the firms compete. To

4. A high pre-entry output level or low price may signal to a potential entrant that the incumbent firm has low costs. This may deter entry by firms that would enter against a high-cost incumbent. Bain's limit price theory has accordingly been developed into a signalling model (*e.g.*, Milgrom and Roberts, 1982).

bring out the underlying mechanism a full multi-market setting is required.

8.3 A BASIC MODEL

This section gives the assumptions of the generalised multi-market capacity-commitment model. The basic idea is that an investment reduces marginal costs. Two varieties exist of this argument. The *narrow* definition of capital refers to a given amount of capacity. An upfront capacity investment k_i transforms the production costs $(w+\beta)x_i$ into sunk costs βk_i and variable costs wx_i, where x_i is the output level, w the constant marginal production cost and β the unit capacity cost ($i = 1,2$). Constant returns to scale are assumed throughout. The upfront investment reduces marginal costs from $w+\beta$ to w, therefore, for output levels within the capacity constraint. In a *broad* definition of 'capital', the commitment instrument is any (in)tangible asset that reduces marginal costs for all output levels. Productive capital and R&D are cases in point. Variable production costs are $C^i(x_i,k_i)$, with

(C8.1) $C^i_{ki} \equiv \partial C^i(x_i,k_i)/\partial k_i < 0$, (investments reduce total variable costs), and
$C^i_{xiki} \equiv \partial^2 C^i(x_i,k_i)/\partial x_i \partial k_i < 0$ (investments reduce marginal costs);

where a subscript C_x refers to a first-order derivative and C_{xx} to a second-order derivative. On the demand side, revenues are $R^i(x_1,x_2)$:

(C8.2) $R^i_{xj} \equiv \partial R^i(x_1,x_2)/\partial x_j < 0$ (the products are (im)perfect substitutes), and
$R^i_{xixj} \equiv \partial^2 R^i(x_1,x_2)/\partial x_1 \partial x_2 < 0$ (the products are strategic substitutes);

where $j \neq i$; $i,j = 1,2$. For convenience, I assume homogeneous products and a duopoly throughout. Write each firm's profit function as

(8.1) $\pi^i = R_i^A(x_1,x_2)+V_i^B(x_1,x_2,k_1,k_2)-C^i(x_i,k_i)$;

with revenue R in product market A ($i = 1,2$). The superscript B refers to a product or factor market and V is a revenue or cost function. I will ignore the market superscripts A,B when convenient. The firm's reaction curve follows from profit maximisation (equation 8.2a), which also determines its investments and thus its marginal costs (equation 8.2b):

(8.2a) $\partial\pi^i/\partial x_i = 0 = \partial R^i/\partial x_i+\partial V^i/\partial x_i-\partial C^i/\partial x_i$;
(8.2b) $\partial\pi^i/\partial k_i = 0 = \partial V^i/\partial k_i-\partial C^i/\partial k_i$.

The strategic effect of an investment, *i.e.*, the shift of the reaction curve, can be found by totally differentiating the first-order conditions (Dixit, 1986, p. 111):

(8.3a)

$$\left(\frac{\partial^2 R^i}{\partial x_i^2}+\frac{\partial^2 V^i}{\partial x_i^2}-\frac{\partial^2 C^i}{\partial x_i^2}\right)dx_i+\left(\frac{\partial^2 R^i}{\partial x_i \partial x_j}+\frac{\partial^2 V^i}{\partial x_i \partial x_j}\right)dx_j+\left(\frac{\partial^2 V^i}{\partial x_i \partial k_i}-\frac{\partial^2 C^i}{\partial x_i \partial k_i}\right)dk_i+\frac{\partial^2 V^i}{\partial x_i \partial k_j}dk_j=0.$$

(8.3b)
$$\left(\frac{\partial^2 V^i}{\partial k_i \partial x_i}-\frac{\partial^2 C^i}{\partial k_i \partial x_i}\right)dx_i+\frac{\partial^2 V^i}{\partial k_i \partial x_j}dx_j+\left(\frac{\partial^2 V^i}{\partial k_i^2}-\frac{\partial^2 C^i}{\partial k_i^2}\right)dk_i+\frac{\partial^2 V^i}{\partial k_i \partial k_j}dk_j=0.$$

An investment k_i has an own-effect on firm i. Firm j's investment has a cross effect on firm i (through dk_j) only through market B ($\partial^2 V^i/\partial x_i \partial k_j$ and $\partial^2 V^i/\partial k_i \partial k_j$): *the cross-effect is a multi-market effect*. Both effects may entail a *direct effect* on a firm's marginal revenue or cost (equation 8.3a) or an *indirect effect* through a feedback effect from the output levels on the investment incentives (equation 8.3b).[5]

There are three specific cases to be discussed in this chapter. First, $V_B^i = -\beta k_i$, where β is the parametric price of a unit of capital. This case occurs if the factor markets are perfectly competitive on the supply and demand sides. Moreover, there is only one product market, A, which implies that the entrant is a new firm, *i.e.*, *de novo* entry occurs. This is the initial case studied by Dixit (1980). Equations 8.3 (a and b) show that firm i's investment only has own effects ($\partial^2 V^i/\partial x_i \partial k_j = \partial^2 V^i/\partial k_i \partial k_j = 0$). Firm 1's investment reduces its *own* marginal cost (in equation 8.3a - a direct effect). This raises its output level (which in turn increases its investment by an indirect feedback effect in equation 8.3b) and reduces firm 2's marginal revenue.

The second case is the *horizontal* multi-market competition case, where the firms sell in related product or country markets. Firm 2 is an established-firm entrant, whose home market is market B. In case of symmetry both firms have $V_B^i = R_B^i(k_1-x_1,k_2-x_2)-\beta k_i$, the revenue when firm i sells its excess capacity (k_i-x_i) in product market B, minus the capacity costs as above. Capacity can be used for sales in either product market, if it is specific to the set of related markets as a whole, rather than to any market in particular. In other words, it may be firm- rather than product-specific. Each firm allocates its sales across markets A and B such that at the margin the (net) revenues of selling a product are equal: $MR_i^A(x_1,x_2) = MR_i^B(k_1-x_1,k_2-x_2)$, which implies that the opportunity cost of selling in market A consists of the marginal revenue of selling the product in market B instead. Since k_1 affects firm 1's sales in market B, it affects firm 2's marginal revenue there, which constitutes its marginal cost in market A. This implies the existence of direct and indirect cross effects (if $\partial^2 R_i^B/\partial x_i \partial k_j \neq 0$ and $\partial^2 R_i^B/\partial k_i \partial k_j \neq 0$).

In the case of *vertical* multi-market competition, firms compete in an input market as well as in the product market. The input markets may be imperfectly competitive rather than perfectly competitive as in Dixit (1980). For example, V_i^B

5. Dixit (1986, p. 113) also uses these terms, with a different meaning however.

$= -B(k_1,k_2)$, the sunk costs of acquiring k_i units of capital, given investments k_j by the other firm. The incumbent firm may use its market power in the input markets to raise entry costs. For instance, its demand for inputs may affect input prices, which in turn shifts the second mover's reaction curve. This will affect firm 2's investment decision and thus its marginal costs. There is an indirect cross effect ($\partial^2B/\partial x_i\partial k_j = 0$ and $\partial^2B/\partial k_i\partial k_j \neq 0$). The mechanisms underlying vertical and horizontal multi-market competition are, therefore, closely related. In both cases firm 1 has a mechanism for a cross effect, which allows it to shift firm 2's reaction curve in market A.

Table 8.1
Cross-effects of investments

Entrant	Factor markets	
	Perfect competition	Imperfect competition
New firm	No cross-effect Dixit (1980) Section 8.5	Indirect cross-effect Salop and Scheffman (1983) Section 8.7
Established firm	Direct and indirect cross-effects Calem (1988) and others Section 8.6	-

Table 8.1 relates these three cases of interest to some of the literature and the sections where they are discussed. The next section gives an example. This provides an institutional setting that may serve as a background for the subsequent sections 8.5 to 8.7.

8.4 AN EXAMPLE: THE U.S. STEEL INDUSTRY

Capacity investments will be the central instrument in competition for capital-intensive industries. These industries include food processing, textile fabrics, basic metals and chemicals, stone and clay, and pulp and paper (Ghemawat, 1991, p. 28; from D.J. Collis). They produce fairly homogeneous commodities (which rules out product characteristics as instruments in competition), the technology is largely mature (which rules out R&D as an important instrument), and the markets are quite concentrated (*e.g.*, Lieberman, 1987, p. 612). These industries inspired economists to develop the capacity-commitment models with (usually) homogeneous products and given technology.

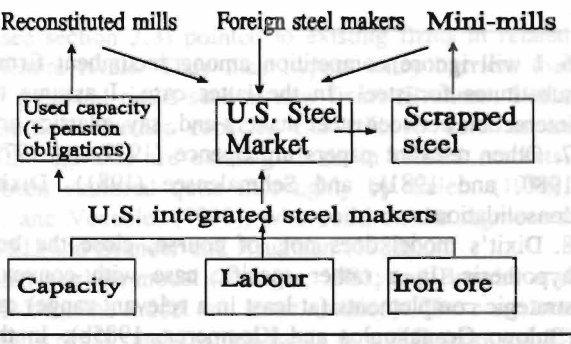
The U.S. steel industry is an example. In the first part of the century it was dominated by 'Big Steel', *i.e.*, large, integrated, full-line steel manufacturers, such as U.S. Steel (the largest one), Bethlehem and Armco. U.S. Steel was the long time price leader since its creation by merger in 1901 (Scherer, 1980, pp. 178-180). They derived a first-mover advantage from their capacity commitments. They seem to have (had) few other advantages. Notwithstanding its size, for

instance, U.S. Steel did not have a cost advantage over smaller rivals (Scherer, 1980, p. 239). After the second world war Big Steel faced import competition from foreign manufacturers. The importers' market share increased to nearly 20% of the American market by 1968 (Scherer, 1980, p. 179) and 26% in the mid-1980s (*Fortune*, 9-3-92, p. 28). The steel industry responded by lobbying for protectionism, which gave rise to a VER (voluntary export restraint) in 1984 to limit imports to 20% of the market (*The Economist*, 16-5-92, pp. 101-2).

Big Steel faced new domestic competition as well, however. Mini-mills arose, such as Nucor Corp., Birmingham Steel, and Chaparral, which make steel from scrap rather than from ore as the integrated steel makers do. The mini-mills derive a cost advantage from being non-unionised, with wages a half and a third of what unionised workers receive (*The Economist*, 16-5-92, pp. 101-2). Nucor, moreover, is a very innovatory firm (*Fortune*, 24-2-1992, pp. 50-55). Import and domestic competition caused excess capacity to which Big Steel reacted by closing plants. This, however, is a costly affair. The U.S. steel manufacturers pioneered internal labour markets from the mid-1890s on (Elbaum, 1983, p. 262). By 1980, U.S. steel wages were almost double those in Japan and West Germany (*The Economist*, 16-5-92, pp. 101-2). Employee protection also means that closing plants is costly due to the obligation to fund the pension liability. 'One way steelmakers minimise future pension obligations is to sell assets for a song rather than shut them down. Geneva Steel, Weirton Steel, and Gulf States Steel are composed of plants bought from the big integrated outfits' (*Fortune*, 23-3-1992, p. 29). These 'reconstituted mills' are an additional source of new competition. Geneva Steel, for instance, was created in 1987 from a U.S. Steel mill after its new owners gained concessions from the union which the latter had apparently been unwilling to give to U.S. Steel itself (*ib.*, p. 29).

Figure 8.2

Entry in the U.S. Steel Industry



This example shows several types of entrants with different strategies. Figure 8.2 illustrates the setting. The figure is grafted on Porter's (1980, p. 4) *extended rivalry* scheme in a multi-market setting (see figure 2.1). The U.S. steel makers compete with the buyers from their excess capacity (the reconstituted mills), firms using substitutes for iron ore (mini-mills using scrap), and with new entrants (*e.g.*, mini-mills) as well as established-firm entrants (*e.g.*, foreign steel makers). Backward integration entry (by a buyer of steel) occurred when Nucor, originally a producer of steel construction joists, started producing its own steel (*Fortune*, 24-2-1992, p. 51). A multi-market framework points to the vertical interactions between the

steel market and input markets, notably the labour market, the raw materials markets (ore or scrap), and the markets for new and used capacity (the reconstituted mills). It also points to the horizontal interaction between the U.S. steel market and foreign countries (giving rise to import competition). The subsequent sections show how dominant firms, such as Big Steel, may use capacity as an instrument in these competition games.[6]

8.5 *DE NOVO* ENTRY

The initial capacity-commitment model features *de novo* entry where the potential entrant invests from scratch, *i.e.*, it is not committed to any capacity or output level (Dixit, 1980).[7] The incumbent firm is the first mover in the game: by the time the entrant makes its (investment) move, the first mover has its investments already in place. Both firms are price takers in the capacity input market, with a unit capacity price β.

In the 'narrow' definition of capital as capacity, the upfront investment reduces marginal costs from $w+\beta$ to w (see section 8.3). Consider the special case where entry is profitable if the incumbent firm's marginal cost is $w+\beta$, and unprofitable if equal to w. To deter entry, the incumbent firm may commit capacity in order to reduce its marginal cost to w. This implies a capacity such that $x_1^d \leq k_1$, where x_1^d is the duopoly output level if entry occurs. If firm 2 does not enter, firm 1 produces its monopoly output level x_1^m. Since in normal conditions this quantity exceeds the duopoly output level, excess capacity is not required to deter entry (*i.e.*, $x_1^d \leq k_1 \leq x_1^m$). This model shows that the incumbent firm may deter entry even though the entrant knows, contrary to the Sylos' Postulate, that the incumbent firm will reduce its output level in the face of entry. The point is, it will not reduce its output level enough to make entry worthwhile. This gives the meaningful result that although capacity has a strategic role here, this does not mean that excess capacity is required.[8] Lieberman (1987) tests (and rejects) the hypothesis that firms use excess capacity as an entry barrier. His data

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6. I will ignore competition among incumbent firms as well as competition by substitutes for steel. In the latter case, I assume that there is no oligopolistic interaction between steel makers and, say, plastics or ceramics makers.

7. Other relevant papers are Spence (1977 and 1979), Eaton and Lipsey (1979, 1980, and 1981), and Schmalensee (1981). Dixit (1986) provides an early consolidation.

8. Dixit's model does not, of course, close the book on the 'excess capacity' hypothesis. In a rather specific case with convex demand, output levels are strategic complements (at least in a relevant range) rather than strategic substitutes (Bulow, Geanakoplos and Klemperer, 1985b). In that case, the incumbent firm may expand its output upon entry (*i.e.*, $x_1^m < x_1^d$). Excess capacity (since $x_1^m < x_1^d$ and $x_1^d \leq k_1$) is required to deter entry. Eaton and Lipsey (1981) resurrect the excess capacity idea in a dynamic case with finitely durable ('radioactive') capital. The incumbent firm chooses excess capacity knowing that if entry occurs, its disinvestments take longer the larger its capacity. The incumbent firm does reduce output upon entry but not fast enough to make entry profitable.

are a set of 38 chemical products over a 20 year period. Of these products, ten had chronic excess capacity. In only three of these did excess capacity appeared to have been created or used for the sake of entry deterrence. Entry occurred in all but six products; the latter include titanium dioxide, a case to be discussed later.

In the 'broad' definition of capital, total costs are $TC^i = C^i(x_i,k_i)+\beta k_i$. Given an output level x_i, total costs are U-shaped in capital with a minimum where $TC^i_{ki} = C^i_{ki}+\beta = 0$. The game is a two-stage one: first firm 1 chooses k_1 and next both firms choose their quantities x_i as well as k_2. Since firm 2 cannot use capital as a commitment instrument it chooses a capital stock to minimise its costs given its output x_2. In the first stage, firm 1's investment shifts its reaction curve outward by reducing its marginal costs. The result is called an *over- (under-) investment* relative to a benchmark where capital has no (perceived) commitment value, *e.g.*, because it is not observed by the rival.[9]

The (over-)investment result depends upon the type of product market competition. If the products are strategic substitutes, *e.g.*, in a Cournot duopoly, the incumbent firm over-invests and the entrant anticipates this, either by reducing its scale of entry (*i.e.*, Bain's ineffectively impeded entry or partial entry deterrence) or by backing out altogether (*i.e.*, effectively impeded entry or total entry deterrence). Under-investment results with Bertrand competition (Dixit, 1986) and a competitive product market (Dixon, 1985). In a Japanese recession cartel, over-investment may occur (Matsui, 1989). Hall (1990) tests Dixit's (1980) model [with the broad definition of capital] for the U.S. titanium dioxide industry, with Du Pont as the preempting incumbent and its rivals as second movers. Titanium dioxide is a bulk chemical. She finds that in the period 1972-77, Du Pont increased its capacity in an effort to preempt at least some of its rivals, namely those who had the potential to expand their market share in the future.

8.6 COMPETITION IN MULTIPLE PRODUCT MARKETS

The ease-of-entry approach (see section 3.3) pointed to existing firms in related markets as highly salient potential rivals. They may bypass entry barriers that seem unsurmountable to other potential rivals such as new firms (Brunner, 1961, p. 250). This raises the question whether capacity can still be used as an instrument to deter entry if the entrants are existing rivals in related markets. Fortunately, this game has been explored quite thoroughly by Calem (1988), Anderson and Fischer (1989), and Venables (1990), who build on the segmented markets model in Brander (1981) and Brander and Krugman (1983).

First consider the segmented markets model (Brander, 1981; and Brander and Krugman, 1983) (see section 5.2 for the model and some notation). There are two firms, 1 and 2 (denoted by subscripts), and two markets, A and B (denoted by

9. The benchmark for over- or underinvestment in this section and section 8.7 is the investment level that would minimise costs given the output level that itself arises because of strategic interaction. Bulow *et al.* (1985) proposed this benchmark.

superscripts). Firm 1 is the incumbent firm in A and firm 2 in B. The game is a one-stage, two-market Cournot duopoly. Simultaneously each firm chooses sales x_i^j (i = 1,2; j = A,B) for both markets. Marginal costs c_i^j are c_i in the home and c_i+t_i in the entry market, where c_i and t_i are constant unit costs. The products are homogeneous, and the inverse demand function is $p^j(x_1^j+x_2^j)$ (j = A,B). The firms treat the two markets as completely separate (see definition 5.1). Profits are $\pi_i = \Sigma_j[p^j(x_1^j+x_2^j)-c_i^j-\beta_i]x_i^j$; where β_i is the constant unit capacity cost. In each market each firm maximises profits. The first-order condition for optimality implies that marginal revenue, $(\partial p^j/\partial x_i^j)x_i^j+p^j$, equals marginal cost, $c_i^j+\beta_i$. Figure 8.1 can be interpreted as pertaining to market A. Call this the *one-stage game*.

Now introduce capacity investments. Each firm chooses capacity, k_i (i = 1,2) with costs $C(k_i)$. This allows it to produce up to the capacity constraint with marginal costs $c_i(+t_i)$ as above. If sales exceed the capacity constraint, the marginal cost can be said to be infinite (which rules out sales beyond the capacity constraint). If the investment implies complete preproduction, c_i refers to distribution costs and may be zero. Simultaneously firms choose capacity levels k_i and output levels (x_i^j), with the constraint that $\Sigma_j x_i^j \leq k_i$ (i = 1,2; j = A,B). Call this the *simultaneous game* (Anderson and Fischer, 1989). Assume that capacity will be fully utilised, such that $x_i^B = k_i - x_i^A$. By implication each firm has two decision variables. For instance, given x_2^A and k_2, firm 1 chooses x_1^A and k_1 to maximise its profits

(8.4) $\pi_1 = [p^A(x_1^A+x_2^A)-c_1]x_1^A+[p^B(k_1-x_1^A+k_2-x_2^A)-c_1-t_1][k_1-x_1^A]-C(k_1)$.

A similar equation holds for firm 2. Hence

(8.5a) $\partial\pi_1/\partial x_1^A = 0 = p_x^A x_1^A+p^A-c_1-p_x^B[k_1-x_1^A]-[p^B-c_1-t_1]$,
(8.5b) $\partial\pi_1/\partial k_1 = 0 = p_x^B[k_1-x_1^A]+p^B-c_1-t_1-C_{k1}$, and
(8.5c) $\partial\pi_2/\partial x_2^A = 0 = p_x^A x_2^A+p^A-t_2-p_x^B[k_2-x_2^A]-p^B$.

This determines x_1^A as a reaction function of x_2^A (8.5a) and *vice versa* for firm 2 (8.5c). The intersection of the reaction curves defines a Cournot equilibrium. If a firm were to defect from the equilibrium, marginal revenue would fall below the *ex ante* marginal production cost, c_i+C_{ki}, but for a small change it will still exceed the *ex post* marginal cost, c_i. Thus the firm will sell all output at the new capacity level. This validates the full capacity utilisation assumption above.

Because of simultaneity, a firm's capacity decision has no effect on the other firm's output decisions. In the absence of a strategic role, each firm chooses output levels such that marginal revenue equals marginal cost (which follows from 8.5a and 8.5b). Capacity just equals the sum of these optimal sales levels. Since this result also holds for the one-stage game, the outcome of the simultaneous game is identical to the one-stage game if the segmented markets and constant returns assumption hold. The latter implies that $C(k_i) = \beta_i k_i$.

Strategic moves come in if competition is a two-stage game. In the first *capacity stage*, firms choose k_i. Knowing each other's capacity in the second, *allocation stage*, the firms choose sales levels (x_i^j). This stage is identical to the

one-stage game, except for the binding capacity constraint. Call this the *sequential game* (Calem, 1988; Anderson and Fischer, 1989; and Venables, 1990). The second stage entails reaction curves in output levels, identical to equation (8.5a). Given these second-stage reaction curves, in the first stage both firms choose a capacity k_i (i = 1,2). To find their effect, totally differentiate the first-order conditions for both firms to the sales x_i^A and the capacities, k_i. This gives:

$$(8.6)\quad \begin{bmatrix} p_{xx}^A x_1^A + p_{xx}^B[k_1 - x_1^A] + 2p_x^A + 2p_x^B & p_{xx}^A x_1^A + p_{xx}^B[k_1 - x_1^A] + p_x^A + p_x^B \\ p_{xx}^A x_2^A + p_{xx}^B[k_2 - x_2^A] + p_x^A + p_x^B & p_{xx}^A x_2^A + p_{xx}^B[k_2 - x_2^A] + 2p_x^A + 2p_x^B \end{bmatrix} \begin{pmatrix} dx_1^A \\ dx_2^A \end{pmatrix} =$$

$$\begin{bmatrix} p_{xx}^B[k_1 - x_1^A] + 2p_x^B & p_{xx}^B[k_1 - x_1^A] + p_x^B \\ p_{xx}^B[k_2 - x_2^A] + p_x^B & p_{xx}^B[k_2 - x_2^A] + 2p_x^B \end{bmatrix} \begin{pmatrix} dk_1 \\ dk_2 \end{pmatrix}.$$

Consider first the case when firms use their output levels rather than capacity as competition instruments. If $dk_1 = dk_2 = 0$ and $dx_i^A = -dx_i^B$ then equation 8.6 gives the slope of the reaction curves R_i in figure 8.1. The diagonal elements in the 2x2 matrix G in the left hand side in equation 8.6 can be characterised as $G_{ii} = \partial^2\pi_i/\partial x_i^{A2}$ and the off-diagonal elements as $G_{ij} = \partial^2\pi_i/\partial x_i^A \partial x_j^A$. This gives the familiar result that the slope of the reaction curve $dx_1^A/dx_2^A = -G_{12}/G_{11}$ (Tirole, 1988, p. 207). The reaction curves are downward sloping if sign $(G_{ij}/G_{ii}) > 0$. The second-order conditions to equation 8.6 imply that $G_{ii} < 0$. Also, $G_{ij} < 0$ (i $\neq$ j) if demand is linear ($p_{xx}^j = 0$, j = A,B) or not 'too' convex (where $p_{xx}^j > 0$).

If capacity is given and the capacity constraint is binding, the firm faces a negative multi-market supply spillover. By raising its sales in market A from x_1^A to $x_1^{A'}$, firm 1 reduces capacity in market B from $x_1^B = k_1 - x_1^A$ to $k_1 - x_1^{A'}$. That is, the sales level x_1^B is no longer possible. This raises the cost of the marginal unit (x_1^B) from $c_1 + t_1$ to infinite. Increasing sales in A thus reduce the marginal profitability in B from $\partial\pi_1/\partial x_1^B$ to minus infinite, which entails a negative multi-market spillover. If the capacity constraint is not binding, the spillover is zero: sales can change in market A without effect on the profitability of the marginal unit in market B.[10]

With downward-sloping reaction curves, an increase in x_1^A reduces x_2^A and thus (given k_2) raises x_2^B: by increasing its home market sales, firm 1 reduces the scale of entry in its market. This result is similar to Bain's limit output argument, and the same critique by Dixit (1980) in section 8.2 holds: firm 1 does not have a commitment to increase its home market sales. An irreversible move (an investment) is required.

A change $dk_i > 0$ in equation 8.6 represents a shift of the reaction curve R_i (in figure 8.1). Total differentiation of firm 1's profit function (8.4) gives

10. This validates table 5.2, where an unanticipated local demand shock (leading to an increase of sales in one market) leads to a spillover effect if the shared resource is a private good.

$$(8.7)\quad d\pi_1 = \left[p_x^A x_1^A + p^A - c_1 - p_x^B(k_1 - x_1^A) - p^B + c_1 + t_1\right]dx_1^A + \left[p_x^A x_1^A - p_x^B(k_1 - x_1^A)\right]dx_2^A + \left[p_x^B(k_1 - x_1^A) + p^B - c_1 - t_1 - \beta_1\right]dk_1 + p_x^B(k_1 - x_1^A)dk_2.$$

The coefficient of dx_1^A equals zero because of equation 8.5a [which is an application of the envelope theorem]. A reduction of firm 2's sales in market A ($dx_2^A < 0$) raises firm 1's aggregate profits if $p_x^A x_1^A - p_x^B(k_1 - x_1^A) < 0$. This is plausible: due to equation (8.5a) $p_x^A x_1^A - p_x^B(k_1 - x_1^A)$ equals $p^B - p^A - t_1$, which is negative if there is cross-market symmetry ($p^A = p^B$) and $t_1 > 0$, or if transport costs t_1 are sufficiently large. If an investment by firm 1 induces firm 2 to opt out of firm 1's home market into its own home market B ($dx_2^A < 0$), firm 1's aggregate profits increase. There is a prisoners' dilemma as both firms would benefit if each would back out to its home market. This result gives the rationale for the *spheres-of-influence* hypothesis (Scherer, 1980, pp. 340-342; Bernheim and Whinston, 1990; see subsection 5.5.5).[11] Equations (8.6) and (8.7) solve for dx_i^A, and give $d\pi_1$ as a function of dk_i.

I will first give an interpretation of the model in equations (8.4) to (8.7). In line with section 8.3, (8.5c) can be rewritten as equality of the marginal revenues, MR_2^j (j = A,B), net of marginal costs in both markets:

$$(8.5c')\quad p_x^A x_2^A + p^A = p_x^B[k_2 - x_2^A] + p^B + t_2.$$

The right hand side, $MR_2^B + t_2$, is firm 2's opportunity cost of entry in market A. Whereas with *de novo* entry firm 2's marginal cost of entry, $c_2 + \beta_2 + t_2$, is exogenous to firm 1, in the case of related-firm entry its opportunity cost of entry is *endogenous* to firm 1, which accounts for a strategic effect of capacity (Calem, 1988, p. 172). Firm 1's investment changes its allocation dx_1^j (j = A,B). That is, $dk_1 > 0 \rightarrow dx_1^j > 0 \rightarrow dMR_2^j < 0$. The investment reduces firm 2's marginal revenue from export (MR_2^A), which is the classical own effect in figure 8.1. It also reduces $MR_2^B + t_2$, which is the cross effect. The investment may *raise* the rival's opportunity cost of entry relative to its marginal revenue from entry if $dMR_2^A < dMR_2^B < 0$. It thereby reduces the scale of entry. Equation (8.6) demonstrates this. Rewrite its second row into

$$(8.6b')\quad [p_{xx}^A x_2^A + p_x^A]dx_1^A - [p_{xx}^B(k_2 - x_2^A) + p_x^B]dx_1^B = -G_{22}dx_2^A;$$

where $dx_1^B = dk_1 - dx_1^A$, the arguments in brackets [] are identical to $\partial MR_2^j/\partial x_1^j$ (j = A,B), and $dk_2 = 0$ (unilateral defection by firm 1). The left hand side is negative if $dx_1^A = dx_1^B$ and firm 1's allocation reduces firm 2's marginal revenue in market A relative to its marginal revenue in market B. If also $G_{22} < 0$, this will opt firm 2 to move out of market A, *i.e.*, $dx_2^A < 0$. Firm 1's investment may thus (partially) deter entry in market A by combining the own effect and the cross effect. To see whether this is feasible, I will solve equations (8.6) and (8.7)

11. This argument shows that, if markets are otherwise equal, spheres-of-influence are based on transport costs.

for four special cases.

Case 1. Linear demand.

Proposition 8.1. Capacity does not qualify as a commitment instrument if demand is linear.

Proof. Substitute linear demand, where $p_{xx}^j = 0$ (j = A,B), into equation (8.6) and use Cramer's rule to find

(8.8) $dx_i^A = (p_x^B/(p_x^A+p_x^B))dk_i$.

With unilateral defection by firm 1 ($dk_2 = 0$), it follows that $dx_2^A = 0$. If demand is linear, firm 1 is *unable* to use capacity as a commitment instrument in competition with firm 2 (Calem, 1988, p. 179; Anderson and Fischer, 1989, p. 175; and Venables, 1990, p. 30). Substitute $dk_2 = 0$ and $dx_2^A = 0$ in equation (8.7) to find that

(8.9) $d\pi_1 = [p_x^B(k_1-x_1^A)+p^B-c_1-t_1-\beta_1]dk_1$.

The firms are in equilibrium if the expression in brackets equals zero, *i.e.*, if marginal revenue equals marginal cost: $p_x^B(k_1-x_1^A)+p^B = c_1+t_1+\beta_1$. Since this is also the condition of the one-stage and the simultaneous games, it follows that their equilibrium outcomes pertain in this two-stage game as well. *QED*

The intuition is as follows (Venables, 1990, p. 36). If firm 1 increases its capacity k_1, it will adjust its allocation (x_1^j) such that marginal revenue falls by the same amount in both markets, thus preserving the equality in equation (8.5a). With linear demand, marginal revenue is linear and downward sloping in quantity: $MR_1^j = p^j+p_x^jx_1^j$, where p_x^j is constant, and j = A,B. Assume symmetric demand for the sake of the argument. Thus the reduction in marginal revenue does not depend upon the level of quantities, which may differ as $x_1^A > x_1^B$ if $t_1 > 0$, but only on the change in output levels. An identical reduction in marginal revenues requires identical sales' expansion in markets A and B: $dx_1^A = dx_1^B$ (which equation (8.8) confirms if $p_x^A = p_x^B$). But, again with linear demand, this reduces firm 2's marginal revenues in both markets by an identical amount. Thus firm 2 has no incentive to adjust its allocation if demand is linear.

Case 2. Cross-market symmetry.
Assume symmetry of the cost and demand functions. That is, $c_i = c$, $t_i = t$, $\beta_i = \beta$ and $p^j(x) = p(x)$ (i = 1,2 and j = A,B). It seems acceptable to assume that the associated equilibrium is symmetric, that is, $k_i = k$ (i = 1,2), $p_{(x)(x)}^j = p_{(x)(x)}$ (j = A,B), $x_1^A = x_2^B = k_2-x_2^A$, and $x_2^A = x_1^B = k_1-x_1^A$. It follows that $x_1^A+x_2^A = k$. Substitute these assumptions in equations (8.6) [using Cramer's rule] and (8.7) to get

(8.10a) $dx_2^A = \frac{1}{4}(p_{xx}/p_x)(x_1^A-x_2^A)dk_1$,

(8.10b) $dx_1^{\wedge} = \frac{1}{2}dk_1 - dx_2^{\wedge}$, and

(8.10c) $d\pi_1 = p_x(x_1^{\wedge} - x_2^{\wedge})dx_2^{\wedge} + [p_x(k_1 - x_1^{\wedge}) + p - c - t - \beta]dk_1$.

Substitute equation (8.10a) in (8.10c) to find that

(8.11) $d\pi_1 = [\frac{1}{4}p_{xx}(x_1^{\wedge} - x_2^{\wedge})^2 + p_x(k_1 - x_1^{\wedge}) + p - c - t - \beta]dk_1$.

Proposition 8.2. If there is intra-market symmetry ($t = 0$ and $x_1^{\wedge} = x_2^{\wedge}$), capital has no commitment value and the outcome is identical to the simultaneous game.

Proof. If $x_1^{\wedge} = x_2^{\wedge}$, firm 1 is both unable (equation 8.10a) and unwilling (equation 8.10c) to affect firm 2's output level. In either case, the equilibrium is attained, *i.e.*, $d\pi_1/dk_1 = 0$, if $p_x(k_1 - x_1^{\wedge}) + p = c + t + \beta$, that is, combining this with equation 8.5c', if in each market marginal revenue equals the (*ex ante*) marginal cost. Since this is the condition underlying the one-stage and simultaneous equilibrium, the simultaneous game outcome holds. In the simultaneous game the intra-market symmetry, $x_1^{\wedge} = x_2^{\wedge}$, implies absence of transport costs: $t = 0$. No entry deterrence occurs, and capacity has no commitment value. *QED*

The adjustment (transport) cost t may indicate the product- (location-) specificity of the firm's capacity. If $t = 0$, capacity is non-specific: it can without costs be used for either (product or country) market. Non-specific capacity is, therefore, not a commitment, which is consistent with the basic idea in capacity-commitment models:

> 'If capital is to be used as a vehicle for commitment, it is then clear that the capital must be product-specific in some degree' (Eaton and Lipsey, 1981, p. 594).

If $p_{xx} \neq 0$ and $x_1^{\wedge} - x_2^{\wedge} \neq 0$, equilibrium is attained if $p_x(k_1 - x_1^{\wedge}) + p - c - t - \beta = -\frac{1}{4}p_{xx}(x_1^{\wedge} - x_2^{\wedge})^2$. If demand is concave, *i.e.*, if $p_{xx} < 0$, this implies that $p_x(k_1 - x_1^{\wedge}) + p > c + t + \beta$, that is, marginal revenue exceeds the (*ex ante*) marginal cost. Production, therefore, falls short of the outcome in the simultaneous game. Each firm under-invests relative to the simultaneous game.[12] If demand is convex, *i.e.*, if $p_{xx} > 0$, then $p_x(k_1 - x_1^{\wedge}) + p < c + t + \beta$: sales exceed the level in the simultaneous game, and firms over-invest relative to it. For intuitive explanations of these results, I turn to two special cases of the symmetry case. They follow the

12. As a benchmark for judging over- or underinvestment, used in this section, the simultaneous game is a special case of the *open loop equilibrium*, where firms ignore (do not know) each other's investment choice when deciding about production levels. Fudenberg and Tirole (1984) proposed this benchmark.

same route as Anderson and Fischer (1989).[13] That is, start with a possible outcome and then find out whether this constitutes an equilibrium in the sequential game.

Case 3. The simultaneous equilibrium.
Anderson and Fischer (1989) explore the simultaneous equilibrium outcome. Substitute equation (8.5b) in equation (8.10c) to get

(8.12) $d\pi_1 = p_x(x_1^{\wedge}-x_2^{\wedge})dx_2^{\wedge}$.

Consider somewhat product-specific capital ($t > 0$) such that $x_1^{\wedge}-x_2^{\wedge} > 0$. Since $p_x < 0$, it follows from equation (8.12) that $\text{sign}(d\pi_1) = -\text{sign}(dx_2^{\wedge})$. To see whether $dx_2^{\wedge} < 0$, turn to equations 8.10(a and b). Since (from equation 8.10a) $\text{sign}(dx_2^{\wedge}) = -\text{sign}(p_{xx}dk_1)$, the following cases exist.

If demand is concave (*i.e.*, $p_{xx} < 0$), $\text{sign}(dx_2^{\wedge}) = \text{sign}(dk_1)$. If firm 1 would increase k_1, it raises its export level: $dx_1^{B} = dk_1-dx_1^{\wedge} = \frac{1}{2}dk_1+dx_2^{\wedge}$ (from 8.10b), where $dx_2^{\wedge}$ increases in k_1. Since dx_1^{B} ($= \frac{1}{2}dk_1+dx_2^{\wedge}$) increases more than $dx_1^{\wedge}$ ($= \frac{1}{2}dk_1-dx_2^{\wedge}$), firm 2's marginal revenue in market A would increase more than in market B. Firm 2 reacts to this by reallocating output (given its capacity) out of its home market B into market A ($dx_2^{\wedge} > 0$). *Entry induces reciprocal entry* (see sections 2.5 and 5.2). The net effect in figure 8.1 is that firm 2's reaction curve in market A, R_2, shifts upward. This move may be very unwelcome to firm 1, as total output increases in its most profitable market (the home market A). In this case, firm 1 contracts its capacity relative to the simultaneous outcome. Under-investment deters entry, *i.e.*, reduces $x_2^{\wedge}$ (equation 8.10a), which raises profits (equation 8.12). Trade ($= x_1^{B}+x_2^{\wedge}$) decreases as well, which implies a (small) move towards spheres-of-influence.

If demand is convex (*i.e.*, $p_{xx} > 0$), firm 1's over-investment reduces $x_2^{\wedge}$ by equation 8.10a, which raises firm 1's profits by equation 8.12 (Anderson and Fischer, 1989, p. 178; and Venables, 1990, p. 36). Entry by firm 1 into market B induces firm 2 to (partially) exit from market A. Entry deterrence (in A) by entry (into B), therefore, a paradox which has been called *counter-competition*

13. Explicit solutions of the second stage and first stage of the game are cumbersome and difficult to interpret. I am unable to prove in general that capacity investments are strategic substitutes, *i.e.*, that the first-stage reaction curves in capacity are downward sloping. The following thought experiment suggests that capacities are strategic substitutes in the special case where they have no commitment value (that is, if demand is linear or transport costs are zero). If firm 1, *e.g.*, is informed of firm 2's capacity choice, it knows how much sales firm 2 will have in each market (this does not depend on firm 1's capacity choice if capacity has no commitment value). It thus knows which output levels it would like to offer in each market (given a Cournot duopoly) in the absence of a binding capacity constraint. Its capacity choice aggregates these output levels (again, this is because capacity has no commitment value). Since output levels are usually strategic substitutes (see Bulow, Geanakoplos and Klemperer, 1985b, for an exception), the same will hold for the capacity levels.

(Watson, 1982; section 2.5). That is, R_2 in figure 8.1 shifts downward and firm 1 over-invests relative to the simultaneous equilibrium. The next question is whether entry is completely deterred.

Case 4. Entry deterrence.
If entry is deterred, $x_1^A = k_1 = k$, $x_1^B = 0$, $x_2^B = k_2 = k$, and $x_2^A = 0$. This is again a special case of case 2 with $t > 0$. Substitute these assumptions in equation (8.5a) to see whether firm 1 will defect in the second stage of the game (for a given capacity level k). Defection (*i.e.*, $dx_1^A < 0 < dx_1^B$) is profitable if $\partial\pi_1/\partial x_1^A < 0$, *i.e.*, if $p_x k+t < 0$. Entry will occur. To see if entry deterrence is possible, assume a transport cost sufficiently high that this not hold, *i.e.*, $k \leq t/(-p_x)$. Substitute $x_1^A = x_2^B = k$ and $x_1^B = x_2^A = 0$ in equations 8.10(a and c):

(8.13a) $dx_2^A = \max\{0, \frac{1}{4}(p_{xx}/p_x)k dk_1\}$, and
(8.13b) $d\pi_1 = p_x k dx_2^A + [p-c-t-\beta]dk_1$.

Equation (8.13a) takes into account that $x_2^A = 0$, such that a change can only be positive. If demand is linear, an investment by firm 1 ($dk_1 > 0$) will not affect firm 2's output level (equation 8.13a). The same holds if demand is convex ($p_{xx} > 0$) and firm 1 expands its capacity. In both cases, firm 1 will expand its output level in order to export to market B, which is profitable if the monopolist's price p exceeds the marginal export cost, $c+t+\beta$ (equation 8.13b). This is the same condition that underlies Brander's (1981) one-stage trade model. Capacity, therefore, fails to deter entry. If, on the other hand, demand is concave ($p_{xx} < 0$), an investment by firm 1 and associated entry induces reciprocal entry by firm 2: $dx_2^A > 0$ (equation 8.13a). This in turn reduces firm 1's entry profit by $p_x k dx_2^A$, where k is firm 1's sales level in market A (equation 8.13b). Entry, that is, has an opportunity cost based on marginal production costs ($c+t+\beta$) plus home market profits foregone. The entry profit is wiped out completely if $\frac{1}{4}p_{xx}k^2+p-c-t-\beta \leq 0$. This condition implies 'very' concave demand and 'high' transport costs t, such that the monopoly price is close to the marginal export cost. Complete entry deterrence is feasible only in this special case.

See table 8.2 for a summary of the results of all four cases, assuming that $t > 0$. Call m_i^A firm i's market share in market A, *i.e.*, $m_i^A = x_i^A/(x_1^A+x_2^A)$; k_i^S is firm i's equilibrium capital stock in the simultaneous game, and m_i^S the associated market share.

Table 8.2
Competition in two symmetric product markets

Demand curve	p_{xx}	Firm i's investment	Importer's market share (*e.g.*, m_2^A)
concave	< 0	$k_i < k_i^S$	$0 \leq m_2^A < m_2^{A,S}$
linear	$= 0$	$k_i = k_i^S$	$m_2^A = m_2^{A,S}$
convex	> 0	$k_i > k_i^S$	$0 < m_2^A < m_2^{A,S}$

The main implication from these models is that import competition undermines the commitment value of capacity. Only if $t > 0$ and demand is

convex, does firm 1 overinvest (some) capacity to deter entry (*i.e.*, to reduce firm 2's sales in market A). In another special case, with concave demand, both firms underinvest and may completely deter entry. The use of capacity as an entry deterring instrument against, for instance, import competition is highly circumscribed. This result differs rather starkly from the original capacity-commitment model. It tallies rather well with Big Steel's vulnerability to import competition after the war (see section 8.4).

The reason for these results is two-fold. First, the sequence of moves is different than in the *de novo* capacity-commitment model. In the latter model, the incumbent firm is the first mover: it invests before the entrant does. In a real world setting, such as in international trade, entrants are often established firms in other (product or country) markets. In this case, incumbent firm and potential entrant play symmetrical roles. Both commit to capacity simultaneously, each in its own home market.

Second, capital is not completely product-specific. As equation 8.5c' shows, the correct opportunity cost of selling at home is the marginal revenue abroad, rather than the marginal production or distribution cost. A capacity investment may reduce the marginal *production* cost (from $\beta+c$ to c) but it does not (*per se*) reduce the opportunity cost. Hence it fails to make the incumbent firm aggressive in its home market. The entrant knows this, and thus does not keep out of this market. The possibility of 'output shifting' undermines the commitment to the product market (Calem, 1988; and Anderson and Fischer, 1989). Capacity may have an indirect effect, though, by changing the entrant's opportunity cost (which is its home market marginal revenue, $MR_2^B+t_2$). In particular, the incumbent firm's investment may raise the entrant's opportunity cost of entry *relative* to its marginal revenue of entry, thereby reducing its scale of entry. The next section explores cases where the preemptive firm raises its rival's costs in *absolute* terms.

8.7 VERTICAL MULTI-MARKET COMPETITION

Bain (1962) mentioned absolute cost advantages as a particular class of entry barriers, which were important in the steel industry. He traced these advantages to input market conditions, *i.e.*, they arise if entry raises factor prices, incumbents secure factors at lower prices than entrants, or established firms have access to better factors than entrants (Bain, 1962, p. 14). He treats these cost differences as given to firms. However, a far-seeing incumbent firm may exploit these input market conditions in order to raise entry costs. If inputs need to be acquired prior to production, the incumbent firm may as it were ambush the entrant in the input market rather than in the product market (see subsections 3.3.3 and 6.4.1). This is salient only if the dominant firm and its (potential or actual) rivals participate in the same input market. It may not hold if the rivals are located in different regions or countries. Moreover, if the entrants are established firms, they may already own the required assets. The cost-raising strategy seems to aim at small rivals, a competitive fringe, or new (*de novo*) potential rivals. I will first focus on the intermediate product market, then on the capital goods market, and finally on the labour market.

8.7.1 Competition in the Intermediate Products Market

The dominant buyer of an intermediate product may affect the price charged to rival buyers by the sheer quantity of its purchases. For example, the dominant U.S. aluminum supplier Alcoa may have 'overbought' bauxite in order to raise its rivals' costs (Krattenmaker and Salop, 1986, p. 236).[14] The quantity of bauxite which Alcoa buys in the open market depends, in turn, on its vertical integration. In a make-or-buy context an investment reduces the demand for intermediate goods in the external market. A dominant incumbent firm may use its investments as an instrument to affect the external intermediate input price if the associated input market is imperfectly competitive. I will explore this argument in a variety of the cost-raising models in Salop and Scheffman (1983 and 1987) and Dixit (1986) (see subsection 6.6.3). Firm i (= 1,2) can invest in capital k_i to reduce the variable production costs $C^i(q_i,k_i)$. The quantity q_i refers to the firm's production of an intermediate input. The input can also be purchased in an external market, in a quantity of y_i units at price α. With a fixed proportions technology, one may normalise such that one unit of output requires one intermediate input: $x_i = q_i+y_i$, where x_i is the final good output. The intermediate product market is competitive on the supply side, with a supply function $\alpha = A(y_1+x_2)$, where A is a continuously differentiable function. In order to focus on market power in this market, assume that both firms are price takers in the capital goods market. Thus β is a parameter. The first mover, firm 1, is partially integrated with profits as in equation (8.1) with $V_B^i = -\beta k_i-\alpha y_i$:

(8.14a) $\pi^1 = R^1(x_1,x_2)-C^1(q_1,k_1)-\beta k_1-\alpha y_1$; with $x_1 = q_1+y_1$.

Firm 2, the second mover, is a new or small firm, which purchases all its inputs. Its profits are

(8.14b) $\pi^2 = R^2(x_1,x_2)-\alpha x_2$.

In the first stage, firm 1 chooses k_1; in the second stage, firm 1 chooses y_1 and q_1 and firm 2 chooses x_2. Profit maximisation in the second stage entails the first-order conditions:

(8.15a) $\partial\pi^1/\partial y_1 = 0 = R^1_{y1}(y_1+q_1,x_2)-A_{y1}(y_1+x_2)y_1-A(y_1+x_2)$;
(8.15b) $\partial\pi^1/\partial q_1 = 0 = R^1_{q1}(y_1+q_1,x_2)-C^1_{q1}(q_1,k_1)$; and
(8.15c) $\partial\pi^2/\partial x_2 = 0 = R^2_{x2}(y_1+q_1,x_2)-A_{x2}(y_1+x_2)x_2-A(y_1+x_2)$.

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14. Lopatka and Godek (1992) criticise the view that Alcoa raised the costs of electricity and bauxite to (potential) rival suppliers. They show that Alcoa was not a dominant buyer of these inputs. They misconstrue the cost-raising argument as implying the purchase of inputs which one does not use (*ib.*, p. 314). The model in this chapter reiterates that the issue rather is the purchase of more (or less) inputs than one would buy absent the cost-raising motive. But given a stock of inputs, one will generally utilise them fully (as production will imply zero marginal costs as far as these inputs are concerned).

The second-order maximisation conditions (suppressing arguments) imply that

(8.16) $R^1_{y1y1}-A_{y1y1}y_1-2A_{y1} < 0;$
$R^1_{q1q1}-C^1_{q1q1} < 0;$
$R^2_{x2x2}-A_{x2x2}x_2-2A_{x2} < 0.$

The first-order conditions implicitly define reaction curves. In the first stage, firm 1 anticipates on the shift of these reaction curves induced by its capacity investments k_1. To find these shifts, totally differentiate equations (8.15):

$$(8.17a)\quad \begin{bmatrix} R^1_{y_1y_1}-A_{y_1y_1}y_1-2A_{y_1} & R^1_{y_1q_1} & R^1_{y_1x_2}-A_{y_1x_2}y_1-A_{x_2} \\ R^1_{q_1y_1} & R^1_{q_1q_1}-C^1_{q_1q_1} & R^1_{q_1x_2} \\ R^2_{x_2y_1}-A_{x_2y_1}x_2-A_{y_1} & R^2_{x_2q_1} & R^2_{x_2x_2}-A_{x_2x_2}x_2-2A_{x_2} \end{bmatrix} \begin{pmatrix} dy_1 \\ dq_1 \\ dx_2 \end{pmatrix} = \begin{pmatrix} 0 \\ C^1_{q_1k_1} \\ 0 \end{pmatrix} dk_1 .$$

Call the 3*3 matrix D and its determinant Δ. In order to get stability of the Cournot-Nash equilibrium in equation 8.15 assume that $\Delta > 0$ (Dixit, 1986, p. 110). Before solving (8.17a), I will rewrite it for the sake of interpretation. Solve dq_1 as a function of dy_1, dx_2, and dk_1, and substitute, to get:

$$(8.17b)\quad \begin{bmatrix} R^1_{y_1y_1}-A_{y_1y_1}y_1-2A_{y_1}-\dfrac{R^1_{y_1q_1}R^1_{q_1y_1}}{R^1_{q_1q_1}-C^1_{q_1q_1}} & R^1_{y_1x_2}-A_{y_1x_2}y_1-A_{x_2}-\dfrac{R^1_{y_1q_1}R^1_{q_1x_2}}{R^1_{q_1q_1}-C^1_{q_1q_1}} \\ R^2_{x_2y_1}-A_{x_2y_1}-A_{y_1}-\dfrac{R^2_{x_2q_1}R^1_{q_1y_1}}{R^1_{q_1q_1}-C^1_{q_1q_1}} & R^2_{x_2x_2}-A_{x_2x_2}x_2-2A_{x_2}-\dfrac{R^2_{x_2q_1}R^1_{q_1x_2}}{R^1_{q_1q_1}-C^1_{q_1q_1}} \end{bmatrix} \begin{pmatrix} dy_1 \\ dx_2 \end{pmatrix} =$$
$$-\frac{C^1_{q_1k_1}}{R^1_{q_1q_1}-C^1_{q_1q_1}} \begin{pmatrix} R^1_{y_1q_1} \\ R^2_{x_2q_1} \end{pmatrix} dk_1 .$$

The formula shows that firm 1's investment dk_1 works both ways: it shifts its own reaction curve, the top row, which is the own effect in figure 8.1, and it shifts firm 2's reaction curve, the bottom row, which coincides with the cross effect. The reason is that firm 1's investment reduces its marginal production costs (the own effect), which induces it to buy less in the external market. This in turn affects firm 2's marginal costs (the cross effect). Applying Cramer's rule on equation (8.17a) gives $dx_2/dk_1 = \Delta^{-1}C^1_{q1k1}\{(R^2_{x2y1}-A_{x2y1}x_2-A_{y1})R^1_{y1q1}-R^2_{x2q1}(R^1_{y1y1}-A_{y1y1}y_1-2A_{y1})\}$. Simplify this by taking into account that with homogeneous products, $R^2_{x2y1} = R^2_{x2q1}$, $R^1_{y1q1} = R^1_{y1y1}$, $A_{x2y1} = A_{y1y1} = A_{yy}$, and $A_{y1} = A_y$. That is,

$$(8.18)\quad dx_2/dk_1 = -\Delta^{-1}C^1_{q1k1}\{A_{yy}(x_2R^1_{y1q1}-y_1R^2_{x2q1})+A_y(R^1_{y1q1}-2R^2_{x2q1})\}.$$

Total differentiation of firm 1's profit function gives

(8.19) $d\pi^1 = (R_{y1}-A_{y1}y_1-A)dy_1+(R^1_{q1}-C^1_{q1})dq_1+(R^1_{x2}-A_{x2}y_1)dx_2-(C^1_{k1}+\beta)dk_1 = 0.$

The coefficients of dy_1 and dq_1 equal zero because of equation (8.15). For convenience, assume that $A_{yy} = 0$, such that A_y is a constant. Rewrite revenues: $R^i = x_i p(x_1+x_2)$, where p(.) is the downward sloping inverse demand function for a homogeneous good. Then, $R^1_{y1q1}-2R^2_{x2q1} = (x_1-2x_2)p_{xx}$. It follows that the $\text{sign}(dx_2/dk_1) = \text{sign}(A_y(x_1-2x_2)p_{xx})$. This gives the result that a strategic or indirect effect of k_1 on x_2 is absent if and only if either (i) there are constant returns in the intermediate product market ($A_y = 0$), (ii) firm 2 is sufficiently small ($x_1 = 2x_2$), or (iii) demand is linear ($p_{xx} = 0$). The implication for firm 1's profits is:

(8.20) $d\pi^1 = -\{(R^1_{x2}-A_{x2}y_1)\Delta^{-1}C^1_{q1k1}A_y(x_1-2x_2)p_{xx}+(C_{k1}+\beta)\}dk_1.$

The optimal capital stock implies that the coefficient of dk_1 equals zero, *i.e.*,

(8.21) $C_{k1}+\beta = -(R^1_{x2}-A_{x2}y_1)\Delta^{-1}C^1_{q1k1}A_y(x_1-2x_2)p_{xx}.$

$R^1_{x2} < 0$ (condition C8.2). $R^1_{x2}-A_{x2}y_1$ will be negative if A_{x2} is either positive or negative but small in absolute size. The determinant Δ is positive. $C^1_{q1k1} < 0$ (condition C8.1). In that case, $\text{sign}(C_{k1}+\beta) = -\text{sign}(A_y(x_1-2x_2)p_{xx}) = -\text{sign}(dx_2/dk_1)$. In the case of Big Steel, over-investment and thus excessive integration will occur with the following conditions. The fringe rivals are small, *i.e.*, $x_1-2x_2 > 0$. Demand for steel may be concave, *i.e.*, $p_{xx} < 0$. The reason is that steel has substitutes (*e.g.*, aluminium, plastics, and ceramics). If the steel price increases above a threshold, users may switch to a substitute. If these thresholds hover around a similar steel price, steel demand may trail off strongly at a higher price. Demand may be concave if demand is inelastic below that price. Decreasing returns may exist in the raw material market ($A_y > 0$) if low-cost ore deposits are scarce. As a result, $C_{k1}+\beta > 0$. The function C_{k1} is negative (condition C8.1) and increases in k_1 if

(C8.3) $C^i_{kiki} \equiv \partial^2 C^i(x_i,k_i)/\partial k_i^2 > 0$ (decreasing returns to investments).

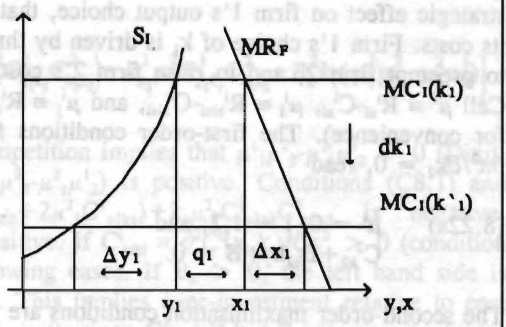
Since C_{k1} increases in k_1, the fact that $C_{k1}+\beta > 0$ in the strategic case and $C_{k1}+\beta = 0$ in the cost-minimising case implies that firm 1 over-invests relative to cost minimisation.

Figure 8.3 illustrates the case. Given firm 2's scale of entry, MR^F is firm 1's marginal revenue and S^I is the marginal cost of the intermediate inputs bought. An investment by firm 1 reduces its marginal production cost MC^I (the figure assumes constant returns). The firm will raise its production of the intermediate input, q_1, while buying less intermediate inputs ($\Delta y_1 < 0$). Because of the reduced marginal cost it raises its supply by Δx_1. The entrant suffers from the fall in the market price (as $\Delta x_1 > 0$) but benefits from the reduced market price of the intermediate product (as $\Delta y_1 < 0$). The own and cross effect partly cancel out in this case. The net effect may be negative, as a concave demand curve implies that an increase in output can cut price quite strongly. The entrant may reduce the

scale of its entry. The commitment value of capital therefore entails a strategic over-investment.[15] With convex demand, the entrant might benefit, in which case the firm may underinvest and 'overbuy' in order to raise the entrant's costs and reduce its output level (as $dx_2/dk_1 > 0$).

Figure 8.3

An Intermediate (I) and Final (F) Product Market



If there are constant returns to scale in the intermediate product market, *i.e.*, $A_y = 0$, firm 1's make-or-buy decision and associated investment level cannot be used as instruments in competition. This result differs from the Dixit (1980) model, where in the absence of market power in input markets, firm 1 does commit to capital in order to deter firm 2's entry. The reason is that in Dixit (1980) an investment reduces the firm's marginal cost. In the above model, however, partial integration implies that the firm's marginal cost equals the price of the externally acquired intermediate product, α. If $A_y = 0$, the marginal cost of buying inputs is pegged at a parametric α, which destroys the own effect. An investment reduces the firm's marginal in-house production cost, C'_{x1}, which changes the firm's 'make-or-buy' decision, y_1 versus q_1, but it does not affect its marginal production cost, α, and its total production, x_1. Firm 1 chooses k_1 and x_1 to minimise production costs without strategic implications.

8.7.2 Competition in the Capital Goods Market

I will now suppress the intermediate product market altogether, in order to focus on the capital goods market. If final good suppliers compete in (new) capacity, they may be confronted with capacity constraints in the capital goods industry. This provides the setting for Ghemawat's (1990) *snowball effect*, where two firms simultaneously bid for a given supply of (*e.g.*, newly produced) capital goods (subsection 6.6.1).

A model has cost functions as in equation (8.1) with $V_B^i = -B(k_1+k_2)k_i$,

15. Mr. Dixit points out (personal communication) that firm 1 may commit to buying external resources by entering into a long-run contract with external suppliers. A contract may indeed substitute for an over-investment in capital goods as a commitment instrument. Some well-known problems stand in the way of a contract as a commitment, however. First, contracts may be renegotiable, and second, firm 1 might sell excess resources (acquired by the contract) to other parties, *e.g.*, to a new entrant.

which reflects a continuously differentiable supply function $\beta = B(k_1+k_2)$. The capital goods market is competitive on the supply side. If there are decreasing returns to scale, *i.e.*, $B_k > 0$, the situation reflects capacity constraints in the capital goods industry in similar vein as Ghemawat (1990). In the first stage of the game, firm 1 chooses k_1 as before. In the second stage, firm 1 chooses x_1 and firm 2 chooses x_2 and k_2 simultaneously.[16] Firm 2's capacity choice has no strategic effect on firm 1's output choice, that is, firm 2 chooses k_2 to minimise its costs. Firm 1's choice of k_1 is driven by three motivations: to reduce its costs, to preempt firm 2, and to raise firm 2's costs. Consider the second stage first. Call $\mu^i \equiv R^i_{xi}-C^i_{xi}$, $\mu^i_i \equiv R^i_{xixi}-C^i_{xixi}$, and $\mu^i_j \equiv R^i_{xixj}$ (i,j = 1,2) (omit the arguments for convenience). The first-order conditions for profit maximisation, $\partial\pi^i/\partial x_i = \partial\pi^2/\partial k_2 = 0$, read

(8.22a) $\mu^i = 0$, i = 1,2; and
$C^2_{k2}+B_{k2}k_2+B = 0$.

The second-order maximisation conditions are

(8.22b) $\mu^i_i < 0$ (i = 1,2); and
$C^2_{k2k2}+B_{k2k2}k_2+2B_{k2} > 0$.

In the first stage firm 1 explores the effect of dk_1 on the second-stage decision variables by totally differentiating equations (8.22a). This gives:

(8.23) $\mu^1_1dx_1+\mu^1_2dx_2-C^1_{x1k1}dk_1 = 0$;
$\mu^2_1dx_1+\mu^2_2dx_2-C^2_{x2k2}dk_2 = 0$; and
$C^2_{k2x2}dx_2+(B_{k2k1}k_2+B_{k1})dk_1+(C^2_{k2k2}+B_{k2k2}k_2+2B_{k2})dk_2 = 0$.

Rewrite equations (8.23) as a linear system of dx_1, dx_2 and dk_2 in dk_1. Call Δ the determinant of the matrix, which is positive in order to guarantee stability of the equilibrium in (8.22a). Cramer's rule gives

(8.24) $dx_2/dk_1 = \Delta^{-1}\{-\mu^1_1C^2_{x2k2}(B_{k2k1}k_2+B_{k1})-\mu^2_1C^1_{x1k1}(C^2_{k2k2}+B_{k2k2}k_2+2B_{k2})\}$; and
$dk_2/dk_1 = \Delta^{-1}\{-(\mu^1_1\mu^2_2-\mu^2_1\mu^1_2)(B_{k2k1}k_2+B_{k1})+\mu^2_1C^1_{x1k1}C^2_{k2x2}\}$.

The B_{k2k1} factor shows firm 1's cost-raising competition, the cross effect, and the C^1_{x1k1} factor the own effect. To find the optimal k_1, firm 1 totally differentiates its profits:

(8.25) $d\pi^1 = \mu^1dx_1+R^1_{x2}dx_2-B_{k2}k_1dk_2-[C^1_{k1}+B_{k1}k_1+B]dk_1 = 0$.

16. This implies the simplifying assumption that although investment decisions (k_1, k_2) are sequential, pricing in the capital input market occurs simultaneously ($\beta = B(k_1+k_2)$). See Salop and Scheffman (1987, p. 28) for a similar assumption. Introducing time in the capital input markets makes for more cumbersome notation.

Investments have a rival's cost raising effect as well as the own effect (indirectly through dx_2 and dk_2) as well as cost reduction (directly through dk_1). Substitution of equations (8.22a) and (8.24) in (8.25) gives the total effect. For convenience, assume that the second derivative, B_{kk}, equals zero such that the first derivative, B_k, is constant. Rewrite (8.25) into:

$$(8.26) \quad C^1_{k_1} + B_k k_1 + \beta =$$

$$\frac{1}{\Delta}\left[-B_k\left(R^1_{x_2}(\mu^1_1 C^2_{x_2k_2} + 2\mu^2_1 C^1_{x_1k_1}) + k_1\mu^2_1 C^1_{x_1k_1} C^2_{k_2x_2}\right) - R^1_{x_2}\mu^2_1 C^1_{x_1k_1} C^2_{k_2k_2} + B^2_k k_1(\mu^1_1\mu^2_2 - \mu^2_1\mu^1_2)\right].$$

Stability of the product market competition implies that $\mu^1{}_1\mu^2{}_2 - \mu^2{}_1\mu^1{}_2 > 0$ (Dixit, 1980, p. 104), hence $(B_k)^2 k_1(\mu^1{}_1\mu^2{}_2 - \mu^2{}_1\mu^1{}_2)$ is positive. Conditions (C8.1) and (C8.2) imply that $R^1{}_{x2}(\mu^1{}_1 C^2{}_{x2k2} + 2\mu^2{}_1 C^1{}_{x1k1}) + k_1\mu^2{}_1 C^1{}_{x1k1} C^2{}_{k2x2}$ is negative. Moreover, $-R^1{}_{x2}\mu^2{}_1 C^1{}_{x1k1} C^2{}_{k2k2}$ is positive, if $C^i{}_{kik} \equiv \partial^2 C^i(x_i, k_i)/\partial k_i^2 > 0$ (condition C8.3). This gives rise to the following cases. If $B_k > 0$, the left hand side is positive. Thus $C^1{}_{k1} + B_k k_1 + B > 0$. This implies over-investment relative to cost minimisation, where $C^1{}_{k1} + B_k k_1 + B = 0$, since $C^1{}_{k1} + B_k k_1 + B$ increases in k_1 (as $C^1{}_{k1k1} > 0$, $B_k > 0$ and $B_{kk} = 0$). Thus if there are decreasing returns in the capital goods industry, the first mover overinvests both in order to preempt the second mover and to raise the costs at which it acquires capacity. This tallies with Ghemawat's (1990) result. If $B_k = 0$, the left hand side is still positive. This implies over-investment, that is, the outcome is identical to Dixit's (1980, pp. 103-104) model. If $B_k < 0$ there are increasing returns in the capital goods industry. This may give firm 1 an incentive to underinvest. This runs counter, however, to the commitment motive. If B_k is sufficiently strong, the left hand side in equation (8.26) may be negative, with under-investment as net outcome.

8.7.3 Competition by Raising Wage Costs

Nelson (1957) argues that labour unionisation resulting in higher wage rates might raise the quasi-rents of coal mines. In general, he shows that industry profits (quasi-rents) can increase if variable costs increase, even if the product market and factor markets are competitive, *i.e.*, firms are price takers, and if firms are symmetric. His analysis is short-run, that is, entry is barred, and capital is fixed. An increase in marginal (wage) costs raises the market price, and thus the industry producer surplus (given an upward sloping marginal cost curve). In the long run, of course, entry and investments (substituting for labour) will reduce the quasi-rent until it just covers the fixed capital costs. The short-run assumption implies that some imperfection (in factor and or product markets) must be assumed. Moreover, the increase of the cost must be an unanticipated shock, rather than deliberate firms' policy. Otherwise more firms would have entered the market initially, expecting to recover their capital outlays from the windfall gain. The analysis suggests that firms may raise the wage rate deliberately.

Williamson (1968) explored the Pennington case in the U.S. bituminous coal industry, where large coal mines and the United Mine Workers union conspired to raise the fringe firms' wage costs. They were able to do so since a wage increase agreed upon with the union was imposed upon all U.S. coal mines. Since

the small mines were less capital-intensive than the large ones, a wage increase would raise the former's unit costs more. This induced exit of small producers such as the Pennington mine. Exit would raise the market price, which may have overcompensated the large mines for the increasing wage rates, such that their profits increased. It remains implicit, however, how capital-intensive firms competed with labour-intensive firms to write a contract with the union that specified an industry-wage rate.

Gollier (1991) proposes to integrate Williamson's theory into modern labour economics (insider-outsider theory) and industrial organisation (entry deterrence). His attempt is valiant but the implementation seems deficient. His model has n homogeneous incumbent firms, and one potential entrant. Labour is the only input, sunk costs are absent, and the product market is competitive. In the second stage of the game, the entrant decides about entry taking as given the industry-wide wage rate w and price p. Each incumbent firm ($i = 1..n$) negotiates with a firm-specific union about an insiders' wage rate w^i ($\geq w$) and insiders' employment level. In the first stage of the game, the incumbent firms negotiate with a union to set an industry-wide minimum wage rate (w). Incumbent firms have a motive to raise the industry-wide wage rate w above a market wage (w'): by doing so they raise the entrant's cost. This reduces its output level and raises the market price (see figure 2 in Gollier, 1991, p. 401). This is, however, inconsistent with perfect competition where firms by definition assume that the effect of an individual firm on the market price is negligible. In the special case where Gollier (1991, p. 404) assumes that incumbent firms ignore the effect of the entrant's output level on the market price, he correctly shows that incumbents will not raise the industry-wide wage rate above the market wage rate.

Gollier's paper underplays the importance of asymmetry between incumbents and entrant. Assume symmetry in that each firm has access to the same technology. In that case, if $w^i > w$, the incumbents' unit costs exceed those of the entrant (*e.g.*, Varian, 1984, p. 44). With perfect competition in the product market, the incumbents' output and profit levels will be less than the entrant's. The worst incumbents can do, therefore, is to set w such that $w = w^i$. In this symmetry case any step taken to hurt the entrant hurts the incumbents in the same way. Entry deterrence will not occur, therefore. Entry deterrence will occur only if the entrant is 'very inefficient with respect to the incumbent's technology' (Gollier, 1991, p. 399). This is an *ad hoc* imperfection in the factor markets, considering that incumbent firms are assumed homogeneous. Moreover, if the entrant is inefficient, why bother with it if its output level is even smaller than those of the atomistic incumbents? These results appear to support my argument that cost-raising competition (in the labour market) requires either imperfect competition in the product market (such that incumbent firms really gain if entry is deterred) or an imperfectly competitive factor market (*e.g.*, if incumbents own factors unavailable to entrants).

A model explores a case where both conditions occur. It is inspired by Dewatripont (1987, p. 152) and integrates Williamson's insights with labour economics (albeit in a perfunctory way) and industrial economics. Moreover, it allows the preempting firm to choose its capital-intensity. In Williamson's case, capital-intensity was exogenous. Mines with rich coal deposits would be capital-

intensive and those with poor deposits labour-intensive.

The dominant firm (1) chooses capital (k_1) and an industry wage rate w. Implicitly, the union imposes this wage on fringe firms as well. The industry wage is subject to a lower boundary w^m, the market wage. Assume one second mover, firm 2.[17] It chooses an investment and employment level (unobserved by firm 1). Both firms compete in the product market as a Cournot duopoly with a homogeneous product. In the absence of a strategic motive to influence firm 1 by a choice of investment or employment level, firm 2 chooses the cost-minimising technique and invests accordingly. Firm 1 may overinvest in order to preempt firm 2 by reducing its marginal cost. By choosing a high wage ($w > w^m$) it may raise firm 2's marginal costs more than its own if its capital-intensity exceeds firm 2's level. Firm 1's profits are $\pi_1 = R^1(x_1,x_2)-wl_1-\beta k_1$, where $x_1 = F(k_1,l_1)$, and firm 2's profits are $\pi_2 = R^2(x_1,x_2)-C^2(w,x_2)$, where $C^2(w,x_2) = \min_{l2,k2}\{wl_2+\beta k_2\}$ subject to $x_2 = F(k_2,l_2)$. Given k_1, firm 1's short run cost function is such that $l_1 = g(k_1,x_1)$ with $F(k_1,g(k_1,x_1)) \equiv x_1$. Obvious conditions to impose on g(.) are $g_k < 0$, $g_x > 0$, and $g_{x1k1} < 0$ (investments reduce marginal wage costs). In the first stage of the game firm 1 chooses its investment and wage rate. In the second stage, profit maximisation implies the first-order conditions:

(8.27a) $\partial\pi_1/\partial x_1 = 0 = R^1_{x1}-wg_{x1}$; and
$\partial\pi_2/\partial x_2 = 0 = R^2_{x2}-C^2_{x2}$.

The second-order conditions are

(8.27b) $R^1_{x1x1}-wg_{x1x1} < 0$; and
$R^2_{x2x2}-C^2_{x2x2} < 0$.

Equations (8.27a) imply reaction curves. In the first stage, firm 1 anticipates these. It chooses k_1 to shift its own reaction curve outwards, and w to shift both its own and firm 2's reaction curve inwards. Total differentiation of equations (8.27a) gives:

(8.28) $$\begin{bmatrix} R^1_{x_1x_1}-wg_{x_1x_1} & R^1_{x_1x_2} \\ R^2_{x_2x_1} & R^2_{x_2x_2}-C^2_{x_2x_2} \end{bmatrix}\begin{pmatrix} dx_1 \\ dx_2 \end{pmatrix} = \begin{bmatrix} g_{x_1}dw+wg_{x_1k_1}dk_1 \\ C^2_{x_2w}dw \end{bmatrix}.$$

Assume that the determinant of the matrix in the left hand side Δ ($= [R^1_{x1x1}-wg_{x1x1}][R^2_{x2x2}-C^2_{x2x2}]-R^1_{x1x2}R^2_{x2x1}) > 0$, *i.e.*, own effects on revenue exceed cross effects. Cramer's rule gives

(8.29) $dx_2 = \Delta^{-1}([R^1_{x1x1}-wg_{x1x1}]C^2_{x2w}dw-R^2_{x2x1}[g_{x1}dw+wg_{x1k1}dk_1])$.

---

17. If the union and the dominant firm decide to maximise their joint interests, *e.g.*, with efficient bargaining, they act as an integrated firm which supplies an input (labour) to a fringe firm (2) with which it competes in the product market. This setting is conducive to a price squeeze on firm 2, which is similar to the situation in this section (see subsection 6.6.3).

Totally differentiate firm 1's profit function:

(8.30) $d\pi_1 = [R^1_{x1}-wg_{x1}]dx_1-gdw-[wg_{k1}+\beta]dk_1+R^1_{x2}dx_2.$

The coefficient of dx_1 equals zero because of the first-order condition. Substitute 8.29 in 8.30:

$$(8.31) \quad d\pi_1 = \left(\frac{R^1_{x_1}}{\Delta}[R^1_{x_1x_1}-wg_{x_1x_1}]C^2_{x_1w}-\frac{R^1_{x_1}}{\Delta}R^2_{x_2x_1}g_{x_1}-g\right)dw$$

$$-\left(wg_{k_1}+\beta+\frac{R^1_{x_2}}{\Delta}R^2_{x_2x_1}g_{x_1k_1}w\right)dk_1.$$

If the firm sets out from a situation where $w = w^m$ and k_1 minimises costs (*i.e.*, $wg_{k1}+\beta = 0$), then $dk_1 > 0$ raises profits as $-\{wg_{k1}+\beta+R^1_{x2}\Delta^{-1}R^2_{x2x1}g_{x1k1}w\} = -R^1_{x2}\Delta^{-1}R^2_{x2x1}wg_{x1k1} > 0$. A wage increase, $dw > 0$, raises profits if the (positive) cost-raising effect on firm 2, $R^1_{x2}\Delta^{-1}[R^1_{x1x1}-wg_{x1x1}]C^2_{x2w}$, exceeds the (negative) direct effect that firm 1's marginal costs increase ($-g < 0$) with the indirect effect that this raises firm 2's output ($-R^1_{x2}\Delta^{-1}R^2_{x2x1}g_{x1} < 0$). This is the more likely the more labour-intensive firm 2 is, *i.e.*, the more impact the industry wage has on its marginal costs by a higher C^2_{x2w}, and the more capital-intensive firm 1 is, *i.e.*, the smaller g and g_{x1}. Firm 1 is more capital-intensive than firm 2 as it is the first-mover: it preempts firm 2 by an over-investment. This creates an asymmetry which allows firm 1 to benefit from a wage increase which hurts firm 2.

8.8 APPRAISAL

The chapter shows that Dixit's (1980 and 1986) approach can accommodate a wide range of multi-market situations. The multi-market framework shows that an incumbent firm may try to beat the entrant between hammer and anvil, so to speak, by reducing the marginal revenue of entry (the own effect) while raising the marginal (opportunity) cost of entry (the cross effect). See table 8.3.

It also demonstrates the importance of the precise setting of competition, similar to Porter's (1980) extended rivalry. This suggests that any models to be tested should be context-specific. For this reason, case studies as Ghemawat (1984 and 1990) and Hall (1990) on the U.S. titanium dioxide industry are interesting. Ghemawat and Caves (1986) and Smiley (1988), on the

Table 8.3
The Place and Instrument of Competition

Locus of competition	Focus of competition	
	Reduce rival's revenue	Raise rival's costs
Product market	x	-
Rival's home market	x	x
Rival's input market	-	x

other hand, are incapable of tailoring their models to specific industries because of the diversity of their data. Ghemawat and Caves (1986) have a test on PIMS data pertaining to North American manufacturing firms of non-durables. They show that capital-intensity has a significantly negative impact on profitability. This does not seem to accord with the capital-commitment story. Smiley (1988) questioned managers about entry deterrence, and finds that in the case of new products, '[e]ntry deterrence through advertising is most often followed 'frequently' (32%), followed by R&D preemption, building a reputation for toughness, use of the learning curve, and capacity preemption. Again, the two price preemption policies are used least often (3% and 2%).' (p. 173) This suggests that capacity preemption is not terribly important to managers. But its importance may differ starkly across industries. Evidence, therefore, seems inconclusive. According to the foregoing analysis, this is indeed to be expected.

The overview offered by the chapter suggests that the commitment value of capacity depends on at least six factors: (1) the competitiveness and the returns to scale on the supply side of the input markets, (2) the first- and second-mover's buyer market power in the input markets, (3) the product- or firm-specificity of capital, *e.g.*, transport and adjustment costs, (4) the slope of the demand curve, (5) the identity of the entry threat, and (6) the sequence of moves. A change along any dimension may completely overturn the commitment value of capacity. Even if conditions (1) to (6) are suitable, moreover, a firm may prefer a substitute commitment instrument (see *e.g.* note 17). These outcomes point to the hazards of capacity commitments.

First, reciprocal entry models show that capacity commitments do not prevent that firms are vulnerable to import competition. Second, entry barriers are also exit barriers. Steel firms derive their commitment partly from the huge (psychological, social and political) costs involved with cutting capacity and employment. These exit barriers imply that overcapacity can plague the industry for years (*e.g.*, Morrison, 1988). The associated losses reduce the commitment value of capital. Third, a commitment strategy may turn into 'clay feet' when the institutional setting changes (Yip, 1982, p. 29). For instance, a firm 1's wage cost-raising strategy against firm 2 holds only if firm 2 is active in the same labour market as firm 1. This condition obviously failed to hold for foreign importers into the U.S. steel market. Importers, therefore, undermined the wage-cost increasing approach by U.S. Big Steel. Steel makers from developing countries such as Korea benefit from low wages. As they gained market share, excess capacity arose in Big Steel. Given the threat of lay-offs, new domestic firms were able to gain union concessions. Excess capacity induced entry (by reconstituted mills) rather than deterring it. Big Steel's rigid labour practices had turned into its clay feet as it could not (timely) accommodate changes in the U.S. labour market. In an uncertain world firms face a trade-off between flexibility and pre-commitment (Spencer and Brander, 1993). The upshot of the chapter, therefore, is that capacity's use as a commitment instrument is highly precarious.

PART V
DYNAMIC MARKET BOUNDARIES

Part V discusses the interdependence between multi-market competition and market definition. The use of shared resources and multi-market collusion may blur existing market boundaries. Firms' market definitions may also affect their entry decisions and thus have an effect on multi-market competition. The part introduces a dynamic markets perspective that indentifies causes of changing market boundaries (chapter 9). It then applies these ideas, as well as the multi-market competition framework, to the consumer electronics and computer industries (chapter 10).

PART V
DYNAMIC MARKET BOUNDARIES

9 MARKET DEFINITION AND STRATEGY

The chapter will argue that markets do not exist in real life. Instead, markets aggregate actual and potential transactions by combining products and regions whose transactions are interdependent. The market definition debate has mainly addressed the difficulty at which level to aggregate transactions. Should markets be broad, that is, including products and regions which are even slightly interdependent, or should they be narrow, including only highly interdependent products and regions? The chapter endorses the view that markets are subjective concepts. The aggregation level reflects a choice for management and theorists. Multi-market competition also highlights the fact that market definition is a dynamic process. Firms test their market definition in competition. Their competitive moves (entry and exit, innovation) change the underlying determinants of their market concepts. In particular, shared resources (multi-market spillovers) and collusion affect market boundaries. Market boundaries are changing occasionally, therefore.

9.1 INTRODUCTION

The book has assumed throughout that markets are clearly defined. This is, however, not usually the case. The chapter argues that a firm's (or economist's) market definition captures his understanding of what the relevant customers, substitute products, and (actual and potential) competitors are. Market definition is instrumental in focusing attention on what is relevant, while suppressing from view those consumers, products and firms which are of no direct concern. Market definition is a device to reduce information overload, but it may put blinkers on. It may inspire a firm to ignore developments outside its market (or business) that may become of utmost importance to it. A theory of market definition is not, therefore, a theory about an object called markets. It is a theory of decision making. In particular, it addresses how strategists use a decision tool called 'market definition'. The chapter focuses on how the tool is used and should be used in a multi-market setting.

The first part of the chapter reviews the literature on market definition. Since this literature is enormous and scattered, it cannot try to be complete. It focuses on two themes: how broad or narrow one should define markets, and which proxies (empirical indicators) one should use to make market definition operational. Section 9.2 discusses the definition of markets. This definition has the basic problem that it is nonoperational. Economists are well aware of this, and the subsequent sections describe their efforts to cope with it. Section 9.3 discusses the theoretical economics literature, section 9.4 the empirical literature, section 9.5 antitrust, and section 9.6 strategic management. Section 9.7 compares these strands of literature. It argues in favour of a subjective interpretation of markets. For a contribution to these debates, the chapter then turns to multi-

market competition. Section 9.8 discusses the effect of multi-market competition on market boundaries. Section 9.9 combines the insights of the previous two sections. It introduces the dynamic markets perspective, which centres on the interdependence between the firms' market concepts and their multi-market competition. The perspective focuses on the interaction between firms' decision making, competition, interdependence across markets, and changing market boundaries.

9.2 MARKET DEFINITION AND CROSS-ELASTICITIES

Economists use cross-elasticities to define markets. If two markets are completely unrelated, output in one market will not react to prices in another market: $(\partial q^A/q^A)/(\partial p^B/p^B) = 0$, where q is output and p is price for two products or regions, A and B. If the cross-elasticities are non-zero, or at least sufficiently large, A and B should be lumped into one market. If, for example, products A and B are (im)perfect substitutes in demand, an increase of p^B induces consumers to switch to q^A, that is, $(\partial q^A/q^A)/(\partial p^B/p^B) > 0$. That is,

> 'An industry should embrace the maximum geographical area and the maximum variety of productive activities in which there is strong long-run substitution. If buyers can shift on a large scale from product or area B to A, then the two should be combined. If producers can shift on a large scale from B to A, again they should be combined. (.) All products or enterprises with large long-run cross-elasticities of either supply or demand should be combined into a single industry.' (Stigler, 1955, p. 4)

There are three problems with this approach. The first one is the threshold problem. Market definition would be an exact science if one could define two markets as different whose cross-elasticities are equal to zero or within some thresholds, and as part of one integrated market otherwise. Call the thresholds $t_{(-)i}$ where i = s (supply) or = d (demand) and $t_{-i} < 0 < t_i$. If both cross-elasticities of demand and supply are within the thresholds, the two markets are different: $t_{-i} < (\partial q_i^A/q_i^A)/(\partial p^B/p^B) < t_i$ (i = d,s). If one or both conditions do not hold, the two products are aggregated in one market. However, strict threshold values cannot be given. Stigler and Sherwin (1985, p. 562) argue that

> 'markets can show every level of interdependence from absolute homogeneity to complete independence --the continuity of the conventional criteria of cross-elasticities of demand and supply are enough to suggest that.'

By an appropriate choice of threshold values $t_{(-)i}$, almost any pair of products A and B can be construed to be in one market or in different markets.[1] Another problem is the time scale: substitution takes time. The shorter the time horizon, the less substitution one will observe, and the more one is inclined to consider

1. The exception is that if both cross-elasticities equal zero, the products are unrelated and belong in different markets.

two goods as being in different markets. A third problem is that cross-elasticities are not usually observed. Hence one will resort to proxies. These problems have been subject of extended debates, as the next sections show.

9.3 MARKET BOUNDARIES IN ECONOMICS

The theoretical discussion about thresholds focuses among others on market structure. In the case of pure and perfect competition, market definition seems clear. Within a market the products are homogeneous. Consumers are indifferent among them and buy the lowest-priced product without hesitation. Consequently, the elasticity of substitution among the suppliers' products is infinite. The law of one price holds: all transactions are in the same price. The infinite elasticity of substitution and the uniform price delineate the market. This argument can be extended somewhat. If products are homogeneous, but supplied or demanded at different locations, transport costs modify the law of one price. Prices (f.o.b.) may differ by the unit transport or arbitrage cost. This is the classical approach of Cournot and Marshall (Stigler and Sherwin, 1985, p. 556; and Spiller and Huang, 1986). Furthermore, if products are different on the demand side, they may still be aggregated in one market if they are homogeneous on the supply side. Andrews (1951, pp. 143-4) argued that the Marshallian market is not narrow (limited to products that are homogeneous on the demand side) but broad, since differentiated products can be perfect substitutes in production.

Imperfect substitutes may exist, however, even in the case of perfect competition and a uniform market price for homogeneous products. Examples are coffee and tea, or different types of tea. Perfect competition, therefore, wrestles with the problem of heterogeneous products, which blur the distinction between markets.[2] Marshall already recognised the problem. Market definition may be *ad hoc*, as required by the problem at hand (Marshall, 1982, pp. 84^n, 89^n, and 109^n; and Triffin, 1949, p. 749). This is a reasonable point of view, but offers the economist little in the way of guidelines.

Whereas in perfect competition theories market definition remained a peripheral problem, monopolistic competition pushed the problem centre stage (Chamberlin, 1933; and Triffin, 1949). Each supplier is the monopolist of its own product. The competitors' products are imperfect substitutes. The infinite elasticity of substitution and the uniform price can no longer serve to delineate the market. Each product is bound to have an imperfect substitute of some kind. Chamberlin (1962, p. 81) defined the *group* as 'a number of producers whose goods are fairly close substitutes.' This seems a mere restatement of the Marshallian industry, with little precision about how close 'fairly close' is (see

2. Marshall's argument groups products A and B in one market if $p^B = p^A + t$, where t is the arbitrage or transport cost. If one groups in one market products with heterogeneous locations, one should for consistency also group in one market products with heterogeneous product characteristics. For example, A and B may be physically different, and t is a psychological adjustment cost of consumers. Consumers may buy a different brand of tea if it is sufficiently cheaper than their preferred brand.

Stigler's, 1968, devastating comments). Robinson (1950, p. 17) defines the market as a product 'homogeneous within itself' and 'bounded on all sides by a marked gap between itself and its closest substitutes.' She does not explain why products enclosed by a common gap would be homogeneous, and begged the question: 'How much inelasticity of substitution shall be required before we call it a gap?' (Triffin (1949, p. 86). It seems impossible to delineate markets unambiguously such that products within a market have 'high' cross-elasticities and products in different markets have 'low' cross-elasticities.

The problem to rigorously define market boundaries inspired two opposite approaches. Kaldor (1935, p. 38-39) ranks products along a scale, such that products nearby have high elasticities of substitution. Competition is localised between a producer and its closest (potential) competitors on the scale. Each firm develops a market concept that is appropriate for itself but not necessarily for others. This ushered in the idea of *individualised markets*. Kaldor (1942, p. 409) defines a "competitive field,"

> 'the boundaries of which need not be co-extensive to all members, or rather, might vary with the position of any particular firm within the field.'

For Kaldor, therefore, the market becomes a subjective, firm-specific concept, rather than an object or fact. Each firm operates in a market which may include other firms as well. The latter firms, however, have their own markets, which may only partly overlap with the former market. Firm 2 may, for instance, be active in the markets of firm 1 and firm 3. The products of 1 and 3 may not be direct substitutes for each other. Firm 2 is a *straddler* if its product is located in between the products 1 and 3, *i.e.*, if 2 is an imperfect substitute for both. In Robinson's chain of substitutes, the straddler fills a 'marked gap' between products 1 and 3. The result is *indirect competition* between firms 1 and 3 through their influence upon firm 2 (Cooper, 1989). If the influence is sufficiently weak, one will not include firms 1 and 3 in the same market. The construct of a scale (consisting of line segments in DeGraba, 1987, and circles in Cooper, 1989) is a special case, however. If firms locate on a single scale (*i.e.*, a unique characteristic of their products), each firm faces just two neighbours. If, however, there are several scales (*i.e.*, multidimensional products), firms may face numerous neighbours. Moreover, even on one scale each firm may be interdependent with firms far down the scale. Indirect competition assures this. Kaldor's partial equilibrium approach may then lead to a non-exclusive and thus non-operational market definition.

Triffin (1949) faced the same problem in Chamberlinian theory as Kaldor. Like him he notes that market definition is an instrument to order the economic environment:

> 'The Chamberlinian "group" veers definitely away from the old Marshallian concept. It is no longer a definite economic entity, the existence of which has merely to be recognized by the investigator; it is an analytical tool which may and should be used with all degrees of inclusiveness.' (Triffin, 1949, p. 84).

From this insight Triffin (1949) derived some unique insights. The critical problem in applying this analytical tool are the threshold values of the cross-elasticities. If the thresholds are sufficiently small, any two products may be related. They may include the entire economy in one 'market.' Triffin faces a tradeoff. He notes that Robinson recognised,

> 'the logical dilemma of paying attention either to the uniqueness of each firm's product, or to the universal substitutability of all economic goods, in their competition for the consumer's dollar.' (Triffin, 1949, p. 82)

Triffin cuts the Gordian knot by emphasising the 'general competitiveness between non-homogeneous products'. He urges economists to use a general equilibrium approach instead of a partial equilibrium approach (p. 86). Each product competes with many others, which compete with yet others, and so on. Market boundaries cannot be drawn as there is no end to the chain of substitutes, nor are there marked gaps. Triffin's preference for general equilibrium theorising can be interpreted as an argument in favour of cross-elasticity thresholds sufficiently small (or zero) to include all products in one market (economy).

Triffin subsequently draws his famous conclusion. The market is not a useful theoretical concept. Exit partial equilibrium theory! Considering the theoretical contributions by industrial economics, Triffin throws away the baby with the bath water. Yet his logic is flawless: if there is an error, it must be in his assumptions. Triffin assumes that monopolistic firms and other decision makers find their way in a general equilibrium world. They will optimise their objectives taking into account all opportunities and threats, both present and future. Each decision maker comprehends the whole canvass, fully aware of how its decisions interact with and call forth decisions by other decision makers, including those not yet active. This requires, of course, unbounded computational and intellectual abilities. This assumption is I believe mistaken when discussing market definition. Economists, for sure, at least most of them, including the present author, do not have the required intellectual abilities! Triffin himself, by the way, does not actually *use* general equilibrium modelling.

Triffin's approach is counterfactual. It describes the hypothetical situation when rationality is perfect. No markets will be defined in this case. Indirectly, it demonstrates rigorously that market definition is the progeny of constrained rationality.[3] To have ushered in this conclusion is in my opinion Triffin's contribution. This insight offers a solid foundation for the views espoused in the later part of the chapter. Stigler (1968) fails to give Triffin this credit. Stigler correctly notes that the counterfactual approach offers little help to positive analysis. It creates a gap between theory, which requires a general equilibrium context, and empirical work, which focuses on particular markets. Triffin

3. I avoid the term bounded rationality not to get mixed up in the debate on the causes of the constraints. Bounded rationality centres on the human mind's computational constraints similar to computers. This theory has been criticised for ignoring nonrational thought processes (Mintzberg, 1989, p. 67-8), such as motivational and emotional limits of rationality (Selten, 1990).

acknowledges that the Chamberlinian group is useful in empirical work:

> 'we can, in this way, reduce to a manageable size the research work involved, without any serious loss in precision or exhaustiveness.' (p. 88)

Kaldor and Triffin appear to have wrestled with a dilemma. On the one hand, decision makers may focus attention on a narrow market because of limits in gathering and processing information. On the other hand, a general equilibrium context forces each decision maker to understand the interdependence among all products, suppliers and consumers. Section 9.8 further elaborates the dilemma. With the theoretical issues unsettled, market definition turned into an empirical problem.

9.4 MARKET BOUNDARIES IN EMPIRICAL STUDIES

Since cross-elasticities are usually unobserved, economists resort to proxies. A familiar proxy is the correlation between the prices of two goods (Kaldor, 1942, p. 410; and Stigler and Sherwin, 1985). If the correlation coefficient is high (close to unity), the two goods are considered to be in the same market. Stigler and Sherwin (1985, pp. 566-7) argue that the proxy is useful as its data requirements are modest: the time series of the two prices. The proxy is appropriate, because a high cross-elasticity is likely to lead to correlated price movements. The correlation can be spurious as it may be due to a common cause, *e.g.*, inflation or a price change of a common input. The authors propose a two-step method that gets around this problem. First they regress both prices on the common influence (*e.g.*, the price level of a common input), and then they correlate the residuals (which approximate the value added to the common input). The theoretical argument for expecting correlation of values added is, however, weaker than for prices (Stigler and Sherwin, 1985, p. 572).[4]

Since price correlations fail to paint the full picture, it is important to use additional information. For example, large shipments between areas have been used as indicator that both are in the same market. The same holds for price differences between areas (or goods). If these are identical to arbitrage costs, the areas can be included in one market. This approach is solidly based on Cournot and Marshall's market definition. If transport costs are unknown, Spiller and Huang (1986) have a method that gets around this problem. Their model does have the drawback, however, that markets are either autarkic or integrated. It does not appear to accommodate the intermediate situation of segmented or joined markets. Moreover, for their model to work, each market has to behave as if it is autarkic at some and integrated at other periods (Spiller and Huang, 1986, p. 136[a]). When market definition is not itself the topic of the research, economists may resort to other proxies. For example, SIC industry classifications are used as markets; the digit level used may depend upon availability of data (*e.g.*, Dunne,

4. The correlation of prices seems an appropriate argument if the products are imperfect substitutes. If they are complements, correlation of sales may be the better proxy.

Roberts, and Samuelson, 1988). An applied field that frequently dealt with market definition, is antitrust.

9.5 MARKET BOUNDARIES IN ANTITRUST

U.S. antitrust literature searches for market definition which is operational and useful for its aims. The 1982 and 1984 Merger Guidelines of the U.S. Department of Justice are inspired by the aim to prevent mergers that may raise prices. They ushered in 'antitrust markets', to be distinguished from 'economic markets', that have been defined in the theoretical literature (section 9.2). The Merger Guidelines define an 'antitrust market'

> 'such that "a hypothetical firm that was the only present and future seller of these products ('the monopolist') could profitably impose a small but significant and nontransitory increase in price - generally five percent lasting one year."' (quoted by Jorde and Teece, 1991, p. 123).

The antitrust market is thus a potential cartel. Scheffman and Spiller (1987) make this approach operational by modelling the residual demand function of a potential cartel. The cartel combines the suppliers in a region; it faces a competitive group in another region. Their products are homogeneous, and can be shipped into each region. Given the rival group's price, each group faces the residual demand. Associated with the residual demand is an elasticity of demand. If the elasticity remains below a threshold, the potential cartel could raise price by the threshold indicated (*e.g.*, a 5% increase). If a potential cartel has been defined, a merger can be forbidden if it leads to an excessive increase of the concentration ratio within the cartel. The maximum increase in concentration ratios allowed is made precise by Herfindahl indices. Stigler and Sherwin (1985) criticise the two-step approach in the Merger Guidelines: why not bypass the market definition issue, and directly forbid a merger if it is expected to raise prices by more than a threshold value (*e.g.*, 5%)?! The antitrust approach does have the merit that it relates the thresholds to an ulterior motive. Confronted with a proposed merger, legislators trade off the interests of the firms involved, their rivals, and the consumers. They should derive the thresholds from their preferences about the tradeoff.

There are criticisms that antitrust leads to markets that are too narrowly defined. In measuring cross-effects on prices, the Department of Justice uses one- or two-year periods in its Merger Guidelines [see the quote above from Jorde and Teece (1991)]. Jorde and Teece (1991) argue that these periods are too short. As noted in section 9.2, the larger the time scale, the higher the amount of substitution that can occur. In technologically dynamic markets, innovations take time to spread through the market. Users have to acquire experience in using the product, existing equipment has to be scrapped, and complementary assets have to be installed. As a result, it may take years for buyers to switch to a new product even if it is a superior substitute for an existing product. The one- and two-year periods underestimate the substitution, and thus fail to include existing products (which may be inferior substitutes) in the market of a new product. The new

product's market is narrowly defined and the innovator is alleged to have a large market share. Antitrust is likely to be hostile to R&D and product market cooperation between innovators. Jorde and Teece (1991) argue in favour of adjusting antitrust regulation for high-tech industries. In particular, the time scale has to be extended to four years, with the option of adjusting it to individual cases (Jorde and Teece, 1991, p. 127). This point is well taken. Note, however, that if the period is long, it may occur that the basic conditions (*e.g.*, technology and consumer preferences) change in the mean time. Innovations may change the boundaries between markets (see section 9.8). Like antitrust, strategic management theories have to deal with market definition.

9.6 MARKET BOUNDARIES IN STRATEGIC MANAGEMENT

Two themes loom as large in the strategic management literature as in economics and antitrust: the importance of market definition, and which proxies to use for cross-elasticities.

9.6.1 The Aims of Market Definition

Strategic management considers market definition an important part of decision making. The importance can be illustrated by the consequences of errors. First, firms may over- or underestimate the interdependence among markets. The distinction between global firms and multidomestic firms hinges in part on whether the firm defines the world market as integrated or joined markets (the global view) or as segmented markets (the multidomestic view) (Hout, Porter, Rudden, 1982; Levitt, 1983; Prahalad and Doz, 1987; and Yip, 1989). This literature cautiously advocates a global view. Second, firms may ignore some markets altogether. A strategy that acknowledges this may consist of entry into a market that is outside the business definition of incumbent firms. For the incumbent firms, the entrant is an 'over horizon competitor' (Clarke and Brennan, 1990, p. 12). The incumbents will not observe the entry as a threat to their business, and will not respond. Their inertia may allow the entrant to encroach upon the incumbent firms' market. Hatten and Hatten (1987a, p. 300) appreciate this point when they write:

> 'Competition between companies ultimately comes down to competition between concepts of what their business is. (.) Different concepts ensure competition without confrontation.'

Porter (1980) dissents from the view that market definition is important, provided that the firm focuses broadly on competition. In the context of *extended rivalry* it is important to identify the players (see chapter 2):

> 'Any definition of an industry is essentially a choice of where to draw the line between established competitors and substitute products, between existing firms and potential entrants, and between existing firms and suppliers and buyers. Drawing these lines is inherently a matter of degree and has little to

do with the choice of strategy.' (Porter, 1980, p. 32)

Porter here ignores that market definition is important for strategy formation exactly because it is about identifying the firm's buyers, rivals, *etc.* Market definition does not only draw the lines within the extended rivalry framework, between existing firms and potential entrants, *etc.*, but it also draws the lines around the extended rivalry to set it off from the wider economy. Porter's extended rivalry framework should be considered the basic argument in favour of a broad market definition within strategic management.

Strategic management researchers usually urge a broad market definition (analogous to small thresholds of the cross-elasticities). A narrow market definition may imply a neglect of potential competitors or substitutes. The arguments in favour of a broad market definition are based on substitution, which is consistent with Stigler's definition (section 9.2). Levitt (1975) wrote a well-known invective against 'marketing myopia' that firms get trapped by using narrow market definitions. Managers may fail to notice or welcome the appearance of substitute products. For instance, railroads 'let others take customers away from them because they assumed themselves to be in the railroad business rather than in the transportation business. (.) they were product-oriented instead of customer-oriented.' (Levitt, 1975, p. 26). The firm, that is, should have a broad market definition in terms of the demand side by focusing on the utility that consumers derive from products. Cars, *e.g.*, may serve for transport as well as image. A firm should be imaginative, and include in its market non-intuitive substitutes like mink coats to Cadillac cars (Drucker, 1977, p. 72). Grant (1991) argues that firms should include in a market all products they could conceivably produce using their resources. This entails a broad market definition based on substitutes in production. Hatten and Hatten (1987a) prefer a broad definition that identifies (im)perfect substitutes to a firm's products, as well as possible sources of entry, *e.g.*, existing firms in (supply or demand) related markets. The latter have eliminated some entry costs (p. 92). They may have different resources that are difficult to match by the incumbent. The incumbent firm should be aware of firms which use Grant's diversifying approach. Strategic management faces the usual problem of making market definition operational, that is, of finding proxies for the cross-elasticities.

9.6.2 Identifying Firms' Market Definitions

Abell (1980) proposes to identify market boundaries on the basis of firms' market definitions, rather than the other way round. A firm's market definition can be gleaned from the interdependence among three dimensions of competition: competition *in* a market *with* instruments *against* competitors. First, the markets served by a firm (the 'competing *in*' dimension) may indicate its business definition. This is indicative especially if all competitors use the same market definition (Abell, 1980). If firms' product lines do not completely overlap the business may be defined as the union or cross-section of their activities.

Second, a firm may have a core competence or central resource, *e.g.*, know how or marketing skill (the 'competing *with*' dimension). Its business is then the

collection of markets that may exploit this shared skill (Gilbert and Strebel, 1988; and Grant, 1991). Some publicly available data can be used to identify what the firm considers its central skill. Its R&D-intensity, advertising-intensity and other data indicate its investments in its resources. Circumstantial evidence can also be used. Investments or acquisitions to acquire public resources (*e.g.*, a brand name or patents) are moves by *which* a firm competes which may indicate the business it thinks it is competing *in*. The internal organisation of the firm also reflects its opinion on the importance of shared resources. A corporate firm will often centralise the provision of a public resource (such as basic research) as it has higher investment incentives than any of its individual business units. The latter may ignore synergies among them (*e.g.*, Clarke and Brennan, 1990, p. 11). This centralisation in turn indicates which shared resources the firm considers of paramount importance. These data may help to identify a firm's business.

Third, if a firm constitutes a strategic group with other firms, it is assumed to resemble these firms (Caves and Porter, 1977, p. 250). It may, *e.g.*, be conjectured to have the same market definition (the 'competing *against*' dimension). If market boundaries expand, a firm will face new rivals in hitherto different markets. This generates new challenges and requires new learning. To facilitate this learning, Westney (1988) argues that firms may engage in cooperative linkages with some of their new rivals. This argument can be turned around to argue that new cooperative linkages and new partners may indicate that a firm is redefining its industry. The next section compares the theories in the previous sections.

9.7 RELATING THESE PERSPECTIVES ON MARKET DEFINITION

The economics and antitrust discussions and the strategic management discussion differ markedly. They put forward different proxies for the enigmatic cross-elasticities. To see why, consider the introduction of a new product. It will take the firm two years to develop the product. Subsequently it may take four years before all potential customers have decided whether to switch to the new product. Following Jorde and Teece's (1991) argument, it is only after the four year period that one can ascertain the market of the new product. The innovator, however, has to estimate the extent of the market prior to its investment decision. Strategic management looks six years ahead, whereas economics will look back, six years from now. The proxies used by strategic management are predictive; the proxies used by economics are descriptive. They should be considered complementary: decisions which according to economics will (ultimately) affect market definition, can be used as proxies by strategic management. Section 9.9 returns to this argument.

Antitrust seems to prefer narrow market definitions. Economics and strategic management instead favour broad market definitions. If the market definition is 'too' broad, however, it loses its function:

> 'a market should not be the entire economy. In particular, it should allow partial-equilibrium analysis. It should also allow a single description of the main interactions among firms.' (Tirole, 1988, p. 12).

An appropriate threshold represents a tradeoff between constrained rationality (which favours a narrow market definition) and the interdependence between products (which favours a broad market definition). This is the basic dilemma in theory and applied work (management).

The literature discussed in the previous sections appears to have some common views as well. It largely agrees about the importance of research aims in defining markets, the subjective choice of critical thresholds and time periods, and the need to use proxies for unobserved cross-elasticities. These conclusions are rather unsettling. They offer theorists too much latitude in defining markets. If, for example, the cross-elasticity of demand $(\partial q^{A}/q^{A})/(\partial p^{B}/p^{B})$ between products A and B were know to be 0.5, would you include both in one market? How does a research aim translate into an appropriate threshold value? The conclusion of the discussion must be: *there is no positive basis to market definition.* One cannot falsify a claim that two products are in one market. This suggests the conceptual nature of markets.

9.7.1 Markets are Concepts in the Managers' Minds

Markets are *subjective* concepts used by theorists and participants to aggregate transactions which in their perception belong together. A market indicates the players' roles by identifying buyers and sellers, and by distinguishing actual from potential competitors. It distinguishes close substitutes from (highly) imperfect ones. It is a preliminary step to calculating market share, which firms consider an important indicator of performance, and which antitrust officials consider an indicator of market power. Market definition, in short, separates the part of the economy that is of immediate concern from more remote areas. It economises on information costs and focuses scarce computational abilities on those areas where they have the highest payoff to a decision maker. Its key function is relevance in decision making:

> 'we explicitly define an 'industry' as any grouping of individual manufacturing businesses which is relevant when we study the behaviour of any one such business.' (Andrews, 1951, p. 168).

If information is costly, some concept of the market is required.

Market definition is about *focusing* attention to those products and processes that have a (potential, long-run) effect on a firm's demand and supply. The theory of *perceptual filters* (Starbuck and Milliken, 1988) may provide an explanation. This theory argues that people do not act upon the raw data of their environment (stimuli). Instead, people act upon perceptions which they filter from the real world. Filters bring relevant information to the foreground and push irrelevant information to the background. 'The filtered information is less accurate but, if the filtering is effective, more understandable.' (Starbuck and Milliken, 1988, p. 41). They distinguish two filters: noticing (scanning) and sensemaking (interpreting). These filters imply distortions. Stimuli may not be noticed (brought to one's attention) if they have certain characteristics (*e.g.*, if they are familiar). They may also be distorted if they clash with the observer's sensemaking.

Unwelcome information may be ignored. Market definition is a sensemaking filter: by locating product B in A's market, B is judged to be important to A. Cross-elasticities denote the size of the stimuli (*i.e.*, the impact which a shock in B has on A). This helps suppliers and buyers of A to focus on those products which are relevant to them. Starbuck and Milliken note two characteristics of filters which are relevant in this context. First, a filter that was appropriate in some context may in other situations focus attention on unimportant, irrelevant stimuli. Moreover, 'these types of filtering may persist over time and so characterise organisations or individual executives.' (p. 44). These are two key characteristics of firms' market definitions: they may inspire errors, and they are slow to change. Competition without confrontation is an example where a firm fails to notice the arrival of a new rival or fails to classify the other as a rival (subsection 9.6.1).

The multi-market competition framework may contribute to market definition in two ways. It shows how firms' decision making affects market boundaries (section 9.8). It suggests a perspective that relates market definition to a firm's decision making process in an iterative and interactive way (section 9.9).

9.8 MARKET BOUNDARIES IN MULTI-MARKET COMPETITION

The multi-market framework is an attempt to alleviate the dilemma noted in sections 9.3 and 9.7. It tries to offer some of the advantages of general equilibrium (*i.e.*, the interdependence between markets) while respecting the bounded rationality of decision making (by means of a partial equilibrium context). By focusing on a set of related markets it may avoid the extremes of too narrow or too broad market definitions. Among related markets, multi-market competition affects the extent to which local demand or cost shocks in a market spill over to other markets. Firms' (re)actions in multi-market competition, such as investments, can be used in turn as proxies of their market definitions.

Multi-market competition suggests a three-step approach to (the analysis of) decision making. Information costs induce the firm to delineate a multi-market framework with the largest number of markets (n) that still allows Tirole's (1988, p. 12) 'single description of the main interactions.' Given a product, the 'n-1' products with highest cross-elasticities or proxies are joined with it in one market or business. The critical threshold values are chosen implicitly to accommodate this selection. In the context of joined markets, the firm identifies its core competence and then selects markets where the investments in the competence can be recovered. Finally, competition within this set can be analyzed using the game theoretical tools discussed in parts III and IV. The first two steps in this approach are probably *ad hoc*. As the reader will have noticed, this book is limited to studying interactions between two markets at a time. The reason for this is bounded rationality. When better instruments become available, it will be possible to extend the reasoning beyond two markets. Industrial economics progressed from a focus on competition in one market in the period up to the 1970s, to multi-market competition in the 1980s.

9.8.1 Market Definition in Related Markets

Since markets are concepts used to order the real world, they are inherently taxonomic. A market has to be understood relative to market segments and businesses, where a *business* is defined as a set of related markets. The business is the setting of extended rivalry (Porter, 1980, p. 4; see section 2.2). By *market definition* I will henceforth mean the extended sense of identifying these segments, markets, and businesses. Each prospective 'market' has cross-elasticities with other 'markets' ranging from quite small to fairly large. This suggests that markets can be grouped into larger units using a series of threshold values of the cross-elasticities (Shepherd, 1985, p. 49). There is a hierarchy of markets with increasing relatedness from market segment (where all products are close substitutes) to the business (where most suppliers may be each other's potential rather than actual rival). For example, if products are imperfect substitutes in demand, a series of thresholds exists, $0 < t_d^B < t_d^M < t_d^S$ for defining a business (B), market (M), or market segment (S). If A and B have a cross-elasticity t_d such that $t_d^B < t_d < t_d^M$, A and B are assumed in the same business but in different markets.

Chapter 5 made market definition operational by distinguishing direct cross-market links between prices and output levels (due to arbitrage or multi-market collusion) and indirect links (through investments in shared resources). The existence of arbitrage trade, for example, is a clear proxy for (and determinant of) high cross-elasticities. In the case of integrated and coordinated markets, prices move in the same directions, such that price correlations may be used as proxies of the degree of integration. The next subsections discuss how links between joined (*etc.*) markets transmit local demand and cost shocks to other markets. Each link affects market boundaries and is a proxy for market definition.

9.8.2 Segmented Markets

Common suppliers in segmented markets are a link that may transmit supply shocks. Consider the Brander and Krugman (1983) trade model in chapter 5. Assume that a small shock in one market raises marginal production costs of the domestic firm by dc_i. As a result, prices will increase in both markets. In a Cournot duopoly with linear demand, price in each market will increase by $\frac{1}{3}dc_i$, provided that firm i's cost does not increase prohibitively, *i.e.*, provided it continues to export to the foreign market. The prices will correlate positively (and perfectly, if exports continue). The common suppliers, price correlation, and shipments between the markets may be proxies for supply-side cross-elasticities.

9.8.3 Joined Markets

A business may comprise the activities that use a shared resource. This is consistent with Abell (1980, p. 197), who rather arbitrarily limits the shared resource to technology. Investments in shared resources lead to multi-market spillovers (see appendices 5.B and 5.C). These in turn transfer a local (demand) shock in one market to a related market (appendix 5.D). This generates a non-

zero cross-elasticity as a change in price in one market coincides with a change in quantities in the related market. The size of investments in shared resources can therefore be a proxy for the existence of (moderately) high cross-elasticities. A related proxy is the resource-intensity. If, for example, advertising is a shared resource (with umbrella branding), advertising intensity (advertising over sales) is a proxy for the cross-elasticities, and for the degree of integration or relatedness. There are two counter-arguments to this approach. First, shared resources do not necessarily lead to a spillover effect and, second, larger investments in a shared resource may reduce costs or raise product quality such that sales increase: it can not be excluded that a spillover reduces the resource-intensity.

Shared capacity investments may illustrate the former counter-argument. Capacity investments may (but need not) transfer a local demand shock in one market to another market. This in turn will affect market definition. Consider the model in section 8.6. Say, a shock Z raises demand in market A. If it shifts upward the demand function by a constant amount, price includes a variable Z and profits include an amount $x_i^A Z$. For firm 1 this gives:

$$(9.5)\ \pi_1 = [p^A(x_1^A+x_2^A)-c_1]x_1^A+[p^B(k_1-x_1^A+k_2-x_2^A)-c_1-t_1][k_1-x_1^A]-C(k_1)+x_1^A Z.$$

The mean of Z is zero; the distribution is unspecified. If the shock occurs in the second stage of the game, the capacity investments have already been installed. To solve the game, add Z to the second stage reaction curves $\partial\pi_1/\partial x_i^A = 0$ (see equations 8.5) and totally differentiate these to the variables x_i^A and Z. Since the capacity levels are given in the second stage, $dk_i = 0$. Cramer's rule then solves dx_i^A as functions of dZ. Call $dX^A \equiv dx_1^A+dx_2^A$. It is straightforward that

$$(9.6)\ dX^A = -2((p_x^A+p_x^B)/|G|)dZ;$$

where G is the 2x2 matrix defined in equation (8.6), and the determinant $|G| > 0$. With given capacity levels this gives $dX^B \equiv dx_1^B+dx_2^B = -dX^A$. Prices in both markets change as a result:

$$(9.7a)\ dp^B = 2p_x^B((p_x^A+p_x^B)/|G|)dZ; \text{ and}$$
$$(9.7b)\ dp^A = (1-2p_x^A((p_x^A+p_x^B)/|G|))dZ.$$

If the demand shock dZ is positive, supply increases in market A and decreases in market B. Price increases in market B, but its sign in A is *a priori* unknown. The shock has the direct effect of increasing price and the indirect effect of reducing it through the output expansion. In the case of linear demand, it holds that $dp^A = (1-\frac{2}{3}p_x^A/(p_x^A+p_x^B))dZ$, such that $\frac{1}{3}dZ < dp^A < dZ$. Market definition is affected as follows. Cross effects appear: $dp^A/dX^B < 0$ and $dp^B/dX^A > 0$. The cross elasticities of supply are, therefore, unequal to zero. If they are of sufficient magnitude, one might conclude that A and B belong in one market. It also follows that $dp^j/dZ > 0$ for j = A,B. The prices are (perfectly) correlated, and again one may conclude that both products belong in one market.

Now consider the case where the shock occurs before investment decisions are taken. Compare the situation without a shock (Z = 0) to the situation with a

shock. As case 1 in the previous chapter showed, with linear demand firms will install capacity in each market up to the point where the *ex ante* marginal production cost (which does not change) equals marginal revenue. Each firm expands production capacity just enough to satisfy the increased demand in market A. Sales in market B (k_i-x_i^A) remain unaffected. The shock in market A does not transmit to market B. If demand is non-linear some transmission will occur as each firm will reallocate part of its increased capital stock to market B.

A different case holds when the shared resource is a public good with increasing returns. This case may illustrate the second counter-argument to using resource-intensity as a proxy of cross-elasticities. Consider R&D investments by a multinational firm which is active in markets A and B. Market B also features a domestic non-exporting firm (De Bondt, Sleuwaegen and Veugelers, 1988). The R&D produces know how which, for instance, reduces marginal costs. Apart from the shared know how, the markets are unrelated. If the multinational firm did not anticipate the shock when taking the investment decision, a positive demand shock in A will raise the output level and profit in A, but will have no effect in market B. If it did anticipate the shock, a positive shock will raise its R&D. This will reduce marginal costs in both markets. Prices fall in market B because of the reduced marginal costs. The price in market A may rise (because of the demand shock) or fall (because of the R&D). Only in a freak case will the cross-elasticity be (close to) zero. The multi-market spillover effect of R&D is likely to raise the multinational firm's R&D relative to a domestic firm. However, competition effects (Veugelers and Vanden Houte, 1990) and inter-firm R&D-spillover effects (De Bondt *et al.*, 1988) determine whether this really holds. Even if the multi-market spillover raises the multinational firm's R&D, it need not raise its R&D-intensity, as they also raise its sales. Increasing investments in shared resources indicate increasing (absolute values of the) cross-elasticities and might be used as a proxy; the resource-intensity is, however, an ambiguous signal of cross-elasticities.

These cases show that investments in shared resources may raise the cross-elasticities of demand or supply. Market definition depends on the interplay of shared resources (private or public goods, with constant or increasing returns), information (unanticipated or anticipated shocks), and competition. Market boundaries are fuzzy if markets are joined by shared resources. This is the predominant reason why market definition becomes a pressing issue in the context of multi-market competition. The size of these shared resources depends on the investment decisions by multi-market firms. The *potential* for spillovers is given by structural conditions, *i.e.*, technology, consumer preferences, and the state of information. The realisation of multi-market spillover effects depends on firms' strategies. Only these actual spillovers determine the cross-elasticities that define markets. Thus if, for instance, firms do not invest in shared R&D processes, no actual spillover arises. Empirical tests will then indicate that the markets are unrelated. By way of example, General Motors carries different product lines in the U.S. and in Europe, each requiring its own R&D. Few spillovers are realised, and a test (and perhaps GM as well) would conclude that the markets are unrelated. A Japanese or European firm that sells a single line of products worldwide will draw different conclusions. Market definition may be a

self-fulfilling prophecy.

9.8.4 Spheres-of-Influence

Firms establish spheres-of-influences by (partially or completely) withdrawing to the market where each has an advantage from being the lowest-cost supplier (see subsection 5.5.5). Market boundaries interact with spheres-of-influence. On the one hand, exclusive influence-spheres lead to sharply delineated market boundaries. If firms establish exclusive spheres-of-influence, a small local (demand or cost) shock will not have an effect in the other market unless it disrupts multi-market collusion. If market demand increases in market A, the supplier in market B may prefer being active in that market while disrupting spheres-of-influence to being monopolist in its market B. A demand shock in market A will then have an effect in B as well: prices fall, demand levels increase, and cross-elasticities are negative (see Appendix 9.A). If they are sustainable, however, spheres-of-influence contribute to sharply delineated market boundaries, and the absence of shipments can be construed as a proxy for low cross-elasticities. On the other hand, a widely accepted, inter-subjective market definition is helpful in delineating spheres-of-influence that firms will accept and can abide by without explicitly colluding. Thus, market definition may help to sustain collusion. The next section discusses the dynamics of market definition.

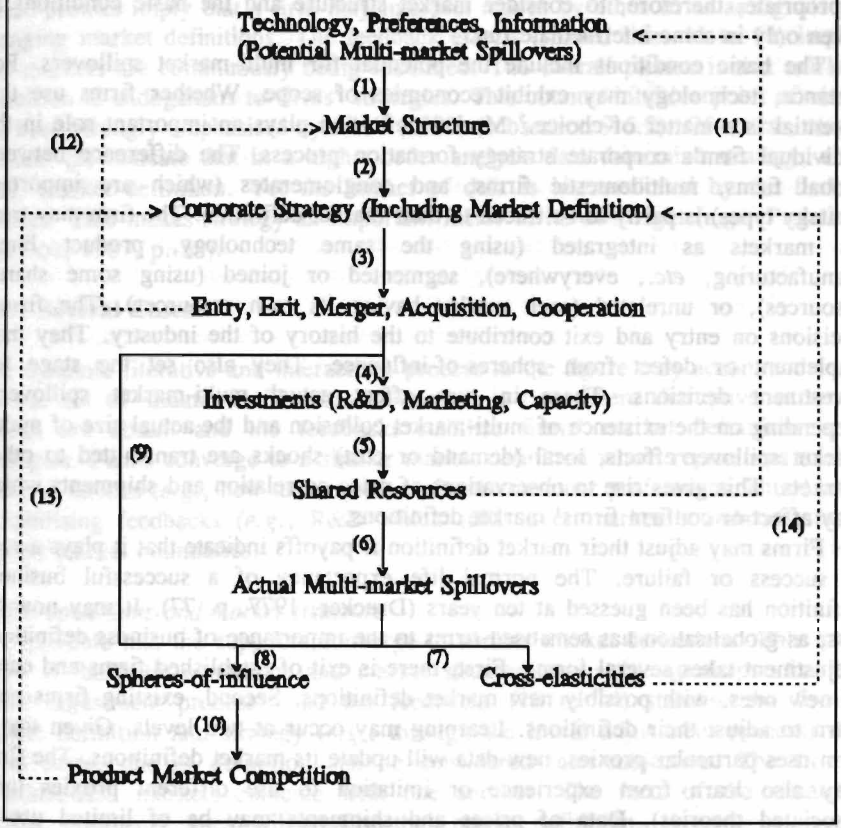
9.9 A DYNAMIC MARKETS PERSPECTIVE

The *dynamic markets* perspective may integrate two points raised in the previous sections. From multi-market competition theory (see the previous section) it accepts that investments do not only change supply and demand conditions within a market. They also spill over market boundaries, up to a point where they change the boundaries between these markets. From the theory of perceptual filters (section 9.7) it accepts that a firm acts upon its perception, *i.e.*, upon facts which are filtered (distorted) by its market definition. Moreover, a firm's market concepts are dynamic, if it (slowly) adjusts them to its performance in competition. The firm learns to use market definition to make predictions about rivals, consumers, *etc.*, and to initiate its own decisions. Important aspects of many learning theories are *delays* (of adjustments) and *heterogeneity* (of economic agents). These aspects may play a role in competition, where they create a potential for losses (due to delayed adjustments) as well as profits (by exploiting rivals' inflexible beliefs). Two well-known types of (operant) learning are reinforcement and extinction (*e.g.*, Van Witteloostuijn, 1990c). Positive reinforcement implies that successful market outcomes (profits) strengthen the firm's belief in the correctness of its market definition and decision making process. Its perceptual filters become more entrenched. Extinction implies that adverse market outcomes (losses) raise doubts about its filters, and initiate a search for alternatives.

The combination of these two starting points (investments and learning) suggests a feedback between perceived market boundaries and the firm's basic conditions (technology, preferences, legislation, *etc.*). This entails an iterative

Figure 9.1

The Dynamic Markets



process: perceived market boundaries → decision making (*e.g.*, R&D) → basic conditions (*e.g.*, technology) → market boundaries. Because of their individualised markets, firms may use different market definitions (section 9.3). Competition among heterogeneous firms affects the underlying determinants of market boundaries and firms' perception of them. This adds an interactive aspect to market definition. Market boundaries are subjective (within firms), inter-subjective (if firms agree on market definition proxies and thresholds), but never objective (*i.e.*, pertaining to real world objects). The perspective is a descriptive

tool rather than a theory that allows testable predictions.

A framework may help to identify the dynamic and subjective elements in market definition. See figure 9.1. Causation in the framework is interactive and iterative. The Structure-Conduct-Performance paradigm in industrial economics emphasises the flow of causation from basic conditions (technology, preferences, the law, *etc.*), through market structure and conduct to performance (*e.g.*, the firm's payoffs) (Scherer, 1980). The flow runs from the 'most irreversible' parameters from a firm's point of view to the 'least irreversible.' Game theory has shown that strong feedbacks exist (the dashed lines) from conduct to market structure. These feedbacks (*e.g.*, through entry and entry deterrence) also impact on technology (through R&D), and information (advertising, learning). It appears appropriate, therefore, to consider market structure and the basic conditions as given only in some intermediate run.

The basic conditions include the potential for multi-market spillovers. For instance, technology may exhibit economies of scope. Whether firms use this potential is a matter of choice.[5] Market definition plays an important role in the individual firm's corporate strategy formation process. The difference between global firms, multidomestic firms, and conglomerates (which are important strategy types) is partly to be traced to their market definition. The firm may treat its markets as integrated (using the same technology, product lines, manufacturing, *etc.*, everywhere), segmented or joined (using some shared resources), or unrelated (each market having its own resources). The firm's decisions on entry and exit contribute to the history of the industry. They may implement or defect from spheres-of-influence. They also set the stage for investment decisions. These in turn affect actual multi-market spillovers. Depending on the existence of multi-market collusion and the actual size of multi-market spillover effects, local (demand or cost) shocks are transmitted to other markets. This gives rise to observations of price correlation and shipments which may affect or confirm firms' market definitions.

Firms may adjust their market definition if payoffs indicate that it plays a role in success or failure. The normal life expectancy of a successful business definition has been guessed at ten years (Drucker, 1977, p. 77). It may now be less, as globalisation has sensitised firms to the importance of business definition. Adjustment takes several forms. First, there is exit of established firms and entry of new ones, with possibly new market definitions. Second, existing firms may learn to adjust their definitions. Learning may occur at two levels. Given that a firm uses particular proxies, new data will update its market definitions. The firm may also learn from experience or imitation to use different proxies (and associated theories). Data of prices and shipments may be of limited use if investments are tailored to expectations of new developments and if substitution suffers from long delays (section 9.5). The foregoing has shown the importance

5. Van Cayseele (1987), *e.g.*, shows that firms may forego a potential economy of scope (in R&D), if other conditions are more compelling.

of circumstantial evidence (subsection 9.6.2).[6] The previous sections have come up with the following proxies:

- the size of and investments in shared resources (subsection 9.8.3),
- internal organisation, especially centralised control over some shared resources (subsection 9.6.2).
- new joint ventures and new partners (subsection 9.6.2),
- acquisitions to enter new markets or acquire new resources (subsection 9.6.2),
- markets served, shipments, (reciprocal) entry and exit (subsection 9.8.4), and
- straddlers, *i.e.*, intermediate products (section 9.3).

These proxies imply that a firm may interpret moves by other firms as signals of changing market definitions. The feedback effects (shaded lines 11 to 14) imply that markets are continuously being redefined. The overall picture is that market definition is endogenous to firms' strategies. This counter-intuitive point of view has been strongly emphasised by Abell (1980) (subsection 9.6.2). Of course, steps (1) and (2) indicate that in a higher-order analysis data determine strategy, and thus, market definition. Yet the impact of data is intermediated by the firms' choices. This makes strategy an important factor in its own right (*e.g.*, Prahalad and Doz, 1987, p. 39).

9.9.1 Several Cases

The dynamic (iterative and interactive) process in the figure may accommodate a diverse set of situations. The basic situation is one where disruptive external shocks are absent and the feedbacks stabilise firms' market definitions and strategies. Firms converge to a similar market definition which reproduces itself. External shocks (*e.g.*, new techniques, shifts in consumer preferences, entry) and destabilising feedbacks (*e.g.*, R&D which spills over market boundaries) may disrupt market boundaries.

Stable conditions and market structure

It is possible that the suppliers converge to similar market definitions. This may occur if the basic conditions and market structure are stable (perhaps after an initial adjustment process), and the feedbacks (10 to 14) stabilise the firms' market definition and strategy (*e.g.*, through the initial adjustment process). In these cases, market definition can be considered inter-subjective. The firms' individualised markets coincide with one another. The facts of the situation (prices, shipments, sales) will confirm their market definition.

The case of multi-market collusion shows, moreover, that firms may have an interest in sharing a common view. The western European market of soda ash is an example. It displayed what appears like multi-market collusion of the spheres-of-influence type. The suppliers distinguish a continental market from an Anglo-

6. These two level types of learning are examples of a corresponding learning strategy and an incorporating learning strategy, respectively (Van Witteloostuijn, 1990c, pp. 192-3).

saxon market. Soda ash (sodium carbonate) is a bulky product, with high transport costs, and production processes that exhibit high capital requirements and economies of scale (Martin, 1961, p. 236). This suggests the existence of sunk costs and associated exit barriers. These conditions may lead to a persistent presence of incumbents, which facilitates tacit collusion. The persistence of the market presence of firms in this market can be gleaned from the statement:

> 'The sales pattern established in the 19th century persists today. ICI has more than 90 per cent of the UK and Irish soda ash markets and sells very little on the continent. Solvay, conversely, has 70 per cent of the continental market.' (*The Financial Times*, 29-3-1991)

The Belgian firm Solvay is the market leader in the western European soda ash market since it invented the production process of synthetic soda ash in the 1860s. Solvay and the U.K. firm ICI had a formal market-sharing agreement up to the 1960s; they claim that there is no longer any (multi-market) collusion between them. Nevertheless in 1990 the E.C. fined ICI, Solvay as well as BASF for operating a soda ash cartel (*The Financial Times*, 29-3-1991). As predicted by the models discussed in chapter 5, the spheres-of-influence may be based on transport costs, which may be considerable as soda ash is a bulk chemical. Moreover, low-cost U.S. producers where kept out of the European market by an anti-dumping duty of $65 per tonne on a current price of $200. The E.C. lifted the duty, however. This entails changes in the basic conditions of the market (*i.e.*, duties) and market structure (entry by U.S. rivals) which may undermine the multi-market collusion.

Changing market structure

Perceptual filters, such as market concepts, may link behaviour into self-reinforcing cycles (Starbuck and Milliken, 1988, p. 52). A group of firms may commit to strategies which reinforce (*e.g.*, through feedback 14 in the figure) the market definition upon which their strategies are based. This may create a window of opportunity for mavericks, that is, outsiders who do not partake in the joint view and history. If they successfully encroach upon the established firms' markets, market definition has to adjust. One-sided entry, for example, occurs if the incumbent firm believes it has no profitable access to the entrant's home market (section 5.2). Its belief is based on economic data that may have become obsolete. The (established-firm) entry may alert the incumbent firm to the need of updating its views.

The inertia of U.S. firms to entry by Japanese rivals and the ensuing debate on global versus (multi)domestic firms are examples. Prahalad and Doz (1987) illustrate this by the demise of the U.S. manufacturing industry of colour TVs. In the 1960s and 1970s the U.S. manufacturers (RCA, GE, and Zenith) were concerned with defending their home market. They failed to perceive of Japanese competition as the cause of a shift from a local to a global TV industry. Being limited to the U.S. market, they could not justify the investments which were needed to compete with the Japanese suppliers. Moreover, U.S. colour television set manufacturers did not initially perceive of the Japanese imports as a

competitive threat (Willard and Savara, 1988, pp. 61 and 69). They rather saw the Japanese as filling up a gap in their product lines, which were centred on large screens. This provides an example of Hatten and Hatten's (1987a, p. 300) 'competition without confrontation'. The difference in vision entailed a difference in strategy. This led to one-sided entry by Japanese suppliers in the U.S. market, and the subsequent overtaking of the U.S. firms by the Japanese competitors.

Changing basic conditions

Changes in the basic conditions may disrupt previously accepted market boundaries. Product innovations may, for example, straddle two different product markets. Cooper (1989) refers to videocassette recorders, which are substitutes for home entertainment (*e.g.*, stereos) and movies (theatres). This innovation may, therefore, contribute to a breakdown of the market boundaries between home entertainment and movies. These innovations can result from an exogenous shock as well as from continuous R&D by the industries' suppliers (feedback 11). The latter case is an example where the feedbacks themselves destabilise market definition and firms' strategies.

These cases may be applied to other real-world examples. The economy witnesses several processes where market boundaries are changing: globalisation, European integration, the NAFTA (North American Free Trade Agreement), and the convergence of banking and insurance. The next chapter has a case study which applies the framework to the convergence of the computer and consumer electronics industries.

9.10 APPRAISAL

The chapter has noted the following points. Multi-market competition may proceed in two steps. Constrained rationality arguments warrant firms to focus attention on a subset of related markets. Within the subset, they may rationally compete for customers with actual and potential suppliers (as analyzed by game theory). Multi-market competition affects the extent to which local shocks are transmitted to other markets. It will thus affect market definition. In a dynamic setting, where firms invest and where they may establish spheres-of-influence, market boundaries may change through time. This implies that markets are transient phenomena.

Appendix 9.A. Transmission of a Local Shock among Spheres-of-Influence

The multi-market collusion model in Pinto (1986) may illustrate that a large or critical demand shock in market A may disrupt multi-market collusion in markets A and B. In this case, a quantity shock in A is related to a price change in B, a cross-elasticity of demand appears, and the markets seem related. To recap, Pinto's model is as follows (see chapter 5). There are two markets, A and B, and two firms, 1 and 2. The firms have constant marginal production costs c (≥ 0) and transport costs t (> 0). Firm 1 is located in A and 2 in B. The output levels are q_i^j ($i = 1,2$; $j = A,B$). Demand functions are $P^j(q_1^j+q_2^j)$ ($j = A,B$). For computational ease, they are assumed linear: $P^j(q) = a^j-bq$, where a^j, $b > 0$. The parameter a^j indicates the size of demand, and will be subject to shocks. Firms compete in outputs (Cournot).

In the case of duopoly competition in each market, the home output level is $(a^j+t-c)/3b$, for firm 1 in A and 2 in B; and the export level is $(a^j-c-2t)/3b$, for firm 1 in B and 2 in A. A firm exports to the export market j if $a^j > c+2t$, which I will assume. Prices P^j are $(a^j+t+2c)/3$. The profits are $(a^j+t-c)^2/9b$ in the home market and $(a^j-c-2t)^2/9b$ in the entry market.

In the case of exclusive spheres-of-influence, each firm is monopolist in its home market, with an output level $(a^j-c)/2b$, price $(a^j+c)/2$, and profits $(a^j-c)^2/4b$. Exports are zero. If a firm defects, it does so by exporting to its entry market. The export level is the firm's best response to the unsuspecting rival's monopoly output level. This gives an export level $(a^j-c-2t)/4b$; price falls from the monopoly level to $(a^j+3c+2t)/4$, and the export profits are $(a^j-c-2t)^2/16b$. The punishment consists of eternal reversion to Cournot duopoly competition in both markets. (This assumption, of a grim trigger strategy, is for convenience. Pinto assumes a temporary reversion to Cournot competition). The firm defects if $\Pi_i^D-\Pi_i^C > 0$, *e.g.*, firm 2 defects if:

(9.A1)

$$\Pi_2^D-\Pi_2^C = \left[\frac{1}{16}(a^A-c-2t)^2+\frac{1}{i}\left(\frac{1}{9}(a^B+t-c)^2+\frac{1}{9}(a^A-c-2t)^2-\frac{1}{4}(a^B-c)^2\right)\right]\frac{1}{b} > 0.$$

This expression increases in a^A, the demand level in firm 2's export market, A:

$$(9.A2)\quad \frac{\partial(\Pi_2^D-\Pi_2^C)}{\partial a^A} = \frac{1}{b}(a^A-c-2t)\left[\frac{1}{8}+\frac{2}{9i}\right].$$

The expression is positive as by assumption $a^j > c+2t$: a higher demand level in A raises the temptation for firm 2 to defect by exporting to A. The gain of defection increases towards infinity if a^A increases to infinity: if market A grows sufficiently large, defection will certainly happen. At the demand size a^A where firm 2 is indifferent about defection and collusion, a small increase of a^A leads to a collapse of collusion, that is, price falls in both markets from the monopoly level $(a^j+c)/2$ to the duopoly level $(a^j+t+2c)/3$ (which is less than $(a^j+c)/2$ if $a^j > c+2t$, as assumed). A demand increase in market A coincides with a price fall in market B: the cross-elasticity of demand is negative, and the goods appear to

be complements. Note that this occurs only if collusion breaks down: before a breakdown as well as after it (when the markets are segmented) a local demand shock has no influence in the other market.

A cost shock, for example a change in the transport cost, has no influence either as long as exclusive spheres-of-influence remain intact. The shock may disrupt collusion:

$$(9.A3)\quad \frac{\partial(\Pi_2^D-\Pi_2^C)}{\partial t} = \frac{1}{b}\left[\frac{2}{9i}a^B - a^A\left(\frac{1}{4}+\frac{4}{9i}\right)+\left(\frac{1}{4}+\frac{2}{9i}\right)c+\left(\frac{1}{2}+\frac{10}{9i}\right)t\right].$$

Pinto's (1986, p. 365) presumption is that low transport costs facilitate defection (by two-way trade), that is, $\partial(\Pi_i^D-\Pi_i^C)/\partial t < 0$. Equation (9.A3) bears this out in special cases, *e.g.*, if a^A is at least half the size of a^B and c and t are sufficiently small. Pinto (1986) explores the symmetry case, $a^A = a^B$, where this result is likely, although still not guaranteed. If t changes such that collusion gives way to defection, prices fall in both markets (even if transport costs rose).

10 THE CONVERGENCE OF INFORMATION INDUSTRIES

The topic of chapter 10 is the convergence of the information industries, such as the consumer electronics and computer industries. Innovations create new possibilities for shared resources (especially, information) and multi-market spillovers. These in turn blur existing market boundaries and encroach upon spheres-of-influence. The chapter uses some proxies and concepts proposed in chapter 9. It may illustrate that market definition is an important step in the strategy formation process. It also illustrates some vertical and horizontal dimensions of multi-market competition (in parts III and IV).

10.1 INTRODUCTION

The computer, telecommunication, consumer electronics, and entertainment industries appear to converge into an *information* or *multimedia industry*. This emerging market will change competition and consumer behaviour in information-related industries. The main cause of the convergence process is the digitisation of information. Digitisation converts several types of information (text, sound and images) into digital code (bits). New products manipulate, mix, and transmit these kinds of digital information. Information will flow more easily from one person to another, from one medium (*e.g.*, a photo negative) to another (*e.g.*, a journal). Consumers will benefit from the rapid (*e.g.*, on-line) availability of enormous amounts of information. To put this in historical perspective, transferring the world's information to digital formats may be a revolution as much as the introduction of writing thousands of years ago.

New information media mix characteristics of computers, consumer electronics, and entertainment. They fill the 'marked gaps' between, for instance, computers and consumer electronics. As a result they create a chain of substitutes between previously unrelated products. If the interactions among these products (captured by cross-effects of demand and prices) become strong, the previously unrelated products may have to be grouped in the same market. Information that is stored in digital format can be supplied in different media for different ends and buyers. Information therefore develops into a shared resource that can be used in several markets. This creates new occasions for positive multi-market spillovers. As firms introduce products and techniques that cut across industries, they tend to destroy established spheres-of-influences (markets or market segments) in the computer, consumer electronics, and other related industries. Competition intensifies as a result. These consequences break down the market boundaries between these industries.

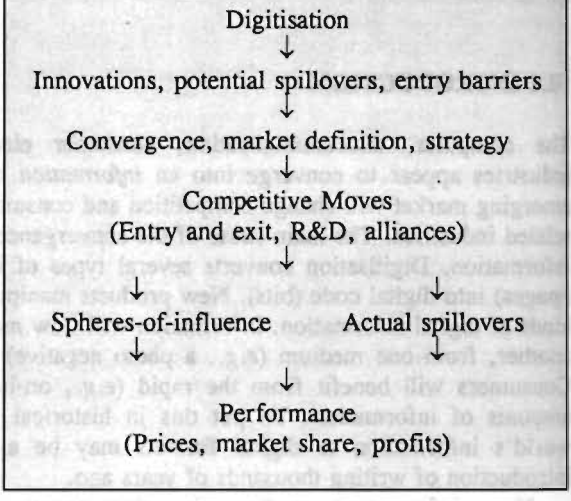
The previous chapter argued that markets do not exist. Instead, the market is a concept used to classify information about products, prices and quantities as highly relevant (within the market) or less relevant (outside the market). The

same holds for convergence: it is a belief that participating firms are acting upon by making moves such as takeovers, strategic alliances, *etc.* The chapter documents some of these moves. It suggests that firms are indeed preparing themselves for a major overhaul of these industries. There is no immediate evidence that market boundaries are currently breaking down. Market definition requires information on prices and production quantities. These data will come available only after considerable lags. Proxies, or rather circumstantial evidence, will have to be used. The moves (decisions) firms make can be used as proxies (indicators or signals) of their underlying beliefs about market boundaries.

The discussion in this chapter is preliminary. It explores information technology industries throughout the 1980's and 1990's. Its aim is to demonstrate the need for more theoretical and empirical work in the area and to contribute to its formulation. This case study may also illustrate the theories discussed in the previous chapters. Figure 10.1 reflects the topics in the chapter and their interrelations. The chapter will discuss convergence (section 10.2) and some technical and economic aspects of digitisation (section 10.3). It then explores the consequences for market definition (section 10.4). Changes in market definition are important as they affect the intensity of competition (section 10.5). In particular, competition increases and margins have fallen. Firms anticipate or respond to these changes by making competitive moves, such as mergers and strategic alliances (section 10.6). Finally, the chapter turns to the required evidence for finding convergence (section 10.7) and gives an appraisal (section 10.8).

FIGURE 10.1

Dynamic Market Boundaries



10.2 CONVERGENCE: A PROCESS TAKING ITS TIME

As convergence proceeds it seems to affect an increasing number of industries. By 1987 the convergence of the computer and telecommunication industries was already discernible (Von Tunzelmann and Soete, 1987), as was the convergence between the consumer electronics (audio and video), computer, and telecommunication industries (*NRC*, 18-3-87). Currently, convergence is also expected to involve education and entertainment (*PC Magazine* 27-10-92, p. 31)

and the media (*The Wall Street Journal Europe*, 21-5-92, pp. 1 and 8).

Expected progress of HDTV in the U.S.	
Start of R&D	1986 <
Choice of a standard	1993
Product introduction	1995-6
Diffusion to 1% of households	2002-3

Source: *Business Week*, 27-4-92, p. 66.

The associated technologies appear to undergo three stadia: product and process development (±mid 1980's-mid 1990's), product introduction (±1990's), and diffusion (±1990's-2010). Currently in 1993, some 'convergent' products are in their introduction phase (*e.g.*, multimedia computers, CD-i), others are preparing introduction (*e.g.*, PDA's, personal digital assistants), and still others are in the research and development phase (*e.g.*, HDTV, High Definition Television). A proliferation of new products and processes is under way. None of these seems to have reached a diffusion level where 1% or more of the households in a country owns one. Firms are preparing the convergence process, but it has not yet transformed the marketplace. Convergence refers to expectations, therefore, with considerable uncertainty about the likely outcomes. According to Dave Nagel, head of Apple's Advanced Technology Group, "Right now, the industry is throwing lots of things against the wall. What will stick isn't clear." (*Business Week*, 7-9-92, p. 54). The successful products will define the direction the industry is going, who the winners and losers are, and which standards for information processing, transmission, compression, *etc.*, will become dominant.

The chapter will focus on the broad outlines of the convergence process. It avoids predictions on issues as 1) the time frame over which convergence will occur, 2) the size (revenues) which a unified information industry may have over a specified laps of time, and 3) the identity of survivors, losers, and emerging new players among the suppliers. For the participants these are the most pressing questions. Prediction is difficult as the markets are turbulent and the success of new products highly uncertain. The time frame and the size of the market will be influenced by consumer adoption decisions, government standard setting activities (*e.g.*, in High Definition Television), and antitrust policy. Incompatible information standards probably delay diffusion of new technology. Strategic alliances have high failure rates. The chapter warrants the qualitative prediction that there are two scenarios likely to emerge.

First, convergence may lead to a new strategic group of products and suppliers, called multimedia. This requires inputs from the converging industries; its products may substitute for some of their existing products (*e.g.*, emerging video-phones may replace conventional telephones). This view of convergence is consistent with a view that separate consumer electronics, computer, telecommunication, and media industries will continue to exist. Niche players may survive in these markets due to strong entry or mobility barriers.

Second, convergence may also have deeper effects, if it merges all constituent markets into a single integrated *information industry*. John Sculley, the former chief executive officer of Apple, seems to support this view. He expects that

computers, consumer electronics, telecommunications, and media & publishing will converge into a $3 trillion 'megamarket' (*Business Week*, 25-5-92, pp. 69 and 71). In this case, all surviving and new firms should address the convergence process. Niche players may survive only by supplying components, but they will be unable to sustain in the consumer product market. These two scenarios imply that a consensus about the salience of convergence may hide important differences in firms' market definitions and strategies.

10.3 THE DIGITISATION PROCESS

Many barriers between types of information (*e.g.*, the human voice, music, text *etc.*) are breaking down as information is increasingly translated into digital form. The code of the digital world, the 'bit' or binary digit, 0 or 1, is becoming the unit of information. New media appear to store or process digital information. Whereas LP records store music in analog format, the CD stores music in digital format. The analog processing of video in television screens is expected to give way within a decade to digital processing by HDTV systems.

Several innovations facilitate digitisation. Probably the most important one is the decreasing cost of computing power as ever more powerful and fast chips are developed (*Business Week*, 6-3-89, p. 42). These chips speed up existing tasks, but they also facilitate developments, such as graphical user interfaces (modeled after the Macintosh), and new uses, such as desktop publishing. New video chips can store, retrieve, compress, or process images. Digital video processors, *e.g.*, mix video, graphics and text (*Business Week*, 24-8-92, pp. 54-5). These chips can provide (decompress) television images sufficiently fast for the watcher to see a flowing motion in full screen (so-called full motion video). No less important, data compression software is reducing the amount of bits needed to store digital information. Examples are pk.zip for text in MS-DOS computers, the PASC compression code for music in the DCC, and the MPEG-code for full motion pictures from a CD. Compression is a necessary stage to transferring, storing, and reading digital information using today's media. The compact disk is becoming the dominant medium for storing all kinds of digital data, rather than just music. Cable TV and new, fibre-optic phone cables greatly increase the capacity for data transmission into and from the house. The digitisation process seems a technology-driven process where hardware suppliers are the initiators, and software producers, consumers, governments and others respond, often with considerable delays.

Digitisation, however, faces an important hurdle: incompatible data formats. New information products need a standard for (de)coding (in and out of digital code), formatting, and (de)compressing information. Incompatibility creates a standard problem (Arthur, 1988; David, 1987; Farrell and Saloner, 1985; Farrell and Shapiro, 1992; and Katz and Shapiro, 1985). Unless a standard is legally imposed, like television standards such as HDTV, private competition will determine who the winners and losers are in the standards battle. Users and software authors have to choose among the incompatible formats. Both groups will try to anticipate each others' choices in order to choose the most widely accepted format. The battle for a video standard (between Matsushita's VHS,

Sony's Betamax and Philips's Video 2000) is legendary. VHS's victory demonstrated most vividly that the standard that gets the most support early on is likely to get most software, most users, which in turn attracts most software, *etc.* This virtuous circle means that standards introduce an economy of scale (a network or bandwagon advantage) where there may only be one winner.[1] A format battle ensues where each supplier tries to position (or sponsor) its format as the most common one. The video war has brought home to firms that introducing a new standard goes beyond introducing hardware. One has to introduce software as well.

The history of the CD illustrates ongoing digitisation (P. Groen in *CD Plus*, 1(1), 1992, p. 5). Philips's invention of the video long play (VLP, or laserdisc as it was later called) introduced a new recording medium: a large disc read by using laser technology. Movies (*i.e.*, sound and images) could be stored in analog format (*CD Plus*, 1(1), 1992, p. 4). As an offspring Philips cooperated with Sony to develop the CD, which stores sound in digital format. In 1987 CD-Video introduced digital sound to replace the analog sound of the VLP. The CD-Rom (XA) and CD-i formats introduced digital images and text, as well as sound. There is an increasing variety of incompatible standards for CD, for instance: CD-Rom, CD-Rom XA, CD-i, CDTV *etc.* Information stored in CDTV format cannot be read by a CD-i player and *vice versa*. Some compatibility exists in that a modern Laserdisc player can play a VLP as well as its more recent offspring. Laserdisc players and most other CD-based players or computers play CDs (*i.e.*, CD audio). Moreover, there are some CD standards that bridge existing standards, such as audio CD, Photo CD, and Video CD. The history of CD formats also shows a trend towards miniaturisation. The large (30 cm) Laserdisc gave rise to the CD (12 cm), which in turn occasioned Sony's even smaller Mini Disc (6.4 cm). This reflects ongoing process innovations. The acceptance of the CD in the early 1980's is partly based on its partisan support by Polygram, Philips's music subsidiary. Software has to be available from the very start, and making it requires huge outlays. This raises the costs of introducing new products. The introduction of new media, such as DCC, MD and CD-i, and new computer operating systems such as IBM's OS/2, illustrate this.

10.4 THE EFFECT ON MARKET BOUNDARIES

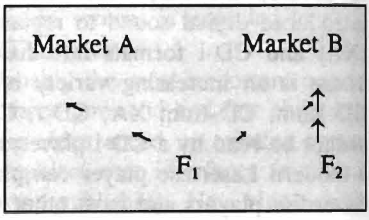
The industries involved in the convergence process have in common that they deal with information. They provide information (*e.g.*, movies, music), process information (*e.g.*, computers), or transmit information (*e.g.*, telecommunication, broadcasting, cable TV). Digitisation ushers in innovations that affect market boundaries in three ways. They alter the chain of substitutes that products are located in, they create a potential for multi-market spillovers, and they create new entry barriers. These three effects come about by three types of transformations of production and consumption processes. New products can complement or

1. It need not be 'winner takes all' if losers can survive in a niche. Witness, *e.g.*, the Commodore Amiga and the Atari ST computers, which are not MS-Dos compatible.

substitute existing products in consumption. New products may also complement (raise the profitability of) or substitute (reduce the profitability of) a firm's existing product line, that is, they may give rise to positive or negative multi-market spillovers (complementary outputs). Finally, process innovations may create new factors that are complements or substitutes in production to existing factors (complementary inputs). New complements or substitutes of these three types will affect market boundaries. This suggests a simple framework for convergence.[2]

10.4.1 A Framework for Convergence

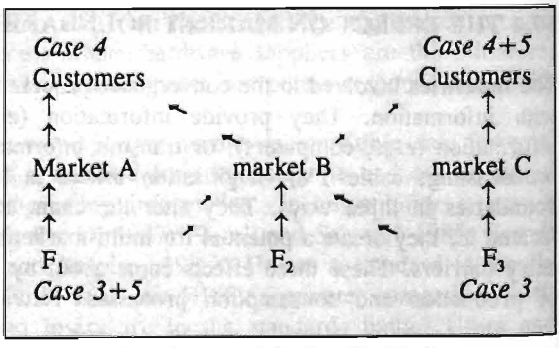
Process innovations can provide complementary inputs or outputs (cases 1 and 2 below). Product innovations can be substitutes or complements in consumption to existing products (cases 3 and 4). There are also intermediate cases (case 5).



Case 1. Call firm 1 the incumbent supplier of product A and firm 2 the incumbent supplier of product B. Firm 1 uses a new resource or factor F_1. A distinguishing characteristic of the innovation is that it can be used in market B as well. Product B may be an existing product. The joint use of F_1 inspires a positive multi-market spillover between A and B, and A and B become complementary outputs (see subsection 5.3.1, section 6.7 and appendix 6.B). Developments in market A will spill over to market B. If the interdependence is sufficiently important, A and B converge into a new market.

Case 2. The entry into B or the development of B may require a complementary resource F_2 (complementary inputs; see definition 6.1). The market of factor F_2 may be imperfect or absent. Sunk costs may have to be incurred in order to develop or acquire F_2. These sunk costs are *entry barriers* or *mobility barriers* for the firm that enters market B (see subsections 4.2.4 and 6.7.2). They fortify market boundaries.

Case 3. Product B may be a new product without close existing substitutes or complements in consumption. Firm 1 in A may develop B using F_1 and F_2, while firm 2 in market C may develop or imitate B using its resource F_3 with F_2. Firms 1 and 2 begin to compete in a third market (B) while previously there was no interdependence



2. See Von Tunzelmann and Soete (1987) for a convergence framework from a diffusion perspective.

among them.

Case 4. Product B can be an imperfect substitute or complement for existing products A and C. B is a straddler between A and C if it is a substitute (see section 9.3) or a new interface if it complements A and C. The markets A and C become related on the demand side by indirect competition (intermediated by B). They may be pairwise related on the supply side as well (*e.g.*, A and B through F_1). Several intermediate situations exist, such as case 5.

Case 5. The innovation F_1 allows firm 1 to develop product B, which is an imperfect substitute or complement for product C in consumption. Markets A and C are now related through a combination of a technical interlinkage (as A and B use F_1) and through customers (who choose between B and C).

Some of these cases blur market boundaries (*e.g.*, spillovers and straddlers), while others (*e.g.*, entry barriers) fortify market boundaries. The next subsections discuss the effects on convergence of three factors in particular: spillovers, product innovations, and mobility barriers.

10.4.2 Changing Potential for Multi-market Spillovers

digitisation
↓
shared resources
(*e.g.*, information)
↓
positive multi-market spillovers
↓
fading market boundaries

Once information is digitised, any type of information (*e.g.*, voice) can be stored on the same digital media, transmitted by the same channels, and processed by the same products. Information can acquire alternative uses. Its increasing importance is widely recognized: 'intellectual property is the asset for the '90s,' argues W.N. Joy, co-founder of Sun Microsystems Inc. (*The Wall Street Journal Europe*, 29-4-1992, p. 1). The returns to investments in information come from transmitting information by a variety of (printed, electronic) media to a variety of (personal or business) users. That is, shared resources, such as information, can be developed for the sake of several products, thus reducing their costs or increasing their appeal. This creates a *potential* positive multi-market supply or demand spillover (case 1). This induces firms to internalise these returns by being active in those media where its information can be sold. Sarathy (1991, p. 127) explains horizontal integration (by mergers and acquisitions) in the media industry primarily by the aim to realize the '[p]erceived gains from selling ideas through books, record, films and TV programs'. He cites Bertelsmann and Time Warner as evolving multimedia publishers.

Examples abound of a potential shared use of information. Libraries of digitised sound, images (*e.g.*, movies), and text, can become the basis of several products (movies, video, games, encyclopedias, *etc.*). Kodak's Photo CD system, *e.g.*, allows the consumer to store photos on CD, watch them on the television set, and manipulate them with a computer. Pictures can be stored, retrieved, and used like any other digital information. This reduces the adjustment costs of transferring information from one medium (photo negatives) to another (*e.g.*, a computer). A database of photos can thus be created for alternative uses. An example is Interactive Home Systems (IHS) created by Microsoft's Bill Gates in

1989. IHS is now 'buying up the electronic rights to images for its digital visual library.' (*PC Magazine*, 27-10-92, p. 31). The same holds for text. If a journal processes its news in digital form, it can with little additional costs store the news in a database, accessible on-line to users. The possibility emerges that a newspaper evolves into a multimedia enterprise using several distinct media to provide access to the same information, *i.e.*, the 'one source, multiple use' strategy (Van Cuilenburg *et al.*, 1992, pp. 89-90). The 'multiple use' may refer to joint exploitation of a journal and broadcasting (see case 1 above), as well as to new products, such as newspapers on CD-ROM, fax news (which is faxed to targeted users), videotext, and on-line services (see cases 3 and 4). Some U.S. journals are beginning to develop into electronic libraries (The *Volkskrant*, 17-8-93, p. 15). A movie, to give another example, requires footage which can also be used in videos, pay-per-view cable TV, games *etc.* Sony is planning the introduction of CD-Rom based video games. 'This is where owning a movie studio is beginning to give Sony an edge, says Olaf Olafsson, president of Sony Electronic Publishing Co. While producing movies, he says, Sony can shoot extra footage for use in interactive video games.' (*Business Week*, 7-9-92, p. 54).

Multi-market spillovers can also be based on shared manufacturing resources. The trend toward portability and miniaturisation favours Japanese manufacturing processes. Japanese firms have built up an enviable record of high quality manufacturing and a talent for miniaturisation. These qualities are increasingly in demand in numerous industries. Apple, *e.g.*, signed up Sharp to produce its Newton Personal Digital Assistant and Sony to develop and build its new Powerbook portable computers.

Technological change may create new as well as destroy existing multi-market spillovers. Vacuum technology, for example, is used in light bulbs, television sets, and X-rays (Frumau, 1992, p. 98 and 113). This induced the global market leader in vacuum technology, Philips, to enter all three areas. The development of LCDs, however, is expected by some industry observers to replace the conventional vacuum tube (cathode ray tube) technology (*The Economist*, 15-8-92, pp. 65-66). This would destroy the current basis of the positive spillover between TV sets, on the one hand, and light bulbs and medical technology, on the other hand. LCD technology, in turn, creates spillovers between product lines such as pocket calculators, computer screens, and flat-panel TV sets.

The next table lists some factors that stimulate or impede the development of positive multi-market spillovers. Multi-market spillovers arise because of the digitisation process. It is stimulated by miniaturisation (which allows the use of electronics in an increasing number of new and existing products), data compression (which reduces the size of digital files to manageable size), and product innovations (which generate potential spillovers). They allow the common use (by new and existing products) of shared (manufacturing and informational) resources. These spillovers will be wasted if data formats (standards) are incompatible and if the internal organisation of firms stands in the way of realising potential spillovers. Consumer inertia, which slows diffusion of new products, and government regulation also constitute impediments to the convergence process. These aspects affect the potential spillovers. It is up to individual firms to realise *actual multi-market spillovers* by investing in shared

resources.

Table 10.1
Multi-market spillovers

Drivers	Impediments
digitisation	incompatible data formats
data compression	
miniaturisation	organisational boundaries within firms (departments) and between firms (organisational cultures, opportunism)
product innovations	adoption inertia
investments in shared resources (*e.g.*, by R&D)	antitrust legislation (*e.g.*, which prevents cross-ownership of multiple media in the same region)

10.4.3 New Consumer Products

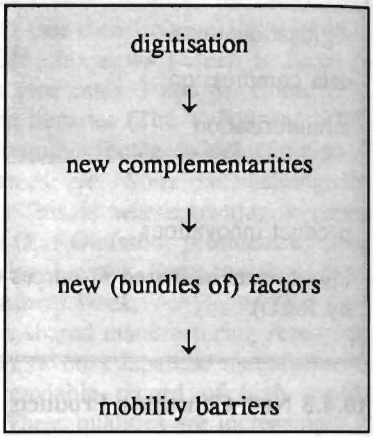
Digitisation makes possible a barrage of product innovations in the 1990's. Successful innovations may create spillovers among themselves and with established products (see cases 1, 3 to 4 in subsection 10.4.1). How valuable the spillovers will be depends on the highly uncertain demand levels that the innovations will encounter. Firms from traditionally different industries compete with each other for access into the emerging markets. Interactive TV, for example, connects the TV to the phone system. It will allow the user to choose which programs to watch at which time, to call up information on a program or event while the event appears on TV, to order products, or to exchange messages by means of on-line services. The on-line services will turn TV sets and phone lines into complements as both are needed to search through on-line databases. These services may turn cable and phone lines into substitutes, as both lines may in principle be used to connect the TV set to the outside world (see case 4). Whereas phone companies upgrade the phone system to expand its transmission capacity (*e.g.*, by using fibre-optic cables), cable companies try to bypass the phone lines altogether. Cable has the advantage over phone lines of having a far larger data transmission capacity. However, 'Phone companies have a crucial skill that the cable companies lack -experience in managing two-way communications.' (*Fortune*, 2-11-92, p. 78). The market boundaries between phone companies (telecommunication) and cable TV (broadcasting) are, therefore, breaking down.

If a new product straddles two markets which were previously unrelated, the incumbent firms may compete in the supply of the new product (case 4). For instance, multimedia systems, such as PC's, Commodore's CDTV and Philips's CD-i, combine the techniques and functionality of computers with consumer electronics. The software on these machines mixes characteristics of books (education) with records and games (entertainment). Again market boundaries

break down.

10.4.4 Mobility Barriers

Digitisation not only induces entry, but it may also raise entry costs (case 2). Frumau's (1992, p. 111) research confirms that 'business applications in general need technology from more than one area.' Associated with digitisation is increasing *complexity*, as new products need more different types of technology (W. Dekker in *NRC*, 11-2-87, p. 4). The ability to mix (digital) sound, text, pictures, *etc.*, requires know how about fields that used to be different, such as audio, video, and photography. An important implication for firms' strategies is the need to bundle activities or resources from several industries, for instance, hardware and software. To remain or become active, firms need to put together these bundles (or teams). This induces firms to acquire additional resources. The associated sunk costs raise entry barriers (see subsections 6.7.1 to 6.7.3). For instance, some consumer electronics firms intend to enter the multimedia market. To implement this strategy, they acquire firms with an expertise in entertainment at sometimes staggering costs. In 1988 and 1989 Sony, for example, acquired four U.S. entertainment firms for a total of $5.63 billion (Sarathy, 1991, p. 140).



Innovations may also, however, reduce entry barriers. Innovations may allow a firm with resources F_1 and F_2 to enter a market that previously required it to purchase a resource F_3. Photography, for example, used to be a chemical process. It is now gradually becoming an electronic process, which is to the advantage of (Japanese) firms with experience in electronics (P. Nulty in *Fortune*, 1-7-91, pp. 36-43; and *Business Week*, 10-8-92, p. 26). Digitisation induces entry by creating a potential for positive multi-market spillovers (subsection 10.4.2) and by introducing new products (subsection 10.4.3), but it also raises entry barriers (this subsection). How does it affect competition?

10.5 COMPETITION AND SPHERES-OF-INFLUENCE

Convergence between markets will change the terms of competition. Innovations spawned by the digitisation process may lead to product life cycles as short as in the computer industry. The huge costs of developing complex products (which involve complementary inputs and outputs) strongly urge firms to globalise their business, *i.e.*, to recover these outlays worldwide. These pressures may

undermine geographical market boundaries and intensify competition.[3] Vanishing market boundaries may coincide with a breakdown of spheres-of-influence. In the context of European integration, Daems (1990, p. 43) argues that 'collusive market sharing arrangements will break down as traditional market positions come under pressures.' Similar developments seem to occur in the information industries. Multi-market collusion gives way to multi-market competition. Firms will, therefore, experience new competition originating in previously distant markets.

Break-down of influence-spheres by

- globalisation
- convergence
- imitation

leading to new competition

As Stoop (1992, pp. 83-92) convincingly argues, electronics firms (tacitly) colluded by creating spheres-of-influence. They divided their markets along three dimensions: a geographic, a product, and a timing dimension. The geographic dimension refers to firms' respect for each other's original home market (esp. the U.S., Japan, and the E.C.). The product dimension implies that firms focus on particular products, *e.g.*, IBM on computers and Philips on consumer electronics. The timing dimension implies that innovators and imitators divide the product life cycle between them. These economic foundations for spheres-of-influence have been eroded, however. As a consequence, in all three dimensions, spheres-of-influence have come under attack as rivals rethink their strategies.

Globalisation

The globalisation process undermines the geographic basis of influence-spheres.[4] Technological cost-reducing changes are among the drivers of this process. The trend towards miniaturisation reduces the transport costs of highly valuable (consumer) electronic products. Information technology has reduced the costs of coordinating a worldwide operation. As consumer preferences become more homogeneous across the globe, similar product lines can serve worldwide markets with presumably few adjustment costs (Levitt, 1983). Although Levitt's contention is controversial, the expansion of American fast food and beverage companies is undeniable evidence. In particular the Japanese worldwide export success has brought globalisation to the fore. It forced other firms to counter or anticipate such moves. U.S. computer makers IBM, Apple, Compaq, and AST Research Inc. are stepping up activities in Japan. They are trying to prevent being attacked in the U.S. like the car and consumer-electronics industry:

> 'as with other industries, the Japanese are using that lock on their lucrative home market as a springboard to become major competitors worldwide. Six years ago, Japanese companies had virtually no presence in the U.S. Today

3. These arguments underlay Philips's strong support for the renaissance of European integration in 1985.

4. See Stoop (1992) for an illustration.

they have nearly 10% of the total PC market (.) and about half of the rapidly growing portable PC market.' (*The Wall Street Journal Europe*, 18-7-1991, p. 1).

The U.S. firms seem to be aware of the problem. Mr. Lautenbach, head of IBM's operations in Asia is quoted as saying 'Our most important competitors are in Japan, and we have to fight them on their territory.(.) They implement their technology first here, and it's important to compete against it first here. We can't just wait for them to come to the U.S.' (*The Wall Street Journal Europe*, 18-7-1991, p. 1). Reciprocal entry also occurs because of political developments. Privatisation of state enterprises and liberalisation of their previous monopolies open up national markets. This is particularly important in the telecommunication industry. The French and British Telecom firms now enter each other's home market (*The Wall Street Journal Europe*, 1-8-92, pp. 1 and 4).

Convergence

Convergence encroaches on product-based influence-spheres. Positive multi-market spillovers may induce firms to break with spheres-of-influence by (reciprocal) entry into each other's product markets (subsection 10.4.2). For example, Sony and Matsushita enter the entertainment industries. Apple, IBM and Microsoft try to enter the home by introducing home software and home computers. Convergence implies that these attempts differ from diversification moves into unrelated fields. New products (straddlers) also undermine influence spheres among established products (subsection 10.4.3).

Imitation

Rapid imitation, finally, undermines spheres-of-influence based on product life cycles. Product life cycles in the personal computer industry have shrunk to six months (*Business Week*, 31-8-92, p. 64). These short lags make it impossible for innovators and imitators to coexist in different 'niches': innovators in the early and imitators in the mature stadia (Stoop, 1992). Ever shorter imitation lags wipe out innovator monopoly profits. This creates dilemmas for innovators. In order to increase consumer acceptance of its CD-i format, Philips has defined it as a world system. That is, firms can license the CD-i technology. Rivals may, therefore, develop competing CD-i machines. The associated competition is expected to reduce price and raise product quality (*Financieele Dagblad*, 2-9-92, pp. 1 and 4). This prospect is attractive to users and software programmers alike. It may convince them to favour the CD-i standard over proprietary standards. But it also means that Philips facilitates imitation. Monopoly profits are rapidly eroded, therefore. If it had chosen for a proprietary format, as Apple and Commodore did with their multimedia computers, it would have the market to itself. Innovators may find it an act of justice that shorter imitation lags reduce the imitators' profits as well. The losses experienced by the British consumer electronics firm Amstrad are indicative. Amstrad's forte is low-cost imitation of computer and consumer electronics technology. According to *The Wall Street Journal Europe* (29-7-92, p. 12), Amstrad now suffers as 'the delay between a product advance and an affordable version by its creator has shrunk from several years to six months (.)

That leaves little time for an outsider.' Analysts advise Amstrad to exit the computer industry (*The Wall Street Journal Europe*, 5-10-92, p. 8).

10.6 MOVES FIRMS MAKE

The convergence process induces firms to make cross-market moves as they introduce new products. Their entry into new markets has numerous implications. Firms assemble new (teams of) resources to make entry possible. They adjust their organisation by creating new divisions, such as Apple's new division Personal Interactive Electronics that launches the Newton Personal Digital Assistant. They also acquire, merge or form alliances with firms in different information industries. As a result of cross-market moves, firms face a string of related decision problems.

First, about the extent of their activities, which raises product innovation, market selection, entry and exit choices. There appears to be a flurry of entry and exit actions, and firms continuously reconsider their activities. Philips and Tandy, for example, recently left the computer industry, and NEC is retreating from most consumer electronics products (*The Wall Street Journal Europe*, 22-4-1992, p. 4). One reason for exit is that competition heats up as mobility barriers and spheres-of-influence break down, and entry occurs. Another reason is that the shared resources upon which multi-market spillovers are based are changing (see case 1 in subsection 10.4.1 and subsection 10.4.2). In PCs, *e.g.*, R&D-based firms as IBM have lost ground to distribution-based firms such as Dell. The second decision problem is about the timing of entry and exit decisions. The appearance of new market (segments), such as multimedia, leads to early entry by some firms, and by waiting (late entry) strategies by other firms. Timing may depend on the time it takes firms to accumulate the resources (*e.g.*, experience) to make entry profitable (Deneffe, 1993).

Third, how do firms create appropriate bundles of complementary resources necessary to enter a new market? The next subsections focus on this issue, which is a key input in the former decisions. I will discuss three methods to implement entry. A firm may develop new resources through own R&D. It may acquire or merge with a firm that owns complementary resources. Alternatively, it may set up strategic alliances with firms that have such resources. I choose these three because of their visibility (see the next section).

10.6.1 Internal Development

Entry into a new market will be preceded by R&D into that area. By setting up R&D, a firm develops the know how and the patents required for a sustainable position in a new product market. This is an important method in R&D-intensive industries such as computers and consumer electronics. The technological drive of the convergence process primarily appears to consist of new combinations of knowledge from different sciences (new complementary inputs) and of application of knowledge in new fields (new multi-market spillovers). Cross-citations between firms, patented technologies, or markets may provide clues about these developments. According to bibliometric research within Philips, cross-citation of

articles and patents indicates the existence of clusters of technology areas within information industry: mechanics, domestic, professional, picture tubes, imaging, instruments, integrated circuits, data processing, communication and basic materials (Frumau, 1992, p. 114). Firms can also be clustered on the basis of their portfolio (*i.e.*, the relative sales of the firm in each of six 'business areas' or industries). Both indicators show for 1986 and 1981-1983, respectively, that there is little overlap between the clusters. The convergence process is, therefore, of more recent date and cannot yet be substantiated.[5]

10.6.2 Takeovers and Mergers

An acquisition or merger may be an indirect way to acquire a factor, owned by the acquired firm. It can be a step in an entry process if the acquired firm serves as a springboard in the new market. This argument may also explain why new or small firms accept to be acquired. A large parent company may help to overcome barriers to its growth. Mergers and acquisitions are often explained by synergies that would raise the firms' joint performance (*e.g.*, because of complementary inputs or outputs). In particular the need to accompany new hardware products with compatible software favours the development of multimedia firms. These are active in entertainment and information industries, on the one hand, and hardware industries such as consumer electronics, on the other hand. The simultaneous introduction of new hardware and software is expected to speed up consumer acceptance of an innovation. This, in turn, raises the probability of success given the existence of the above mentioned, standard-based first-mover advantages and short imitation lags. Sony and Matsushita are leading this process, following an earlier example when Philips created its Polygram music subsidiary. Sony now has two film-making units, Columbia Pictures and smaller Tristar Pictures Inc. As *Business Week* (7-9-92, p. 54) writes, 'Sony Corp. boasts a fuller cupboard of ingredients than any other company trying to cook up a digital stew.'

Synergies are notoriously difficult to realise. Well-known problems with mergers are different company cultures, conflict over the spoils of the merger, frustrated career perspectives, *etc.* Sony, for instance, has taken several years to come to grips and reorganise its film industry (*Business Week*, 7-9-92, pp. 44-45). The evidence on mergers shows mixed results. Shareholders of the acquiring firms do not gain on average; shareholders of the acquired firms do (Mueller, 1977; and Caves 1989). The acquiring firms may lose money; productivity may not increase; the acquisition substitutes for internal growth, and market share may decline. Moreover, even if successful, mergers and acquisitions may fall short of producing a firm that owns all resources required to compete successfully in the new emerging market(s). I now turn to strategic alliances as possible alternatives.

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5. Similar work is by Hagedoorn and Schakenraad (1992) who cluster firms on the basis of the intensity of their technology collaboration. They acknowledge the importance of interlinkage (p. 166). Their report, however, allocates strategic R&D joint ventures to either one of five fields (computers, industrial automation, microelectronics, software, and telecommunications). It does not focus on joint ventures that span across these fields.

10.6.3 Strategic Alliances

Throughout the converging industries, firms are frantically forming, or at least talking about, partnerships. Kodak, for instance, enlisted Philips's support in developing the Photo CD system. The new HDTV systems being developed in Europe and the U.S. are the product of joint ventures. A *strategic alliance* 'can be defined as a bilateral or multilateral relationship characterised by the commitment of two or more partner firms to a common goal.' (Jorde and Teece, 1991, p. 132). The alliance is strategic, if it has an effect on 'the long-term product market positioning of at least one partner' (Hagedoorn and Schakenraad, 1992, p. 164). If the common goal is price-fixing or market-sharing, the agreement is a cartel. In the convergence process the relevant alliances are technology alliances, where exchange of technology is an important goal. As an instrument to achieve a common goal, the strategic alliance is a substitute for national planning or merger. 'The case for planning and industrial policy recedes if a degree of operational and strategic coordination can be attained through private agreements.' (Jorde and Teece, 1991, p. 133). The partners in strategic alliances can be rivals, customers, suppliers, *etc.* The ability to maintain durable relationships with stakeholders to one's advantage is a source of profits and, therefore, an intangible resource (section 2.4). The growing importance of strategic alliances is a source of change that benefits firms who have this intangible resource. Japanese firms, especially, have long since nourished durable relations with stakeholders. They have a known ability to benefit from these alliances.

Partnerships seem to have several reasons. There may be a (technical) need to bring together complementary factors (cf. Frumau's interlinkage of technology areas). A partnership may help a firm to acquire the appropriate size, and share the costs of a new venture. Moreover, team effort is required for speedy development of new products. This is important as the speed of imitation has gone up. Forming partnerships may be a means for a firm to capitalise on some key resources in areas with which it is unfamiliar. Firms which own (an) important resource(s) can use this as a basis to become partners in numerous partnerships. That is, a partnership may internalise some externalities (multi-market spillovers) which a firm's resources may induce in other markets. Sharp, *e.g.*, is too small compared with Sony and Matsushita to become a full-line multimedia firm. For future growth it relies on its skill in opto-electronics (*e.g.*, LCD screens and laser diodes for CD players), where is has accumulated know how for decades (*Business Week*, 29-4-91, pp. 52-3). In uncertainty about which direction the industries are going, it is important to join several developments. This spreads the risk but it does add to the firm's costs. The information industry, that is, witnesses both competition (a breakdown of influence-spheres) and cooperation between the participants.

Research partnerships require a smaller degree of commitment by the partners than a merger or acquisition. Moreover, one can have numerous R&D joint ventures but only so many mergers (given antitrust, for example). The ad hoc nature of an R&D partnership may also, however, induce opportunistic behaviour by partners. Firms may join the partnership to hedge their bets, or they may be

interested in acquiring some know how from the partner. Jacquemin (1988) argues that R&D cooperation is advantageous because of (1) being more flexible than merger and having more commitment value than a market transfer of knowledge, (2) allowing risk-spreading between firms and risk-pooling over several joint R&D projects, and (3) producing synergies by combining complementary assets (*i.e.*, positive R&D spillovers). On the down-side, he argues that they are fragile and unstable, with many early breakups. Partner selection is a problem as each partner may fear that the other one becomes a powerful competitor. Contracts or an organisational design to prevent this may give rise to high transaction costs.

Firms may try to overcome opportunism by building trust over time. The literature on collusion has recognised this possibility. The sustainability of collusive arrangements can be facilitated by an increased number of contacts over time. Contact may increase through two avenues. First, the theoretical and empirical literature on multi-*market* contact has explored the case of firms which, by meeting in several product markets, can sustain multi-market collusion where single-market cooperation would fail (*e.g.*, Bernheim and Whinston, 1990). Second, Edwards (1955) suggests that any form of contact may induce collusion. A joint R&D project, for instance, provides firms with a contact point. Moreover, it offers the firms involved an additional means of retaliation in the case of opportunistic behaviour. R&D partnerships may go beyond coordination towards tacit collusion in the product markets:

> 'technological partnerships tend to grow into complex systems of mutual accommodation among large business enterprises, within which the permissible sphere of activity of each enterprise is defined with ever-increasing precision as one agreement after another establishes a boundary, or a mutually satisfactory joint occupancy, between that enterprise and some other enterprise with reference to additional products and additional markets.' (Edwards, 1955, p. 344)

As an example, Scherer and Ross (1990, p. 625) note that cross-licensing agreements may be used as a 'fulcrum' for price-fixing and entry-excluding cartels. To encompass these arguments, multi-market collusion theory can be widened to multi-*contact* collusion theory which includes multi-project encounters (Van Wegberg and Van Witteloostuijn, 1993). The large number of alliances between leading firms in the information industries, as documented by Hagedoorn and Schakenraad (1992) and Frumau (1992), may thus be a vehicle to build trust between the partners.

Apart from opportunism, R&D joint ventures may run into problems if close ties exist between R&D and the product market. Spillovers may extend beyond R&D to the production and marketing of the product. Speedy product development may require interaction and coordination of R&D and product market strategies (output, *etc.*). *Simultaneous* R&D development and production capacity investments may be technically efficient relative to sequential R&D and production processes. Limiting cooperation to R&D deters such coordination (Jacquemin, 1988, p. 553). R&D joint ventures may then continue to be less

stable than full coordination (or merger) between firms or full competition. These problems may explain the diversity of the organisational forms of firms' R&D cooperation (see Table 10.2).

R&D development should also be co-aligned with potential buyers and software makers. The DAT recorder, *e.g.*, was killed (at least in Europe) by the music industry's refusal to record music on DAT discs (*The Economist*, 13-4-1991, survey). Initially, DAT recorders did not have copy protection. The music industry feared that it would loose royalties, as consumers or bootleggers could easily make numerous (illegal) copies of music on DAT discs. The same problem exists with cassettes, of course, but the high quality of DAT recorders made the problem particularly acute. By the time DAT did have copy protection, it had lost momentum, and Sony and Philips had announced alternative technologies (the Mini Disc and Digital Compact Cassette, respectively). If the R&D strategy has to be integrated with the interests of the firm's stakeholders, it is less likely that cooperation is limited to R&D.

10.6.4 Costs of Implementing these Strategies

Solutions where a firm internalises new developments usually imply a costly commitment to new products and technologies. Uncertainty about future revenues may lead firms to prefer strategic alliances. Parent companies face a

> 'trade-off between synergy and interlinkage on the one side and the pressure to focus and to go back to core activities on the other side' (Frumau, 1992, p. 97).

Pressures to go back to the core are based on mobility barriers (or entry costs). First, there are the sunk costs of complementary resources. Acquisitions can be costly, as the example of Sony shows (subsection 10.4.4). The owners of the acquired firm may be able to appropriate a large part of the expected rent from merging the acquiring and acquired firm (see chapter 6). The acquiring firm may net the difference between its value (V_1) derived from the acquisition and the next best alternative (V_2). If each firm faces some close rivals, this difference may not be large.[6]

Second, there are opportunity costs when a firm expands its activities. Increasing employment levels create the danger of excessive hierarchy and low responsiveness to market needs (Jorde and Teece, 1991). Coordination problems further increase if the new activities make different demands upon the organisation, its employees, incentives and rewards. Firms whose strengths are in manufacturing may reward discipline. Firms in entertainment or software will rather stress creativity and individualism. These differences are likely to pose problems for 'hardware' firms (*e.g.*, in computers or consumer electronics) moving into 'software' (see subsection 6.7.3). Incompatible incentive schemes may lead to negative multi-market spillovers or managerial diseconomies of scope

6. The argument is diluted if the acquiring firms play off potential acquisition targets against each other.

(Rotemberg and Saloner, 1991; subsection 6.5.2). To prevent these conflicts, a corporation may split up in divisions (*e.g.*, telecommunication, computers, *etc.*). Intra-organisation boundaries, however, hamper cross-market activities if the latter benefit from employees moving easily across organisational boundaries within the firm (Hatten and Hatten, 1987, p. 210). In Japan, *e.g.*, the market leaders in the telecommunication and computer industries lead in both areas. Unlike western firms, which traditionally separate telecommunication and computers,

> 'most large Japanese companies do not erect barriers between their various businesses. Regular job rotation moves managers and technical staff between different product divisions. (.) Marketing and sales staff also move back and forth between telecoms and computers. Firms like Fujitsu, NEC, Hitachi, Toshiba, Mitsubishi Electric and Oki do not consider telecoms and computers to be separate businesses.' (*The Economist*, 15-12-90, p. 60).

This suggests that internal organisation barriers constitute entry barriers.

Third, there are legal mobility barriers to the convergence process. Antitrust litigation endows U.S. firms with different choice sets than European and Japanese firms. The latter may face lower regulatory entry barriers. Cable TV and phone companies, *e.g.*, might want to cooperate in two-way data transmission services between homes and (industry and government) databases. In the U.S., however: 'regulatory restrictions on the Bell operating companies rule out such linkups now' (Mr. Barada, vice-president for corporate strategy at Pacific Telesis Group, quoted in *Business Week*, 7-9-92, p. 52). U.S. law prevents telephone companies from providing cable-TV programming. Mr. A. Sikes, the chairman of the U.S. Federal Communications Commission (FCC), 'aims to break down the regulatory barriers that have kept companies in each industry from either cooperating or poaching on the other's turf.' (*Fortune*, 2-11-92, p. 78).

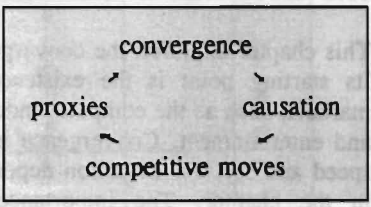
10.7 FINDING CONVERGENCE

The chapter has discussed causes and consequences of convergence. I now turn to some available evidence. The convergence process can be tracked first by looking at its technological causes. New products appear that straddle existing markets. Existing or new resources can be used in several markets. Data limitations probably stand in the way of tracking these developments in a quantitative way. Patents and scientific papers may be the exception. In line with Frumau's (1992) research, convergence may be hypothesised to imply an increase of cross-cluster references in patent descriptions and in papers. The clusters can be identified with separate fields of technology. Even without market convergence, however, the existence of complementary resources implies that patents and papers will contain cross-references. Hence an increase in cross-references may not be direct evidence of convergence. A hypothesis can be formulated as

Hypothesis 10.1. Convergence in the 1990's leads to a marked increase of cross-cluster references in patent descriptions and in papers.

Direct evidence on market boundaries should be based on prices and sales. For example, correlation of the price movements of two products has been taken as indicator that the two products belong in the same market. These data will become available when the convergence process is already well under way. They should be used in due course, therefore, but are of no avail in the current stage of the process.

Indirect evidence for convergence can be derived from the moves firms make. Actions that firms take when they believe in convergence may testify the extent to which firms hold this belief. Does an increase in the number of cross-market moves (mergers and strategic alliances) indicate convergence?



Economists have uncovered numerous explanations of mergers (Mueller, 1977; and Caves; 1989) and strategic alliances (Hagedoorn and Schakenraad, 1992a, 1992b, and 1993). Convergence is at most one explanation. Other independent variables may have an effect on or interact with it. Convergence suggests the hypothesis:

Hypothesis 10.2. Convergence indicates an increase in the number of cross-market mergers plus strategic alliances (a) in absolute terms and (b) relative to intra-market actions.

The hypothesis has to be made operational. The results will depend on market definition. Problems arise as increasing difficulties in defining market boundaries are the essence of convergence. One may interpret the expression 'cross-market' in the hypothesis as referring to standard industry classifications. Evidence of convergence might consist of an increase in the number of alliances and mergers which do not fit in in traditional market definition (*i.e.*, industry classification). Evidence to test the hypothesis has not yet been collected, although some of the data are publicly available. Table 10.2 may illustrate that many cross-market strategic alliances and acquisitions emerged in the 1980's/1990's. I do not currently have data to prove that their number has increased.

Care should be exercised when interpreting these moves as proxies of convergence. An *ex ante* check that they do indicate convergence might consist of studying public statements by entrepreneurs. If those firms most active in cross-market movements publicly discuss the convergence process, there may be a link. Apple, *e.g.*, is active in this field and has spoken out clearly on its belief in convergence (*Business Week*, 25-5-92, p. 69). An *ex post* check consists of verifying predictions later by using data on prices and quantities. As I argued above, these data are not yet available.

Hypothesis 10.2 does not address the issue whether firms will prefer strategic alliances or mergers and takeovers. This is a separate, closely related topic. Important determinants may be organisation structure (*e.g.*, M-form), company cultures, legislation, and national culture (see subsection 10.6.4). The chapter's emphasis on positive multi-market spillovers suggests the importance of size. Large firms face a different choice set than do medium-sized or small and startup

firms. A full analysis of the choice between merger and strategic alliance may need an interdisciplinary research approach, with input from industrial economics, strategic management, and sociology (*e.g.*, company cultures). This chapter hopes to add an ingredient to this mix of explanations.

10.8 APPRAISAL

This chapter explored the convergence process among the information industries. Its starting point is the existence of several more or less clearly delineated markets, such as the computer industry, consumer electronics, telecommunication, and entertainment. Convergence implies a series of changes to this situation. Its speed and sectoral extension depend on many drivers and impediments identified in the chapter. The importance of complementary inputs, techniques, and products, shows the interconnectedness among information products (subsection 10.4.1). Interconnectedness in turn partly explains why convergence is slow to occur. The overall speed in an interconnected system is determined by laggard elements in the system (Von Tunzelmann and Soete, 1987, p. 26). As a result, higher degrees of interconnectedness may slow down progress. Other impediments are factors that impede potential spillovers (Table 10.1), and mobility barriers (subsection 10.4.4), including the costs of strategy implementation (subsection 10.6.4). The internal organisation of firms, incompatible standards, consumer adoption, government legislation, and uncertainty should also be mentioned.

Due to convergence, the industries will intensify the joint use of resources, such as R&D, manufacturing capacity, and information. This occurs by cross-market actions such as strategic (technology) alliances and mergers. Products appear that exist on the boundaries of these industries. These changes affect the nature of competition as each market faces new competitors, which may originate from related industries. This calls for a realignment of firms' activities. Many will respond to intensified competition by exit from some product markets. Some try to develop into multimedia firms in order to benefit from the shared use of resources. Firms also rethink their R&D decisions. Increased competition may lead to a withdrawal of R&D activities or to intensification. The convergence and digitisation process are in turn driven by these decisions. Visions of the future and market definitions held by key entrepreneurs and managers play a large role in this process. This tallies with the view that markets are not realities; they rather are concepts about what the relevant rivals, substitute products, and consumers are. One corollary is that firms have heterogeneous market concepts, expectations, and strategies. Convergence is a belief held by many firms. They may impose this belief on others if it inspires them to actions whose performance proves them justified. Although this is too early to judge, the chapter clearly comes out in favour of convergence.

Table 10.2[7]

Technology alliances

Project	year	Means (*e.g.*, joint venture)	consumer electronics	telecom	computers	software	micro-electronics	entertainment, broadcast	Other
256 megabit DRAM	1992						IBM, Siemens, Toshiba		
multimedia PCs (MPC)		standard setting and joint marketing committee	Philips		Tandy	Microsoft			
(operating) software		4 projects, a joint company, licenses			Apple, IBM				
PDA	1993m e		Sharp		Apple				
CD-i	1986f 1991m	standard setting	Philips Sony Matsushita						
CD-i (Full Motion Video chip)	1992f	joint design center	Philips				Motorola		

7. f = year of formation of the joint venture; m = year of market introduction; e = estimated; r = year of report.

Photo CD	1992m		Philips Kodak						
HDTV (U.S.)[8]			Zenith	AT&T					
HDTV (U.S.)		consortium	Philips Thomson					NBC	David Sarnoff
HDTV (E.C.)			Philips Thomson Nokia						
Sony Records	1988	acquisition	Sony					CBS Records	
Sony Pictures (Film)	1989	acquisition	Sony					Columbia Pictures	
network services in Japan				NTT	IBM				
Multimedia services	1992r, 1995me	joint venture: First Cities	Philips Kodak	Soutwestern Bell, US-West	Apple				

8. The FCC is expected to choose an HDTV standard for the U.S. in 1993.

AFTERWORD

What I hope this book has achieved is an integration of different perspectives, theories, and models within industrial economics and strategic management. Its content derives largely from industrial economics, while its research aim is predominately inspired by strategic management, in particular Porter's (1980) extended rivalry framework. It draws insights from contestability, transaction cost theory, committed competition, competition by raising rivals' costs, and the resource-based view of the firm, to mention its most important sources. Integration also means that theories have been discussed not so much from the perspective of their developers as from the central perspective in this book. This may give the book its critical overtones here and there. The integrated framework consists of two dimensions (the horizontal and vertical one). These are related in terms of the institutional setting (chapter 2), through the common importance of shared resources (section 4.3), by exploring interaction effects (section 6.7), and in a basic model (section 8.3).

There are obvious limits to what a conceptual framework can contribute. It focuses on links between theories rather than on further development of any particular hypothesis. It is not testable in a clearly defined, empirical or logical way. Its aim is to be useful in guiding research on multi-market firms. As is often the case, the proof of the pudding is in the eating. Current research is usually characterised by streams focusing on specific topics, in particular, vertical integration, multinationals, and diversified firms. Research also tends to occur in rivalrous approaches (or paradigms), such as contestability, game theory, and transaction cost economics. This book contains a plea to explore a specific topic by drawing inspiration, ideas, and hypotheses from any of these topical streams and paradigms. Synergies, that is, may exist in theory as well as in fact. The framework's contribution may be to support synergies by facilitating communication among different theories and theorists. I will next mention some sources of the framework; a short summary reiterates some results, and a section on future research closes off the book.

Sources

The contribution made by the source theories can be summarised as follows. Transaction cost economics contributed especially to the analysis of shared resources (*e.g.*, internalisation theory). It showed that shared resources give an efficiency rationale to the multi-market enterprise only if transaction costs exist in the market(s) of these resources. Its emphasis on bounded rationality shines through in the chapter on market definition, which argued that bounded rationality has an effect on firms' decision making. Contestability contributed to the analysis of shared resources (economies of scope) and established-firm entry (to explain hit-and-run entry). Industrial economics contributed to multi-market modelling (international trade models), committed competition (game theory), and cost-raising competition. Theories on vertical integration contributed to the latter topic as well. Theories of diversification and multinational firms brought the importance of shared resources to the fore, as well as established-firm entry. Theories on multinational firms also emphasised market definition (global versus multidomestic firms). Strategic management contributed indirectly, to

diversification and other fields, and directly, to the analysis of resources (the resource-based view), market definition, and multi-market theory (extended rivalry).

Short Summary

Part II has shown how economists developed insights, step by step, on the issues in this book. Research by Chamberlin demonstrated the importance of potential competition. Bain, Andrews, Hines and others developed the implications of heterogeneity of the potential entrants. This book tracked the implications of one type of entrant especially -established firm entrants. The competitive advantage of established-firm entrants consists of resources that they can use in their home as well as entry markets. Assets such as plants, know how, and brand name recognition, which initially appeared to be entry barriers to new firms, turned out to be inducements to entry for established firms (Caves' Paradox). Contestability and transaction cost theory shed further light on the existence of economies of scope and scale based on such resources. These debates led to the conclusion that imperfections in the markets for these resources are necessary for the emergence of competitive advantage of multi-market firms. Competitive advantage thus has a horizontal dimension (multiple product markets) as well as a vertical dimension (imperfect factor market and product market). This result ushers in part III.

Part III develops the horizontal and vertical dimensions. Both largely draw on game theory. Before the advent of game theory, economists did discuss entry by established firms, but they did not analyze this in a multi-market setting. Their results were rather limited, and often asserted rather than demonstrated. Game theory changed this considerably. Brander (1981) developed a simple model that has become the basic model in the horizontal dimension. It allows one to explore the interaction between product markets in an increasing degree of integration. The integration depends upon arbitrage trade, centralisation of decision making (in particular, asset management) by firms, and upon the existence and form of collusion. The vertical dimension draws together insights from industrial economics (competition by raising rivals' costs) and strategic management (the resource-based view of the firm). Firms use factor market imperfections in order to preempt rivals. Competition thus shifts from the product market to a prior stage, in the factor market. Especially strategic management theorists developed an early intuition that competitive advantage is created by the firm's endowment and management (including incentive systems) of its resources. Industrial economics adds the insight that the value of resources has to be realised in product market competition. There is increasing analysis of an intangible resource: human capital. The incentives of employees, scientists, and managers may determine whether positive multi-market spillovers appear at all. The lack of success of many mergers further gives salience to this research topic.

Part IV focuses on production capacity as an example of a shared resource. It uses the analytical instruments discussed in part III to explore some theories in part II (especially chapter 7) and to further integrate theories (chapter 8). Chapter 7 shows the strong links between the theory of Andrews and Brunner of contestability theory. Both theories depend upon the existence of a salient entry threat which presumably originates in related markets. The related market itself

remains implicit in their theories, however. The attempt to make this explicit reveals the pitfalls of their arguments. Entry into a related market has repercussions in the home market. These lead to opportunity costs of entry that alter the payoffs. Zero profits and markup prices arise only by a fluke. As in the airline example referred to by Baumol, Panzar and Willig (1982), the model starts with a *given* amount of capacity that is 'waiting in the wings'. This assumption is plausible, for if the entrant would yet have to order and install capacity, it would unlikely be able to enter faster than the incumbent firm can change its price. The use of existing capacity in home and entry markets, however, creates a binding capacity constraint. This inspires the repercussions above. Moreover, the fact that capital has an alternative use in a related market is not enough to argue that it is a marginal rather than a sunk cost. The alternative use of capital mitigates, but does not destroy the commitment value of capital.

Chapter 8 demonstrates the same point in a different setting (with competition in quantities rather than prices). It integrates competition in horizontally and vertically related markets in a unified setting. This gives a concise description of multi-market competition. The horizontal version (with two product markets) provides the basic logic for reciprocal entry, counter-competition, and spheres-of-influence. The commitment value of capital is destroyed by either linear demand or zero transport costs (*i.e.*, absence of any product-specificity). In the (plausible) absence of these assumptions, some commitment value remains. This may shed further light on the airline case in chapter 7. If firms perfectly anticipate each other's reciprocal entry threat (which they do in the models of chapter 8), they may adjust their capacity choice. As a result, they avoid the price cutting entry threat on the basis of excess capacity. An equilibrium with zero profits (as expected by contestability) will not arise. Price cutting will occur if, as in chapter 7, the demand has not been correctly anticipated when capacity levels were chosen. This suggests that the price cutting that occurred in the U.S. after airline deregulation did not express a transition to a contestable market. Rather it expressed the results of unexpected capacity changes (through more efficient hub-and-spoke networks and computer reservation systems), new entry, and demand shocks (terrorism, wars, *etc.*). Excess capacity is in part a transitional phenomenon: it takes time before more efficient entrants drive out established carriers. The vertical version demonstrates the cost-raising logic that firms may over- or underinvest in order to use a factor market imperfection to their advantage in a product market. This too integrates several models of competition (in the markets of labour, capital goods, and intermediate products).

Part V uses the analytical instruments in part III to explore market definition issues. The framework in part III addresses market definition (*i.e.*, increasing degrees of integration). Chapter 9 further develops this theme. It argues that markets are concepts that do not refer to a real world object (unlike concepts such as price, demand, *etc.*). Markets are conceptual filters used to distinguish relevant substitutes (within the market) from irrelevant ones (outside the market). Firms' market definitions are the product of learning and thus are inherently dynamic. The market process may give positive reinforcements to a firm's market definitions if it is successful in the market. Inherent in the idea of perceptual filters is, however, that firms will be insensitive to developments that

do not fit in with the filter. As a result, they will be slow to adjust. It is well documented that European and American firms took a long time to realise that Japanese firms constituted a competitive threat based on (among others) a different market definition. Japanese firms, that is, are pioneers in the globalisation process.

The final chapter (10) applies several ideas of previous chapters to the rich case of information technology. It brings out the importance of firm-specific resources (section 4.3), multi-market spillovers (section 5.3), multi-market collusion (section 5.5), and rents from scarce resources, such as firms and employees (chapter 6). The convergence process induces firms to adjust their strategies and market definitions. Their delays and lack of success allow for entry by new firms which, in turn, may become subject to bidding (acquisitions) by other firms. The interdependence among firms increases as spheres-of-influence break down, standard setting leads to network economies, and entry into new fields requires complementary skills and assets which few firms currently have. All in all, the convergence process is the driving force of a wave of mergers and strategic alliances. The chapter suggests that research should aim at explaining firms' choices among alternative strategy instruments, in particular, mergers, strategic alliances, and internal development. This brings me to the close of this dissertation. What next? Clearly, the book should be able to guide research.

Future Research Issues

Future research issues abound. Consider modelling first. Game theory, of course, focuses on abstract settings. A game usually focuses on one commitment instrument, a duopoly, and two markets. Clearly, many problems in the real world cannot be reduced to such a setting. What if a firm can choose from two or more commitment instruments? A firm, *e.g.*, may invest in production capacity while licensing technology from an R&D firm, or it may invest in R&D while leasing production capacity. The theories discussed may also have to be developed beyond the two-firm, two-market dimension. A new problem in a 3-firm model is, for instance, that two firms may be potential entrant into the same market. If the entry profit is positive only in the case of entry by one firm, the two potential entrants need to coordinate their entry decision (*e.g.*, Nti, 1989). Multi-market firms raise specific issues in internal organisation. Firms may have to balance positive multi-market spillovers from shared resources against negative spillovers from adverse effects on incentives of employees and managers. To analyze this suggests a coupling between the horizontal multi-market dimension with the vertical dimension (relating, *e.g.*, an internal labour market and reward systems to performance in the product market). Another research topic is competition among potential entrants and, especially, competition between new entrants and established-firm entrants. New entrants play a different game against the incumbents than established entrants. Section 6.7 gave an example of this line of work. Do new firm entrants and established firm entrants compete with each other, or do they enter different niches? What are the competitive advantages of new firms, and how do these stack up against those of established entrants?

Another direction of future research is to apply multi-market competition to

new tasks. Similar explorations as by chapter 8 on capacity investments can be done about advertising and other decision instruments. These all raise particular issues that cannot be addressed in one basic model. Multi-market competition can be extended into multi-project competition, as in Van Wegberg and Van Witteloostuijn (1993), where the focus is on firms' multiple joint R&D projects. The ideas in part V may be relevant for convergence of banking and insurance, globalisation and European integration. Van Witteloostuijn and Van Wegberg (1991), for example, raise the issues of the E.C.'s '1992' project in a multi-market context. These topics are certain to raise other issues not represented in the framework in this book. In a metaphorical sense, these ideas may even be relevant for the convergence of strategic management and industrial economics. This dissertation may, for example be considered a straddler in between these two fields. Multi-market competition seems the natural habitat to explore decisions by firms to merge or to join in strategic alliances. The recent merger wave in the EC and in the information industries is arguably related to integration of markets.

The dynamic markets perspective refers both to exogenous (technological) dynamics as endogenous dynamics. In the latter case, chapter 9 pointed to the importance of learning and selection. These phenomena have been emphasised by evolutionary theorists and population ecology. Their theories may be related to the themes in this book. Firms act on the basis of (different) beliefs which give rise to behavioural heterogeneity and market selection. Important decisions to make are timing of entry and exit, as well as the degree of centralisation (leading to a global view). Bounded rationality may lead to sluggish response to new competition, inflexibility in market choice and centralisation (consider the possibility of escalating commitment).

Future research may also apply the framework to specific topics and industries. An example are mergers and strategic alliances. In particular, more should be known about the choice between mergers and strategic alliances. Firms may prefer a merger to gain ownership of important (complementary) resources. Mergers, however, are costly and they may have adverse affects on incentives of the firms' participants (*e.g.*, employees). Alliances may be preferred if numerous firms have to be involved. Standard setting cases come to mind, as well as cases where ownership of complementary resources is fragmented across numerous firms. The development of new combinations of a large number of highly different resources indicates that complexity is an increasingly important characteristic of information technology. This in turn suggests attention to bounded rationality issues, which most research covered in this book has largely ignored.

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Dit boek bevat een conceptueel raamwerk dat, naar ik hoop, een integratie biedt van verschillende perspectieven, theorieën en modellen in de industriële economie en strategisch management. De inspiratie komt vooral van strategisch management (m.n. Porter's uitgebreide rivaliteit), en de inhoud komt vooral uit de industriële economie. Inzichten komen meer bepaald uit de theorie van de open markt, transactiekosten-theorie, gecommitteerde concurrentie, concurrentie door het verhogen van de kosten van rivalen, en de activa-gebaseerde visie op de onderneming. Integratie betekent ook dat theorieën kritisch worden bediscussieerd vanuit het centrale perspectief van dit boek. Het integratieve raamwerk onderscheidt twee dimensies in concurrentie, de horizontale en de verticale dimensie. Deze dimensies zijn verwant vanwege de institutionele context (hoofdstuk 2), het belang van gedeelde activa (paragraaf 4.3), interactie-effecten (paragraaf 6.7), en een basis-model (paragraaf 8.3).

Er zijn enige beperkingen aan het gebruik van een conceptueel raamwerk. Het concentreert zich op relaties tussen theorieën, eerder dan op verdere ontwikkeling van enige stelling. Het is niet testbaar. Het doel ervan is een gids te zijn bij onderzoek naar multi-markt ondernemingen. Of het hieraan voldoet zal de praktijk uit moeten wijzen. Een van de mogelijke bijdragen is synergie te bevorderen tussen de genoemde perspectieven en theorieën. Synergieën kunnen bijvoorbeeld ontstaan door betere communicatie.

Deel I bevat een introductie op het boek. Hoofdstuk 1 motiveert het boek, en hoofdstuk 2 bespreekt de kern-ideeën. Een Nederlandstalig artikel dat voor een deel overlapt met dit hoofdstuk is Van Wegberg en Van Witteloostuijn (1991b).

Deel II van het boek beschrijft hoe economen stap voor stap tot kennis zijn gekomen van de thema's in dit boek. Chamberlin toonde het belang aan van toetreders in een markt. Bain, Andrews, Hines en anderen bouwden hierop voort. Er zijn verschillende soorten toetreders, met ieder hun eigen karakteristieken, die weer specifieke reacties oproepen van de zittende ondernemingen. Dit boek gaat dan vooral in op één type toetreders: elders gevestigde ondernemingen. Hun concurrentievoordeel bestaat uit de activa die ze zowel in hun thuis- als in hun toetredings-markt kunnen inzetten. Het gaat hier om activa zoals fabrieken, kennis, en merknamen. Dit zijn toetredingsdrempels voor nieuwe ondernemingen, maar ze blijken eveneens toetreding uit te lokken door elders gevestigde ondernemingen (de Caves' paradox). Met deze paradox sluit hoofdstuk 3 af, en begint hoofdstuk 4. De open markt-theorie en de transactiekosten-theorie werkten de gevolgen uit van deze activa voor schaal- en assortimentsvoordelen. Deze discussies leiden tot de conclusie dat imperfecties in de markt voor deze activa noodzakelijk zijn voor een concurrentievoordeel van multi-markt ondernemingen. Concurrentievoordeel heeft dus een horizontale dimensie (meerdere goederenmarkten) als een verticale dimensie (imperfecte activa-markten en goederenmarkt). Dit resultaat legt de grondslag voor deel III.

Deel III werkt de aanzetten van hoofdstuk 2 verder uit. Het behandelt de horizontale dimensie van multi-markt concurrentie (hoofdstuk 5) en de verticale

dimensie (hoofdstuk 6). Hoofdstuk 5 neemt als uitgangspunt het befaamde artikel van Brander (1981) over internationale handel. Dit beschrijft de interacties tussen twee gesegmenteerde goederenmarkten. Vervolgens worden gevallen besproken met een hogere graad van integratie. Zodra ondernemingen gedeelde activa gaan inzetten in meerdere goederenmarkten, ontstaat reeds een grotere verbondenheid van deze markten. Immers, ondernemingen zullen nog steeds in iedere markt apart beslissen over prijzen of produktie-hoeveelheden, maar ze zullen op globaal (geïntegreerd) niveau beslissen over hun investeringen in deze activa. Indien nu ook nog goederen-arbitrage mogelijk wordt, zullen ook prijzen of produktie-hoeveelheden op globaal niveau worden vastgesteld. Ondernemingen concurreren globaal, en arbitrageurs vertalen deze beslissingen in verkoopniveaus in de afzonderlijke markten (bijvoorbeeld, landen). In dit geval is de integratie afgedwongen. Ondernemingen kunnen ook overgaan tot heimelijke samenwerking in meerdere markten. Ze coördineren dan vrijwillig hun beslissingen in meerdere markten.

Hoofdstuk 6 heeft als onderwerp de concurrentie in zowel factor- als goederenmarkten. Deze verticale dimensie gaat uit van de mogelijkheid dat ondernemingen hun concurrentie in de goederenmarkt reeds uitvechten in (een van) hun factormarkten. Bij activa moet worden bedacht dat twee factormarkten een rol spelen: de markt van nieuwe activa, en de markt voor gebruikte activa. Stel nu dat de laatste markt-imperfecties (transactiekosten) bevat. Gebruikte activa zijn moeilijk verhandelbaar, en investeringen in activa zijn onomkeerbare beslissingen. In dit geval kunnen investeringen gebruikt worden in de concurrentiestrijd als een strategisch middel. Twee 'spelen' in het bijzonder zijn gecommitteerde concurrentie, waar het onomkeerbaar zijn van de investeringen zelf al een strategisch voordeel oplevert, en signaal-concurrentie, waar een onomkeerbare beslissing een signaal geeft van (geheime of niet verifieerbare) informatie die de onderneming heeft over zichzelf. Stel nu dat ook de markt voor nieuwe activa imperfect is (m.n., onvolledige concurrentie aan de aanbod- of vraagzijde). In dit geval is een type concurrentie-strategie mogelijk dat genoemd is 'concurrentie door de kosten van rivalen te verhogen' of kosten-verhogende concurrentie. Een vooruitziende onderneming verricht aankopen in de activa-markt met het doel latere aankopen door een (nieuwe) rivaal duurder te maken. De hogere (produktie-) kosten van de rivaal vertalen zich dan wellicht in hogere marktprijzen, tot voordeel van de eerst-handelende onderneming. Bij deze activa kan het om machines en patenten gaan, maar ook om minder voor de hand liggende activa. Ondernemingen kunnen zelf activa zijn waarom wordt gestreden, evenals de gunst van de overheid of consumenten. Het hoofdstuk laat tenslotte zien dat in de internationale concurrentie (waar de horizontale dimensie van multi-markt concurrentie domineert) ook kosten-verhoging een rol speelt (de verticale dimensie). De door Japanse ondernemingen gedomineerde markt voor geheugen-chips wordt als voorbeeld genoemd.

Deel IV is iets technischer dan de andere gedeelten van het boek. Hoofdstuk 7 grijpt terug op de discussie over P.W.S. Andrews in hoofdstuk 3 en open markten in hoofdstuk 4. Het biedt een formalisering van de verbale argumentatie bij zowel Andrews als open-markt theoretici dat zittende ondernemingen lage prijzen zetten

uit angst voor snelle en grootschalige toetreding door gevestigde ondernemingen op andere markten. Deze categorie toetreders beschikt reeds over activa en kan daarom (zo is de argumentatie) zowel snel als zonder extra (verzonken) kosten toetreden. De critici Cairns en Mahabir (1988) wezen er reeds op dat deze toetreders wel op kosten stuiten als ze deze activa onttrekken aan hun thuismarkt. Het model toont aan dat dit effect inderdaad van belang is. Deze kosten maken het de zittende producent mogelijk hoge prijzen te vragen (met positieve winstmarges) zonder van de markt te worden verdreven door deze toetreders. Dit resultaat staat haaks op de voorspelling van zowel Andrews als de open-markt theorie. Het weerlegt deze onderbouwing van hun prijzen-theorie (met nul-winsten).

Hoofdstuk 8 maakt gebruik van hoeveelheden-concurrentie in plaats van prijsconcurrentie als in hoofdstuk 7, en het gaat uit van een capaciteitskeuze in plaats van een gegeven capaciteit. Gegeven deze uitgangspunten, biedt het hoofdstuk een geïntegreerde analyse van zowel horizontale als verticale multi-markt concurrentie. De integratie houdt in dat bij beide types, een investering niet enkel de eigen reactiecurve verplaatst (de normale eigenschap van strategisch gedrag) maar ook de reactiecurve van de concurrent verplaatst (hetgeen een typisch multi-markten effect is). De horizontale dimensie heeft een vergelijkbaar uitgangspunt als hoofdstuk 7: twee ondernemingen concurreren in twee goederenmarkten. Iedere onderneming maakt gebruik van één gedeelde produktie-capaciteit. In deze context blijken capaciteitsinvesteringen geen strategische gevolgen te hebben (op de reactiecurves) indien de marktvraagfunctie lineair is of de transport- of aanpassingskosten nul zijn. Alleen als deze voorwaarden niet opgaan, hetgeen overigens plausibel is, blijft enige strategische waarde over. Het blijkt van de concaviteit of convexiteit van de vraagfunctie af te hangen of de onderneming zou moeten over- of onderinvesteren. Dit biedt een (te) zwakke basis om te kunnen stellen dat overinvesteringen in kapitaal een strategische waarde hebben in het concurrentiespel. De verticale dimensie beschrijft de situatie dat een onderneming anticipeert op toetreding door de kosten van een potentiële toetreder te verhogen via acties in een factormarkt. Onderzocht worden de arbeids-, grondstoffen- en kapitaalgoederenmarkten. Dit levert, in combinatie met capaciteitsinvesteringen, concurrentieinstrumenten op tot voordeel van de zittende producent en tot nadeel van de potentiële toetreder. Het hoofdstuk memoreert tot slot de graverende nadelen van onomkeerbare investeringen in produktiecapaciteit. De strategische waarde tegen een elders gevestigde toetreder is zwak, en het risico is groot indien achteraf de marktvraag afwijkt van de verwachting.

Hoofdstuk V begint met de constatering dat de horizontale dimensie een marktdefinitie-probleem oproept. Een toenemende mate van integratie van goederenmarkten impliceert immers dat de marktgrenzen vervagen. Hier zijn tegenwoordig veel voorbeelden van te geven, zoals Europese integratie en globalisering van de wereldekonomie. Hoofdstuk 9 bespreekt de theorie van marktgrenzen in verschillende disciplines: algemene economie, concurrentiepolitiek (Amerikaanse *antitrust* politiek), empirische analyses en strategisch management. De conclusie is dat markten niet bestaan als *objecten* van economisch onderzoek. Een markt is een subjectieve afbakening van transacties.

Doel ervan is besluitvorming te vergemakkelijken door relevante transacties te onderscheiden van minder relevante transacties (een andere 'markt'). Reden voor deze afbakening is de beperkte rationaliteit van beslissers, die versimpeling van gegevens noodzakelijk maakt. Dit inzicht komt overeen met theorieën van leren en rationaliteit, waarin nadruk wordt gelegd op de conceptuele 'filters' die beslissers gebruiken om gegevens te ordenen, interpreteren en dergelijke. Marktdefinitie is dus onderdeel van leer- en besluitvormingsprocessen. Een belangrijke afweging voor beslissers is of ze een 'nauwe' of 'brede' marktdefinitie moeten hanteren. Een nauwe marktdefinitie leidt tot lagere aggregatie en dus minder verlies aan gegevens, maar kan wel tot verlies aan overzicht leiden. De theorie van concurrentie in meerdere markten kan hierbij een middenweg aanbieden, met een zekere mate aan aggregatie (in afzonderlijke markten) alsmede analyse van de interactie tussen die markten (en dus voldoende detaillering). De subjectieve interpretatie van markten betekent dat leerprocessen tot veranderende marktgrenzen kunnen leiden. Dit is het uitgangspunt van het dynamische markten-perspectief. Keuzes die ondernemingen maken op gebieden als onderzoek en ontwikkeling kunnen eveneens tot verandering van marktgrenzen leiden. Marktdefinitie, investeringsbeslissingen, en concurrentie-analyse zijn dus steeds terugkerende elementen in het strategisch management van ondernemingen.

Hoofdstuk 10 illustreert zowel het dynamische-markten perspectief in het voorafgaande hoofdstuk als het multi-marktraamwerk in de eerdere delen. Het onderwerp is de convergentie van sectoren in de informatie-technologie: de markten van computers, consumenten-elektronica, telecommunicatie, en media. De grenzen tussen deze markten vervagen omdat ondernemingen nieuwe produkten introduceren die niet langer duidelijk bij één markt zijn in te delen. Drijfveer van dit proces is de digitalisering van informatie. Tekst, muziek, en beelden worden omgezet in één uniforme code: de digitale computercode. Dit maakt het mogelijk verschillende vormen van informatie te combineren in nieuwe, multimediale toepassingen. Deze leiden tot integratie van audio, video, en gedrukte media. De digitalisering van informatie maakt ook elektronische verzending van berichten mogelijk. Het kernwoord is informatie. Eigenaars van informatie (zoals films, muziek, boeken, ideeën) kunnen deze informatie in talloze (nieuwe) media toepassen en combineren. Informatie wordt dus een vorm van gedeelde activa. Dit beïnvloedt de concurrentie zoals de eerdere delen van dit boek hebben beargumenteerd. Ondernemingen betreden meerdere markten, en ze beslissen over investeringen in een globaal perspectief (*globalisering*) De concurrentie neemt toe nu oude invloedssferen verloren gaan en nieuwe nog niet zijn veroverd.

Curriculum Vitae

Marc van Wegberg is geboren op 6 oktober 195 te Ell. In 1976 sloot hij met goed gevolg het gymnasium af aan het Bisschoppelijk College te Weert. Van 1976 tot 1980 studeerde hij econometrie, en van 1980 tot 1983 sociale economie aan de toenmalige Katholieke Hogeschool Tilburg (de huidige KUB). In 1983 behaalde hij in de laatstgenoemde studie zijn doctoraaldiploma. In de jaren 1986 en 1987 was hij verbonden aan het Tilburgs Instituut voor Academische Studies (TIAS). Van 1987 tot 1992 was hij AIO aan de economische faculteit van de Rijksuniversiteit Limburg. In 1992 werd hij toegevoegd docent bij de vakgroep algemene economie en sinds november 1992 is hij universitair docent bij de vakgroep bedrijfsekonomie.

M. van Wegberg (1957) studied economics at the University of Tilburg (KUB) (1976 to 1983). He wrote his dissertation largely while being (the Dutch equivalent of) post-graduate student at the University of Limburg (1987 to 1992). He currently works in the section of management science of the economics department of the University of Limburg at Maastricht.

Most modern firms compete in numerous markets, both product markets and factor markets. They often sell several product in different countries. They face potential entrants into their markets from abroad and from related product markets. Michael Porter has called this extended rivalry. It is particularly important to our understanding of global competition.

This book integrates two perspectives about global competition. The first one is inward-oriented. It focuses on the firm's resources, such as know how and brand names. Japanese competition illustrates that relations with suppliers, customers and other stakeholders are also important resources. How can a firm create most value (future profits) from its resources? Firstly, by combining resources that are complementary, for example, by combining employees in teams. Secondly, by supplying products that make an intensive use of these resources. To achieve this, the firm may enter and exit product markets until it has aligned its resources and products. Shared resources may induce a firm to enter related product markets. This prospect in turn inspires the firm to invest in these resources. If these resources are scarce (such as good employees), firms bid for them, thus extending competition from product to resource markets.

The second perspective focuses on the competitive environment. Entry into a related product market may induce a competitive response from the domestic firms. For example, they may enter the entrant's home market (reciprocal entry). If firms meet in multiple product markets, they may develop an understanding that leads to tacit collusion. It may be in the rivals' mutual interests to respect each other's home market (spheres-of-influence).

Information technology shows examples of these competitive dynamics. New technologies combine text, photos, film and music to create new products. Information becomes a shared resource that can be used for multiple media (books, films, videogames). New products spawn a new industry (multimedia) and break down existing market boundaries (convergence) and spheres-of-influence. Competition heats up as new and existing firms such as Microsoft, IBM and AT&T enter each other's domains.

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