Foreign Direct Investment and the Organization of Firms

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Chapter 1

Introduction

Over the last years, world trade and foreign direct investment (FDI) expanded considerably faster than world production. World merchandise exports grew by annually 4.5% in the years 2000 to 2005. During the same period production of merchandise goods grew by only 2.0% (WTO, 2006). We further observe that world FDI inflows in 2005 equal fifteen times the inflows in 1982, whereas world gross domestic product (GDP) is only four times as large (UNCTAD, 2006).[1]

This remarkable growth in world trade and foreign investment is accompanied by a growing fragmentation of production. Feenstra (1998) shows that the share of intermediate goods acquired from abroad increased substantially in the 1980s. Similarly, Hummels et al. (2001) find that vertical specialization between countries became increasingly important between 1970 and 1990.[2] This fragmentation of production takes place between firms and within multinational enterprises. The last point is documented by Borga and Zeile (2004). They find that the share of intra-firm exports for further processing by U.S. parent companies has increased considerably since 1966.[3]

In fact, multinational enterprises play a central role in advancing trade, investment, and the fragmentation of production. According to the United Nations

[1] According to UNCTAD (2006), world FDI inflows grew from 59 billions of dollars in 1982 to 916 billions of dollars in 2005. World GDP valued 10,899 billions of dollars in 1982 and 44,674 billions of dollars in 2005. Dollars denote U.S. dollars throughout the text.

[2] Hummels et al. (2001) measure the use of imported inputs in producing goods that are exported. They include ten OECD and four emerging countries in their study.

[3] Borga and Zeile (2004) report exports by U.S. parent companies to their foreign affiliates for further processing. In 1966, these exports accounted for 39.3 percent of total exports by U.S. parents to their foreign affiliates. The value increased to 64.7 percent in 1999.

Conference on Trade and Development, 77,000 parent companies owned 770,000 foreign affiliates in 2005. These foreign affiliates generated approximately 4.5 trillion of dollars in value added and employed around 62 million workers. Furthermore, they exported goods and services valued at more than 4 trillion of dollars.

Taking a closer look at these multinational enterprises (MNEs), we find that they differ systematically from national firms. A wide range of empirical studies shows that exporters are more productive than non-exporters and that MNEs investing abroad are more productive than exporting firms.[4]

The growing importance of multinational firms prompts for a better understanding of their behaviour. We therefore ask the following questions. When do firms serve foreign markets via exports rather than establishing foreign subsidiaries? How do MNEs organize foreign activities? When do MNEs buy intermediate goods at arm's length and when do they establish foreign subsidiaries?

This thesis addresses these questions and thus contributes to a better understanding of multinational firm behaviour. The findings may guide practitioners to think about the impact of their decisions on the incentives provided to managers and suppliers. Furthermore, some of the questions are of direct interest to policy makers.

The location of production is linked to the concern that firms' offshoring and outsourcing decisions increase unemployment in the home country. Home countries may also fear that they lose their technological advantage over host countries if knowledge dissipates abroad. These spillovers are expected to be larger if multinational enterprises cooperate closely with local firms.[5] Therefore, the ownership decision of firms is of direct relevance from a policy perspective.

Many of the above questions are addressed by the existing literature. Yet, *The Economist* recently asks, "Does economics need a new theory of offshoring?".[6] To answer this question, we provide a quick overview of the relevant literature to show

[4]Greenaway and Kneller (2007) provide a survey of the empirical literature on firm heterogeneity, exporting, and FDI. Wagner (2007) provides a survey of the literature on firm heterogeneity and exporting.

[5]Smarzynska (2004) provides empirical evidence that productivity spillovers from foreign direct investments arise from projects with shared domestic and foreign ownership but not from fully owned projects.

[6]Economics focus| *The great unbundling*, The Economist, January 20th, 2007.

which aspects have been considered and which have not.

Traditional trade theory focuses on differences between countries and provides a framework to analyse multinational activities that are driven by cost-reducing motives. Lately, Leamer (2007) asks "Did David Ricardo Understand Outsourcing?". He shows in a basic Ricardian setting how welfare may be affected if software programming is shifted from the U.S. to India. The main insight from that comparative advantages model is that there are gains from trade whenever people exchange goods.

Also the factor-proportions model proposed by Eli Heckscher and Bertil Ohlin provides a framework to think about the specialization of countries on certain production steps. Accordingly, capital-intensive countries specialize in the production of capital-intensive goods.[7] The model further predicts that trade increases overall welfare but that there are also winners and losers of trade liberalization. We may again consider all sorts of multinational activities as a special case of trade. Note, however, that traditional trade models do not consider firms. Hence, they do also not allow to analyse multinational enterprises.

Both theories explain trade by country differences either in technology or in factor endowments. They are therefore less suited to explain trade between similar countries. This is at odds with the empirical observation that most trade and actually also most foreign direct investments flow between rich and developed countries.[8] Based on this observation, the New Trade Theory emerged. Krugman (1979) explains trade in a world with identical firms that produce differentiated goods and are characterized by increasing returns to scale. A central assumption of the model is that consumers have a love of variety, in particular, they want to consume all of the produced goods. Hence, trade is induced by foreign demand. The main contribution of this theory is to explain market-seeking trade activities.

Both perspectives, cost-reduction and market-seeking, are still prevalent in the literature on multinational enterprises that can broadly be distinguished into vertical multinationals that exploit differences in factor prices and horizontal multinationals that serve foreign markets.

[7] Krugman and Obstfeld (2006) describes both models, also providing classic references.

[8] According to UNCTAD (2006), developed economies accounted for 85.8 percent of world FDI outflows and received 59.4 percent of world FDI inflows in the years $2003 - 2005$. The share was even higher when the new trade theory emerged. In the period $1978 - 1980$, developed countries accounted for 97.0 percent of outflows and received 79.7 percent of inflows.

Helpman (1984) models vertical MNEs by extending a two factor Heckscher-Ohlin framework by a third production factor, which captures the idea of capital-intensive headquarter services. It follows that multinational enterprises emerge if the relative factor endowments of countries are rather dissimilar. Capital-rich countries specialize in highly capital-intensive headquarter services whereas labor-rich countries specialize in the labor-intensive stages of production. The crucial difference to the original model is that headquarter services can only be exploited within multinational enterprises. However, the model does not define the boundaries of the firm.

Horizontal multinational enterprises are first modelled by Markusen (1984). Horizontal MNEs duplicate their production facilities in a foreign country in order to serve that market. Foreign direct investments thus substitute for exports, provided that the foreign market is served in either case.[9] Again, the model does not consider the boundaries of the firm.

One of the first authors who actually links international openness to the organizational choice is McLaren (2000). He develops a theoretical model in which globalization leads to a situation that makes it easier for firms to find a suitable supplier. As a result more international openness increases the probability that a firm chooses outsourcing.

Subsequently, Grossman and Helpman (2002) start a series of papers that analyse the behaviour of multinational firms which simultaneously decide about the location of production and the mode of organization. A main contribution of these papers is to highlight that both dimensions, location of production and organization of the firm, are intertwined and can only be fully understood in a common framework.

These papers draw on different theories of firm boundaries. Most of them are based on the property-rights approach developed by Grossman and Hart (1986) and Hart and Moore (1990). This means that they rely on relationship-specific investments that are not fully contractible to determine the boundaries of the firm (e.g. Grossman and Helpman (2002), Grossman and Helpman (2003), Antràs (2003), and Antràs and Helpman (2004)). However, some models also consider other aspects that may influence the decision between integration and outsourcing. Grossman and Helpman (2004), for example, relate their paper to Holmström and

[9] Markusen (2002) provides a summary of this strand of literature.

Milgrom (1991) and focus on incentive effects in a moral hazard framework. Marin and Verdier (2002) apply the idea of formal and real authority developed by Aghion and Tirole (1997) to determine the organizational structure of a firm. A survey of these models is provided by Spencer (2005).[10]

A second innovation in the trade literature is to relax the assumption of identical firms. By introducing productivity differences between firms, Melitz (2003) shows that only the most productive firms operate internationally if foreign market entry causes fixed costs. This idea is also present in the above mentioned literature on international production strategies (Grossman and Helpman, 2004; Antràs and Helpman, 2004). These models argue that productivity also shapes the international investment strategies of MNEs.

In this thesis we built on the existing literature and analyse the two-dimensional decision of firms: whether to outsource or integrate, and whether to produce abroad or not.

We add to the existing literature by further developing the incentive-based view of the firm. This strand of the above mentioned literature has received little attention so far. Yet, empirical work shows that incentive considerations have a considerable impact on a firm's decision to integrate or to outsource in a national context. Lafontaine and Slade (2007) conclude in their extensive literature review on vertical integration that moral-hazard models perform very well in explaining the empirical findings. They show, in particular, that higher monitoring costs, i.e. costs of monitoring an agent's effort, make vertical integration less likely. Further empirical support for the relevance of monitoring costs is provided by Lin and Png (2003). Their results suggest that monitoring costs significantly influence the decision of foreign investors to integrate their operations in China.

For this reason, we focus on the related parties' incentives to exert effort. Unlike the property-rights approach, we do not focus on *ex ante* inefficiencies due to underinvestment into relationship-specific assets.

We further add to the existing literature by considering that MNEs may lack information about the foreign business environment. The concept has long been established but is hardly considered in a formal framework. Hymer (1976), for example, argues that national firms have better information about their country

[10]Helpman (2006) also surveys many of the relevant papers but restricts the discussion to relationship-specific investments.

including language, laws, and politics. Moreover, he argues that a part of these disadvantages are permanent.[11] Yet, the above mentioned models are mostly limited to fixed costs of foreign operations and to transport costs.

Both theoretical models as well as the empirical analysis in this thesis explicitly consider that information about the foreign business environment may be incomplete and that firms may learn how to operate a foreign business.

In the following, we provide a short sketch of the three main chapters. The first part focuses on horizontal, i.e. market-seeking, motives of multinational activities. In the second part, we restrict our attention to vertical, i.e. cost-reducing, motives of multinational activities. Both causes are relevant for the actual investment decisions of German MNEs, which are investigated in the third part.

Export versus FDI: The impact of distance In this chapter we focus on the effects of cultural distance on the way multinational firms serve a foreign market. Foreign activities are driven by market-seeking motives and foreign investments may be classified as horizontal FDI. As mentioned earlier, firms decide about the location of production and the mode of organization. On the one hand, the investor chooses whether to export goods or to produce in the foreign country. On the other hand, the investor decides whether to cooperate with a local partner or to establish a wholly owned subsidiary.

We add to the literature on export versus FDI by considering that a foreign market can only be served if sales services are provided locally. Reasons may be that customers require technical support or build confidence in the continuity of supply (Pennie, 1956). There is quite some empirical support for this point of view. Yamawaki (1991) shows, for example, that Japanese distribution subsidiaries in the United States (U.S.) promote exports by parent companies. Further evidence on U.S.-based MNEs is provided by Lipsey and Weiss (1984). They find a positive relationship between a firm's foreign output in a host country and a firm's exports of finished products to that host country.

Another contribution of the model is that it considers the concept of cultural distance in a formal framework. The investing firm is unfamiliar with the local business environment and therefore faces additional costs of doing business abroad. For this reason the firm has an incentive to enter a joint venture with a local partner

[11] A similar argument is made by Linnemann (1966).

who provides the knowledge to overcome these barriers. The following quote by a manager of a multinational enterprise based in the U.S. illustrates the idea.

> "We have the technology and certain know-how. The Chinese partner knows how to make things happen in China. You put the two together right, it works." (Yan and Gray, 1994)

Contracting with a local partner causes, however, additional costs that stem from an under-provision of inputs, including managerial effort. Hence, there is a trade-off between benefits from local knowledge and agency costs.[12]

We want to highlight one main result which is the non-linear effect of distance on the decision to produce abroad. For low cultural distances the investing firm produces abroad in a wholly owned subsidiary. Because the firm is familiar with the market and its workers it benefits from lower production costs, e.g. because it saves on transport costs, without further drawbacks. For intermediate cultural distances, the investing firm exports its goods and services because the lower production costs do no longer outweigh the additional costs of monitoring production in the host country. For very large distances, the investing firm enters a joint venture because local knowledge is essential to serve the foreign market. In that case, however, production is also shifted to align incentives at the local partner's side.

The result underlines that the decision of multinational enterprises can only be fully understood if we consider the joint decision of location and ownership.

Vertical specialization and learning Chapter 3 focuses on cost-reducing motives for foreign activities, which drive the international fragmentation of production. Foreign investments may therefore be classified as vertical FDI. As in the previous chapter, investing firms decide about the location of production and the mode of organization. Production may be located in a low-cost country or at home. Moreover, production may be integrated or outsourced to a supplier.

The model makes two main contributions. First, it extends the model of Grossman and Helpman (2004) by differences in R&D intensity, a determinant which is highly significant in empirical studies (Barbosa and Louri, 2002; Antràs, 2003;

[12] As in Grossman and Helpman (2002) integration eliminates the agency problem. Insofar, the model relates to the transaction cost approach going back to Coase (1937) and Williamson (1985) because costs of integration are exogenous. However, as we do not consider relationship-investments we think that it is sensible to classify it as an incentive-based approach.

Desai et al., 2004; Marin, 2006; Gattai and Molteni, 2007). Second, it analyses how uncertainty about the foreign production environment, more precisely about monitoring, influences the dynamic pattern of vertical investment decisions; whereas existing models focus on uncertainty about foreign demand.

In particular, we consider that it is difficult to transfer technology to an outside party if goods are R&D intensive. This assumption is supported by Kogut and Zander (1993) who show that Swedish MNEs tend to establish wholly owned subsidiaries in other developed countries if knowledge is difficult to teach or to codify. Mansfield and Romeo (1980) show that U.S.-based firms are more reluctant to transfer new technologies if foreign operations are not wholly owned. This finding may be attributed solely to weak intellectual property rights and the fear of technology dissemination. Yet, Lafontaine and Slade (2007) find that the complexity of goods also reduces the probability that outsourcing is chosen in developed countries. This finding further supports our assumption that it is difficult to outsource R&D intensive goods.

The results show that introducing R&D intensity does not simply add to the results obtained by Grossman and Helpman (2004), e.g. by making all firms reluctant to shift production to external suppliers. In fact, R&D intensity only affects high productivity firms. The reason is that these firms make high profits in case of success and are therefore not willing to accept a high risk of failure, which is associated with outsourcing. Therefore, they refrain from outsourcing even if outsourcing reduces agency costs.

We capture uncertainty about the foreign production environment by assuming that investors do not know about their exact monitoring abilities. This uncertainty gives rise to changes in the vertical production strategy once the investor learns about her monitoring abilities. The results show that more firms switch from outsourcing to integration as they gain experience. The reason is that firms potentially switching to integration are relatively productive and that their reactions are more pronounced.

Hence, uncertainty has the effect that some firms switch from integration to outsourcing and other firms switch from outsourcing to integration. This pattern fits the observation that a considerable number of German MNEs, as recorded by the *Deutsche Bundesbank*, changed their ownership share in foreign affiliates during the period $1996 - 2004$. The second prediction of the model, which is that

firms tend to integrate as uncertainty is reduced, can also be found in the data as an increase in parent ownership is found in about twice as many cases.

On a more abstract level, the model shows how incentive considerations influence the investment decision of the firm. We find that moral hazard considerations and the property-rights approach yield very similar overall effects. So far, many empirical studies, at least in the context of trade and FDI, focus on the property-rights approach (Levchenko, 2007; Feenstra and Hanson, 2005). The model may thus motivate future empirical research to discriminate between the different approaches.

Ownership choices of German MNEs In the last chapter, we provide empirical evidence on the foreign activities of German firms. We exploit newly available survey data which is provided by the *Deutsche Industrie- und Handelskammertag* (DIHK).

Our main hypothesis results from the theoretical model in Chapter 2 and states that joint ventures are more likely if (cultural) distance is high. In particular, we observe the three variables cultural barriers, corruption, and international experience which influence distance, i.e. the ability of a foreign investor to manage its foreign operations.

The survey data allows us to measure the importance of cultural barriers and corruption on the firm level, i.e. we observe the impact on a particular firm. This is an advantage over country level measures because we would expect that certain firms are more affected by e.g. corruption than others.

International experience is measured by the number of world regions in which a firm is active. The idea is that firms operating in many different countries also have the capacities to manage foreign operations more efficiently. Our measure relates to Erramilli (1991) who uses a similar measure of international experience.

The econometric results, which are based on manufacturing firms, show that all three variables have a significant impact on the decision to enter a joint venture instead of establishing a foreign subsidiary. Cultural barriers and corruption make joint ventures more likely. Experience increases the probability that a firm integrates its foreign operations in a wholly owned subsidiary. We thus find empirical evidence for our main hypothesis.

We also investigate differences between service and manufacturing industries.

The results suggest that local knowledge is especially relevant in the service sector. Reasons may be that informational barriers are particularly high in some industries, e.g. the banking market.[13]

[13]See, for example, Lehner and Schnitzer (2007) and the references therein for papers analysing foreign activities in the banking industry.

Chapter 2

Export versus FDI: The impact of distance

2.1 Introduction

We shortly noted at the beginning that most foreign direct investments flow between developed countries.[1] Table 2.1 shows that the share of FDI that is received by developed countries decreased in the last decade but is still very high. This indicates that the majority of multinational activities is driven by market-seeking considerations.

Table 2.1: FDI inflows

	1978-1980	1988-1990	1998-2000	2003-2005
Developed economies	79.9	82.5	77.3	59.4
- European Union	39.1	40.3	46.0	40.7
- United States	23.8	31.5	24.0	12.6
Developing economies	20.3	17.5	21.7	35.9
South-East Europe and CIS	0.02	0.02	0.9	4.7
World	100.0	100.0	100.0	100.0

Source: UNCTAD (2006)

But why is it important for a multinational enterprise to produce close to its customers? And when is it to the advantage of a multinational to employ the help of local firms?

[1] This chapter is based on joint work with Monika Schnitzer.

In this chapter, we investigate these decisions an investor has to take when serving a foreign market: where to locate production, at home or abroad, and whether to enter a joint venture instead of choosing a wholly owned subsidiary. We are in particular interested in answering the following three questions: How do the two decisions, on the location of production and on the ownership choice, interact? How are the two decisions affected by distance? And how do they depend on industry characteristics?

From the empirical literature a number of stylized facts emerge that are set out in more detail in Section 2.2. For instance, it has long been established by empirical gravity equations that the volume of exports decreases in distance. This would be in line with Brainard's (1997) finding that exports are replaced by foreign direct investments as transportation costs increase. Interestingly though, the volume of foreign direct investments decreases in distance as well. Furthermore, there is some evidence that the ratio of direct investments over exports decreases as (cultural) distance increases. But how much distance affects the volume of FDI differs very much across industries. So far, this relationship has not been examined in a systematic way.

Another observation is that distance seems to decrease the likelihood of wholly owned foreign subsidiaries. But again, the propensity of engaging in a joint venture differs very much across industries, it is much less found in R&D intensive industries, but the evidence is mixed for other industry criteria like capital intensity.

In this chapter, we develop a stylized model that provides an explanation how these empirical observations might fit together. Our framework allows us to generate a number of additional predictions that are not systematically explored in the empirical literature yet. In particular we investigate how the ownership decision and the decision about the location of production interact and how they are affected by industry characteristics.

For this purpose we consider a partial equilibrium model with a multinational investor who wants to serve a foreign market. The multinational firm generates revenues by combining three activities. Output is produced with production and R&D activities, this output is marketed with the help of marketing activities. Industries are characterized by the relative importance of each activity for revenue generating. Depending on the importance of R&D we characterize industries as

more or less technology intensive, depending on the relevance of the marketing activity industries are called more or less marketing intensive.

The investor has to decide about the location of production and the optimal ownership structure. Both choices are affected by the relative production costs abroad, the cost of control when engaging in foreign activities and the contracting possibilities with a local partner. In our model, the variable distance captures the idea of increasing costs of control. These costs arise because investors have difficulties in understanding the foreign environment including culture, business customs and administration. Think of it as tacit knowledge that cannot be acquired on the market. The larger this lack of tacit knowledge the more costly it is to provide the necessary marketing activities or to carry out production abroad.

The investing firm can get access to this tacit knowledge by entering a local joint venture. In doing so, agency costs arise which are related to contracting difficulties. Thus, inefficiencies may arise when two partners need to contribute to generating revenues, rather then just one dictating the choices to be taken. Further agency costs may arise from difficulties in preventing technology spillovers to an outside party.

Our framework is consistent with and gives a rationale for the findings described above. But our analysis also shows that industry characteristics affect both decisions, the optimal ownership choice and the location of production. We find that in high tech industries, the likelihood of foreign production decreases as distance increases. Furthermore, joint ventures are relatively less likely to be chosen in high tech industries as compared to low tech industries. Both these findings are in line with the empirical observations described above. We also find that joint ventures are particularly less likely as distance gets large.

In low tech industries, in contrast, the likelihood of joint ventures increases in distance. Furthermore, the relationship of production choice and distance is non-monotonic. The likelihood of foreign production is highest for small distances and large distances, it is lowest for intermediate distances. The U-shape relationship is due to the interaction of location and ownership choice, i.e. large distance foreign production occurs in form of a joint venture whereas low distance foreign production is wholly owned. These varying findings for low and high technology industries pick up some of the evidence that observed relationships differ across industries.

Finally, we find that marketing intensive industries are relatively more likely to set up a foreign production, irrespective of production cost differences. Thus, our model provides a rationale for the frequently made assertion that companies want to produce close to their customers.

What is the intuition for why distance may have a non-monotonous effect on the likelihood of horizontal investments in low tech industries? Consider an investor who wants to exploit production cost advantages abroad. The larger the distance, the less she will be familiar with the local environment and hence the larger will be the cost of controlling production. She will decide against foreign production when these control costs become too large. Hence, we observe a decline in foreign direct investments. When distance is very large, serving the local market with exports becomes very costly as well, due to the lack of local market knowledge. So she may need a local partner to provide the necessary marketing activity. If a joint venture is optimal, it may become profitable again to produce abroad. A local partner then provides both production and marketing activities. Such a contract also makes it more attractive to provide the local partner with a larger ownership share and hence giving high-powered incentives to him.

The results predict for low tech industries that distance increases the likelihood of choosing a joint venture over a wholly owned subsidiary. This is true because of the positive effect of gaining tacit knowledge. In R&D intensive industries, however, the negative effect of transferring knowledge to an outside party dominates and even becomes more pronounced as distance increases, due to the risk of spillovers. As a consequence, less joint ventures are chosen in high tech industries. Furthermore, in high tech industries we do not observe the non-monotonic relationship between location choice and distance. As joint ventures are less likely to be chosen the larger the distance, there is no point in shifting production abroad because of incentive considerations as all activities stay within the boundaries of the multinational firm.

Last, our results point at an additional factor that shapes a firm's market entry strategy, importance of marketing activities relative to other productive activities. The reason is that the more marketing intensive the industry, the more valuable local market knowledge. A high value increases the likelihood of involving a foreign joint venture partner. But if the local partner provides a substantial part of the inputs already, it also becomes more likely that the investor includes him

in production as well, because this gives higher powered incentives to the local partner, as explained above.

Our model is related to three strands of literature. The first strand focuses on the question of how firms serve foreign markets. Possible choices are exports or foreign direct investments. The trade-off is between variable transport costs and fixed plant costs (Brainard, 1997).[2] The mode of organization is not tackled in this literature. One result of this literature is an increase in horizontal FDI as distance increases. We find a contrary effect for wholly owned subsidiaries as we focus on a different mechanism. In our framework, distance increases monitoring costs which makes foreign production plants less likely. Thus, we find that horizontal FDI takes place in form of a joint venture as distance is large. This result underlines the importance of the ownership choice in investigating multinational activities.

A negative effect of distance on foreign production is also found by Norbäck (2001). In a theoretical part he considers a firm's decision between exports and FDI assuming costly technology transfers in the case of horizontal investments. In his framework these additional costs arise independent of the mode of organization. His empirical results show for Swedish MNEs that geographic distance has a negative effect on the probability of a firm locating production in a foreign country.

Similar to our model, Ottaviano and Turrini (2007) show theoretically that there may be a non-linear relationship between distance and foreign direct investments. But the mechanism is very different from ours. Their model relies on incomplete contracts that govern the relationship between an investor and a local partner in case of foreign production. On the one hand, large distances lead to FDI rather than exports to save on transport costs. On the other hand, low trade costs strengthen the outside option of an investor in the *ex post* bargaining with a local supplier. This effect leads to FDI if distance is small. The reason is that a partner has no use for its relationship-specific input outside the partnership. The investor's alternative if bargaining fails, however, is to produce inputs domestically and export them to the local market. In their model all transactions take place at arm's length. Therefore, it does not allow to discuss the mode of organization.

The second strand of literature investigates the mode of organization in case

[2]The literature on horizontal FDI is extensive. Eicher and Kang (2005) e.g. allow for acquisition as an additional entry mode. The knowledge-capital model as developed by Markusen (2002) is widely discussed and also allows for vertical firms.

of horizontal investments, focusing on contractual problems due to informational asymmetries or technology spillovers. Horstmann and Markusen (1996) allow for a local partner who has tacit knowledge about the size of the foreign market. They assume that an investor enters a joint venture in order to avoid costly mistakes that arise because the investor only learns in the second period about the true market size. Additionally, they allow different efficiencies of the sales force in case of integration and in case of joint ventures. Müller and Schnitzer (2005) examine the incentives to engage in a joint venture if they give rise to technology spillovers but can be used to control sovereign risk.

The third strand of literature examines the form of organization of vertical foreign direct investment, focusing on cost reducing motives of shifting production. Different theories of the firm, most prominently Grossman and Hart (1986), are used to explain the form of organization.

Antràs (2003) combines the property-rights approach with a Helpman-Krugman model of international trade and examines how sector characteristics may affect the mode of organization. The central idea is that capital intensity leads to more integrated production while it makes contracting with an external supplier less likely. In his model, relationship-specific investments in labor are always borne by the supplier. In case of integration with the investor the supplier has a relatively weaker bargaining position than under external contracting, leading to more underinvestment. Labor intensive firms therefore enter a partnership with a stand-alone supplier whereas capital intensive firms choose integration.

Grossman and Helpman (2003) discuss whether foreign production is done within or outside firm boundaries conditional on foreign production. Their assumption of a local supplier advantage relates to our idea of increased costs of control to the investor. Grossman and Helpman (2004) examine how falling trade costs influence the prevalence of outsourcing versus foreign direct investment considering firm heterogeneity.[3]

All these papers have a vertical perspective, i.e. they focus on the question of how firms organize their production efficiently given lower costs of production abroad. Whether production is integrated or outsourced relates to our question

[3]Grossman et al. (2006) consider assembly and production as two distinct activities and focus on the effects of firm productivity, transport costs and fixed plant costs. They do not consider firm boundaries but simply assume that firms must produce their own intermediate goods and perform assembly in-house.

of whether production is integrated or done by a local joint venture partner. Our model differs from the papers described in several respects. First, we use a different approach to capture managerial incentive problems as a determinant of the firm's boundaries. Furthermore, we distinguish industries by the relative importance of value chain activities (like marketing intensity, technology intensity). Most importantly, we focus on horizontal investments versus exports to serve a foreign market, and how this decision interacts with the decision about the ownership structure.

The remainder of this chapter is organized as follows. In Section 2.2 we describe the findings of the empirical literature from which we have distilled the stylized facts presented in the introduction. Section 2.3 sets out the model and derives the reduced form payoff functions. In Section 2.4 we analyse the investor's location and ownership choices. Section 2.5 concludes.

2.2 Empirical observations

To set the stage for our formal model we describe a set of empirical observations. In particular, we summarize the effects of distance and sector differences on the location of production as well as on the entry mode choices of multinational enterprises.

Distance It is a well established fact that distance negatively influences trade flows in empirical gravity equations.[4] Buch et al. (2005) extend the gravity approach to foreign direct investments of German firms. They show that distance has also a negative and significant effect on the volume of FDI. Interestingly, the decomposition of the effect reveals that the number of projects declines while the average size of an investment increases in distance. The negative effects of distance on FDI deserves some further consideration.

Distance can capture "geographical" distance (reflecting transport costs), but also "psychic" or "cultural" distance.[5] Many empirical studies include common

[4]See Frankel (1997) and Leamer and Levinsohn (1995) for a summary.

[5]See for example Linnemann (1966) who among others proposes transport costs, time-related costs and a limited "economic horizon" as main impediments to trade. Evans and Harrigan (2005) provide evidence for time-related costs. They show that apparel products for which timeliness matters tend to be imported to the United States from nearby countries.

language or common legal origins as explanatory variables allowing them to analyse the effects of psychic distance. Erramilli and D'Souza (1995) show that an index of cultural distance reduces the likelihood of choosing FDI rather than exporting or contractual arrangements mainly in advertising and consumer services. A more specific concept is used by Guiso et al. (2004), who use data on relative trust among European countries to study bilateral trade and foreign investment. They show that trust encourages direct investment. This result holds after controlling for geographical distance, common borders, and common language. Thus, it seems that foreign investors have difficulties in understanding the local business environment. Distance negatively affects an investor's ability to operate a foreign business and may even make the investor prefer exports over direct investments as a way of serving the foreign market.

Interpreting distance as a measure of cultural distance it is little surprising that distance also influences the entry modes chosen by foreign investors. From a theoretical point of view it is not obvious whether distance has a positive or a negative impact on joint venture relationships. On the one hand, distance may hamper negotiations with an outside party and thus make joint ventures less attractive. On the other hand, unfamiliarity with the local environment may increase the value of a local partner.

Empirically, Lin and Png (2003) provide evidence that the latter effect dominates. They investigate foreign investments in China and relate the distance from Hong Kong to the probability of choosing a joint venture over a wholly owned subsidiary. They argue that geographic distance captures monitoring difficulties of foreign investors. Indeed their results show that distance increases the likelihood of choosing a joint venture. A higher involvement of the local partner in case of high distance costs is also found by Feenstra and Hanson (2005). They investigate export-processing in China and show that pure assembly regimes in which the Chinese factory manager is relatively passive are less often observed in interior and northern provinces. Import-assembly regimes with a more active role of the factory manager are more common in these provinces with presumably high distance costs. Monitoring of the local workforce is also suggested by Nakamura and Xie (1998) as a reason for choosing a joint venture rather than a wholly owned subsidiary. They study foreign investment projects in Japan and show that the number of workers increases the Japanese partner's share in a joint venture.

By a similar reasoning we may proxy the need of local market knowledge by the ratio of local to total sales. Desai et al. (2004) provide evidence that investors are less likely to choose wholly owned subsidiaries if local sales are important. More precisely, they show that the ratio of local to total sales decreases the likelihood to choose whole rather than majority ownership using data on U.S. foreign affiliates.

More direct evidence is obtained by simply asking investors. In a survey among Italian manufacturing firms 54% of the respondents in the survey of Gattai (2005) state that they entered a joint venture to gain local support.[6]

Local support may be needed in order to communicate with local authorities (Zhao, 2005). Communication may be especially difficult when corruption is high. In line with this Marin (2006) shows that corruption makes a minority position of German investors in Central and Eastern European Countries more likely.

Finally, a number of business-related studies find a negative impact of cultural distance on full ownership. The following studies focus on U.S. based multinational enterprises. Davidson and McFetridge (1985) examine foreign production of new products and find that they are more likely to take place in a wholly owned subsidiary than to be licensed to an external party in cases of a common border, language or religion. Similarly, a negative impact of distance on whole ownership is found by Kogut and Singh (1988). They use a composite index of cultural distance and find that this distance makes joint venture more likely than acquisition. Focusing on service firms, Erramilli (1991) shows that cultural distance decreases the probability of choosing wholly owned subsidiaries relative to intermediary exports, contracts or joint ventures. Subsequently, Erramilli and D'Souza (1995) find an insignificant effect of cultural distance on firms choosing FDI relative to contracting with partners or exporting. They show, however, that predominately in advertising and consumer services cultural distance affects negatively integrated FDI modes. Also Brouthers and Brouthers (2001) question the negative effect of cultural distance on the use of full ownership. They list some studies that show similar, insignificant or even opposing results. They argue that country risk may interact with psychic distance and include some empirical evidence for their hypothesis.

These empirical observations suggest that foreign investors enter joint ventures

[6]The second important reason to enter a joint venture, risk and cost sharing, is named by 20% of the respondents, only 8% stated to be forced by law.

with local partners to overcome difficulties in understanding the local business environment. Overall, distance seems to positively affect an investor's willingness to enter a joint venture relationship. While there is some evidence that this effect may not be equally strong for all industries, there is no systematic research on how exactly industry characteristics may effect this relationship.

Sector differences Buch et al. (2005) show that the volume of German FDI decreases in distance. Disaggregating the data according to sectors reveals that the magnitude of the effect varies widely between sectors. In a few cases distance even has a positive effect on the volume of FDI. Hence, sectoral differences seem to matter in analysing the impact of distance on the location of production. However, it has not been systematically analysed why and how sector differences matter.

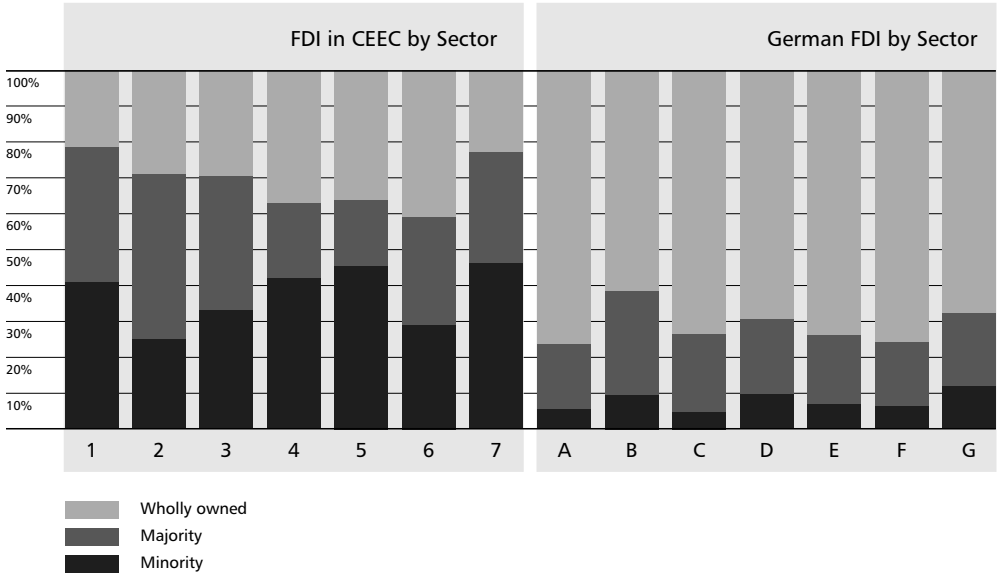


Figure 2.1: Ownership in percent of projects

1: Manufacture and repair 2: Construction, 3: Trading and wholesale 4: Retail 5: Transport 6: Services 7: Farming, fishing, and forestry A: Manufacture of chemicals and chemical products B: Manufacture of food products, beverages, and tobacco products C: Publishing and printing; Manufacture of paper and paper products D: Construction E: Wholesale and retail trade F: Information and other business services G: Transport, storage and communications. Sources are the Business Environment and Enterprise Performance Survey (BEEPS), developed jointly by the World Bank and the European Bank for Reconstruction and Development for investments in CEEC. German data is from the Deutsche Bundesbank.

Sectoral differences also seem to matter in understanding the ownership decision of foreign investors. Figure 2.1 illustrates that ownership decisions vary considerably between sectors. On the left, it shows the prevalence of different ownership structures in case of foreign owned firms in Central and Eastern Europe.[7] On the right, Figure 2.1 shows the prevalence of minority, majority, and full ownership for German subsidiaries of large multinational firms. We counted the number of foreign direct investment projects of which the German multinational owns less than 50%, 50% up to 99%, or owns the whole subsidiary.[8]

One way to capture industry differences is to consider R&D activities. A large set of studies shows that R&D intensity increases the probability that firms set up wholly owned subsidiaries. Davidson and McFetridge (1984) compare the probability whether a U.S. multinational establishes a wholly owned subsidiary or issues a license when producing in a foreign country. They show that setting up a wholly owned subsidiary is more likely if (scientific) R&D spendings are large. More recently, Desai et al. (2004) also investigate U.S. multinationals and show that companies operating in research-intensive industries are more likely to establish wholly owned ventures. Similarly, Antràs (2003) identifies a very significant and positive effect of R&D over sales on the share of intra-firm imports using sectoral data on U.S. multinationals. A positive impact of R&D intensity on the probability to choose full ownership can also be found for foreign investments in Portugal (Barbosa and Louri, 2002)[9] and for German investments in Central and Eastern Europe (Marin, 2006)[10].

The evidence is less clear for capital intensity. There exist opposite results for firm level data and for sectoral data. Using firm level data Marin (2006) finds that the capital labor ratio of the German parent increases the probability to choose outsourcing. Similarly, Barbosa and Louri (2002) and Louri et al. (2002) find a positive effect of capital intensity on the probability of choosing a minority ownership in Greece and Portugal.[11] Using sectoral data, Antràs (2003) instead

[7] The data can be found at http://info.worldbank.org/governance/beeps. Whole ownership is defined as the foreign investor owning more than 94% of the company.

[8] We thank Anselm Mattes at the IAW Tübingen for extracting the data at the Deutsche Bundesbank. For a description of the database see Lipponer (2003).

[9] They measure R&D intensity by the expenditures on patents and trademarks.

[10] Marin (2006) compares the probability to own more or less than 30% of a foreign subsidiary.

[11] They measure the ratio of gross investment to total output in the relevant industry over the three years which precede their study.

shows that the ratio of capital stock to employment increases the share of intrafirm imports in an industry.

Thus, while the impact of R&D intensity of the ownership choice seems to be well established, the impact of other sector differences seem not to be fully explored and understood.

2.3 The Model

Consider a world with two countries *Home* and *Foreign*. An investor is located in *Home* and owns the technology for producing a particular product. She can serve the foreign market by exporting goods or by producing in the foreign country. We call the latter a horizontal direct investment (HDI).[12] Furthermore, she can set up a wholly owned subsidiary (WOS) or enter a joint venture (JV) with a local partner. In case of JV Export, the local partner helps in providing sales services, in case of JV HDI, he participates in both sales and production as specified in more detailed below. Table 2.2 summarizes the different investment strategies of the multinational firm.

Table 2.2: Firm choices

	Home production	**Foreign production**
Full ownership	WOS Export	WOS HDI
Partial ownership	JV Export	JV HDI

We think of the investor as combining different activities contributing to the value chain. To fix ideas think of an investor generating revenues R by combining three activities: production activities p and R&D (technology) activities t determine the output produced, marketing activities m determine the value of that

[12]Note that what we call horizontal investment captures the idea of a subsidiary in which both sales and production take place abroad. What we call exports amounts to the creation of a sales subsidiary where production takes place at home and sales take place abroad.

output. The resulting revenues are assumed to be Cobb-Douglas with constant returns to scale as in Equation 2.1. To save on notation we denote the set of inputs with $\mathbf{x} = (p, t, m)$.

$$R(\mathbf{x}) = m^{\beta} \left(p^{(1-\gamma)} t^{\gamma}\right)^{(1-\beta)} \tag{2.1}$$

The relative importance of these three activities is reflected by the respective Cobb-Douglas parameters. The parameter β describes the importance of marketing relative to output as determined by R&D and production. A high value of β relates to an industry in which marketing is a major component in determining revenues. The importance of R&D, or technology, relative to production is captured by γ. High values of γ relate to industries that are intensive in technology (high tech industries). The modelling strategy thereby allows to capture a wide set of industry characteristics.

In principle, each individual activity would require different inputs such as labor, capital and managerial effort, that are not explicitly modelled here. As we are interested in determining the optimal ownership choice, we focus on incentive considerations that are driven by managerial effort costs. Costs are related to the three activities: production p, marketing m, and technology t. These costs are assumed to be convex, reflecting increasing managerial effort costs. Effort is needed to monitor production, to sell the products, and to provide the firm's technology. The foreign location is characterized by distance d. As discussed in Section 2.2 this distance includes cultural differences. These differences may make it difficult to serve a foreign market. We capture this observation by assuming that marketing costs increase in distance $d \geq 0$. An investor who exports to the foreign market and sets up a wholly owned subsidiary (WOS Export) bears costs that have the following functional form.

$$C_{\text{WOS Export}}(\mathbf{x}, d) = \frac{1}{2}p^2 + \frac{1+d}{2}m^2 + \frac{1}{2}t^2 \tag{2.2}$$

Consider next the investor's costs that arise when serving the foreign market through a horizontal investment. Foreign production may have a positive or negative influence on production costs. We capture cost differences that relate to foreign production by $\delta > 0$. Cost advantages can e.g. arise from differences in factor endowments or savings on transportation costs. They are present if $\delta > 1$.

But we also allow for $0 < \delta < 1$, representing production cost disadvantages. They may also arise from differences in factor endowments or additional overhead costs.[13] Furthermore, production abroad requires monitoring whose costs increase with cultural or geographical distance. Both effects are captured by the following equation.

$$C_{\text{WOS HDI}}(\mathbf{x}, d, \delta) = \frac{1+d}{2\delta}p^2 + \frac{1+d}{2}m^2 + \frac{1}{2}t^2 \tag{2.3}$$

The investor chooses p, m, and t to maximize her payoff Π which equal revenues R minus costs C.

$$\max_{\mathbf{x}} \Pi = R(\mathbf{x}) - C(\mathbf{x}, d, \delta) \tag{2.4}$$

Consider now the possibility that the investor enters a joint venture relationship. Foreign activities are then operated by a local partner as indicated above. We assume that research and development is always done by the investor who alone has the abilities to provide technology inputs.[14] By entering a joint venture (JV) the investor can avoid the costs that arise from the lack of market knowledge and monitoring skills. Yet, such a relationship is hampered by contractual difficulties. To capture these difficulties we assume that the parties can only write a contract on how to share after sales revenues. The investor gets a share $\alpha \in [0, 1]$ of the revenues while the joint venture partner gets the remainder of the share $(1 - \alpha)$.[15]

Further details cannot be specified in the contract. In particular, cost sharing is excluded as we assume that costs, which comprise effort costs, are non-verifiable. Furthermore, upfront lump sum payments are excluded, for instance because the local partner is financially constrained in a way that he cannot afford to pay for his share of revenues upfront.

Technology t, production p, and marketing m activities are combined to generate revenues R as in Equation (2.1). The only difference is that inputs are provided by two different parties. In order to distinguish the investor and the partner we use indices 1 and 2, respectively.

[13] Note that production cost advantages may also apply to marketing services. As marketing services are always provided in *Foreign* this does not affect our results and hence is not explicitly modelled.

[14] Even if technology is not considered in producing the goods, i.e. even if γ equals zero, the investor is inevitable. In that way, we acknowledge the existence of multinational firms without explicitly modelling the provision of headquarters services.

[15] Wang and Zhou (2004) and Wang and Zhou (2005) also consider revenue sharing contracts and argue that firm's revenue can be audited in reality. They also point out that revenue sharing is a common practice in joint ventures.

We consider two different types of joint ventures. In an export joint venture (JV Export) the local partner is solely responsible for the marketing activities in these foreign market and provides $\mathbf{x}^2 = m_2$. The investor conducts research and development and produces the goods domestically. Therefore, she decides about $\mathbf{x}^1 = (p_1, t_1)$. The level of all inputs determines the revenues $R(\mathbf{x}^1, \mathbf{x}^2)$ that are generated in the foreign market.

In a horizontal joint venture (JV HDI) the local partner additionally operates foreign production and provides $\mathbf{x}^2 = (p_2, m_2)$ altogether. The investor only conducts research and development activities and provides $\mathbf{x}^1 = t_1$.

The revenue function now depends on where production takes place, at home, in which case the investor provides p_1, or abroad, in which case the joint venture partner provides p_2.

Of course, the joint venture partner does not face any distance costs in the foreign country. He knows about market particularities and has the necessary communication skills to deal with workers, business partners and the local administration. His cost function is hence described by Equation (2.5) in case of an export joint venture and by Equation (2.6) in case of a horizontal joint venture.

$$C^2_{\text{JV Export}}(\mathbf{x}^2) = \frac{1}{2}m_2^2 \tag{2.5}$$

$$C^2_{\text{JV HDI}}(\mathbf{x}^2, \delta) = \frac{1}{2\delta}p_2^2 + \frac{1}{2}m_2^2 \tag{2.6}$$

We further allow for the possibility of technology spillovers in case of joint ventures.[16] To capture this effect, we assume that technology provision becomes more costly if a partner is involved. This reflects the danger of dissipating technological know how through a foreign partner in the foreign country.[17] The danger is stronger if institutions and the protection of intellectual property rights are weak.[18] Again, we capture this lack of reliance on intellectual property rights by the variable distance. Thus, distance d increases technology costs in case of joint ventures.

[16] Smarzynska (2004) reports evidence that projects with joint ownership give rise to spillovers that do not occur in case of full ownership.

[17] See Müller and Schnitzer (2006) for a model of spillovers in case of joint ventures.

[18] A second source of higher technology costs may originate from costly transfers to the local partner. This complementing view is outlined in more detail in Chapter 3.

The investor's cost function is now described by

$$C^1_{\text{JV Export}}(\mathbf{x}^1, d) = \frac{1}{2}p_1^2 + \frac{1+d}{2}t_1^2 \quad (2.7)$$

$$C^1_{\text{JV HDI}}(\mathbf{x}^1, d) = \frac{1+d}{2}t_1^2 \quad (2.8)$$

in case of a export joint venture or a horizontal joint venture, respectively.

The following Table 2.3 summarizes the different costs for all four scenarios outlined in Table 2.2. Note that we have given three possible explanations for why the cost related to each activity may increase in distance. In case of marketing, distance is supposed to capture cultural distance reflecting the lack of tacit market knowledge. In case of production, distance may also capture cultural distance making it difficult to effectively monitor foreign employees. But it may also capture costs arising from geographical distance, like travel cost or different working schedules. Finally, in case of technology, distance is supposed to capture the idea of difficulties in enforcing intellectual property rights.[19]

A priori, it is not obvious that all three concepts of distance are perfectly aligned. Some countries may be close in one dimension and far in the other, and this may depend on the industry. Costs of control may also vary for different firms.[20]

It would be straightforward, however, to denote three different dimensions of distance. This may be important for empirical work but as we will find below, little would be gained for our theoretical analysis from adding this more complex notation. The effects of distance can easily be attributed to the various dimensions and hence alternative scenarios could easily be incorporated.

For any given ownership α, the investor and the joint venture partner simultaneously choose $\mathbf{x}^1$ and $\mathbf{x}^2$ such as to maximize their respective payoffs $\alpha R(\mathbf{x}^1, \mathbf{x}^2) - C^1$ and $(1-\alpha)R(\mathbf{x}^1, \mathbf{x}^2) - C^2$. Anticipating this Nash equilibrium, the investor picks α so as to maximize her payoff.

The model is solved by backward induction. In the Appendix we derive the subgame perfect equilibrium payoffs of both the investor and the joint venture partner for each of the four different scenarios described in Table 2.2. The investor's

[19] Branstetter et al. (2005) show that firms transfer more technology as intellectual property rights increase.

[20] Raff et al. (2006) show for Japanese data that firm characteristics such as business group membership and firm age increase the likelihood of FDI versus exports.

Table 2.3: Managerial costs

	EXPORT	HDI
WOS	$C^1 = \frac{1}{2}p^2 + \frac{1+d}{2}m^2 + \frac{1}{2}t^2$	$C^1 = \frac{1+d}{2\delta}p^2 + \frac{1+d}{2}m^2 + \frac{1}{2}t^2$
JV	$C^1 = \frac{1}{2}p_1^2 + \frac{1+d}{2}t_1^2$ $C^2 = \frac{1}{2}m_2^2$	$C^1 = \frac{1+d}{2}t_1^2$ $C^2 = \frac{1}{2\delta}p_2^2 + \frac{1}{2}m_2^2$

reduced form payoff functions are summarized in Table 2.4.

Table 2.4: Reduced form payoff functions

	EXPORT	HDI
WOS	$\Pi = \left(\frac{1}{1+d}\right)^{\beta}\phi$	$\Pi = \left(\frac{1}{1+d}\right)^{\beta+(1-\gamma)(1-\beta)}\delta^{(1-\beta)(1-\gamma)}\phi$
JV	$\Pi = \frac{1}{4}\left(\frac{1}{1+d}\right)^{\gamma(1-\beta)}\theta_1\phi$	$\Pi = \frac{1}{4}\left(\frac{1}{1+d}\right)^{\gamma(1-\beta)}\delta^{(1-\gamma)(1-\beta)}\theta_2\phi$

$$
\begin{aligned}
\phi &= \frac{1}{2}\beta^{\beta}\left(\gamma(1-\beta)\right)^{\gamma(1-\beta)} \\
\theta_1 &= \beta^{\beta}(2-\beta)^{2-\beta}(1+\beta) \\
\theta_2 &= \left(2-\gamma(1-\beta)\right)\left(1+\gamma(1-\beta)\right)^{1+\gamma(1-\beta)}\left(\beta+(1-\beta)(1-\gamma)\right)^{\beta+(1-\beta)(1-\gamma)}
\end{aligned}
$$

2.4 Optimal investment choice

In this section, we solve for the investor's optimal ownership and location choices. The multinational investor's choice depends on the business environment which is characterized by the distance d between *Home* and *Foreign*, the cost difference δ that is associated with foreign production and the industry characteristics. As a benchmark case we start analysing the ownership choice when distance, production cost differences and potential technology spillovers play no role, i.e. $d = 0$, $\delta = 1$, and $\gamma = 0$. We then focus on the influence of distance and production cost differences on the location of production and the ownership

mode. To capture the effect of industry characteristics, we look at low tech and high tech industries in turn. Furthermore, we distinguish how results are affected if industries become more marketing intensive.

2.4.1 Optimal ownership structure: a benchmark case

Consider a situation where distance, production cost differences and potential technology spillovers play no role, i.e. $d = 0$, $\delta = 1$, and $\gamma = 0$.

Figure 2.2 depicts the maximum payoffs that an investor can earn for each mode of organization if she optimally chooses α. Location does not matter in these cases because countries are assumed to be identical. Hence, there is no difference between WOS Export and WOS HDI.

Not surprisingly, integration strictly dominates joint ventures because in this benchmark case the joint venture partner does not offer any cost advantages but forces the investor to share revenues if she wants to provide incentives to the partner.

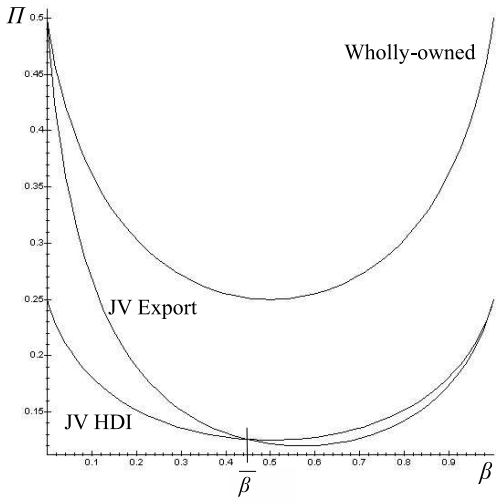


Figure 2.2: Benchmark case

To understand the agency costs that arise from joint ventures consider now a situation where the investor chooses to employ an agent in order to sell the output on the foreign market. Of course, the partner's incentive to provide marketing

inputs is higher if his share of revenues is larger. But sharing revenues is costly for the investor. Hence, she faces a trade-off between gaining a larger share of revenues and providing incentives to the joint venture partner. The optimal sharing rule α^* derived in the Appendix and characterized in Equation (2.9) below optimally balances this trade off.

Consider next a situation where the investor also hands over production to the partner. Of course, if the joint venture partner is supposed to do both, marketing and production, it is worthwhile to provide him with higher incentives, i.e. α should be smaller. This is what we find in the optimal sharing rule α^* in case of a JV HDI, that is also characterized in Equation (2.9).

$$\alpha^*_{\text{JV Export}} = \frac{2-\beta}{2} \qquad \alpha^*_{\text{JV HDI}} = \frac{1}{2} \tag{2.9}$$

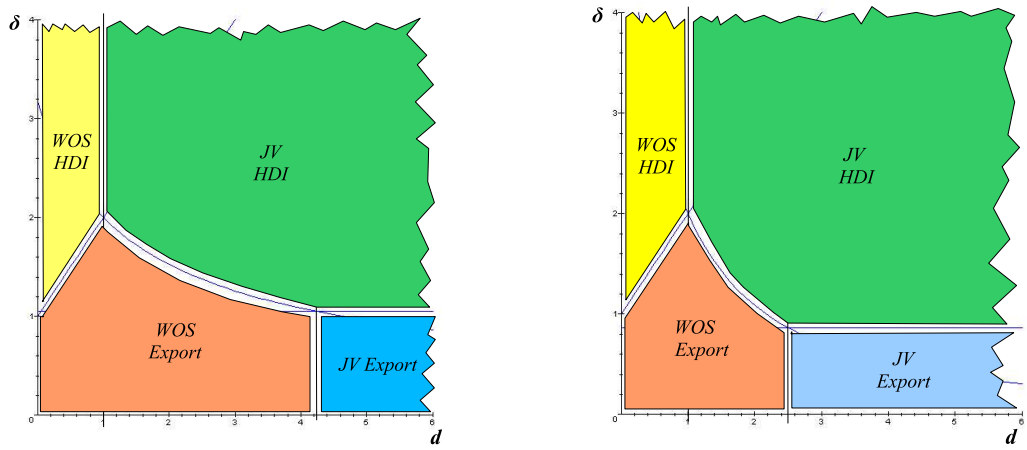
Not surprisingly, the relative advantages of JV Export and JV HDI depend on industry characteristics. The less marketing intensive, the larger the ownership share the investor keeps to herself in case of a JV Export because providing incentives to the local partner is not very important. Thus, JV Export is preferable to JV HDI because a comparatively larger ownership share would have to be given to the joint venture partner if he were to do production as well. If marketing intensity is high, instead, it is crucial to provide the local partner with high incentives. But in this case, it is best not to split incentives by letting two different parties carry out marketing and production. Hence, in marketing intensive industries, JV HDI is optimal. Intuitively, we find that if the partner's contribution is not crucial the investor provides relatively low incentives to the partner and keeps production in-house. If the partner's contribution is very important, however, she needs to provide high incentives to the partner because revenues would be highly distorted otherwise. This, in turn, creates an additional conflict as an increase in the partner's incentives decreases her own incentives to provide production inputs. By handing over production to the partner she can avoid this additional conflict of splitting incentives.

2.4.2 The impact of distance in low technology sectors

We now allow distance and production cost differences to play a role, but still abstract from the possibility of technology spillovers. The optimal choice of the

investor for low tech industries ($\gamma = 0$) is illustrated in Figure 3 2.3. The figure relates the optimal choice to distance d and cost differences δ.

We set two specific values for β to show the differences between marketing and production intensive sectors. On the left, Figure 2.3(a) depicts the optimal choice if production is relatively important. On the right, Figure 2.3(b) depicts the optimal choice if marketing is relatively important.[21]



(a) Production intensive

(b) Marketing intensive

Figure 2.3: Low technology industries

Both figures exhibit a similar pattern. The investor always chooses to locate production in the foreign country if local production cost advantages are very large. In the limit foreign production is for free which makes foreign production preferable to home production. Production cost disadvantages are present if $\delta < 1$. If these disadvantages are very large she chooses to produce domestically. Thus, for very extreme production cost differences, any effect distance may have on the location of production is dominated by production cost effects.

For intermediate ranges of cost differences $\delta \in (\underline{\delta}, \bar{\delta})$, however, distance has a non-monotonous effect on horizontal investments. Proposition 1 specifies the impact of distance on low technology goods. Proofs are provided in the Appendix.

[21] The values are $\beta = 0.4$ in Figure 2.3(a) and $\beta = 0.6$ in Figure 2.3(b).

Proposition 1. Impact of distance in low tech industries *Consider the case of non-extreme production cost advantages* $\delta \in (\underline{\delta}, \bar{\delta})$*. In this case, the investor chooses to produce at home for intermediate distances, but prefers to produce abroad for small and large distances. Foreign production takes place in WOS HDI if distances are small and in JV HDI if distances are large.*

Consider the case where the investor chooses WOS HDI as distance is low, to benefit from a local production cost advantage. As distance increases monitoring abroad becomes more costly. Hence, WOS Export may become optimal even if production costs are higher in *Home*. As control costs increase further a joint venture becomes optimal. The reason is that the investor is too unfamiliar with the local environment which increases her control costs. Hence, distance also increases the value of the partner's tacit knowledge. Consequently, she benefits more from cooperating with a local partner and accepts to bear the agency costs that follow thereof.[22]

But if a local partner is engaged to help with marketing it becomes increasingly attractive to move production abroad again, for reasons discussed in the benchmark case. It is this interaction of ownership and locations decisions that leads to the non-monotonicity of horizontal investments. The very fact that as distance increases, joint ventures become more interesting, makes the investor switch back to foreign production. If she were limited to wholly owned subsidiaries, this effect would not occur.

Above, we have seen that industry characteristics affect the attraction of joint ventures. We find this again in the more general scenario, as illustrated by Figure 2.3. In particular, if marketing contributes a large part to the value chain JV HDI become relatively more attractive than JV Export, an effect we have already noticed in the benchmark case above. Moreover, joint ventures in general become more likely. This is summarized in Proposition 2. Proofs are provided in the Appendix.

[22] In the absence of distance costs she sets-up a wholly owned subsidiary as shown in the benchmark case.

Proposition 2. Impact of marketing intensity
The more marketing intensive the industry, the smaller the critical distance above which the investor prefers to choose a joint venture. Furthermore, the more likely it is that the investor chooses foreign production. In particular,

(i) for any given distance d the smaller the critical value of the production cost (dis)advantage δ above which the investor chooses foreign production

(ii) for any given production cost (dis)advantage δ the smaller the distance d above which the investor chooses foreign production

Why would an investor be more likely to choose a joint venture as marketing intensity increases? She is more inclined to accept agency costs if her own costs of serving the foreign market increase, as is indirectly the case with increasing β. At the same time, agency costs increase in β as well. Figure 2.2 above shows that the difference in payoffs between WOS Export and JV Export increases in β. Proposition 2 shows that the total effect is positive, i.e. the increase in marketing costs dominates and the parameter range for which joint ventures are the optimal ownership choice gets larger as marketing intensity increases.

Like in the benchmark case, industry characteristics also influence the location of production. The result is driven by an expansion of horizontal joint ventures. Comparing JV Export and JV HDI we find that horizontal joint ventures become more likely as marketing intensity β increases. We find that this effect still holds in spite of the fact that we now allow for production cost differences and that potential benefits from lower costs of foreign production $\delta^{(1-\beta)}$ decrease in β. Proposition 2 shows that the benefits from bundling incentives if marketing intensity is high dominates the decreasing cost advantage effect.

In the literature it is often argued that production locates close to markets because the investor saves on transportation costs. In our model, investors may also choose to produce close to markets. Interestingly, this may also happen in the absence of cost advantages, i.e. even if $\delta = 1$. Benefits from foreign production still occur because incentives are better aligned in these cases. In that way, we endogenously determine costs of fragmentation.

2.4.3 The impact of distance in high technology sectors

Do technology intensive sectors differ in their internationalization strategies? We now allow for $\gamma > 0$ to answer this question.

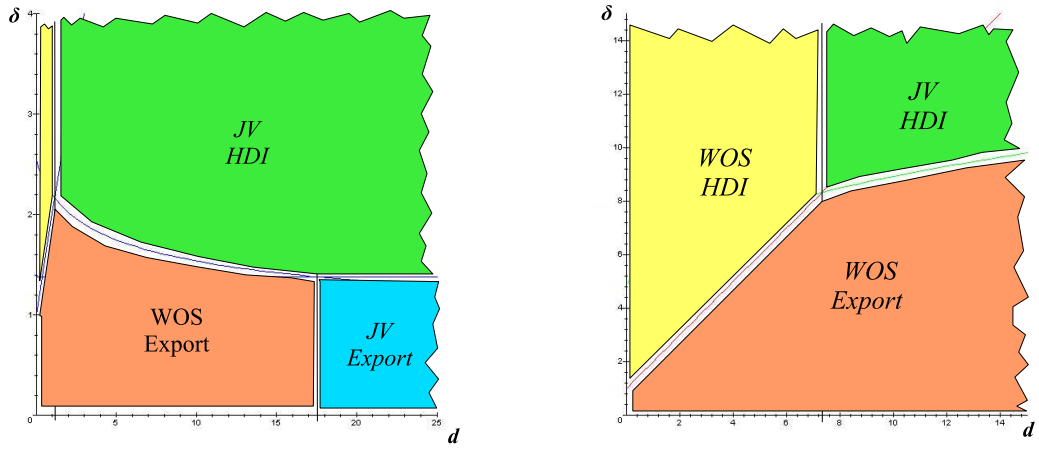
In general, technology makes joint ventures less profitable due to costly spillover effects. This increases the agency costs that are associated with joint ventures and that the investor has to trade off against the advantages of saving control costs. In this scenario, distance increases the investor' production and marketing costs, but at the same time it reduces the firm's capacity to transfer technology and to protect its proprietary knowledge. Note that we model the impact of distance on technology costs in the same way as on marketing or monitoring costs. This assumption eases the illustration of the results but could easily be relaxed by assuming different types of distance costs associated to the activities.[23]

The danger of spillovers obviously encourages the investor to choose wholly owned subsidiaries for a wider range of parameters as the weight on technology γ increases. If the total impact of technology on the value chain $\gamma(1-\beta)$ exceeds the weight on marketing and production activities $\beta+(1-\beta)(1-\gamma)$ joint ventures are never optimal.

Figure 2.4 illustrates the optimal choice of an investor in case of moderate technology intensity and in case of high technology intensity. On the left, Figure 2.4(a) depicts a case in which the total weight on technology is below the weight on marketing intensity, i.e. $\gamma(1-\beta) < \beta$. On the right, Figure 2.4(b) depicts a case in which the overall impact of technology exceeds the weight on marketing but horizontal joint ventures are still a viable option, i.e. $\beta < \gamma(1-\beta) < 1/2$.

Due to this effect on the ownership choice the effect of distance on high technology industries varies considerably from the effect of distance on low technology industries. Proposition 3 specifies the impact of distance on high technology industries. Proofs are provided in the Appendix.

[23] In the Appendix we solve the payoff functions for different types of distances related to the three inputs d_m, d_p, and d_t.



(a) Moderate R&D intensity

(b) High R&D intensity

Figure 2.4: High technology industries

Proposition 3. Impact of distance on high tech firms *As distance increases technology intensive firms, i.e. firms where* $\beta < \gamma(1-\beta) < 1/2$

(i) are less likely to produce abroad.

(ii) always choose wholly owned subsidiaries if production cost advantages are moderate.

(iii) switch from wholly owned foreign production (WOS HDI) to joint venture foreign production (JV HDI) and then again to wholly owned exporting (WOS Export) if production cost advantages are considerable.

Proposition 3 shows that the relative importance of tacit knowledge that a partner contributes to a joint venture relationship and technology spillovers influence the effect of distance on the investment decision. If technology spillovers are relatively weak the results derived without R&D activities in Section 2.4.2 basically remain. Technology simply weakens the impact of distance. If technology spillovers are relatively strong, however, the results vary considerably. The investor no longer switches to joint ventures as distance increases. The investor then always sets up a wholly owned subsidiary. She chooses WOS HDI if control costs are small and WOS Export if control costs are large. Only if foreign production

leads to considerable cost savings she may choose foreign production in form of JV HDI. Nevertheless, we can always find a distance above which spillovers are too large as to make a joint venture profitable.

Of course, if the investor enters a joint venture relationship with a local partner the technology intensity also influences the share of a foreign investor. In particular, as the overall technology intensity $\gamma(1-\beta)$ increases, the investor's share α in case of a joint venture increases. This is shown in the following optimal ownership shares for the investor, which are derived in the Appendix.

$$\alpha^*_{\text{JV Export}} = \frac{2-\beta}{2} \tag{2.10}$$

$$\alpha^*_{\text{JV HDI}} = \frac{1+(1-\beta)\gamma}{2} \tag{2.11}$$

To summarize, the ownership of an investor increases as technology intensity increases. Two effects lead to the result. Wholly owned subsidiaries become a preferred ownership structure. In addition, conditional on joint ventures being chosen the investor's share increases as technology becomes more important.[24]

2.5 Conclusion

At the core of our paper is the simple idea that doing business abroad is more difficult when investors are unfamiliar with the local environment. While many other theories focus on transport costs we explore the influence of that psychic or cultural distance on multinationals' activities. Still, we do allow for the possibility that offshore production affects costs. Moreover, we analyse in detail how the link between distance and multinational activities depends on industry characteristics.

It is straightforward that in low technology industries joint ventures become more likely as distance increases, i.e. as investors increasingly face difficulties in understanding local conditions. In high technology industries, however, there is a countervailing effect due to technology dissipation. Interestingly, distance may have an inverse U-shape effect on the probability to enter a joint venture. Investors may choose wholly owned subsidiaries when distance is very small or very large. Joint ventures are optimal for intermediate distances because investors then benefit

[24]The optimal ownership share in case of JV Export also depends on the overall impact on technology $\gamma(1-\beta)$. This can best be seen from $1+\gamma(1-\beta)+(1-\gamma)(1-\beta)=2-\beta$.

from a partner's local knowledge while spillovers are still tolerable.

The analysis reveals a second non-linear relationship that exists between distance and horizontal investments. We identify parameter ranges in which foreign production is optimal for very small or very large distances. Wholly owned export subsidiaries are optimal in between. In this intermediate range, advantages of entering a joint venture are too small while monitoring costs are too high to benefit from lower production costs abroad.

Both result highlight that an isolated analysis of ownership and location of production may be misleading. They add to standard models of horizontal investments in which foreign production is a way to save on transport costs. In our novel approach, agency considerations trigger foreign production even if no production cost advantage is associated. The intuition is that shifting production turns out to be profitable if a joint venture partner already has a high stake in the project. Thereby, the investor also benefits from an efficiency gain that arises from aligning incentives at the partner's side.

These efficiency gains are especially relevant in marketing intensive industries because in these industries it is relatively more important to employ the help of a local partner to facilitate sales in the foreign market. That is the intuition for why we find that marketing intensive sectors are more likely to produce close to their customers.

Our results are in line with several stylized facts about ownership and the choice of horizontal investments. But they may also motivate future empirical research to closely consider the interaction effects especially between distance and industry characteristics like technology intensity. Moreover, they show that some effects can only be understood if econometric modelling allows ownership and location of production to be jointly determined.

Chapter 3

Vertical specialization and learning

3.1 Introduction

This chapter is motivated by the observation that multinational firms adapt their ownership decisions over time. The business press reports many examples of relocation and reorganization of foreign activities. A recent example includes FedEx which became full owner of a former joint venture in China in 2006 and additionally integrated a domestic express network.[1] Other firms withdrew their foreign production instead of further integrating it. Varta Microbatteries, for example, relocated its foreign production from Singapore back to Germany in 1997.

Changes in the ownership structure of multinational enterprises can also be observed more systematically. We therefore examine data on foreign direct investments by German MNEs provided by the *Deutsche Bundesbank*. We find $4,511$ changes in parent ownership in the years between 1996 to 2004. This number corresponds to 20 percent of the observations.[2]

Provided that firms did not make a mistake in the first place, it is interesting to ask which factors drive these changes in ownership and location. Several empirical studies propose experience, i.e. learning about the foreign environment, as a possible explanation. These studies typically find that firms tend to integrate foreign

[1] The joint venture was formed in 1999 and regulation required a four year period of joint ownership.

[2] More precisely, we observe the last entry of an affiliate in the years 1997-2004 and compare the share of the parent company in that year to its share in 1996. There is a total of $22,160$ observations. Parent ownership decreased in $1,571$ cases and increased in $2,940$ cases. We would like to thank Iris Kesternich for extracting the data.

operations as they gain international experience.[3] Also our econometric analysis in Chapter 4 suggests that internationally experienced firms integrate their foreign activities. However, there are few theoretical contributions that can explain these movements. This brings us to our main research question. What is the impact of experience on the production strategy of a multinational firm?

We answer this question by investigating multinational activities that are driven by factor price differences between countries.[4] Along a first dimension, firms decide whether they shift production abroad to benefit from lower production costs abroad. Hand in hand with the decision about the location of production a firm must decide whether to produce in-house or whether to buy intermediate products from a supplier. This question is also commonly known as the *make or buy* decision of the firm. Both dimensions are jointly considered in a recent strand of literature which combines trade theory and the theory of the firm.[5] We extend that literature by dynamic aspects to account for experience.

In particular, we develop a two-period model in which firms decide about the location of production and the mode of organization. In the first period, multinational firms face uncertainty about their abilities to monitor foreign production. As firms gain experience this uncertainty decreases. However, firms can only adapt their initial decision in the second period. In that way we capture the idea that learning about the foreign production environment takes some time.

Firm boundaries are determined in a moral hazard framework that is closely related to Grossman and Helpman (2004). We draw on their modelling of differences in firm productivity and monitoring technology. We extend the framework by differences in R&D intensity.

At the core of the model is a moral hazard problem with limited liability. The investor, or the principal, has the know-how to produce a good or service but needs the help of a skilled agent in order to produce them. The investor either hires a manager (integration) or she contracts with an independent supplier (outsourcing).

Independent suppliers are assumed to own more assets than managers. Investors therefore have an incentive to outsource because agency costs decrease in

[3] See, for example, Gatignon and Anderson (1988), Gomes-Casseres (1989), Mutinelli and Piscitello (1998), and Meyer (2001).

[4] The empirical relevance of vertical specialization strategies is highlighted by Hummels et al. (2001) and Hanson et al. (2005).

[5] See Helpman (2006) for an overview.

the agent's wealth as is well known from the literature. Managers, on the other hand, can partially be monitored whereas suppliers are completely independent. For this reason, investors have an incentive to choose integration because monitoring reduces moral hazard problems.

A last difference between integration and outsourcing stems from the R&D intensity of the firm. In line with the empirical literature, we assume that transferring technology to a supplier is more difficult if R&D intensity is high, i.e. R&D intensity reduces the probability that a supplier delivers working components.[6]

As mentioned before, investors benefit from lower production costs if they produce abroad. However, distance decreases monitoring abilities of the investor which hampers integrated production in a foreign subsidiary. Furthermore, distance also hampers technology transfers, i.e. foreign suppliers are less likely than domestic ones to deliver working components if R&D-intensity is high.

We derive four main results that focus on the organizational choice. First, more firms switch from outsourcing to integration than vice versa. At first glance this result may be surprising. There is no obvious reason why the share of firms that are positively surprised by the actual scope of monitoring is higher than the share of firms that are negatively surprised. The intuition is that these firms are relatively more productive and therefore react more strongly to changes in the monitoring technology.

Second, uncertainty about monitoring abilities reinforces the effect. The model thus predicts that on an aggregate level experience should lead to relatively more subsidiaries and that the effect should be stronger if initial uncertainty about the firm's monitoring abilities is high.

Third, R&D intensity does not simply add to the results in Grossman and Helpman (2004), e.g. by making all firms equally reluctant to choose outsourcing. In fact, R&D intensity interacts with productivity.

More precisely, the results show that R&D intensity only affects the investment choices of high productivity firms and not of low productivity firms. The reason is that the decision of a low productivity firm depends mostly on the related agency costs. Agency costs are, however, not influenced by technology transfers. Therefore

[6]Kogut and Zander (1993) show empirically that technology transfers are more likely to take place internally if knowledge is hard to codify or difficult to teach. Further evidence is provided in the literature overview.

low productivity firms are little affected if R&D intensity increases. This result may be valuable for empirical research as it suggests to interact productivity with R&D intensity.

Fourth, we find that some R&D intensive firms consciously choose integration in the first period and switch to outsourcing in the second. In early periods, integration is optimal because technology is kept in-house. In that way the firm has a high chance to produce working components and to stay in business. In later stages, technology is transferred to an independent supplier. In that way the firm saves on agency costs because suppliers have higher stakes in the project than a manager. The cost of outsourcing is a higher risk of failure which is acceptable because production is phasing out anyhow. On an aggregate level we thus expect that firms are less likely to choose outsourcing as a strategy to deal with uncertainty if they are R&D intensive.

The remainder of this chapter is structured as follows. In the next section we discuss the related theoretical literature and link our results to empirical observations. Section 3.3 develops the static model. The decision between integration and outsourcing in the one-country case is analysed in Section 3.3.1. Section 3.3.2 extends the analysis to a second country. We make a short detour in Section 3.4 to the comparative static results before turning to the dynamic model. Section 3.5 introduces uncertainty about the monitoring technology in a dynamic framework. Section 3.6 concludes and discusses lines of future research.

3.2 Literature

The model relates to a set of papers on the impact of uncertainty and experience on multinational activities. Horstmann and Markusen (1996) assume that an investor initially faces uncertainty about foreign market size which is resolved in the second period. Outsourcing is a way to deal with uncertainty because local partners actually know the exact market size. Also Rob and Vettas (2003) consider uncertainty about the foreign market. They focus, however, on horizontal MNEs and analyse the decision between export and foreign direct investment.[7] In

[7]Similarly, Kotseva and Vettas (2005) analyse the decision between export and foreign direct investment if demand uncertainty is persistent. Buckley and Casson (1981) also investigate the decision between exports and FDI when firms gain experience. In their model, familiarisation

their model, uncertainty has the effect that horizontal FDI and exports are not an exclusive choice but may complement each other. While these papers consider the aspect of learning they all have a horizontal, i.e. market-seeking, perspective. Our model thus differs substantially as we focus on vertical, i.e. cost-reducing, activities.[8]

The model further incorporates a central trade-off between fixed and variable costs which is well-known from the trade literature on firm heterogeneity. In his seminal contribution, Melitz (2003) shows that high productivity firms accept high fixed costs and choose foreign direct investments. Low productivity firms, on contrary, accept high variable costs and choose exports.

A similar logic applies here, yet for very different reasons. Fixed costs arise endogenously due to agency problems while variable costs arise because of the projects' respective success probabilities. Consequently, high productivity firms choose modes that lead to high agency costs and high success probabilities. Low productivity firms choose modes that lead to low agency costs and low success probabilities. Note that fixed costs are not simply assumed but arise from the underlying model of firm size.

The results further highlight that similar results can be obtained independent of the underlying model of the firm. The sorting of firms in our incentive-based approach is basically identical with the sorting of firms in Antràs and Helpman (2004) who apply a property-rights approach.[9] In a survey article, Spencer (2005) concludes that the sorting of firms according to productivity is highly sensitive to the underlying model of firm size. Opposed to that argument, our results highlight that differences stem from a different set of exogenous parameters.

Next, we link our results to a number of empirical observations. Most of the

with the local market leads to a decrease in variable costs over time.

[8] Antràs (2005) investigates changes in the vertical production decision, yet focusing on the product cycle of a good.

[9] Specifically, the pattern for high technology firms in this paper matches the pattern of headquarters-intensive firms in Antràs and Helpman (2004). The crucial assumption seems to be that integration has some advantage over outsourcing for specific activities. This may be the provision of headquarters-services as in Antràs and Helpman (2004) or the production of R&D intensive goods as in our model. Similarly, the pattern for low technology firms in this paper matches the pattern of component-intensive firms in Antràs and Helpman (2004). Remaining differences depend upon fixed costs of foreign entry. Evidently, low productivity firms then operate domestically or exit the market.

empirical studies focus on the ownership choice of international investments and do not cover both dimensions, location and ownership.

The empirical literature suggests that R&D intensive firms keep production in-house and operate wholly owned subsidiaries. Barbosa and Louri (2002) show for investments in Portugal that foreign investors are more likely to have full ownership if R&D intensity is high. Moreover, R&D intensity makes it less likely that the foreign investor holds a minority of the shares. Davidson and McFetridge (1985) find for U.S. multinationals that the probability of an internal technology transfer is more likely for newer technologies, and if the R&D intensity of a firm is high.[10] Our results predict such a behaviour and generate the additional hypothesis that high productivity firms are affected more strongly.

The model also predicts that some firms switch form integration to outsourcing because they find it difficult to monitor their foreign subsidiaries. Other firms switch from outsourcing to integration because monitoring their foreign subsidiaries turns out to be easier than expected. As noted at the beginning of this chapter, we observe both movements in the data. More precisely, we examine data on German foreign direct investments collected by the *Deutsche Bundesbank* and compare parent ownership in the years $1997-2004$ with parent ownership in 1996. We find that parent ownership decreased in $1,571$ cases, increased in $2,940$ cases, and kept constant in $17,649$ cases.[11]

A further prediction of the model is that firms tend to choose integration as they learn about their monitoring abilities abroad. This overall effect is supported by several studies that find a positive impact of experience on the decision to integrate foreign activities. Gatignon and Anderson (1988), for example, find that international experience positively influences the choice of wholly owned subsidiaries over minority shares. Meyer (2001) and Brouthers and Brouthers (2003) get similar results for Central and Eastern European Countries. The model results are in line with these observations and generate the additional hypothesis that more firms initially choose outsourcing if uncertainty is high.

We are aware of only one empirical study that incorporates both dimensions, location and ownership, and also uses data on firm productivity. In a recent work-

[10] They distinguish between technology transfers to a foreign affiliate and technology transfers to a licensee.

[11] Similar evidence on changes in the ownership structure of U.S. multinationals is documented by Curhan et al. (1977).

ing paper, Jabbour (2005) shows that French firms with high productivity tend to choose in-house production in rich countries if their R&D intensity is high. Our model can explain such a finding if we assume that distance also hampers technology transfers to a foreign subsidiary. This assumption may be justified if a product requires close coordination between R&D and manufacturing activities. Norbäck (2001) provides empirical evidence that supports the idea of costly technology transfers. He finds for Swedish MNEs that foreign production is less likely if R&D intensity is high.[12]

3.3 The static model

In this section, we develop the static model in which a multinational investor chooses the mode of organization and the location of production. The model set-up is related to Grossman and Helpman (2004) and builds on a moral hazard problem with limited liability as in Laffont and Martimort (2002). We start with the simple case of integration versus outsourcing and introduce country differences in Section 3.3.2.

The investor, or principal, has the know-how to produce a differentiated good but needs the help of a skilled agent, who manages operations, in order to produce it. The agent can either be the manager of a subsidiary, or else the supplier of an independent firm. We refer to the first case as (vertical) integration and respective parameters are indexed by superscript V. We refer to the second case as outsourcing and use superscript O.

In both cases the production of components may fail. However, if the investor is successful in obtaining components that meet the product specifications she makes use of the components and sells the final goods on the market. She thereby earns revenues of size R. We follow Grossman and Helpman (2004) and assume that firm size is fixed. The size of R thus reflects the productivity of a firm because higher revenues are achieved with the same amount of inputs. If the agent is not successful in producing components output is zero and the principal does not earn anything.

The probability of success depends on the agent's effort e, which he exerts on a

[12] An alternative justification is that there are skill differences between the high-cost country and the low-cost country. In such a situation, foreign subsidiaries may face difficulties in delivering working components, especially if these components are R&D intensive.

variety of tasks. In particular, there exists a continuum of tasks $I = \{i|i \in (0,1)\}$. Each task influences independently the success of the project.

For each task the agent decides whether he puts in high effort or whether he puts in low effort. If he exerts high effort, i.e. if $e(i) = 1$, he incurs effort costs $\psi(i)$. The probability that this particular task is successful is then relatively high and equals $\pi(1) = \bar{\pi}$. If he exerts low effort, i.e. if $e(i) = 0$, no effort costs occur. Low effort reduces the probability of success to $\pi(0) = \underline{\pi}$. Finally, the sum $\int_0^1 \pi(e(i))\, di$ determines the overall probability that the project is successful.

We further assume that both agents have some initial wealth and own assets of value l^k, where $k = \{V, O\}$. These assets are restricted as specified in Assumption 1. To save on notation, $\Delta\pi$ is used to express the difference between effort levels $(\bar{\pi} - \underline{\pi})$. Without that assumption the agent fears to lose a lot in case of failure and therefore always has an incentive to work hard. Consequently, the investor can implement a first best solution which is not an interesting case to study.

Assumption 1. *The investor cannot punish the agent arbitrarily hard in case of failure. More precisely, the assets of an agent do not allow to implement the first best solution. Formally, it is assumed that* $l^k < \frac{\pi\psi}{\Delta\pi}$*, where* $k = \{V, O\}$.

Production of the components requires not only an agent but also primary inputs. These primary inputs cause production costs c which may consist of variable and fixed parts. We do not need to distinguish these costs further because firm size is fixed. These costs are paid by the investor in case of integration and are paid by the supplier in case of outsourcing.

Technology We introduce an additional parameter ρ which captures differences in R&D intensity. This parameter is exogenous in the model and captures the idea that external suppliers are less likely to meet the product specifications in case of high technology goods. Kogut and Zander (1993) provide empirical evidence which shows that technology transfers are more likely to take place internally if technology is hard to codify or difficult to teach. An interesting case study is provided by Lim and Fong (1982). They investigate the investment behaviour of three big electronics companies in Singapore. They describe that two of the companies provide extensive training and support to indigenous suppliers, e.g. by providing detailed technical specifications and occasional expert help. The third company relies on suppliers from the more developed home country because

of their "superior technology, quality and reliability".[13] Apart from case studies R&D intensity has a positive and significant impact on integration in many studies that rely on statistical regressions.[14]

We therefore assume that technology changes the probability of success to $\rho\pi(e)$. As we are interested in differences between integration and outsourcing we use integration as our base case and set $\rho = 1$ if technology is kept in-house. In case of outsourcing, R&D intensity is assumed to decrease the probability of success, i.e. $\rho \leq 1$. The parameter can thus be interpreted as difficulties in transferring technology to an external supplier. More generally, it reflects the inverse of R&D intensity.

At first glance, it may be disturbing that advanced technologies reduce the probability of success. Note, however, that the parameter allows us to compare internal versus external technology transfers. It does not state that firm performance is generally reduced if advanced technologies are used.

Outsourcing Next, we turn to the investor's maximization problem in case of outsourcing. She maximizes her profits by offering an optimal incentive scheme to the supplier. The incentive scheme, or contract, specifies two payments. If the supplier succeeds in producing functioning components he receives a monetary payment of size $\bar{w}$. If the supplier does not succeed he receives a monetary payment of size $\underline{w}$. It may be that the payment is negative and thus reflects a payment from the supplier to the investor.

In principal, the investor may find it optimal to offer an incentive scheme which induces the supplier to exert effort on only a fraction of the tasks. In the model, however, this case is not relevant. The reason is that all tasks are symmetric. The agent trades the effort costs ψ against the higher probability to earn $\bar{w}$. If the benefits outweigh the costs for a single task i the same applies to all other tasks.[15]

[13] Antràs (2005) cites another case study, taken from Moran (2001), which further illustrates the idea. In 1998, Eastman Kodak set up joint ventures with different Chinese partners. These joint ventures specialized in producing conventional films under the Kodak name. When Kodak was allowed to establish a fully owned plant, the latest digitalized film and camera products were shifted to this affiliate. The example highlights that in reality the plant may choose technology and that ρ is at least partially an endogenous choice variable. Moreover, it fits the idea that firms prefer to keep the production of R&D intensive goods in-house.

[14] See, for example, Barbosa and Louri (2002), Antràs (2003), Desai et al. (2004), and Marin (2006).

[15] The situation would be different if marginal costs were not constant or if the tasks complemented one another.

We can thus concentrate on the case in which the investor offers a contract to the supplier which induces him to exert high effort on all tasks $i \in (0,1)$. The investor determines the optimal contract by maximizing her expected profits. Profits equal the revenues R minus the payment $\bar{w}$ in case of success, and zero revenues minus the payment $\underline{w}$ in case of failure. The following program formalizes the investor's maximization problem.[16]

$$\begin{aligned}
&\max_{\underline{w},\bar{w}} \rho\bar{\pi}(R-\bar{w}) + (1-\rho\bar{\pi})(0-\underline{w}) \\
&\quad s.t. \quad \rho\bar{\pi}\bar{w} + (1-\rho\bar{\pi})\underline{w} - \psi - c \;\geq\; 0 && (3.1)\\
&\qquad\qquad \rho\bar{\pi}\bar{w} + (1-\rho\bar{\pi})\underline{w} - \psi \;\geq\; \rho\underline{\pi}\bar{w} + (1-\rho\underline{\pi})\underline{w} && (3.2)\\
&\qquad\qquad \underline{w}, \bar{w} \;\geq\; -(l^O - c) && (3.3)
\end{aligned}$$

The investor faces several constraints which describe the supplier's reaction to her offer. Equation (3.1) reflects the fact that the supplier only agrees to the contract if he expects a (weakly) higher payoff from participating than from his outside option which is normalized to zero. Equation (3.2) states that the supplier only exerts high effort if he expects a (weakly) higher payoff thereof than from exerting low effort. The wealth constraint, formalized in Equation (3.3), states that the supplier cannot be asked to pay more than he owns minus the costs he pays for primary inputs.

The solution to the above maximization problem yields the optimal contract $(\underline{w}^*, \bar{w}^*)$. The supplier loses all his wealth net of production costs $\underline{w}^* = -l^O + c$ in case of failure and earns $\bar{w}^* = -l^O + c + \frac{\psi}{\rho\Delta\pi}$ in case of success.[17] Consequently, the investor's expected profits from outsourcing equal Π^O.

$$\Pi^O = \bar{\pi}(\rho R - \frac{\psi}{\Delta\pi}) + l^O - c \tag{3.4}$$

The investor's expected profits from outsourcing decrease in production costs c. This result is different from Grossman and Helpman (2004). In their model, the supplier is assumed to own assets l equivalent to production costs c. In that case both parameters cancel out as can be seen from Equation (3.4). Hence, production costs do no longer influence the investor's profits.

[16] We only make use of superscripts where the distinction between supplier and manager may be unclear.

[17] The supplier earns a limited liability rent that values $-l + \frac{\pi}{\Delta\pi}\psi$.

For this reason, we think that it is more appropriate to distinguish production costs from the supplier's wealth. Otherwise, the model predicts that production costs are always borne by the supplier. This implies that cost-reducing considerations do not influence foreign outsourcing.

Integration In case of integration the investor sets-up a subsidiary, run by a manager, and pays for the primary inputs. Moral hazard problems also exist within firm boundaries. However, the investor can monitor a fraction of the tasks which reduces the scope of moral hazard considerations. We denote the fraction of the tasks that can be monitored by $I_m = \{i|i \in (0, \delta]\}$. These tasks can be observed and verified and are therefore not subject to moral hazard. Nevertheless, the remainder of the tasks $I_n = \{i|i \in (\delta, 1)\}$ is not observable just as in the case of outsourcing.

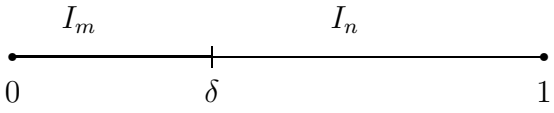


Figure 3.1: Monitoring of a manager

Suppose that the investor offers a contract that specifies high effort on the monitorable tasks I_m only. How does the optimal contract $(\underline{w}, \bar{w})$ look like? In fact, the investor only needs to ensure the manager's participation. For this reason the offer must be as good as his outside option, which is normalized to zero. We find that any combination of $\underline{w}$ and $\bar{w}$ that leads to an expected income $E(w) = \delta\psi$ is equally well suited, because incentive considerations do not play a role here. Without loss of generality we restrict our attention in the following to a flat wage scheme that pays $\delta\psi$ to the manager in any case and does not include a bonus payment.

The investor's expected profits in case effort is only exerted on the monitorable tasks I_m are given in Equation (3.5).

$$\Pi^{V}_{|(e_m=1,e_n=0)} = (\delta\bar{\pi} + (1-\delta)\underline{\pi})R - \delta\psi - c \tag{3.5}$$

Expected profits depend on the expected revenues $(\delta\bar{\pi}+(1-\delta)\underline{\pi})R$, the manager's wage $\delta\psi$, and production costs c. Note that, in the relevant parameter space, the

investor's profits increase in the scope of the monitoring technology δ.[18]

Now, suppose that the investor offers an incentive scheme that induces the manager to exert high effort on all tasks $i \in (0,1)$. The crucial difference to outsourcing is that managers have less private wealth than suppliers, i.e. $l^V < l^O$. In particular, we assume that the manager has no private wealth at all, i.e. $l^V = 0$. Furthermore, the investor can observe a fraction of the tasks δ, hence, also the incentive constraint changes slightly.

The optimal wage contract is determined by the following maximization problem.[19]

$$\begin{aligned}
&\max_{\underline{w},\bar{w}} \bar{\pi}(R-\bar{w}) + \underline{\pi}(0-\underline{w}) - c \\
&s.t. \qquad \bar{\pi}\bar{w} + (1-\bar{\pi})\underline{w} - \psi \;\geq\; 0 && (3.6)\\
&\qquad\quad \bar{\pi}\bar{w} + (1-\bar{\pi})\underline{w} - \psi \;\geq\; (\delta\bar{\pi} + (1-\delta)\underline{\pi})\bar{w} && (3.7)\\
&\qquad\qquad\qquad\qquad +(\delta(1-\bar{\pi}) + (1-\delta)(1-\underline{\pi}))\underline{w} - \delta\psi \\
&\qquad\qquad\quad \underline{w}, \bar{w} \;\geq\; 0 \quad (= l^V) && (3.8)
\end{aligned}$$

The solution to the above maximization problem turns out to be identical to the case of outsourcing except that the manager's wealth is lower. The investor pays no wage to the manager if no working components are produced, i.e. $\underline{w}^* = l^V = 0$. If the project is successful the manager receives a bonus payment which amounts $\bar{w}^* = \frac{\psi}{\Delta\pi}$. Equation (3.9) states the investor's expected profits in case she offers a wage scheme to a manager that induces high effort on all tasks.

$$\Pi^V_{|(e=1)} = \bar{\pi}(R - \frac{\psi}{\Delta\pi}) - c\ . \tag{3.9}$$

At first, it might be surprising that profits do not depend on the monitoring technology. The reason is, as discussed in the case of outsourcing, that all tasks are symmetric and marginal effort costs are constant. It follows that a manager who has an incentive to exert effort on one of the non-monitorable tasks I_n also has an incentive to exert effort on all other tasks. As long as one of the tasks is

[18] For low values of R the investor can increase expected profits by fixing effort on a fraction of the monitorable tasks I_m only. In that case expected profits decrease in δ. These cases are, however, dominated by the trivial solution of no effort at all.

[19] The probability that the project succeeds is given by $\int_0^1 \bar{\pi} di$. If the manager shirks the probability becomes $\int_0^\delta \bar{\pi} dj + \int_\delta^1 \underline{\pi} di$ which is equal to $\delta\bar{\pi} + (1-\delta)\underline{\pi}$.

not observable the respective bonus payment is high enough to fulfill this incentive condition for all tasks I. For this reason the scope of monitoring δ does not play a role here. We summarize the derived profit functions in Table 3.1.

Table 3.1: Investor's profits

		Success probability	Fixed components
Integration (I_m)	$\Pi^V_{\|(e_m=1,e_n=0)} =$	$(\delta\bar{\pi} + (1-\delta)\underline{\pi})$	$R \; -\delta\psi - c$
Outsourcing	$\Pi^O =$	$\rho\bar{\pi}$	$R \; -\frac{\bar{\pi}\psi}{\Delta\pi} + l^O - c$
Integration ($I_m \cup I_n$)	$\Pi^V_{\|(e=1)} =$	$\bar{\pi}$	$R \; -\frac{\bar{\pi}\psi}{\Delta\pi} - c$

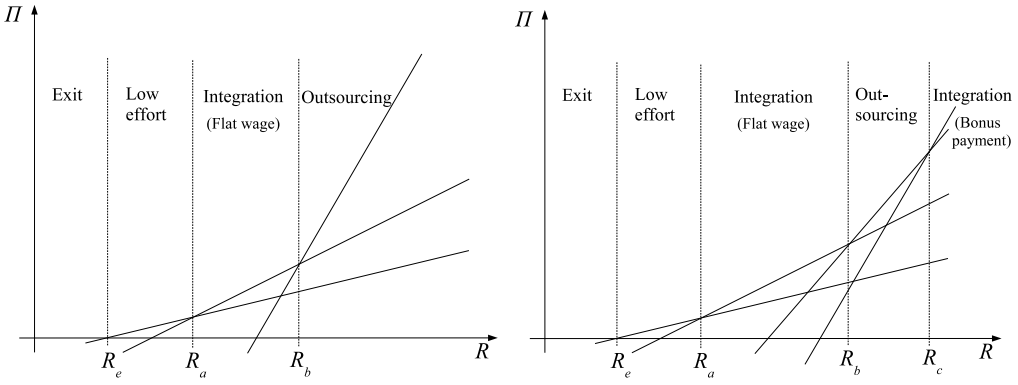
The table highlights the way in which success probabilities and fixed components, which comprise wages and production costs, influence expected profits. This distinction will become convenient when analysing the optimal investment strategy.

3.3.1 Organizational choice

In this section, we analyse the organizational choice between outsourcing and integration. We thereby focus on the impact of productivity, measured by the size of revenues R, on the investor's choice. We found in the previous section that integration can be further differentiated. On the one hand, the investor may offer a flat wage to a manager and agree with him that effort is exerted on the monitorable tasks I_m. On the other hand, the investor may offer a bonus payment which provides incentives to the manager to exert high effort on all tasks.

In order to determine the investor's choice we make a further assumption about the relative importance of monitoring, reflected by δ, and the difficulties of an R&D intensive firm to shift complex tasks to an external supplier, reflected by $\rho < 1$. Assumption 2 states that the probability to obtain working components is higher if a supplier exerts high effort on all tasks I than if a manager exerts high effort on the monitorable tasks I_m only.

Assumption 2. *The probability of success is higher if effort is exerted on all tasks rather than on monitorable tasks only. This assumption is expressed by* $\rho\bar{\pi} > \delta\bar{\pi} + (1-\delta)\underline{\pi}$.



(a) Low R&D intensity (b) High R&D intensity

Figure 3.2: Organizational Choices

Technically, we need Assumption 2 to make outsourcing a viable option.[20] Economically, we may argue that a considerable amount of managerial tasks cannot be observed or verified. We think, for example, about the manager's attitude towards employees, business partners, and government representatives. As long as δ is not too large Assumption 2 is likely to hold. Alternatively, we may argue that the skills of an entrepreneur to handle complex tasks are not too different from the skills of manager.

We are now ready to compare the three main choices, integration in combination with a flat wage, outsourcing, and integration in combination with a bonus payment. Figure 3.2 illustrates the investors' expected profit levels with respect to revenues R. On the left, Figure 3.2(a) draws expected profits for low technology firms ($\rho = 1$). On the right, Figure 3.2(b) draws expected profit levels for high technology firms ($\rho < 1$).

We find that firms exit the market if expected revenues do not cover the production costs. The minimum revenue level R_e can be found by setting expected revenues in case no effort is exerted by the agent equal to production costs. It follows that $R_e = \frac{c}{\underline{\pi}}$. Firms with lower expected revenues, i.e. lowest productivity firms, therefore exit the market.

The second observation we make is that inducing effort is not optimal for the

[20]The intuition is straightforward. Any investment option that leads to a lower probability of success, and also leads to higher fixed costs is not viable. If outsourcing makes it less likely to obtain functioning components than integration and additionally causes agency costs, resulting from the supplier's limited liability rent, the investor prefers integration and pays a flat wage. The formal proof is provided in the Appendix.

investor if revenues do not exceed a second threshold $R_a = \frac{\psi}{\Delta\pi}$. The reason here is that the increase in the success probability, which is reflected by $\Delta\pi$, does not outweigh the costs ψ, which arise from compensating a manager for his effort.

In the following we focus on cases in which effort is valuable, i.e. we focus on revenue levels that exceed R_a. We think that these cases are more relevant and also more interesting to study.

Investors whose revenues in case of success are just above R_a hire a manager and offer a flat wage. Consequently, the manager only exerts effort on the monitorable tasks I_m and the probability of success is rather low. The wage compensates the manager for his effort and forgone opportunities. The manager does thus not earn a limited liability rent and, in that sense, a first best solution is achieved.

Only as revenues increase further the investor switches from integration to outsourcing. The threshold level at which the investor is indifferent between hiring a manager and contracting with an entrepreneur is denoted by R_b.

$$R_b = \frac{-l + \frac{\bar{\pi}\psi}{\Delta\pi} - \delta\psi}{\rho\bar{\pi} - (\delta\bar{\pi} + (1-\delta)\underline{\pi})} \tag{3.10}$$

The threshold value R_b highlights a trade-off between the success probability and the compensation of agents. On the one hand, the investor benefits from a higher success rate $\rho\bar{\pi}$ which results from the supplier's exerting high effort on all tasks I. This effect is incorporated in the denominator. On the other hand, the investor suffers from the higher net compensation of the supplier which she expects to equal $-l + \frac{\bar{\pi}\psi}{\Delta\pi}$.[21] This effect is incorporated in the nominator.

Suppose for a moment that R&D intensity is low and that tasks can be easily shifted to an external supplier, i.e. suppose that $\rho = 1$. In that case all firms whose revenues exceed R_b choose outsourcing. This choice is optimal because only a manager who receives a bonus payment, which encourages him to exert high effort on all tasks, is equally likely to produce working components. However, the investor then faces additional costs, equal to $l^O - l^V$. It follows that integration in combination with high-powered incentives is never optimal for low technology firms. Intuitively, the manager has lower stakes in the project and therefore it is harder to incentivize him.[22]

[21] The expected payment to the supplier equals $-l + \frac{\bar{\pi}\psi}{\Delta\pi} + c$. As production costs are borne by the investor in both cases they do not influence this trade-off.

[22] This effect is also highlighted by Grossman and Helpman (2004).

Now suppose that R&D intensity is high and outsourcing becomes more difficult, i.e. $\rho < 1$. In this case, the investor may want to provide high-powered incentives to an internal manager. Projects are more likely to be successful because technology is transferred internally ($\bar{\pi} > \rho\bar{\pi}$). The higher probability of success is traded against the higher compensation due to the difference in private wealth. The threshold value above which integration dominates outsourcing is then given by R_c.

$$R_c = \frac{l^O}{\bar{\pi} - \rho\bar{\pi}} \tag{3.11}$$

Proposition 4 summarizes how the interplay of technology and productivity influences the organizational choice of the investor and is provided without further proofs.

Proposition 4 (Organizational choice). *If R&D intensity is low, i.e. if $\rho = 1$, there exists a threshold value R_b above which all firms outsource. If R&D intensity is high, i.e. if $\rho < 1$, there exists a threshold value R_c above which all firms integrate their production.*

The investor has two conflicting goals. On the one hand, she wants to achieve a high probability of success. On the other hand, she wants to keep agency costs low. The benefits of high success probabilities increase as revenues increase. Agency costs, by contrast, do not depend on the revenue level. The resulting trade-off is therefore characterised by variable and fixed components.

A trade-off between variable and fixed costs is familiar from the trade related literature on firm heterogeneity. Helpman et al. (2004) show that high productivity firms are willing to pay a high fixed cost of foreign direct investment in order to save on variable transport costs. A similar logic applies in our model, yet for very different reasons.

If revenues are low, i.e. if productivity is low, the investor chooses integration and pays a flat wage. Thereby she accepts a low probability of success. At the same time the agent does not earn a limited liability rent. More general, the investor saves on (fixed) agency costs but bears the (variable) loss of foregone expected revenues.

If revenues are high, i.e. if firm productivity is high, the investor chooses the investment mode that leads to the highest success rate $\bar{\pi}$. In case of high technology goods this goal is achieved by providing high-powered incentives to an

integrated manager. In case of low technology goods an external supplier is equally able to produce functioning components. Moreover, agency costs are lower in the case of outsourcing due to the lower limited liability rent. Consequently, high technology firms choose integration and low technology firms choose outsourcing if firm productivity is very high.

By distinguishing high and low technology firms the model leads to a result that is in line with the observed behaviour of firms to integrate their production if they are intensive in research and development.[23] Moreover, the model predicts that these differences should be more pronounced for high productivity firms. Whether such a behaviour can be observed in reality is open to empirical investigation.

3.3.2 Production strategy

In this section, we extend the analysis to a second dimension which is the choice between domestic and foreign production. The investor still decides about the organizational choice, additionally she decides about the location of production. Production can be located in *Home* or in *Foreign*. In the following, we use superscript H when we refer to the domestic country, and F when we refer to the foreign country. The investor thus chooses among four investment strategies which are summarized in Table 3.2.

Table 3.2: International Production

	Home	**Foreign**
Integration	In-house production	Offshoring
Outsourcing	Domestic outsourcing	Foreign outsourcing

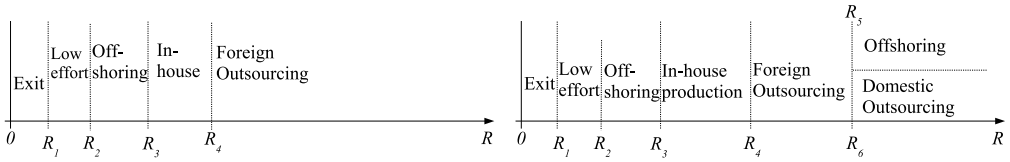
This work is motivated by the observation that there is a growing fragmentation of production, in which multinational firms take a prominent role (Helpman, 2006). The main motive to shift production, or, more generally, parts of the value chain, abroad are lower foreign production costs. Trade theory proposes differ-

[23] See, for example, Barbosa and Louri (2002), Antràs (2003), Desai et al. (2004), Marin (2006), and Gattai and Molteni (2007).

ences in the factor endowment as a rationale to split up the production process between countries (Helpman, 1984). We capture this motive by the assumption that production costs are lower abroad: $c_F < c_H$. Foreign production also reduces the monitoring abilities of the investor due to the larger distance between the subsidiary and the investor, i.e. the headquarters.[24] The reduced scope of monitoring is captured by $\delta_H > \delta_F$. So far, we rely on the assumptions made by Grossman and Helpman (2004).

Additionally, we assume that transferring technology to foreign suppliers, which are located in the low cost country, reduces the probability that the investor obtains working components that meet the product specifications, i.e. $\rho_F < \rho_H$. We think of this assumption as capturing the idea that foreign suppliers are less skilled than domestic suppliers. This aggravates the problem of outsourcing in R&D intensive industries. In the following we focus on these country differences and therefore set $\rho_H = 1$. Other variables do not vary between *Home* and *Foreign*.[25]

What is the optimal investment strategy of a multinational firm in this world consisting of a high cost and a low cost country? When answering this question we focus again on productivity, reflected by R, as the main variable of interest. The result is illustrated in Figure 3.3.[26]



(a) Low-tech firms (b) High-tech firms

Figure 3.3: International production

The first steps of the analysis are very similar to the analysis in the one-country setting. Firms with very low revenue levels below $R_1 = \frac{c_F}{\underline{\pi}}$ exit the market as they

[24]Lin and Png (2003) provide empirical evidence that supports the assumption. They show that less integrated modes of production become more likely within China if production is located in remote regions that are far from Hong Kong.

[25]It is straightforward to extend the idea to skill differences between countries and introduce a parameter that captures the idea that shifting production to a foreign subsidiary, i.e. offshoring, also reduces the probability of success if R&D intensity is high. However, we refrain from introducing an additional parameter to achieve a clearer exposition of the model.

[26]The investment pattern as illustrated in Figure 3.3 can be observed for some parameter constellations. However, it is not necessarily true that all investment choices are viable. Importantly, the sequence of choices cannot be reverted based on the assumptions we made.

expect losses. Exerting effort is only valuable if revenues exceed $R_2 = R_a = \frac{\psi}{\Delta\pi}$. These cases are just mentioned for the sake of completeness.

More interestingly, if inducing effort is valuable for the investor she offers a flat wage to the manager of a foreign subsidiary and thus chooses offshoring. Production is located abroad because the investor thereby benefits from the cost difference $\Delta c = c_H - c_F$. This choice results in a relatively low probability of success equal to $\delta_F\bar{\pi} + (1 - \delta_F)\underline{\pi}$, though.

As revenues increase further, i.e. as firms are more productive, the investor moves from offshoring to in-house production. The switching point is determined by R_3.

$$R_3 = \frac{\Delta c + \Delta\delta\psi}{\Delta\delta\Delta\pi} \tag{3.12}$$

The threshold level R_3 crucially depends on the foreign cost advantage Δc and on the monitoring advantage in Home $\Delta\delta = \delta_H - \delta_F$. In-house production causes higher production costs c_H, yet the investor has a higher chance to obtain working components because $\delta_H > \delta_F$. Hence, the advantage of the home country results from better monitoring abilities.

As the investor's revenues increase further, i.e. as productivity increases, she chooses outsourcing instead of in-house production because she wants to further increase the probability of success to $\rho_F\bar{\pi}$. We find that the investor is indifferent between in-house production and foreign outsourcing if her revenues equal R_4.

$$R_4 = \frac{-\delta_H\psi - \Delta c - l^O + \frac{\bar{\pi}\psi}{\Delta\pi}}{\rho_F\bar{\pi} - (\delta_H\bar{\pi} + (1 - \delta_H)\underline{\pi})} \tag{3.13}$$

What is different as compared to the one-country setting? Production costs, c_H and c_F, add to the fixed components which formerly only comprised the expected net compensation paid to the agents. Furthermore, success depends on the skills of a foreign supplier, reflected by a high ρ_F, as well as on the monitoring abilities in the home country δ_H.

As we move along the x-axis in Figure 3.3 we see that all firms with revenues larger than R_4, i.e. highest productivity firms, choose foreign outsourcing if R&D intensity is low. This choice is optimal because all other investment strategies that lead to an equally high success rate $\bar{\pi}$ cause higher costs. In case of domestic production, the investor bears higher production costs Δc. In case of offshoring, the investor bears higher agency costs l^O. That result relates to the finding in

Grossman and Helpman (2004).

Now, suppose that R&D intensity is high, i.e. suppose that $\rho_F < 1$. This means that transferring technology to a supplier in the low cost country reduces the probability to obtain working components to $\rho_F \bar{\pi}$. Therefore it is no longer optimal to choose foreign outsourcing if revenues are very large. The investor rather chooses offshoring or domestic outsourcing in these cases. If she chooses domestic instead of foreign outsourcing she faces higher production costs Δc. If she chooses offshoring instead of foreign outsourcing she faces higher agency costs l^O.

It follows that the investment strategy of the firm now depends on the relative size of Δc and l^O. In the following, we therefore distinguish two cases. In the first case, the foreign cost advantage is larger than the incentive effect, i.e. $\Delta c > l^O$. In the second case, the assets of a supplier are larger than the foreign production cost advantage, i.e. $\Delta c < l^O$.

Foreign cost advantage dominates The investor never chooses domestic outsourcing if the foreign cost advantage Δc values more than the assets a supplier brings into the relationship l^O. It follows that investors who expect to earn revenues that exceed R_5 in case of success choose offshoring. They provide high-powered incentives to an internal manager. This means effectively that investors pay a bonus to the manager which induces him to exert high effort on all tasks I. Note that we are still analysing the behaviour of R&D intensive firms.

$$R_5 = \frac{l^O}{\bar{\pi}(1 - \rho_F)} \tag{3.14}$$

Investors thus pay a relatively large limited liability rent to the manager due to the fact that he does not lose any private wealth in case of failure. Yet, the benefits from foreign production still outweigh the costs.

Incentive effect dominates The investor never chooses offshoring if the incentive effect, captured by l^O, is larger than the cost savings resulting from foreign production Δc. The reason is that we assume domestic suppliers to be equally able to produce working goods, i.e. $\rho_H = 1$.[27] Hence, domestic suppliers

[27]The effects of skill differences between suppliers and managers should be clear from the previous discussion.

succeed with probability $\bar{\pi}$ and it is relatively cheap to provide incentives because they have high stakes in the project. It follows that firms switch from foreign outsourcing to domestic outsourcing if revenues exceed R_6.

$$R_6 = \frac{\Delta c}{\bar{\pi}(1-\rho_F)} \tag{3.15}$$

The switching point R_6 crucially depends on the foreign cost advantage and on the skill difference between domestic and foreign suppliers. These findings are summarized in Proposition 5, which is given without further proofs.

Proposition 5. *If R&D intensity is low, i.e. if $\rho_F = \rho_H = 1$, there exists a threshold value R_4 above which all firms choose foreign outsourcing. If R&D intensity is high, i.e. if $\rho_F < \rho_H = 1$,*

(i) there exists a threshold value R_5 above which all firms choose offshoring if the cost effect dominates the wealth effect ($\Delta c > l^O$).

(ii) there exists a threshold value R_6 above which all firms choose domestic outsourcing if the wealth effect dominates the cost effect ($l^O > \Delta c$).

The most important insight from the one-country setting is that high productivity firms choose outsourcing if R&D intensity is low, and integration if R&D intensity is high.

What is different in the two-country setting? Most strikingly, Proposition 5 implies that the home country may attract production of high technology components if (i) domestic suppliers are highly skilled, and if (ii) domestic suppliers credibly commit to bring in a large amount of assets l^O.

Both conditions reflect firm characteristics such as the ability to transfer managerial tasks to a supplier who in turn needs the know-how to produce R&D intensive components. At the same time they also reflect country characteristics.

More specifically, we think that the educational as well as the legal system influence both parameters. The educational system is most likely to influence the chance to find a supplier who is able to produce R&D intensive components and may thus increase the value of ρ. The legal system is most likely to influence the enforcement of contracts. Outsourcing contracts, however, rely on the legal system because the fear of a supplier to lose his assets l^O in case of failure makes

it easier to incentivize him. Hence, the model provides a rationale for the impact of institutional quality on investment decisions.

In the analysis we abstract from skill differences between domestic suppliers and managers. However, it is straightforward to extend the analysis to skill differences between managers and suppliers in *Home* analogously to the arguments provided in Section 3.3.1. Hence, skill differences between countries also influence the offshoring decision of investors.

3.4 Comparative statics

In this section, we derive comparative static results based on the static model. These results elaborate the impact of a change in the foreign business environment on the investment decision. More precisely, they allow us to show how a change in the R&D intensity or skills of a foreign supplier ρ_F, in the improvement of the monitoring technology δ_F, and in the seizable assets of a foreign supplier l_F changes the relative prevalence of investment strategies. The results add to the understanding of the static model. They are, however, not essential for the dynamic setting which is introduced in Section 3.5.

Improvement of foreign skills We find that an increase in the supplier's skills to produce working components, i.e. an increase in ρ_F, increases the range of firms that choose outsourcing.

The following proposition states the effect of a skill improvement of foreign suppliers on the international production decision of the investor. Note that all other factors, including production costs, are treated as constant. Proofs are provided in the following text.

Proposition 6. *An increase in foreign supplier skills ρ_F increases the scope of foreign outsourcing. Firms substitute in-house production with foreign outsourcing. High technology firms additionally substitute*

(i) offshore production for foreign outsourcing if foreign cost advantages dominate.

(ii) domestic outsourcing for foreign outsourcing if incentive considerations dominate.

On the one hand, more firms choose foreign outsourcing in stead of in-house production. This effect results from a downward shift in R_4 as the skills of a foreign entrepreneur ρ_F improve. The negative sign is derived in the Appendix.

$$\frac{\partial R_4}{\partial \rho_F} = -\frac{\bar{\pi}(-l - \Delta c - \delta_H \psi + \frac{\bar{\pi}\psi}{\Delta\pi})}{(\rho_F \bar{\pi} - \delta_H \bar{\pi} - (1-\delta_H)\underline{\pi})^2} < 0$$

On the other hand, more firms choose foreign outsourcing instead of domestic outsourcing or instead of offshoring. It depends on the relative magnitude of the foreign cost advantage Δc and the private wealth l^O whether offshoring is replaced or whether domestic outsourcing is replaced. In both cases, the respective threshold level, R_5 and R_6, shift up.

$$\begin{aligned} \frac{\partial R_5}{\partial \rho_F} &= \frac{l}{\bar{\pi}(1-\rho_F)^2} > 0 \quad , \Delta c > l \\ \frac{\partial R_6}{\partial \rho_F} &= \frac{\Delta c}{\bar{\pi}(1-\rho_F)^2} > 0 \quad , l > \Delta c \end{aligned}$$

Improvement of foreign monitoring The ability to monitor a higher fraction of the tasks δ_F affects the threshold level R_3 at which the investor is indifferent between in-house production and offshoring. As one might expect more firms choose offshoring which can be seen from $\frac{\partial R_3}{\partial \delta_F} = \frac{\Delta c}{(\Delta\delta)^2 \Delta\pi} > 0$.

A decrease in the domestic monitoring advantage $\Delta\delta$ leads to more offshoring. The model predicts that firms with high revenue levels are not affected by better monitoring technologies. The reason is that firms with high revenues pay a bonus which induces the agent to exert effort on all tasks I. As discussed in the previous sections, these profits are not affected by δ.

Improvement of foreign institutions Missing legal enforcement may lead to a situation in which the investor cannot be sure to seize the assets of a supplier in case of failure. Translated into the modelling framework such a situation can be captured by shifting the value of the assets l.

The model predicts that an increase in the institutional quality increases the scope of foreign outsourcing if it translates into a credible threat to seize the entrepreneur's assets in case of failure.

The reason is that the threshold level R_4 shifts down and the threshold level R_5 shifts up as l increases. Both effects become evident by inspecting the threshold levels. More firms choose foreign outsourcing instead of in-house production because R_4 decreases in l. At the same time more firms choose outsourcing instead of offshoring because R_5 increases in l.

3.5 The dynamic model

In this section, we extend the model to dynamic considerations. We further introduce initial uncertainty about the investors' monitoring capabilities which is resolved over time. In that way the model captures the idea of learning about the production environment and allows us to answer our main research question. What is the impact of experience on the vertical production strategy of a multinational firm?

We assume that investors operate in two periods. When deciding about the production strategy in the first period investors face uncertainty about the true value of δ. However, they do know the distribution which generates δ. More precisely, investors know that monitoring is possible for a wide range of the managerial tasks, denoted by $\bar{\delta}$, with probability p. They also know that monitoring is possible for a small range of managerial tasks, denoted by $\underline{\delta}$, with probability $(1-p)$.

After the investor made her decision, the true value of δ is realized, and production takes place. If the investor is successful in obtaining working components she sells the final goods on the market and earns revenues of value R. If the investor is not successful in obtaining working components she does not earn any revenues and leaves the market.

The surviving firms reconsider their production strategy in both dimensions.

This means that investors can change the organizational as well as the locational decision. Finally, production takes place according to the decisions made in period two. Figure 3.4 illustrates the sequence of events.

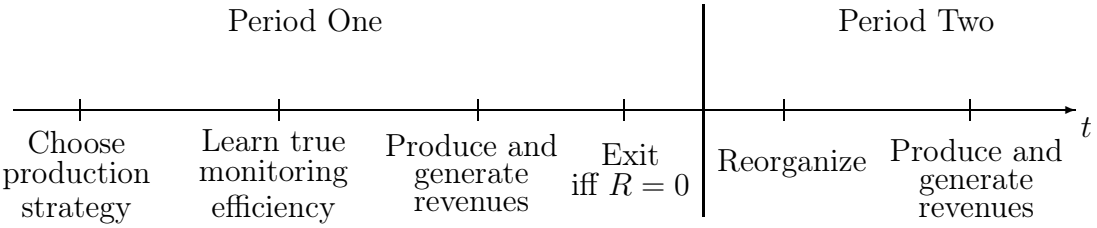


Figure 3.4: Time Structure

In the following, we derive the optimal choice of the investor with respect to our main variable of interest, which is revenues R. We follow the same structure as for the static model. This means that we first analyse the choice between integration and outsourcing in Section 3.5.1. Section 3.5.2 extends the analysis to the full set of choices, which are in-house production, offshoring, domestic outsourcing and foreign outsourcing.

3.5.1 Organizational Choice

The static model revealed that productivity and technology are key determinants that shape the investor's organizational choice. The two-period model will show that the characteristics of the learning process mainly influence the dynamic pattern of organizational choices.

We start the analysis in the second period. As investors know their monitoring abilities and face no uncertainty about δ all decisions are identical to the static setting. Hence, the threshold levels R_e to R_c remain unchanged.

In the first period, however, investors face uncertainty about the scope of their monitoring technology. Nevertheless, they have complete information about the probability p that a large fraction $\bar{\delta}$ of the tasks can be monitored. They also know that otherwise only a small fraction of tasks $\underline{\delta} < \bar{\delta}$ can be monitored. Therefore they form expectations about the monitoring technology and expect $E(\delta) = p\bar{\delta} + (1-p)\underline{\delta}$. Investors are also aware of the fact that they exit the market if they fail to obtain working components in the first period.

Firms with revenue levels below $R_e = \frac{c}{\underline{\pi}}$ expect negative revenues and exit the market. This value can be found by setting expected profits in case low effort is exerted equal to zero. The investor expects to earn $\underline{\pi}R - c$ in period one, with probability $\underline{\pi}$ she enters the second period, only then she has the chance to earn R with probability $\underline{\pi}$.[28] She hence solves $\underline{\pi}R - c + \underline{\pi}(\underline{\pi}R - c) = 0$ to determine the minimum revenue level R_e.

Next, we determine the threshold level above which it is valuable for the investor to agree with a manager to exert effort on the monitorable tasks I_m. We therefore solve for the revenue level R_α, where Greek letters refer to the first period, at which the investor expects equal profits from integration in combination with a flat wage and low effort on all tasks I.

Investor who earn R_α are thus indifferent between compensating the manager for his effort on the monitorable tasks I_m and inducing low effort on all tasks I.[29] It turns out that these investors, characterized by R_α, are strictly better off if they do not induce managers to exert effort in the second period.

The critical revenue level R_α is implicitly defined by the following equation. We introduce $\hat{\pi}$ to denote the probability of success conditional on the mode of organization.

$$\Pi^V_{|(e=0)} + \hat{\pi}_{|(e=0)}\Pi^V_{|(e=0)} = \Pi^V_{|(e_m=1,e_n=0)} + \hat{\pi}_{|(e_m=1,e_n=0)}\Pi^V_{|(e=0)}$$

On the left hand side, the equation states investor's expected profits in case the agent is not compensated for his effort $\underline{w} = \bar{w} = 0$ and consequently does not exert any effort. On the right hand side, the equation states investor's expected profits in case a manager agrees to exert effort on the monitorable tasks in the first period and receives $\underline{w} = \bar{w} = \delta\psi$, but not in the second.

Equation (3.16) solves the above equality for the threshold level R_α.

$$R_\alpha = \frac{\psi}{\Delta\pi(1+\underline{\pi})} \quad \left(< \frac{\psi}{\Delta\pi} = R_a \right) \tag{3.16}$$

We find that the marginal investor, earning R_α, does not pay a positive wage in the second period because $R_\alpha < R_a$ holds. Intuitively, the investor increases the probability of success in early stages as future revenues can only be earned if the

[28] We abstract from a discount factor.

[29] In both cases the manager is hold down to his outside option.

project is successful. The probability of success increases if high effort is exerted on a fraction of tasks δ. Investors in the range (R_α, R_a) thus know that they induce the agent to exert less effort in the second period. This change in incentives is, however, not related to uncertainty about monitoring but to the timing of the model.

We interpret this timing effect as being linked to the product life cycle. Production stops in the second period, which may happen because the product is replaced by a new one. While the stop is abrupt in the model it may reflect that trends change and that firms expect a decreasing demand for the product and therefore future revenues become less relevant. Yet, we do not want to (over-)stress this result. We rather focus on the main question which is to understand the effect of experience, i.e. of resolving uncertainty over time.

First, we need to derive the remaining threshold levels corresponding to R_b and R_c. The revenue level R_β at which the investor is indifferent between integration paying a flat wage and outsourcing is determined by the following equality.

$$\Pi^V_{|(e_m=1,e_n=0)} + \hat{\pi}_{|(e_m=1,e_n=0)}\Pi^V_{|(e_m=1,e_n=0)} = \Pi^O + \hat{\pi}_{|(e=1,\rho<1)}\Pi^V_{|(e_m=1,e_n=0)}$$

We know from the previous discussion that the marginal investor reduces incentives in the second period and switches to integration. Hence, nothing new can be learned and with some calculus we derive.

$$R_\beta = \frac{\phi\psi E(\delta) + l - \frac{\bar{\pi}\psi}{\Delta\psi}}{\phi E(\delta)\Delta\pi - \rho\bar{\pi} + \phi\underline{\pi}} \quad , \tag{3.17}$$

where $\phi_\beta = 1 - \rho\bar{\pi} + E(\delta)\bar{\pi} + (1 - E(\delta))\underline{\pi}$. Analogously, the investor is indifferent between outsourcing and integration offering a bonus payment which provides incentives to a manager to exert high effort on all tasks I if revenues equal

$$R_\gamma = \frac{l + \frac{\bar{\pi}}{\Delta\pi}(1 - \phi_\gamma)}{\bar{\pi}(1 - \phi_\gamma\rho)} \quad , \tag{3.18}$$

where $\phi_\gamma = 1 + \rho\bar{\pi} - \bar{\pi}$.

The threshold values in the first period incorporate the same trade-offs we discussed in Section 3.3.1. Yet, one new effect can be observed. Investors provide high-powered incentives in the first period because they consider future revenues which only accrue if the project succeeds. They are therefore willing to bear higher

agency costs in the first than in the second period. The parameters ϕ_β and ϕ_γ capture this effect in Equation (3.17) and Equation (3.18). It is easy to see that both threshold values equal their counterparts in the static setting if we set $\phi = 1$ and $E(\delta) = \delta$.

Thus, we find that two considerations drive the decision in period one. First, the decision depends on the expectations about monitoring abilities. An increase in the expected monitoring ability $E(\delta)$ works similar to an increase in δ. Second, the decision depends on expected future revenues that only accrue if the project succeeds in the first period. For this reason firms tend to reduce incentives over time.

Changes in the Mode of Organization The preceding discussion revealed that some investors change their initial decision if they reach the second period. The reason is that less incentives are provided after firm survival is assured. These changes are, however, not linked to the fact that investors face uncertainty about their monitoring capabilities δ.

We now focus on the isolated effect that results from experience, i.e. from realizing the true value of δ, and abstract from firm survival.

As investors face uncertainty in the first period, some of them will find themselves in a situation in which the chosen strategy is not optimal. Consequently, they want to change their initial decision. However, they cannot do that before they reach the second period, i.e. learning takes some time.

There exist two situations in which investors may find themselves trapped in an inefficient production strategy. If their monitoring abilities are good firms may want to switch from outsourcing to integration. If their monitoring abilities are bad firms may want to switch from integration to outsourcing.

More precisely, firms in the range $R \in (R_b(\underline{\delta}), R_b(E(\delta)))$ switch to from integration to outsourcing if they realize that monitoring is more difficult than expected, i.e. that only a fraction $\underline{\delta}$ of the tasks can be monitored. Firms in the range $R \in (R_b(E(\delta)), R_b(\bar{\delta}))$ switch from outsourcing to integration if monitoring is better than expected, i.e. that a fraction $\bar{\delta}$ of the tasks can be monitored. Figure 3.5 illustrates these changes.

The model thus predicts that some firms switch from integration to outsourcing. Some other firms switch from outsourcing to integration. This prediction matches

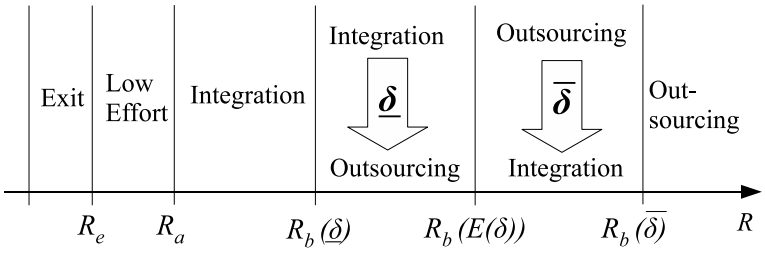


Figure 3.5: Organizational changes

the observation in Curhan et al. (1977). Moreover, these switches occur because firms gain experience. Barkema et al. (1996) provide empirical evidence for that mechanism. In particular, they show that joint ventures are more stable as firms gain experience.[30]

Are both changes equally likely in our model? To answer that question we assume that revenues R are distributed according to a density function $g(R)$. The fraction of firms that switch from outsourcing to integration over firms that switch from integration to outsourcing is then determined by the ratio s.

$$s = \frac{p \int_{R_b(E(\delta))}^{R_b(\bar{\delta})} g(R)dR}{(1-p) \int_{R_b(\underline{\delta})}^{R_b(E(\delta))} g(R)dR} \frac{\hat{\pi}_{|(e=1)}}{\hat{\pi}_{|(e_m=1,e_n=0,\underline{\delta})}} \tag{3.19}$$

The first part of the expression reflects the number of firms that choose outsourcing in the first period and switch to integration if $\bar{\delta}$ is realized over those firms that choose integration in the first period and switch to outsourcing if $\underline{\delta}$ is realized. The second part reflects the fact that only firms that are successful in obtaining working components stay in business.

Assuming a uniform distribution of those firms that potentially change their ownership mode allows further simplifying the above expression.[31] An equal dis-

[30]More precisely, the longevity of majority joint ventures is significantly increased by prior experiences in the same country and the same cultural block. Unfortunately, their study is limited to a small number of large Dutch firms.

[31]Grossman and Helpman (2004) assume a Pareto distribution over a productivity parameter that directly maps into R. We argue that in the relevant range a uniform distribution is a reasonable approximation. However, shifting mass to the left of the distribution also has an impact on the results.

tribution of revenues R on the range $[\underline{R}_b, \bar{R}_b]$ yields[32]

$$s = \underbrace{\frac{(\rho\bar{\pi} - \underline{\pi} - \underline{\delta}\Delta\pi)}{(\rho\bar{\pi} - \underline{\pi} - \bar{\delta}\Delta\pi)}}_{:=u} \underbrace{\frac{\hat{\pi}_{|(e=1,\rho)}}{\hat{\pi}_{|(e_m=1,e_n=0,\underline{\delta})}}}_{:=v} > 1 \ .$$

We find that the relative number of firms s that switch to integration in the second period is strictly greater than one. Hence, uncertainty about the monitoring technology leads to a situation in which more firms switch from outsourcing to integration in later stages than vice versa. This result is in line with a number of empirical studies that find that the overall effect of experience on the probability to choose integration is positive.[33].

The next question we ask is, what happens if uncertainty increases? We find that relatively more firms switch from outsourcing in the first period to integration in the second. This can be seen by investigating the ratio s which increases in $\Delta\delta$. Such a wider spread $\Delta\delta$ corresponds to an increase in the variance of the underlying distribution, which equals $\sigma^2 = p(1-p)\Delta\delta^2$. Hence, more firms choose outsourcing in the first period if uncertainty about monitoring increases.

The impact of a change in the R&D intensity on the relative prevalence of firms that initially choose outsourcing and then switch to integration is ambiguous.

$$\begin{aligned} \frac{\partial s}{\partial \rho} &= \underbrace{u'v}_{<0} + \underbrace{uv'}_{>0} \ , \\ \text{where } u' &= -\frac{\bar{\pi}\Delta\pi\Delta\delta}{(\rho\bar{\pi} - \bar{\delta}\bar{\pi} - (1-\bar{\delta})\underline{\pi})^2} < 0 \\ v' &= \frac{\bar{\pi}}{\underline{\delta}\bar{\pi} + (1-\underline{\delta})\underline{\pi}} > 0 \end{aligned}$$

The partial derivative reveals two opposing forces on the ratio s as transferring production to an external supplier becomes easier. On the one hand, fewer investors switch to integration in the second period because outsourcing becomes more profitable. On the other hand, more outsourcing projects succeed in the first period and therefore more firms survive which potentially switch to integration.

The above result is established for the isolated effect of experience. Rational

[32]The distribution function is given by $G(R) = \frac{R-\underline{R}_b}{\bar{R}_b - \underline{R}_b}$.

[33]See, for example, Gatignon and Anderson (1988), Meyer (2001), and Brouthers and Brouthers (2003).

investors also consider future revenues and therefore tend to provide high-powered incentives in the first period. We find that the above results are reinforced in case R&D intensity is low, i.e. if $\rho = 1$. The reason is that firms in the range (R_β, R_b) additionally switch from outsourcing to integration. Moreover, the mass of firms that potentially switch from integration to outsourcing is reduced to $\int_{R_b(\underline{\delta})}^{R_\beta} g(R)dR$. This finding is summarized in Proposition 7, which is provided without further proofs.

Proposition 7. *Suppose that R&D intensity is low, i.e.* $\rho = 1$. *In that case, more firms switch from outsourcing in the first period to integration in the second period than vice versa. The ratio increases as uncertainty measured by* $\Delta\delta$ *increases.*

However, if technology is relevant the result is more ambiguous. High technology firms may opt for integration in early stages. Whether they do so is jointly determined by firm productivity and R&D intensity. More precisely, firms in the range (R_γ, R_c) choose integration in the first period and switch to an external supplier in the second period. The results are thus weakened in case of R&D intensive firms.

Proposition 8. *Suppose that R&D intensity is high, i.e.* $\rho < 1$. *In that case, there exist a range* $R \in (R_\gamma, R_c)$ *in which investors choose integration in the first period and switch to outsourcing in the second.*

Propostion 8 states that the overall effect of experience on the probability to choose integration is lower in case of R&D intensive firms. Some high productivity firms consciously choose integration in early stages and switch to outsourcing as future revenues become less important. This effect is, however, not due to uncertainty but should be more closely related to the life cycle of a product. The isolated effect of uncertainty has no impact on high productivity firms because they provide high-powered incentives. Therefore they make no use of the possibility to monitor internal managers and rather pay a high bonus to ensure that the manager exerts high effort on all tasks.

3.5.2 Production strategy

Finally, we analyse the dynamic behaviour of firms when investors decide about the mode of organization and the location production. We thereby focus on gaining

experience in the foreign country.

Therefore we assume that investors face uncertainty about their monitoring capabilities abroad δ_F in the same way as we did in the one-country case. This means that investors learn about their monitoring capabilities only after their initial investment decision has been made. However, they know that with probability p a large fraction $\bar{\delta}_F$ of the managerial tasks can be observed and verified, and with probability $(1-p)$ only a small fraction $\underline{\delta}_F$ of the tasks can be observed and verified.

We draw on the same set of assumptions made in Section 3.3.2 which are shortly summarized in the following. Production costs are lower abroad $c_F < c_H$, technology transfers to the low cost country reduce the probability of success $\rho_F < \rho_H$, domestic suppliers are highly skilled $\rho_H = 1$, and monitoring is less complete abroad $\bar{\delta}_F < \delta_H$.

We start the analysis in the second period. Investors reaching that point know about their abilities to monitor a foreign manager δ_F and do not expect future revenues. Hence, their decisions are identical to the static case. It follows that the threshold levels R_1 to R_6 determine the optimal production strategy of an investor.

This means that investors earning revenues below R_1 exit the market. Effort is only valuable if revenues further exceed R_2. Offshoring is optimal up to R_3, however, high effort is only exerted on the monitorable tasks. In the range (R_3, R_4) in-house production is optimal. If revenues exceed R_4 investors choose outsourcing up to the revenue level R_5 if the cost effect dominates. If the wealth effect dominates investors choose domestic outsourcing to highly skilled suppliers for revenue levels above R_6.

In the following discussion we focus on the case in which the cost effect dominates, i.e. $c_F \geq l$ to avoid a taxonomy of cases. We further think that it is also empirically the more relevant case because most data sets containing information on foreign investments do not cover domestic outsourcing relationships.

In the first period investors face uncertainty about the monitoring in *Foreign*. They form expectations about the scope of monitoring equal to $E(\delta_F) = p\bar{\delta}_F + (1-p)\underline{\delta}_F$. Monitoring in *Home* is not subject to uncertainty.

The analysis shows that the sorting of firms according to productivity is identical to the static case analysed in Section 3.3.2. The threshold levels are shifted to the left because investors consider future revenues and therefore provide high-powered incentives in the first period. This effect should be familiar from the

discussion in Section 3.5.1 and nothing new can be added here. Table 3.3 provides the resulting threshold levels that are necessary to analyse the effects of experience. Roman numbers are used to refer to the first period.

Table 3.3: Investment decision - Threshold values

R_I	=	$\frac{c_F}{\underline{\pi}}$
R_{II}	=	$\frac{\bar{\psi}}{\Delta\pi(1+\underline{\pi})}$
R_{III}	=	$\frac{c_F+E(\delta_F)\psi+\frac{\Delta\delta\psi+\Delta c}{\Delta\delta\Delta\pi}}{E(\delta_F)\Delta\pi+\underline{\pi}+1}$
R_{IV}	=	$\frac{-\phi_4\delta_H\psi-\phi c_H+c_F-l+\frac{\bar{\pi}\psi}{\Delta\pi}}{\rho\bar{\pi}-\phi_4\delta_H\bar{\pi}-\phi_4(1-\delta_H)\underline{\pi}}$

Changes in International Production Changes in international production occur for the same reasons as changes in the mode of organization. As before, we first analyse the isolated effect of experience on the dynamic pattern of international production.

If we consider the full set of choices we find that investors adapt their initial decisions for the same reason, i.e. because they realize that their decision is no longer optimal after δ_F is realized. Yet, the effect is different.

Investors who expect revenue levels in the range $R \in (R_3(\underline{\delta}_F), R_3(E(\delta_F)))$ choose offshoring in the first period. With probability $(1-p)$ they realize that they can monitor less tasks than expected and relocate production back to the home country. Investors who expect revenue levels in the range $R \in (R_3, \bar{R}_3)$ choose in-house production in the first period. With probability p they realize that they can monitor more tasks than expected and choose offshoring.

The ratio of firms that switch from in-house production to offshoring over firms that switch from offshoring to in-house production depends on the distribution of the revenue levels. As before, we assume that firms that potentially adopt their production strategy are equally distributed on the interval $(\underline{R}_3, \bar{R}_3)$. The number of firms that shift their production abroad and choose offshoring over the number of firms that relocate their production back home and choose in-house production is then given by the ratio r in Equation (3.20).

$$r = \frac{\delta_H - \underline{\delta}_F}{\delta_H - \bar{\delta}_F} \underbrace{\frac{\hat{\pi}^V_{|e_m=1,e_n=0,\delta_H}}{\hat{\pi}^V_{|e_m=1,e_n=0,\underline{\delta}}}}_{>1} > 1 \tag{3.20}$$

The ratio r is strictly greater than one, revealing that relatively more firms shift their production abroad after learning the true value of δ_F than vice versa.

A forward looking investor does not only consider the impact of success on current earnings but additionally considers the effect of success on expected future earnings. For this reason, forward looking investors choose investment modes that lead to higher success rates. We find that the effect of experience on the ratio r is reinforced. Forward looking investors with revenue levels R in the range between $R_{III}(E(\delta_F))$ and $R_3(E(\delta_F))$ additionally choose in-house production in the first period and offshoring in the second and thus increase the ratio r.

Proposition 9. *The ratio of firms firms that switch from in-house production in the first period to offshoring in the second period over firms that switch from offshoring to in-house production, denoted by r, is strictly greater than* 1.

We should thus observe more firms shifting production to a foreign subsidiary as uncertainty about monitoring is reduced. Investors may also realize that they overestimated their abilities to monitor foreign production. The model predicts, however, that the latter case is less likely.

The underlying assumption is that firms learn about their monitoring abilities independent of their initial investment decision. Reasons may include that firms benefit from other firms' experiences. Blonigen et al. (2005) show empirically that firms benefit from informational effects within horizontal business groups. Shaver et al. (1997) provide evidence that firms operating abroad generate information spillovers that are valuable to firms that enter the same industry. Their evidence is based on 354 foreign investments in the U.S. in 1987.

The model reveals two strategies to deal with uncertainty. The first strategy is to choose outsourcing at early stages and switch to integration at later stages. The second strategy is to produce domestically in early stages and to establish a foreign subsidiary once uncertainty is reduced. Both effects should be especially pronounced for firms with intermediate productivity levels whose R&D intensity is low.

Additional to the effects related to monitoring uncertainty the model predicts

that firms adopt their strategy due to timing. Firm survival is especially important in early periods as the stream of future revenues can only be earned in case of success. This finding may be linked to the product cycle of a good. It might also be that firms entering a new market need to build up reputation and win a significant market share. If success becomes less relevant to guarantee future revenues firms adopt their production strategy. Some high technology firms then switch from integration to outsourcing. Their behaviour thus differs from the majority of low technology firms.

3.6 Conclusion

In this chapter, we analysed the vertical production strategies of MNEs. The dynamic setting allows us to identify changes in the pattern of firm behaviour which arise due to experience. Thereby, we add to the existing literature in two dimensions. First, the incentive-based approach to international production is extended by differences in the technology intensity of firms. Second, firms face uncertainty about the foreign production environment which allows us to study the dynamics of vertical foreign direct investments.

The model reveals a basic trade-off between fixed agency costs and a project's probability of success. The ranking of the investment modes according to their related agency costs determines the optimal production strategy with respect to productivity. Low agency costs arise if low-powered incentives are provided within firm boundaries. Intermediate agency costs arise if high-powered incentives are provided to an external supplier. High agency costs arise if high-powered incentives are provided to an internal manager. Interestingly, differences in the technology intensity of firms do not only shift the results obtained by Grossman and Helpman (2004) but they interact with firm productivity. Furthermore, we find that domestic outsourcing may dominate foreign production if incentive considerations are important.

Uncertainty about the production environment leads to a situation in which firms tend to choose in-house production or outsourcing in early stages and shift to foreign direct investment as they gain experience. This result fits the empirical observation that firms expand gradually. Still, the model predicts various shifts in ownership and location of production and relates these shifts to firm produc-

tivity. It may thus help to explain why some empirical studies fail to show an impact of experience on investment modes or identify U-shaped relationships if firm productivity is neglected.

Dynamic considerations strengthen the effect of uncertainty for low-technology firms. However, if firms are technology intensive they opt for immediate foreign direct investment if firm productivity is high, too. As they phase out production a fraction of these firms switches to outsourcing. Interestingly, this switch does not occur due to unfulfilled expectations but is related to the product life cycle.

Our model includes lump sum payments for suppliers. Feenstra and Hanson (2005) highlight that these payments are characteristic for joint ventures, less for market transactions. Yet, we elaborate a basic trade-off between monitoring abilities and limited liability. In that sense the model captures more generally differences in the depth of integration. Furthermore, external suppliers in *Foreign* may originate from a technological advanced country. Obviously, the model does not describe such a complex production network. Nevertheless, we are convinced that the modelling strategy reflects a considerable part of real world observations. Gatignon and Anderson (1988), for example, find that for U.S. multinationals 84% of the investigated joint ventures include one local partner.

Future empirical work may benefit from the easy to grasp intuition of the basic framework. The results link firm productivity and technology intensity to international production decisions and can be tested with existing data. They point to a so far neglected trade-off between the impact of incentive considerations and production cost differences that eventually relate to differences between industries. Last, the dynamic approach allows exploiting panel characteristics of the data. Future theoretical work may consider a correlation of the monitorable and non-monitorable tasks as in Holmström and Milgrom (1991) or introduce competition between multinational firms.

Chapter 4

Ownership choices of German MNEs

4.1 Introduction

In the two previous chapters we analysed some trade-offs an investor faces when deciding about the location of production and the organization of activities. In this chapter, we confront a couple of the theoretical predictions with the data.

We therefore investigate several factors that shape the organizational choice of a firm operating abroad. The main hypothesis to be tested relates to the concept of local knowledge as introduce in Chapter 2. We argue that local partners contribute tacit knowledge to a joint venture. The value of that knowledge is higher when the foreign investor is less familiar with the local business environment. We test that hypothesis by estimating the impact of international experience, legal protection, and cultural barriers on the probability to operate a subsidiary or a joint venture abroad. All three factors are assumed to reflect the value of a partner's tacit knowledge.

The data further allows us to shed light on differences between manufacturing and service industries. In addition, we analyse the decision of a multinational investor to invest abroad or else to trade with a foreign country.

The results show that internationally more experienced firms, i.e. firms that operate in many regions of the world, are more likely to organize their foreign investments in form of a subsidiary. The probability to set up a subsidiary further increases in R&D intensity and decreases in capital intensity, which is in line with other firm-level studies.[1] Furthermore, we find a negative relationship between

[1]Barbosa and Louri (2002) analyse the ownership choice of foreign investors in Portugal and

the probability to integrate foreign operations and cultural barriers. Bad legal protection, reflected by difficulties with the legal environment and corruption, also has a negative impact on the decision to operate a foreign subsidiary instead of entering a joint venture.

The data suggests that knowledge about the local business environment is more relevant in the service sector than in the manufacturing sector. Most visibly, cooperation and joint venture are more common in service industries. Furthermore, service firms consider cultural barriers more often as a main problem in establishing international business relationships.

Last, we distinguish between investments, including joint ventures and foreign subsidiaries, and trade activities. First results suggest that R&D intensive firms are more likely to be multinational investors. This observation is in line with the concept of knowledge capital which has a public good character and facilitates foreign operations (Markusen, 2002).

Yet, it differs from previous studies focusing on horizontal FDI and the related proximity-concentration trade-off proposed by Brainard (1997). Helpman et al. (2004) investigate exports relative to FDI sales of U.S. firms and find that R&D intensity is not a useful predictor. Note, however, that they use quite a different dependent variable. We ask whether a foreign investment is undertaken or not, we do not consider the relative share of affiliate sales. Investments therefore also contain sales subsidiaries which do not actually produce goods for the host market.

Norbäck (2001) even finds a negative impact of R&D intensity on the on the share of affiliate sales, studying the investment behaviour of Swedish MNEs. Interestingly, the impact of R&D intensity is also negative on the probability to establish a foreign production affiliate in the first place. The study differs from our data insofar as Norbäck (2001) focuses on horizontal activities, for example by only including OECD countries. Furthermore, he uses firm-level data on R&D intensity. Our study, on contrary, includes vertical FDI and relies, just as Helpman et al. (2004), on industry level measures of R&D intensity.

We add to the existing evidence by exploiting survey data on German multinational firms which covers all regions of the world and contains investments as well as trade activities. We are not aware of a related empirical study on the

Greece, Marin (2006) considers German firms that invest in Central and Eastern European Countries. Desai et al. (2004) include regressions on the ownership choice of U.S. multinationals.

ownership structure of German firms that is not limited to specific host countries.[2] Apart from a policy report, we are the first to exploit this data set systematically.[3] Another advantage of the data is that it also covers small and medium-sized firms.

One limitation of the data set is, however, that it only covers Bavaria and Baden-Wuerttemberg. Yet, both regions are of considerable size. They account for more than 32% of the German gross domestic product (GDP) in 2005.[4] If we consider both *Laender* as a separate region within Europe their combined GDP ranges between those of The Netherlands and Spain.

The remainder of this chapter is structured as follows. Section 4.2 reviews the empirical literature focusing on the impact of experience on the ownership choice of multinational firms. Section 4.3 derives the empirical hypotheses, which are mainly based on the theoretical models in the previous chapters. The data is described in Section 4.4. The econometric analysis of the choice between joint venture and foreign subsidiary is presented in Section 4.5. Section 4.6 provides additional results on differences between service and manufacturing firms, as well as results on the decision between trade and investment. Section 4.7 concludes and suggests lines of future research.

4.2 Empirical literature

In the literature review we focus on studies that investigate the impact of experience on the ownership choice of multinational firms. At the end of the section we present additional papers on the ownership choice of multinational firms that do not consider experience.[5]

The early literature mainly uses data from the Harvard Multinational Enterprise Project, which comprises foreign direct investments of the largest U.S. multinationals from 1900 to 1975.[6]

Gatignon and Anderson (1988) use these data and study the choice between

[2]Marin (2006) studies German investments in Central and Eastern European countries.

[3]We exploit the data in a policy report for the German Ministry of Economics and Technology (Buch et al., 2007).

[4]The German gross domestic product in 2005 valued 2,241,000 million Euro. Baden-Wuerttemberg contributed 325,893 million and Bavaria 398,450 million. *Source*: Statistisches Landesamt Baden-Wuerttemberg.

[5]Empirical papers that focus on the effect of cultural distance on the ownership mode can be found in Chapter 2.

[6]Curhan et al. (1977) present the data in a collection of tables.

four different modes of organization, which are minority share, equal share, majority share, and whole ownership, based on a multinomial logit regression. Additionally, they provide results for the binary choice between shared and whole ownership. In both specifications experience, measured as the number of previously recorded investments, increases the probability of full ownership.

Based on the same data, Gomes-Casseres (1989) also finds a positive impact of international experience on full ownership. He measures international experience by the number of foreign subsidiaries an American parent firm has in the subsidiary's industry.[7] An even stronger effect is reported for host country experience which relates to previous investments in the same country.

Blomström and Zejan (1991) study the ownership choice of Swedish MNEs in 1974. The data excludes full ownership but allows distinguishing majority from minority positions. The results show a positive and significant impact of experience on majority ownership.

Mutinelli and Piscitello (1998) also identify a positive impact of experience on full ownership in case of Italian foreign investments, including small and medium-sized firms. They distinguish country experience and international experience which both are significant.[8]

Meyer (2001) examines international operations of British and West German firms in Central and Eastern European countries (CEEC)[9] using questionnaire data on 567 activities of 269 firms. He applies a multinomial logit model with four choices: Trade, contracts, joint-venture, and wholly owned subsidiary. The results show a positive impact of global experience, measured as the share of foreign over total employees, on the probability to choose a wholly owned subsidiary. We might find it little surprising that firms investing abroad also hire people who work at the foreign location whereas trading companies have a smaller foreign workforce.

Also studying entries in CEE countries, Brouthers and Brouthers (2003) find a positive impact of regional experience, measured as years of business experience in

[7]The logit estimation results predict that the probability of an investor to own less than 95% of a foreign subsidiary decreases in experience. His principal measure relates to our alternative measure of experience which is the share of foreign over total sales because it does not consider the geographic scope of a firm's activities.

[8]Country experience is operationalized as a dummy variable which equals one if a firm had previous foreign investments and zero otherwise. International experience is calculated as the average of years since the first foreign investment and the total number of foreign subsidiaries.

[9]More precisely, Meyer (2001) studies investments in the Czech Republic, Hungary, Poland, Russia, and Romania.

CEEC, on the likelihood that 227 western European firms operate a wholly owned subsidiary in CEEC.

The above cited studies all find a positive impact of experience on the probability to operate a wholly owned subsidiary. However, other empirical work suggests an insignificant, negative, or non-linear impact of experience on integration.

Kogut and Singh (1988) do not find a significant impact of experience on the ownership choice of 228 investments into the United States.[10] They estimate a multinomial logit model which allows for joint venture, acquisition, and greenfield investment. Unfortunately, no results are presented for the decision between joint venture versus both other modes. A particularity of the data is that the home countries of the investing firms are mostly located in other developed countries.

Also Raff et al. (2006) study multinational activities between developed countries.[11] In particular, they investigate 478 investments of Japanese multinational firms into 21 developed countries, mainly the United Kingdom. The last stage in their sequential modelling approach consists of a binary logit model with the outcomes joint venture and wholly owned subsidiary. Two measures of experience, which are previous manufacturing investments and previous manufacturing investments in the same host country, are included as controls. The coefficient on previous investments is insignificant; also host country experience is insignificant in most of their specifications. However, it makes wholly owned subsidiaries less likely when they control for firm size. Hence, there is slight evidence of a negative impact of experience on integration.[12] Also based on Japanese data, Gattai and Molteni (2007) provide further evidence for a negative effect. They find that early Japanese investments in Europe are more likely to be organized as a wholly owned subsidiary and late investments in form of a joint venture.

Erramilli (1991) studies U.S.-based service firms and argues that the effect of experience on integration is U-shaped. He provides evidence which is based on 151 observations.[13] Experience is measured in two ways. First, the number of

[10]Experience is measured by the firm's pre-entry presence in the US, and by the number of countries in which a firm has subsidiaries.

[11]Raff et al. (2006) provide one of the few studies that consider firm productivity as a determinant. We are aware of a working paper by Jabbour (2005) who investigates French firms, and of Tomiura (2005) who investigates the trade-off between foreign and domestic outsourcing.

[12]Their measure of experience differs from our approach as we also consider experience that results from trade, representative offices or cooperation. Another difference is that they exclude retail and wholesale subsidiaries which are included in our study.

[13]Each respondent only provided data on one project he was most familiar with. Hence, unlike

years of previous international experience is used. Second, an ordinal variable is constructed that measures the geographic scope.[14] Both variables have a negative impact on integration, whereas their squared values have a positive impact.

We briefly summarize the literature on experience and ownership choice. Most of the studies find a positive impact of experience on the probability that a multinational firm operates a wholly owned subsidiary instead of less integrated modes such as joint ventures. However, experience does not seem to matter for investments between developed countries. Furthermore, some authors propose a non-linear relationship, yet related empirical evidence is weak. The econometric modelling mostly relies on binary or multinomial logit models. Typically, they do not consider firm cluster effects and thus do not allow activities of one firm to be correlated with each other. Yet, it seems plausible that there are unobserved firm effects. In case of multinomial outcomes the discussion on the appropriate choice of relevant outcomes tends to be limited. A problem arises if we consider joint ventures and subsidiaries to be similar investment choices compared to trade. In that case these three alternatives should not be considered simultaneously in a multinomial logit model that requires the independence of irrelevant alternatives. We discuss that point in more detail in Section 4.6.2.

Next, we shortly present several empirical studies which investigate ownership choices of multinational enterprises but do not include experience as an explanatory variable.

German investments in Central and Eastern European countries are investigated by Marin (2006).[15] The probability to choose integration, more precisely to own more than 30% of the foreign investment, increases in the R&D intensity of the parent firm. The probability decreases in the capital intensity of the parent firm, in distance, in corruption, and in the number of the parent firm's employees. These results are in line with our findings except for size. Her results suggest that larger parent firms are more likely to own a minority share.

Louri et al. (2002) exploit data on foreign investments in Greece. In a related

in most other data sets we do not observe many foreign activities per firm.

[14]The rank is no previous international operations, operations in North America only, operations on one continent outside North America, operations on more than one, operations in every continent outside North America.

[15]She distinguishes investments with a foreign ownership share above 30% from shares equal or less to 30%. Thereby she deviates from most other studies which typically assume a threshold level of $95\% - 99\%$.

study, Barbosa and Louri (2002) additionally include data on foreign investments in Portugal. In line with most studies they find a positive impact of R&D intensity on full ownership in case of Portugal.[16] Capital intensity, on the other hand, has a negative impact in both countries. More surprisingly, affiliate size, measured by the number of employees, makes full ownership in Portugal more likely. This is slightly at odds with the finding of Nakamura and Xie (1998). They study foreign investments in Japan and find that the number of workers in Japan reduces the ownership share of the foreign investor in a joint venture. However, the same variable has no significant effect on the decision between full and partial ownership.

4.3 Hypotheses

In this section, we establish the empirical hypotheses which are derived from the theoretical models in Chapter 2 and Chapter 3. Additionally, we present related theoretical models which generate similar effects. Finally, we provide the theoretical underpinnings for the control variables.

Our central hypothesis is that multinational firms enter joint ventures abroad as a way to benefit from a partner's local expertise. The valuation of the partner's contribution is higher if *cultural barriers* are high, if investors are *inexperienced*, or if *legal protection* is bad. In the following we discuss these points one after the other.

Cultural barriers The results of our formal model in Chapter 2 focus on the impact of cultural, or psychic, distance.[17] The business related literature sometimes refers to a closely related concept as 'liability of foreignness'.[18] In the model, foreign investors face additional costs due to their unfamiliarity with the local environment, captured by the distance parameter d. Investors therefore have an incentive to enter a joint venture with a local partner if cultural barriers are high. The drawback of a joint venture is that additional agency costs arise because contracting possibilities are limited. As a result, investors are more likely to enter a

[16]Full ownership is defined as a foreign ownership share above 95%.

[17]Beckerman (1956) introduces the notation of 'psychic' distance.

[18]Hymer (1976) introduces the concept, relating to his thesis from 1960, arguing that entrant firms are disadvantaged vis-à-vis local firms due to their unfamiliarity with business conditions of foreign markets.

joint venture as cultural distance increases because the benefits of local knowledge are then likely to outweigh additional agency costs.[19] This result, which is formally derived in Proposition 1, leads to our first hypothesis.

Hypothesis 1. *Firms that face cultural barriers are more likely to organize their foreign activities as a joint venture than to establish a wholly owned subsidiary.*

The model further suggests two distinct causes of distance costs. On the one hand, costs arise due to difficulties in operating foreign production. On the other hand, costs arise due to difficulties in selling the products on the foreign market.[20] Unfortunately, we are not able to discriminate the two channels in our econometric analysis.

Both causes can also be found separately in the theoretical literature. The respective models offer alternative ways of justifying our first hypothesis and are therefore shortly presented in the next two paragraphs.

In Chapter 3 we follow Grossman and Helpman (2004) and assume that distance reduces the ability to monitor a foreign manager. Formally, we assume that $\delta_F < \delta_H$. We know from the comparative static analysis in Section 3.4 that improvements in the monitoring possibilities lead to more foreign subsidiaries. Provided that cultural barriers influence monitoring possibilities, the model may be used as an alternative way to motivate Hypothesis 1.

Horstmann and Markusen (1996) present a model in which joint ventures are chosen to gain market information. The investor faces uncertainty about the true size of the foreign market. For this reason she may enter a joint venture even if additional agency costs arise. If we assume that market uncertainty increases in cultural distance this theory also suggests that joint ventures more likely as cultural distance increases.

Admittedly, theory also allows for a countervailing effect if cultural barriers

[19] Grossman and Helpman (2002) similarly assume an unspecified cost disadvantage λ in case of integration. They justify cost differences by relatively high costs of governance for integrated production. If we alter their argumentation and assume that this cost disadvantage of integration is due to cultural barriers we can derive an overall effect which goes in the same direction.

[20] Empirical evidence supports, at least indirectly, both links. Lin and Png (2003) show for investments in China that geographic distance from Hong Kong makes joint ownership more likely and argue that a higher distance reflects higher monitoring costs. Similarly, Desai et al. (2004) present descriptive evidence that parent ownership is lower if affiliates sell higher fractions of their total sales in host countries.

hamper the possibilities to write contracts with a joint venture partner. Grossman and Helpman (2002) link contract completeness to the relationship between an investor and its supplier. As a result contract incompleteness, which may also be linked to cultural barriers, makes outsourcing less likely.

International experience Cultural barriers and experience are closely related if we believe that firms overcome cultural barriers by gaining experience. Previous arguments can then be used to derive the hypothesis that experience has a positive impact on the decision to integrate foreign activities. Gomes-Casseres (1989) argue along these lines and expect some investors to be more familiar with some countries than with others because of international experience.

Additional to that reasoning the theoretical model in Chapter 3 predicts that investors tend to switch from joint ventures to foreign subsidiaries as uncertainty about monitoring possibilities is resolved. This result is formulated in Proposition 7 and leads to our second hypothesis.

Hypothesis 2. *Internationally more experienced firms are more likely to organize their foreign activities as a wholly owned subsidiary than to enter a joint venture.*

Legal protection Next, we discuss the impact of the legal environment on the ownership decision of the firm. It is important to note that the legal environment influences three contractual relationships. First, it affects the relationship between an investor and a joint venture partner. Second, it affects the relationship between an investor and the manager of a foreign subsidiary. Third, the legal environment also affects the relationship of the foreign firm and third parties, e.g. business partners or government agencies. The impact of a more reliable legal system on the ownership choice depends very much on the relationship we are looking at.

We focus on the last point because it relates most closely to the concept of local knowledge as set out in Chapter 2. The contribution of a local partner may be especially valuable if legal protection is bad because he knows "how to make things happen" (Yan and Gray, 1994). Reasons may include social networks that serve as alternative means of enforcing agreements. Local knowledge may also be needed if corruption makes the rules of the game intransparent or prevents legal

enforcement of contracts. In that case knowledge about reliable business partners may be especially valuable.[21] In short, we regard bad legal protection as a specific factor influencing the broader concept of psychic distance d. Hypothesis 3 follows from that argumentation.

Hypothesis 3. *Firms that face legal uncertainty are more likely to organize their foreign activities as a joint venture than to establish a wholly owned subsidiary.*

Alternatively, the legal environment may affect contracts between investors and managers of a foreign subsidiary. Antràs and Helpman (2004) interpret the fraction of output an investor can claim in case of a contractual breach as reflecting country characteristics such as corruption and legal protection. Importantly, this fraction does not influence outsourcing relationships because they assume that everything is lost in case an investor and its supplier split up. It follows that less complete contracts, i.e. bad legal protection, decreases the profitability of foreign subsidiaries and integration becomes less likely.

Looking at contractual relations between investors and suppliers we obtain a countervailing effect. This aspect is, for example, captured by the value of the agent's assets l in our model presented in Chapter 3. The better legal conditions, the more likely is the investor to effectively take possession of the assets in case the business is closed down. Grossman and Helpman (2003) use a similar reasoning and argue that contracts govern the relationship-specific investments between investors and outside suppliers. These contracts are characterized by a fraction of tasks that can be verified at court. When this fraction decreases, i.e. if legal protection is bad, outsourcing becomes less likely.

Control variables Having established our three main hypothesis we present in the following the theoretical underpinnings for the two control variables R&D and capital intensity.

Both theoretical models predict that R&D intensity should have a positive effect on integration because additional costs arise if technology is transferred to an external party. On the one hand, additional costs arise because of technology

[21] The dichotomy of legal protection is also pointed out by Smarzynska and Wei (2000).

dissemination. Technology may be stolen and competitors may be found free-riding on the firm's intangible knowledge. On the other hand, additional costs may arise if the foreign partner does not have the skills to successfully accomplish technology intensive tasks or if the technology is difficult to transfer. As a result, additional training may become necessary or produced components are less likely to be functioning.

R&D intensity is also often assumed to reflect the headquarter-intensity of a firm. Headquarter services can typically only be provided by the investor. These models then predict that firms making extensive use of those services are more likely to integrate foreign production. Antràs and Helpman (2004) develop such a model in which the most productive firms integrate if they are headquarter-intensive and outsource if they rely less on headquarter services.

The impact of capital intensity is discussed by Antràs (2003). He uses a property-rights approach of the firm in which relationship-specific investments are necessary. In case of outsourcing the investor can contribute to the investment in capital. Necessary investments in labor, however, must be paid by the supplier alone. It follows that in labor intensive industries outsourcing is more likely. The reasoning is that residual rights should be given to the party undertaking the relatively more important investment.

Table 4.1 summarizes the expected impact on integration, i.e. on the probability to choose a wholly owned subsidiary.

Table 4.1: Probability of integration - Expected Signs

Variable	**Probability of integration**
Cultural distance	-
Experience	+
Legal environment/ Contract completeness	+
R&D intensity	+
Property rights protection	-
Capital intensity	+

4.4 The data

We analyse firm level data from the survey "Going international - success factors in international business", which was collected by the "Deutsche Industrie- und Handelskammertag" (DIHK) in autumn 2005. The data have so far only be investigated in a report commissioned by the German Federal Ministry of Economics and Technology (Buch et al., 2007).

The survey was sent to 55,000 member firms that had international business activities and were located in one of the sixteen German Bundeslaender excluding Lower Saxony. Member firms are mainly active in industry and trade, and according to the IHK, basically all firms that are internationally active in these sectors are also members of a IHK.

The survey was sent to member firms that fulfilled at least one of the following three criteria:

- The member firm reports foreign business relations.
- The member firm receives the newsletter "Außenwirtschaftsnachrichten".
- The member firm makes use of the A.T.A. carnet.

Firms with foreign business relations are chosen from an internal database which is updated regularly. At least once in three years, member firms report whether they import or export, produce abroad, have a foreign subsidiary, foreign agency, foreign investment or licensing partners abroad. Additionally, the questionnaire was sent to member firms that potentially have foreign business relations but are not included in the database. These are recipients of the international business newsletter "Außenwirtschaftsnachrichten" and firms that make use of the A.T.A. carnet for the temporary admission of goods.[22]

Firms were asked to fill out a paper and pencil questionnaire which contained 22 questions. The questionnaire allows to identify firms and to merge additional information, e.g. the industry classification, from internal databases. Firms were offered a summary of the results via e-mail. The total number of responses was 4,325, which corresponds to a response rate of 8 percent.[23]

[22]The carnet ATA is a customs convention that allows the temporary importation of professional equipment, e.g. for demonstration purposes at fairs.

[23]This response rate is comparable to Graham and Harvey (2001) who survey members of a professional association for financial executives.

In principal, we could face a selection bias because firms that participated in the survey are systematically different from firms that did not participate. However, the data does not allow to compare non-responding to the responding firms. Yet, we can compare the characteristics of the responding firms to the characteristics of other samples of German MNEs. Buch et al. (2007) show that the dataset is very similar to the census of large German MNEs which is provided by the *Deutsche Bundesbank*. The comparison shows that there is a slight over-representation in trade and repair, whereas banking, insurance and other services are slightly under-represented. All in all, there are enough similarities which make us confident that there is no drastic selection bias present.

We have access to the responses of firms located in Bavaria or Baden-Wuerttemberg due to data availability. The two regions account in sum for about 40% of foreign activities in the data set. We are left with $10,532$ foreign activities which are due to $1,370$ different firms.

The wide coverage of the data set has several advantages. First, it allows us to study the behaviour of small and medium sized enterprises which are often excluded from other statistics. Second, it contains a variety of foreign activities ranging from market transactions to foreign subsidiaries.

The survey includes information about ten different types of foreign activities in seven regions of the world. We use that information to build a data set that contains foreign activities as the unit of observation. Each observation is characterized by its mode of organization and by the region in which it takes place.

The ten modes of organization are export, sourcing/purchase, loose cooperation partner, representative/sales office, subsidiary, joint venture/alliance, research & development, e-commerce, and import. In the course of this study we name the set of activities comprising export, sourcing/purchase, and import as trade. Furthermore, we call the set of representative/sales office and purchasing office more generally trade office.

The seven world regions are EU 15/EFTA, EU 10, EU candidates / Russia / Commonwealth of Independent States (CIS), North America, Asia/Pacific, Latin America, and Africa.

One shortcoming of the data set is the high heterogeneity within the regions. Considering huge differences between e.g. China and Japan makes it difficult to merge other data such as GDP measures. Categories for the modes of organization

are not mutually exclusive. Sales offices may imply exports; the same is true for purchasing office and import. For these reasons, future surveys may gather data on the level of the investment project. However, that problem only arises for trade activities. The comparison of joint ventures versus wholly owned subsidiaries, which is our main interest, should not be affected.

The data set contains firm-level information about cultural barriers and legal protection. This is an advantage over country-level indices because different firms may be differently affected by cultural distance or legal uncertainty. A good example is the service industry. Section 4.6.1 will show that service firms face higher cultural barriers than manufacturing firms. As another example, think of R&D intensive firms which are most likely to be more affected by weak intellectual property rights than producers of standardized goods.

However, these self-reported measures are subject to endogeneity issues. If, for example, firms entering a joint venture are more likely to state cultural barriers as a problem we observe a causality that goes from ownership to cultural barriers. We are, however, interested in the effect formulated in the following question. How does the probability to choose a foreign subsidiary change if cultural barriers are present? Hence, we want to hold the perception of investors fixed. Econometric techniques to sort out the direction of causality require time series data or suitable instrumental variables which are both not available.[24]

What makes us still confident about using these measures is that the perception of cultural barriers is not linked to a specific investment project and that the question is formulated rather general. Moreover, investors operate on average in more than five world regions and may thus have a good idea about the sensitivity of their business to cultural barriers.

4.5 Empirical analysis

The main purpose of the study is to investigate the decision of a firm whether to integrate or to outsource foreign production. Many economic models that explain this decision rely on a principal-agent approach to determine the boundaries of the firm. These relationships are often based on lump sum payments or relationship

[24] An instrumental variable should be correlated with the firm's sensitivity to cultural barriers but not with the respondent's perception thereof. Eligible survey answers are based on personal judgement and therefore not suited as instrumental variables.

specific investments. The economic models presented in Chapter 2 and Chapter 3 are no exception. Investor and partner share revenues or agree on lump sum payments. In case of failure such a lump sum payment works similar to a collateral because the investor seizes the partner's assets. Feenstra and Spencer (2005) point out that these approaches are suited to describe joint venture relationships.

We follow that reasoning and restrict our sample in the following to joint ventures and foreign subsidiaries and investigate the determinants that lead to the one or the other. This restriction has the further advantage that we avoid multiple entries for the same activity as both categories are mutually exclusive.[25] From an econometric perspective it also simplifies the model selection. If we allow for more than two modes of organization we also need to estimate more complex models, which rely on additional assumptions.

In this section, we further restrict our attention to manufacturing firms. The reason is that we do not obtain significant results for the main parameters if we include service firms. It seems that the explanatory variables are not suited to explain ownership choices in the service sector. Reasons may include that sales is a bad proxy for size in financial services. Furthermore, capital intensity takes very high values for real estate activities. Yet, we do consider whether results are robust to the inclusion of service firms in Section 4.5.6. Additionally, Section 4.6.1 compares manufacturing and service firms based on a descriptive analysis.

4.5.1 The variables

In the following, we describe the variables that enter the regression. Firm level data are from the DIHK survey. Additional information on capital and R&D intensity comes from OECD STAN Industrial Data.

Experience Experience is measured by the number of regions in which a firm operates. All foreign activities, including trade and trade offices, are considered. We do thus not limit experience to investment activities but also consider trade relationships to capture the geographical scope of operations.

[25] As discussed in Section 4.4 other modes of organization such as export and sales office may describe the same activity.

Culture, Contracts, and Corruption These measures are obtained from the following question. "Which are the major problems in establishing international business relationships?". The survey allows the respondents to rank several problems on a scale from (1) to (4). Among these problems we use "cultural differences", "legal environment/ contracts", and "corruption abroad". We introduce a dummy variable which equals one if the respondent stated that the related problem to be large (3) or very large (4).[26] The dummy variable equals zero if respondents regard the related problem as occurring occasionally (1), often (2), or if no answer is given.

Firm size The data contains information about firm sales in the year 2004. The information is provided in nine categories which we further aggregate to four. We introduce four dummy variables which are Sales S, Sales M, Sales L and Sales XL. Sales are measured in Euro. The first category comprises small firms with sales that range up 2.5 million. The second category comprises firms with sales from over 2.5 up to 25 million. The third category ranges from over 25 up to 250 million. Firms with sales that exceed 250 million belong to the last category.

R&D intensity Data on R&D intensity is from STAN industrial data provided by the OECD.[27] R&D intensity using production (RDIP) measures business enterprise R&D expenses as percentage of production (gross output). We use data for the year 2001 which is provided on a 2-digit level according to ISIC Rev. 3 for most industries and contains 3-digit level data for selected industries.

Capital intensity Capital intensity for the industries is measured by the ratio of employees over net capital stock[28] in 2002. Data is from the STAN industrial database and reported on the two digit level. The unit is millions of Euro

[26]The highest rank (4) is called "knock out criterion". The second highest is called "big problem". The lowest two categories have a time dimension "often" and "occasionally". Theoretically, the survey thus allows for multiple answers, e.g. if a problem is considered to be big and occurs occasionally. However, all respondents made exclusive choices. For this reason we assume that the answers are perceived as a ranked order.

[27]OECD data bases can be found at http://www.sourceoecd.org/.

[28]The net capital stock is the value of all vintages of assets to owners where valuation reflects market prices for new and used assets. It reflects current monetary values of capital goods rather than continuing utility.

over thousands of heads. Alternatively, we use the investment intensity (INVIV) in 2001. It measures gross fixed capital formation in percent of value added.

Industry classification We use subsections of the industry classification according to the "Nomenclature générale des activités économiques dans les Communautés Européennes" (NACE) Rev. 1.[29] The dummy variable equals one if the firm is active in the respective industry and zero otherwise. Subsections include textiles and textile products (17, 18), pulp, paper and paper products, publishing and printing (21, 22), chemicals, chemical products and man-made fibres (24), rubber and plastic products (25), basic metals and fabricated metal products (27, 28), machinery not elsewhere classified (29), electrical and optical equipment (30, 31, 32, 33), transport equipment (34, 35), and manufacturing n.e.c. (36, 37). Remaining manufacturing industries[30] are grouped into the category "Other" due to small observation numbers.

We further distinguish manufacturing and service sectors. The manufacturing sector comprises industries $15-37$. We refer to the group of hotels and restaurants (55), finance insurance, real estate and business services $(65-74)$, and community and personal services $(75-93)$ as service industries.

4.5.2 Descriptive statistics

The restriction to joint ventures and foreign subsidiaries in the manufacturing sector leaves us with 842 foreign activities. Summary statistics for these 842 activities are provided in Table A.1 and Table A.2 in the Appendix.

Summary statistics show that subsidiaries are more common than joint ventures. In average four out of five investments are foreign subsidiaries and only one out of five is set up as a joint venture. Around 30% of foreign subsidiaries and joint ventures are observed in the machinery industry, 21% in the electronic and optical industry. Industries with very few observations are grouped into the category *Other*. Among these industries the fewest activities are recorded in manufacturing of leather and leather products and non-metallic mineral products.

[29]The classification corresponds to the International Standard Industrial Classification of all Economic Activities (ISIC Rev. 3) on the two-digit level.

[30]Remaining industries include manufacture of food products, beverages and tobacco (15, 16), leather and leather products (19), wood and wood products (20), coke, refined petroleum products and nuclear fuel (23), and other non-metallic mineral products (26).

We can also see that firms that set up foreign subsidiaries or joint ventures tend to be rather experienced. The average number of regions in which these firms operate is 5.67. The average for the group of trade, trade office and cooperation is 5.15.[31]

Considering location, summary statistics show that most investments are in EU 15, which comprises the European member states before the enlargement in 2004. Asia is the second biggest target region in terms of number of activities. Around 21% of foreign subsidiaries and joint ventures are located in Asia/Pacific. Northern America and EU 10 account for 20% and 16%, respectively. Latin America, CIS/Russia, and Africa play minor roles with shares below 8% each. As a last point, we note that around half of the investment activities are due to firms with sales between 25 and 250 millions.

4.5.3 Econometric model

We estimate a binary logit model to capture an investor's choice between joint venture and foreign subsidiary. The logit model is the appropriate choice because investors make a discrete choice between two alternatives.

We follow Wooldridge (2002) in the exposition of the econometric model. The binary indicator y equals one if an investor chooses a subsidiary ($y = 1$) and zero if the investor chooses a joint venture. The choice of the investor depends on a set of variables $\mathbf{x}$. The model links these variables to the probability that a subsidiary is chosen via a function $G(\cdot)$. The resulting logit model is of the form

$$P(y = 1|x) = G(x\beta) \equiv p(x) \tag{4.1}$$

where $\mathbf{x}$ is $1 \times K$, β is $K \times 1$. The function $G(\cdot)$ is assumed to equal

$$G(z) = \Lambda(z) \equiv \frac{e^z}{1 + e^z} \quad .$$

The function $G(\cdot)$ assures that resulting probabilities are strictly between zero and one. This is one reason to prefer the logit specification over a linear probability model in which case $G(\cdot)$ is assumed to be the identity function.

[31] Note that the mean value is weighted by activities not by firms. To illustrate this point suppose that Firm A is active in six regions and has two investments. Firm B is active in two regions and has one investment. The means then equals 4.67, not 4.

Activities that are undertaken by the same firm may be correlated due to unobserved firm characteristics. Therefore, we form clusters that comprise all of a firm's foreign activities. Activities within that firm cluster are allowed to be correlated, yet we still assume that the observations are independent across firms. The assumption seems sensible because there are relatively few activities per firm $(1-20)$ compared to the total number of firms (334). This clustering accounts for within-firm correlation which arises if unobserved firm effects are present.

4.5.4 Estimation results

Results are obtained by maximum-likelihood estimation of Equation (4.1). We regress the dependent variable WOS, which equals one in case of a foreign subsidiary and zero in case of a joint venture, on our primary variables of interest which are experience, cultural barriers, and legal uncertainty. The model includes control variables for R&D and capital intensity on the industry level as well as for firm size. Estimates are computed using Stata 9.2.[32]

Table 4.2 reports the estimated coefficients for five different specifications. We report region and sector dummies in the Appendix. In the first column, we regress the ownership choice on experience and the control variables, without industry fixed effects. In column (II), we include industry dummies. Next, we add cultural barriers and corruption, first with then without industry dummies. In the last column, we replace corruption by contractual difficulties as a measure for legal protection.

We find that international experience, measured by the number of regions in which a firm operates, has a positive effect on the probability that a firm operates a foreign subsidiary instead of a joint venture. The effect is significant at the 5% level in all specifications. The results thus support Hypothesis 2.

The coefficient on cultural barriers is negative and significant at the 5% level. This result is in line with our theoretical prediction stated in Hypothesis 1. The result is also in line with other studies analysing American, Norwegian, and Italian MNEs (Kogut and Singh, 1988; Erramilli, 1991; Benito, 1996; Mutinelli and Piscitello, 1998). These studies use a country-level index of cultural index based on Hofstede (1980) which is less affected by endogeneity.

[32]Long and Freese (2006) provide an introduction to using Stata that focuses on regression models for categorical dependent variables, which we found particularly useful.

Table 4.2: Joint venture vs Wholly owned subsidiary

Variable	(I)	(II)	(III)	(IV)	(V)
Experience	0.167**	0.168**	0.167**	0.169**	0.165**
	(0.077)	(0.078)	(0.082)	(0.081)	(0.078)
R&D	0.123*	0.123	0.128*	0.131	0.132
	(0.070)	(0.090)	(0.069)	(0.085)	(0.084)
Investment	-0.042**	-0.030	-0.044***	-0.034*	-0.031
	(0.017)	(0.019)	(0.017)	(0.019)	(0.019)
Sales S	-1.027**	-1.111**	-1.116**	-1.198**	-1.220**
	(0.484)	(0.478)	(0.508)	(0.490)	(0.504)
Sales M	-0.234	-0.148	-0.204	-0.155	-0.176
	(0.294)	(0.301)	(0.298)	(0.306)	(0.303)
Sales XL	-0.220	-0.212	-0.313	-0.324	-0.265
	(0.306)	(0.348)	(0.322)	(0.365)	(0.353)
Culture			-0.537**	-0.554**	-0.540**
			(0.244)	(0.252)	(0.254)
Corruption			-0.453*	-0.324	
			(0.237)	(0.229)	
Contracts					-0.420*
					(0.247)
Constant	1.382***	1.092*	1.769***	1.494**	1.461**
	(0.497)	(0.607)	(0.528)	(0.613)	(0.604)
Industry dummies	no	yes	no	yes	yes
No of observations	842	842	842	842	842
Log likelihood	-370.0873	-352.2954	-362.21	-346.2931	-345.4894
Pseudo R^2	.0992699	.1425722	.1184418	.1571808	.1591368

Logit estimates (Foreign subsidiary=1, Joint venture =0). Robust standard errors in parentheses. Error terms are adjusted for 334 firm clusters. Reference group for sales dummies is Sales L. Sales are measured in millions of Euro. Sales S: < 2.5, Sales M: $2.5 - 25$, Sales L: $25 - 250$, Sales XL: > 250. Regional dummies are included in all estimations. McFadden's R^2 is reported, also known as likelihood-ratio index. ***, **, and * denote significance at the 1, 5, and 10 percent levels, respectively.

Next, we turn to the legal system as faced by the investors. On the one hand, we use corruption to measure missing legal protection. On the other hand, we use difficulties in the legal environment (contracts) to capture the same effect. Both measures are closely related. This relationship becomes evident when looking at the correlation coefficients which equals 0.62 in Latin America and is as high as 0.70 in Africa. Also from an economic point of view it is reasonable to assume that both measures have a similar impact on the investor's decision because agreements cannot be enforced at the courts. In the model of Antràs and Helpman (2004), for example, contract completeness is assumed to capture differences in corruption and in legal protection.

Both measures have a negative and significant impact on the investor choosing a foreign subsidiary which can be seen in columns (III) to (V). The significance level of corruption drops, however, below 10% in column (IV) when industry dummies are included. Our conjecture is that corruption is more common in some industries than in others. Yet, the sign remains negative. This result is in line with the general idea that local partners have tacit knowledge which includes the know-how to deal with corruption. Also Marin (2006) finds a negative impact of corruption on the probability that a German investor in CEEC owns more than 30% of the investment. The result is also in line with Smarzynska and Wei (2000) who investigate foreign investments in CEEC.

The coefficient on contracts is significant even when including industry dummies. In other words, firms that state legal conditions or contracts as a major problem when establishing cross-border relationships are also more likely to enter a joint venture. However, endogeneity problems similar to the perception of cultural barriers might play a role here. On the one hand, respondents that have bad experiences in writing contracts with their joint venture partners may report contracting as a major concern. On the other hand, respondents whose businesses depend crucially on contracts and the legal environment in the host country may enter a joint venture to benefit from the knowledge of a local partner. In the following we therefore focus on specifications that use corruption to capture the effectiveness of the legal system. Our presumption is that foreign investors perceive corruption independent of their ownership choice. One may still argue that corruption is a bigger problem if a joint venture partner is involved. Yet, we think that endogeneity is much less pronounced because contracts are the legal basis of

a joint venture.

The results support Hypothesis 3. The empirical evidence is in line with the idea that local knowledge and local networks are especially valuable if legal protection is bad. Networks might, for example, replace missing trustworthiness or local partners may know how to deal with corruption. It does not seem that bad legal protection especially hampers contracting with a joint venture partner as in Grossman and Helpman (2002).

One way to disentangle the effects of the legal environment is to test the specific mechanisms which are proposed by theory. In Chapter 3 we propose that a contract fixes a payment from a supplier to an investor in case the project fails. The extent to which such a contract is credible also depends on the legal environment in the foreign country. A related question arises. Can the investor expect to recover a sizeable amount of the assets that are invested in the project? In an unreported regression we use the recovery rate published by the World Bank as a proxy for the value that is left if a business is closed down.[33] Unfortunately, we do not obtain meaningful results because the regions as defined in the survey are too large and too heterogeneous.

Both industry characteristics, R&D intensity and capital intensity have a significant impact when industry dummies are excluded. The respective signs do not change, however, when industry dummies are included. The drop of significance is little surprising because industry data is merged on nearly the same level on which industry dummies are defined.[34]

Therefore we may want to exclude industry dummies because they capture similar effects and give rise to collinearity. Nevertheless, we include them because we want to capture industry differences which are neither captured by R&D intensity nor by capital intensity. Furthermore, there is quite some variation left in the data. In the chemical industry, for example, R&D intensities take values of 3.7, 4.8, and 9.4. In transport we have data on five different R&D intensities, ranging from 0.7

[33]The World Bank provides country indicators about the ease of doing business on http://www.doingbusiness.org. We aggregate those indicators for the regions and weight countries by population and gross domestic product.

[34]Industry dummies are defined on the level of subsections, industry information is mostly on the 2-digit level of NACE Rev 1.1. Only for few industries 3-digit level information could be obtained in STAN Industrial data.

to 8.3. For this reason we focus on specifications that include industry dummies but also report alternative estimations to show that results are very similar. In that way, R&D and capital intensity are less likely to take up other unobserved industry effects.

The positive impact of R&D intensity is in line with our theoretical prediction. The result thus provides strong support for considering differences in R&D intensity in both theoretical models. They are also in line with other empirical studies.[35] We cannot discriminate, however, whether firms are afraid of technology dissemination or whether they face additional costs when transferring technology to a joint venture partner. Future research may want to investigate the relative importance of both channels as policy implications differ quite substantially in either case.

Capital intensity, on contrary, reduces the probability that a foreign subsidiary is chosen. We report investment over value added as a proxy for capital intensity. Our second proxy for capital intensity which is net capital stock over employees is not significant in specifications (II), (IV), and (V). When industry dummies are excluded it is also negative and significant at the 5% level.

Also the negative impact of capital intensity is in line with previous studies that use firm level data (Nakamura and Xie, 1998; Barbosa and Louri, 2002; Marin, 2006). Interestingly, Antràs (2003) provides empirical evidence that capital intensive industries in the US are more likely to trade within firm boundaries. One difference between Antràs (2003) and our study is that he uses intra-firm trade with majority owned affiliates as the dependent variable while we distinguish between between joint ventures and subsidiaries. Nevertheless, it is somewhat puzzling that capital intensity leads to more intra-firm trade, on the one hand, and to less foreign subsidiaries, on the other hand.

Small firms with sales below Euro 2.5 millions are considerably less likely to choose a foreign subsidiary. The effect of Sales S is negative and significant at the 5% level in all specifications. One explanation is that fixed costs related to affiliates are higher than those related to joint ventures.[36] Interestingly, the impact of size

[35]Barbosa and Louri (2002) show for investments in Portugal that a dummy variable that equals one if R&D spending exceeds one percent of industry output increases the probability of full ownership. Desai et al. (2004) who use firm-level data of US multinational firms show that parent R&D spending over sales makes whole ownership more likely using data on U.S. multinationals.

[36]Mutinelli and Piscitello (1998) provide further arguments why small and medium sized firms

vanishes once a critical level is reached as we do not find statistically significant differences between larger firms.

Table A.3 and Table A.4 in the Appendix show that some regions and some industries are more likely to establish a foreign subsidiary than others. Foreign subsidiaries are more common in the ten new European member states (EU 10) than in the old member states (EU 15). Investments in Asia/Pacific and CIS/Russia, on the other hand, are more likely to be established as joint ventures. Also two industry dummies are significant across all specifications. Chemistry decreases whereas machinery increases the probability of a foreign subsidiary.

4.5.5 Magnitude of effects

Having discussed the direction and the significance of effects we now asses the magnitude of changes in the explanatory variables. We base the discussion on specification (IV) in Table 4.2, which considers industry dummies and includes corruption as a measure for legal uncertainty. One characteristic of the logit model is that the magnitude of an effect is not the same for all observations but depends on the reference point.

We therefore introduce a typical activity that should serve as such a reference point. In line with the descriptive statistics we set the following parameters. The investment is located in EU 15, the respective firm is active in six regions, is of size Sales L, and operates in the machinery industry. Capital and R&D intensity match the machinery industry.

We first focus on the effect of experience. Therefore, we calculate the probability that a typical activity is a foreign subsidiary. Then, we plug different values for the number of active regions. Last, we repeat the exercise for Asia/Pacific. Table 4.3 reports the results and additionally contains the change in probabilities.

The table can be read as follows. If we change the number of regions in which a typical firm is active to one the probability that the investment is a foreign subsidiary drops by 4.72%. If a typical investment is in Asia/Pacific and not in EU 15 the probability drops by 10.96%.

The table also shows that the impact of international experience is more pronounced in Asia. This can be seen in the lower part of Table 4.3. If a firm is active

may be more likely to enter a joint venture relationship.

Table 4.3: Predicted probabilities

No. of Regions	1	2	3	4	5	6	7
EU15	0.9138	0.9262	0.9369	0.9462	0.9542	0.9610	0.9669
Change	–	0.0124	0.0107	0.0093	0.0080	0.0068	0.0059
Asia/Pacific	0.7111	0.7445	0.7753	0.8034	0.8287	0.8514	0.8715
Change	–	0.0334	0.0308	0.0281	0.0253	0.0227	0.0201

Predicted probabilities $Pr(y = 1|x)$ are based on the estimated coefficients $\hat{\beta}$ which can be found in column (IV) in Table 4.2. Dummy variables equal zero except Machinery. R&D and investment intensity equal 2.3 and 9.8, respectively. For Asia the respective dummy is set to one.

in an additional region the probability that an investment in Asia is a foreign subsidiary increases by 2 - 3%, whereas in EU 15 the increase is around 1%.

Furthermore, the estimates predict that the magnitude of the effect is higher for inexperienced firms. This finding hints to decreasing returns to experience, or rather to the geographic scope of a firm's operations. While the result is appealing we also note that it relies on the the characteristics of the econometric specification. The logit model implies that the impact of a variable is lower in the flat parts of the probability function. This can be seen by inspecting the S-shape of $G(z) = \frac{exp(z)}{1+exp(z)}$, which forces resulting values to lie in the interval $(0, 1)$. This shape also explains that the impact of experience is higher in Asia. The negative sign of the Asia dummy shifts our reference point to lower probability levels at which $G(z)$ is steeper. The impact of experience is thus larger. As we are confident about the model selection we conclude that experience has a greater impact in Asia than in EU 15 and if cultural barriers are high.

Now, we turn to the other explanatory variables. Therefore, we vary the variables by one point and additionally plug their minimum and maximum values. A one point increase in case of our sales categories corresponds to the next larger category, e.g. from Sales L to Sales XL. For other dummy variables the discrete change corresponds to a switch into the respective category other things equal.

Table 4.4 shows discrete changes in the predicted probabilities to choose a foreign subsidiary. Values are reported in percent and relate to the reference point of 96.10%, which corresponds to the probability of a foreign subsidiary of a typical investment in EU 15. Predictions are again based on specification (IV) in Table 4.2.

Table 4.4: Percentage changes in predicted probabilities

Change in explanatory variable	- 1	+ 1	Min	Max
Experience	-0.68	+ 0.59	- 4.72	+ 0.59
Cultural barriers	.	- 2.69	0	- 2.69
Corruption	.	- 1.41	0	- 1.41
R&D intensity	- 0.52	+ 0.46	- 1.24	+ 2.74
Investment intensity	+ 0.12	- 0.13	0	-12.41
Sales category	- 0.63	- 1.41	- 7.94	- 1.41

Change in the predicted probability relative to a typical investment. Values are based on specification (IV) in Table 4.2. All values are in percent.

We find that the explanatory variables have a considerable impact on the decision whether an investor chooses a foreign subsidiary or a joint venture. To illustrate the effect, we set R&D intensity to its maximum value, which is 11.8 percent of total production, and find that predicted probability increases by 2.64%. The size of this effect relates to the difference between an investor who has business relationships to three regions of the world instead of six. In this example, an investment by the less experienced firms is 2.41% less likely to be a subsidiary. Cultural barriers decrease the probability by 2.36%, corruption by 1.41%.

We conclude that experience and cultural barriers also have an economically significant impact on the mode of organization. The magnitude is similar to more standard determinants as, for example, R&D intensity.

Some of the control variables have even larger impacts. If a firm has sales below Euro 2.5 million its foreign investment in EU 15 is almost 8% less likely to be a subsidiary. Regional dummies hint to systematic differences between the host regions. Investments in Asia/Pacific are 10.97% less likely to be a subsidiary. In case of CIS/Russia the decrease equals 6.45%. Contrarily, investments in EU 10 are 2.07% more likely to be a foreign subsidiary. The two significant industry dummies relate to a decrease of 11.63% in case of chemicals, and a decrease of 3.83% in case of electronics.

4.5.6 Robustness

We do some robustness checks to see whether our main results persists if we modify the model specification.

First, we use a different measure for experience. Respondents state in the survey the firm's foreign sales in percent of total sales in the year 2004. This measure contains no information about the geographic scope of activities, yet it captures the importance of international business relationships to the firm. We rerun the five regressions replacing the number of active regions by the share of foreign sales in percent.[37] We find that this share also has a positive impact on the probability to choose a foreign subsidiary which is significant at the 1% level.[38]

Second, we estimate a probit model. The logit model assumes the error terms to be drawn from an extreme value distribution, while the probit model assumes the error terms to be normally distributed. Results for the main variables are provided in Table A.5 in the Appendix. Signs and significance levels of the coefficients basically remain unchanged in that alternative specification.

Last, we include service firms into the regression. To do so we need to drop R&D intensity because of missing data.[39] Experience, measured by the number of active regions, is not significant using a sample of 168 investment in service industries. However, we do not get contradicting results as the sign remains positive.

Further regressions including manufacturing and service firms suggest that the model does not capture the relevant determinants if service firms are included. Yet, they are not contrary to our finding that experience increases the probability to choose a foreign subsidiary.

Interestingly, the dummy on service firms is always negative and significant. The negative sign suggests that service firms make more use of joint ventures provided they invest abroad. In the next section, we investigate differences between manufacturing and service industries further and argue more generally that service firms cooperate more frequently with local partners either in the form of a joint venture or in form of a cooperation.

[37] Sample size further reduces due to missing values to 816 investment activities of 322 firms.

[38] If we use both measures of experience both coefficients are positive. The significance level of the number of regions drops, however, below 10%.

[39] R&D spendings are only available for the business service industry. Moreover, the rather low value of 0.1% does not seem to correspond to the use of intangible assets.

4.6 Additional results

In this section, we extend the analysis and raise two more questions. Do we observe differences between the service and the manufacturing sector? Do firms that invest differ from firms that trade? To answer these two questions we rely mainly on descriptive statistics. As mentioned before, our econometric model is not suited to appropriately describe the ownership decision of a service firm. We also lack key variables that influence the trade-off between trade and investment, e.g. distance and market size (Brainard, 1997). Nevertheless, these insights may still be valuable because little empirical work considers differences between service and manufacturing firms.

4.6.1 Manufacturing and services

First, we compare the relative prevalence of organizational choices in the manufacturing and the service sector. Table 4.5 displays absolute and relative numbers of organizational choices for manufacturing, services, and wholesale trade.

Table 4.5: Manufacturing vs. Services

	Manu-facturing	Services	Wholesale	Manu-facturing	Services	Wholesale
	abs.	abs.	abs.	%	%	%
Trade	4,543	657	1,020	65.18	56.11	72.34
Trade office	943	152	148	13.53	12.98	10.50
Partner	642	194	131	9.21	16.57	9.29
Joint venture	161	69	31	2.31	5.89	2.20
Subsidiary	681	99	80	9.77	8.45	5.67
No. of activities	6,970	1,171	1,410	100.00	100.00	100.00

Services comprise restaurants and hotels, financial services, business services, health care, and other public and personal services.

We see that an intermediate level of integration such as joint venture or loose cooperation is more likely in the service sector. Remarkably, only 9.2% of manufacturing activities involve a cooperation partner but 16.6% of service activities are organized in that way. Also joint ventures are more common in the service sector. Both observations hint to the fact that local knowledge is more relevant in service

sectors. Trading and trade offices contribute to more than 82% of wholesale trade activities. In this case, the industry classification also describes the major part of foreign activities.

Table 4.5 further reveals that service firms rely more on investments. Joint ventures and foreign subsidiaries account for 14% of foreign activities in the service sector, two percent more than in the manufacturing sector. Similarly, the difference in trade activities is around 10%. The descriptive statistics thus suggest that services are harder to trade and require local presence.

Next, we look at key characteristics of a general manager. The data contains information about (up to three) important criteria that were considered when hiring a general manager. Table 4.6 reports the means of a dummy variable that equals one if the respective criterion was tacked and zero otherwise. The table compares the mean values for manufacturing and services. The last column reports differences in means $\Delta\bar{x}$. Additionally, it contains the p-values of a t-test to see whether the difference in means is statistically significant. The null hypothesis is that there is no difference in means ($H_0 : \Delta\bar{x} = 0$), the alternative hypothesis is that the difference in means is not equal to zero ($H_1 : \Delta\bar{x} \neq 0$).

Table 4.6: Selection criteria - General manager

	Manufacturing	Services	
	Mean	Mean	Difference
Local networks	0.2899	0.3644	-0.0744
			(0.0243)
Market knowledge	0.2429	0.2429	-0.0000
			(0.9993)
Language skills	0.1641	0.1943	-0.0302
			(0.2629)
Cultural knowledge	0.0460	0.0850	-0.0391
			(0.0162)
Control	0.0613	0.0810	-0.0197
			(0.2670)
Number of firms	914	247	

$H_0 : \Delta\bar{x} = 0$, $H_1 : \Delta\bar{x} \neq 0$, p-values of in parentheses.

In the service sector cultural knowledge and local networks are more often

cited as a selection criterion for a general manager than in manufacturing. About 8.5% of all service firms mentioned cultural knowledge as a key criterion for hiring a general manager. In the manufacturing sector only 4.6% of the firms regard cultural knowledge as one of the major characteristics that a future manager should possess. Local networks are also more relevant in the service sector. 36% of all service firms named good contacts in the host country as a key criterion opposed to 29% of the manufacturing firms. While both differences are considerable in terms of magnitude, they are also statistically different at the 5%-level.

So far, we found two pieces of evidence. First, cooperations and joint ventures are more likely in the service sector. Second, local networks and knowledge about the local culture matter more in the service sector.

We do a last exercise to explore differences between service and manufacturing industries. We explore corruption, contracting difficulties, and cultural barriers as described in Section 4.5.1. Analogously, we create two further dummy variables. The variable quality relates to "quality of goods and services abroad" as a main problem when establishing international business relationships. The variable patents relates to "legal protection (patents and trademarks)".[40] Again we report mean values and perform a t-test to see whether means are statistically different for manufacturing and services.

The categories in Table 4.6 and Table 4.7 relate closely to the empirical work by Brouthers and Brouthers (2003) about Western European investments in CEEC.[41] They argue in their study that service firms are especially prone to what they name behavioural risk. Their measure of behavioural risk relates to (i) costs of writing and enforcing contracts, (ii) monitoring and controlling quality, and (iii) dissemination of proprietary knowledge.

Our explorative results do not support the idea that writing and enforcing contracts or the dissemination of proprietary knowledge is more relevant in the service industry than in the manufacturing industry. On contrary, an even smaller proportion of firms names contracting and patent or trademark protection as a main problem. Quality and control, on the other hand, are named more often by firms in the service sector. However, means are statistically not different from each other.

[40] As for culture, contracts, and corruption the dummy equals one if the firm named a problem to be large (3) or very large (4) and zero otherwise.

[41] The study is based on 103 Dutch, 74 German, and 50 British firms.

Table 4.7: Main problems establishing business relationships

	Manufacturing	Services	
	Mean	Mean	Difference
Quality	0.0550	0.0729	-0.0182
			(0.2810)
Patents	0.1379	0.1174	0.0204
			(0.9993)
Contracts	0.1039	0.0931	0.0108
			(0.6179)
Cultural barriers	0.0569	0.0810	-0.0241
			(0.1641)
Number of firms	914	247	

$H_0 : \Delta\bar{x} = 0$, $H_1 : \Delta\bar{x} \neq 0$, p-values of in parentheses.

Three pieces of evidence thus suggest that local knowledge matters more in the service than in the manufacturing sector. Joint ventures and cooperations are more likely to be chosen in the service sector. Local networks and cultural knowledge are especially relevant when selecting general managers in service firms. Last, alternative explanations such as the legal system or property rights protection do not seem to explain differences between the two sectors.

4.6.2 Trade and Investment

The second question we pose in this section is, what are the determinants of trade and investment activities? To answer this question we would like to estimate a nested logit model or a multinomial model that relaxes the independence of irrelevant alternatives assumption.

In a nested model firms first decide whether to trade or to invest. In a second step trading firms choose between the different subcategories whereas investing firms choose between joint venture and foreign subsidiary. The decision between joint venture and foreign subsidiary in the second stage is identical to the econometric analysis in Section 4.5. Yet, to estimate the complete decision tree we need alternative-specific data.

To illustrate what is meant by alternative specific data think of the popular

example of a commuter choosing between travelling by car or by bus. In that case, we have information about alternative choices. This means that even if a person travels by car, we know what the price for a bus ticket would have been. Such information is not available in our case.

This example is also suited to explain the independence of irrelevant alternatives (IIA). In a multinomial logit model the relative probability to travel by car instead of taking the bus is not affected by a third choice. This implication is clearly not desirable if we introduce very similar choices. Suppose that a commuter is equally likely to travel by bus or by car. The relative odd ratio between both alternatives is therefore equal to $\frac{1/2}{1/2} = 1$. If we introduce a third alternative, e.g. a red bus, IIA implies that this ratio remains constant. It follows, provided commuters do not care about colors, that the probability of each mode falls to $1/3$.[42]

In our case, the independence of irrelevant alternatives is questionable if we consider joint venture and foreign subsidiary to be similar investment modes. Suppose that the investor chooses between export, joint venture and foreign subsidiary. If investors decide to trade or to invest and do not care about the actual mode of investment, its color so to speak, we should group joint venture and subsidiaries into a single category.

Theoretically, it is possible to relax the assumption. The multinomial probit model is identified if we fix one entry in the covariance matrix and a base category; no alternative-specific data is needed for that. In practice, however, Keane (1992) shows that the estimation is very fragile if such information is missing.[43]

We therefore estimate a binary logit model which allows for trade and investment as outcomes. The less this decision depends on the specific alternatives that are available the more reliable are the results.

The dependent variable is a dummy which equals one in case of an investment activity and zero in case of a trade activity. Investment activities comprise joint ventures and wholly owned subsidiaries. Trade activities comprise import, export, sourcing/ purchase, representative/ sales office, and loose cooperation partner.

We use the same explanatory variables as in the decision between joint venture and foreign subsidiary. In doing so, we miss several determinants which are com-

[42]This example is taken from Wooldridge (2002).

[43]Note that the Stata command `mprobit` fixes the covariance matrix to be unity and thus does not allow error terms to be correlated.

monly used in the literature. We would like to include, for example, a country's gross domestic product and the distance between Germany and the host country. Brainard (1997) shows that distance and market size influence the relative prevalence of investments over export. We would also like to include firm productivity as proposed by Helpman et al. (2004). Due to that missing variables we should be careful in interpreting the results. The coefficients rather hint to correlations than to a causal relationship between independent and dependent variables.

In this regression, we exclude the self-reported measures of culture, corruption, and legal conditions. Comparing trade and investments we consider the endogeneity problem as severe. Firms investing abroad are likely to have at least similar perceptions of these problems independent of the mode of organization that is chosen. Firms that trade, however, are clearly less exposed to the foreign culture or the legal system than firms that invest.

Table 4.8 reports the estimation results. The first four columns only include the manufacturing sector. The last column only includes service sector firms.

International experience, measured by the number of regions in which a firm operates, is not significant for manufacturing firms neither with and nor without industry fixed effects (see columns (A) and (B)).

The alternative measure of experience, which is the share of foreign over total sales, has a positive effect on the probability that an investment is chosen. This result may be little surprising. Interestingly, the effect remains if we include a dummy which equals one if the firm states that it "shifted production abroad".[44] This means that controlling for foreign production we still find that firms serving the world market are likely to invest abroad. This finding strongly supports the assumption in Chapter 2 that foreign sales also require local sales activities.

Overall, R&D intensity and firm size increase the probability of foreign investment. The positive impact of R&D intensity is in line with the idea that multinational firms exist because they posses some knowledge capital which is used within the multinational enterprise and has a joint-input property across different production plants (Markusen, 2002). These assets give raise to economies

[44]We also run regressions (C) and (D) including a dummy which equals one if production is shifted abroad and zero otherwise. The dummy is positive and significant. The coefficient on the share of foreign sales remains significant and positive without industry dummies in that alternative specification. The significance level drops below 10% but remains positive if industry dummies are included.

Table 4.8: Trade vs Investment

Variable	(A)	(B)	(C)	(D)	(E)
Experience	0.046	0.024			-0.231***
(No. of regions)	(0.029)	(0.030)			(0.074)
Experience			0.004**	0.004*	
(Foreign sales in %)			(0.002)	(0.002)	
R&D	0.039*	0.069*	0.043*	0.071**	
	(0.023)	(0.035)	(0.023)	(0.036)	
Investment	0.002	0.000	0.003	0.001	-0.013
	(0.006)	(0.008)	(0.006)	(0.008)	(0.014)
Sales S	-1.859***	-1.896***	-1.922***	-1.923***	-2.027***
	(0.221)	(0.222)	(0.222)	(0.223)	(0.589)
Sales M	-0.984***	-1.022***	-1.018***	-1.037***	-1.921***
	(0.104)	(0.107)	(0.104)	(0.105)	(0.523)
Sales XL	0.410***	0.495***	0.461***	0.495***	0.534
	(0.141)	(0.126)	(0.133)	(0.132)	(0.551)
Constant	-1.897***	-1.980***	-1.861***	-2.039***	0.701
	(0.189)	(0.251)	(0.145)	(0.213)	(0.712)
Industry dummies	no	yes	no	yes	no
No. of observations	6970	6970	6753	6753	923
No. of firms	820	820	789	789	158
Log Likelihood	-2376.777	-2358.679	-2294.52	-2280.59	-338.6291
Pseudo R^2	0.0747	0.0817	0.0782	0.0838	0.1264

Logit estimates (Investment=1, Trade=0). Robust standard errors in parentheses and adjusted for firm clusters. Reference group for sales dummies is Sales L. Sales are measured in millions of Euro. Sales S: < 2.5, Sales M: $2.5 - 25$, Sales L: $25 - 250$, Sales XL: > 250. Region dummies are included in all specifications. McFadden's R^2 is reported, also known as likelihood-ratio index. ***, **, and * denote significance at the 1, 5, and 10 percent levels, respectively.

of scale within firms. The higher these economies of scale are, the more likely are firms to be multinational. This concept is also known from Hymer (1976) who proposes firm specific advantages as a major reason why multinational firms exist. Note that R&D intensity is obtained on the industry level. The positive coefficient may partially reflect a comparative advantage of these industries. Yet, such an advantage could also be exploited via trade relationships.

Size seems to play a bigger role in the choice between exporting and investing abroad than in the choice between joint venture and foreign subsidiary as all size dummies are highly significant. The positive impact of size hints to the presence of fixed costs that are related to foreign investments as proposed by Antràs and Helpman (2004).

Size and productivity are not independent. The results may be interpreted in the way that more productive firms have higher sales and that we ultimately capture differences in productivity. However, other empirical work shows that the size effect persists even if we control for productivity. Moreover, productivity effects even become insignificant in Raff et al. (2006) when controlling for size. Similarly, Head and Ries (2003) conclude that size effects are much stronger than those of productivity. For this reason we do not think that the positive coefficient on size is primarily driven by unobserved productivity differences.

Column (E) in Table 4.8 reports the regression results if we only consider service firms instead of manufacturing firms. We exclude R&D intensity as a regressor because of missing information.

Size still has a significant impact, yet no significance difference can be found between large and very large firms. The reason may be that sales is not an appropriate proxy for size in case of service firms.

The negative and significant coefficient on the number of regions in which a firm operates caught us by surprise. It indicates that firms which provide or obtain services from many different countries are less likely to invest abroad. The sample size is considerably smaller than in case of manufacturing firms which reduces the explanatory power. We also question that result because Brouthers and Brouthers (2003) found a positive sign for previous experience in the host region for both sectors manufacturing and services.

In an unreported regression we repeat the estimation based on a combined sample of service and manufacturing activities. We find a positive and significant

impact of a service firm dummy on the probability to invest abroad. This indicates that foreign investments are needed in order to provide services. This result also relates to the observation that trade accounts for 56% in service industries, and 65% in manufacturing industries.

Taken both observations together we may speculate that there exist few services which do not require foreign investments and only those activities are provided globally. In any case, these results underline that the model does not adequately describe the behaviour of service firms.

The coefficient on capital intensity is not significant. We also do not obtain significant results if we use the net capital stock over employees instead.[45]

Industry dummies show that firms in the plastics industry are more likely to invest abroad, also firms in the chemical industry seem to rely more on foreign investments than trade. We also find slight evidence on a negative coefficient for transport equipment, including car manufacturers. Industry dummies are reported in Table A.7 in the Appendix.

Concerning regions, investment is especially relevant in the US/Canada, a negative impact is found for Russia/ CIS and Africa. The positive coefficient on North America is in line with the idea that investments are especially profitable in countries that have large markets and are distant to Germany (Brainard, 1997). Regional dummies are reported in Table A.7 in the Appendix.

To summarize, R&D intensity makes investments more likely which may reflect firm specific advantages. Size effects are considerable and point to fixed costs of foreign investment. The geographic scope of operations has no significant impact on the investment choice of manufacturing firms. However, firms that sell a larger fraction on the world market also tend to invest abroad. This result supports the idea that foreign sales require foreign investments to provide e.g. technical support. Service firms seem to be more likely to invest abroad than manufacturing firms which suggests, just as the results in Section 4.6.1, that local support is even more important in the service sector.

[45]Helpman et al. (2004) find no empirical evidence for R&D intensity to influence exports relative to sales via foreign direct investments. Capital intensity, however, leads to relatively less exports.

4.7 Conclusion

Our econometric analysis of multinational activities of German firms located in Bavaria and Baden-Wuerttemberg addresses one main question. Which determinants shape the decision of a multinational investor to operate a foreign subsidiary or to operate a foreign joint venture?

We find that experience has a positive and significant impact on the probability that an investor integrates foreign operations in a subsidiary. This finding is in line with our theoretical predictions. A positive impact is found independent of the measure of experience. Firms that operate in many world regions are more likely to integrate foreign activities as well as firms that have a high share of foreign sales.

As expected, cultural barriers and legal uncertainty both have a negative and significant effect on the probability that an investor integrates foreign production. The results thus support our main hypotheses that investors cooperate with local partners to benefit from their local expertise.

Considering differences between manufacturing and service industries we provide evidence that services are more difficult to trade. The participation of a local partner, either in form of a cooperation or in form of a joint venture, seems to be more valuable than in the manufacturing sector. Furthermore, service firms are less likely to trade and more likely to invest abroad compared with manufacturing firms.

The decision between trade and investment is considerably influenced by firm size. The effect can also be observed if we compare relatively large firms. Furthermore, investing firms tend to be R&D intensive which hints to the fact that these firms posses some sort of proprietary knowledge, or knowledge capital. International experience does not seem to play a major role in that decision.

Several lines of future research and suggestions for future survey design emerge. First, it would be desirable to extend the study to all of Germany. Second, particularities of service firms, e.g. high cultural barriers, deserve a closer inspection. A promising line of future research may be to investigate specific service industries. Last, the different mechanisms of the theoretical models should be tested to see which transmission channels are the most relevant. The empirical literature on vertical integration in a national context may serve as a source of inspiration.

Considering the survey design the country classification should be reconsidered.

The current structure combines very diverse countries such as Japan and China. Tracking firms over time would allow to study the dynamic behaviour of the firms and to sort out some of the endogeneity issues. In practice, however, identification numbers are not stored in the data base but are generally available.

Chapter 5

Summary

To summarize, the thesis starts with the idea that costs of doing business abroad influence the investment strategy of multinational firms. A first theoretical model shows that these costs may lead to a situation in which the effect of distance on horizontal investment strategies is no longer linear as is commonly assumed in the literature. Furthermore, we provide a reasoning why marketing-intensive firms produce close to their customers. Next, we argue that multinational firms actually learn about the foreign business environment. The idea is captured by a second theoretical model in which we assume that a multinational firm faces uncertainty about the monitoring scope which is resolved over time. The model predicts that firms initially tend to choose outsourcing and switch to more integrated modes of production after gaining international experience. Last, we provide empirical support for both models by investigating foreign activities of German firms. The results indicate that (i) firms enter joint ventures if costs of doing business abroad are high and (ii) integrate foreign operations if they are internationally experienced.

Appendix A

A.1 Appendix to Chapter 2

A.1.1 Payoff functions

First, we derive the payoff function in case of wholly owned subsidiaries. We set specific distances for each activity d_m, d_p, and d_t. First order conditions imply:

$$p_1 = \left(\frac{R(1-\beta)(1-\gamma)}{d_p}\right)^{1/2} \quad m_1 = \left(\frac{R\beta}{d_m}\right)^{1/2} \quad t_1 = \left(\frac{R\gamma(1-\beta)}{d_t}\right)^{1/2} \tag{A.1}$$

Solving for the equilibrium revenue level R^* yields

$$R^* = \left(\frac{\beta}{d_m}\right)^{\beta} \left(\frac{(1-\beta)(1-\gamma)}{d_p}\right)^{(1-\beta)(1-\gamma)} \left(\frac{\gamma(1-\beta}{d_t}\right)^{\gamma(1-\beta)} .$$

Substitution directly leads to the equilibrium payoff level for wholly owned subsidiaries:

$$\Pi^*_{\text{WOS}} = \frac{1}{2}\left(\frac{\beta}{d_m}\right)^{\beta} \left(\frac{(1-\beta)(1-\gamma)}{d_p}\right)^{(1-\beta)(1-\gamma)} \left(\frac{\gamma(1-\beta)}{d_t}\right)^{\gamma(1-\beta)} \tag{A.2}$$

The payoff function in case of export is obtained by setting $d_t = 1$, $d_m = 1 + d$, and $d_p = 1$. In case of WOS HDI we replace $d_p = \frac{(1+d)}{\delta}$ to additionally allow for production cost differences.

Next, we derive the equilibrium payoff functions if a joint venture is chosen. The investor and the partner choose input levels simultaneously and take the ownership share α as given.

In case of JV HDI first order conditions imply:

$$p_2 = \left(\frac{(1-\alpha)R(1-\beta)(1-\gamma)}{d_p}\right)^{1/2} \quad m_2 = \left(\frac{(1-\alpha)R\beta}{d_m}\right)^{1/2} \quad t_1 = \left(\frac{\alpha R\gamma(1-\beta)}{d_t}\right)^{1/2} \tag{A.3}$$

In case of JV Export we obtain:

$$p_1 = \left(\frac{\alpha R(1-\beta)(1-\gamma)}{d_p}\right)^{1/2} \quad m_2 = \left(\frac{(1-\alpha)R\beta}{d_m}\right)^{1/2} \quad t_1 = \left(\frac{\alpha R\gamma(1-\beta)}{d_t}\right)^{1/2} \tag{A.4}$$

In the next step we can derive equilibrium revenue levels R^* that depend on the ownership share α. The investor then chooses α as to maximize her payoff. The solution of $\max_\alpha \Pi^1(\alpha, \cdot)$ yields optimal ownership levels α^*.

$$\alpha^*_{\text{JV HDI}} = \frac{1+\gamma(1-\beta)}{2} \qquad \alpha^*_{\text{JV Export}} = \frac{1+\gamma(1-\beta)+(1-\beta)(1-\gamma)}{2} \tag{A.5}$$

Plugging optimal ownership into R^* yields optimal payoff levels that only depend on sector characteristics. In case of JV Export these are $\frac{1}{4}\beta^\beta(2-\beta)^{2-\beta}(1+\beta)\Pi_{\text{WOS}}$, where $d_t = 1+d$, $d_m = 1$, and $d_p = 1$. In case of JV HDI these are $\frac{1}{4}(\beta+(1-\beta)(1-\gamma))^{(\beta+(1-\beta)(1-\gamma))}(1+\gamma(1-\beta))^{(1+\gamma(1-\beta))}(2-(\gamma(1-\beta))\Pi_{\text{WOS}}$, where $d_t = 1+d$, $d_m = 1$, and $d_p = 1/\delta$.

A.1.2 Low technology industries

Proof of Proposition 1 There exists always a δ above which foreign production is optimal. Obviously, in the limit foreign production leads to infinitely high payoffs as $\lim_{\delta\to\infty}\Pi_{\text{HDI}} = \infty$. Similarly, as δ approaches zero $\lim_{\delta\to 0}\Pi_{\text{HDI}} = 0$. Hence, we find a δ small enough to make exporting more profitable.

Furthermore, comparing WOS HDI and WOS Export we see that the former dominates the latter if $\delta > 1+d$. It is also possible to show that joint ventures are dominated by wholly owned subsidiaries if $d < 1$ and $\delta < 2$. Hence, there exists a region $\delta \in (1,2)$ in which firms choose WOS HDI if $d < \delta - 1$ and WOS Export if $d > \delta - 1$ and $d < 1$. Next, we show that if d is large enough, there exists a critical $\hat{\delta} < 2$ such that JV HDI is optimal.

If distance is large enough joint ventures are optimal because $\lim_{d\to\infty}\Pi_{\text{WOS}} = 0$. We are left to show that JV HDI is optimal somewhere in the range $1 < \delta < 2$. Therefore, we compare JV Export and JV HDI. We find that JV HDI yield higher

payoffs if $\delta > \hat{\delta}$.

$$\hat{\delta} = \left(\frac{1}{2}\beta^{\beta}(2-\beta)^{(2-\beta)}(1+\beta)\right)^{\frac{1}{(1-\beta)}}$$

The examination of the threshold value $\hat{\delta}$ shows that it decreases in β. This can be seen by investigating the logarithmic transformation $\ln(\hat{\delta})$.

$$\frac{d\ln(\hat{\delta})}{d\beta} = \frac{1}{(1+\beta)(1-\beta)^2}\left((1+\beta)\ln\left(\frac{1}{2}\beta(2-\beta)(1+\beta)\right)+1-\beta\right)$$

The derivative is negative if the following condition holds.

$$\underbrace{-\ln(2)+\ln(\beta)+\ln(2-\beta)+\ln(1+\beta)+\frac{1-\beta}{1+\beta}}_{:=l(\beta)} < 0$$

The left hand side $l(\beta)$ strictly increases in the relevant parameter space. This can be seen by investigating the first derivative $\frac{dl(\beta)}{d\beta} = \frac{(1-\beta)(3\beta^2+2\beta+2)}{\beta(2-\beta)(1+\beta)^2}$. The left hand side, in the limit, approaches its maximum value $l(1) = 0$ from below and is strictly negative in the range $\beta \in (0,1)$. Going all the way back we have shown that $\frac{d\hat{\delta}}{d\beta} < 0$. Last, we find that in the limit $\lim_{\beta\to 0}\hat{\delta} = 2$. Hence, non-linearity can be observed for all $\delta \in (\hat{\delta}, 2)$.

Proof of Proposition 2 The investor prefers JV Export to WOS Export if $d > \hat{d}$.

$$\hat{d} = \left(\frac{4}{(2-\beta)(1-\beta)^{1-\beta}(1+\beta)^{1+\beta}}\right)^{\frac{1}{1-\beta}} - 1$$

We investigate the monotone transformation $\ln(\hat{d}+1)$ to show that $\frac{d\hat{d}}{d\beta} < 0$.

$$\frac{d\ln(\hat{d}+1)}{d\beta} = \frac{-1}{\beta^2(1+\beta)}\left(\ln\left(4^{(1+\beta)}(2-\beta)^{-2(1+\beta)}(1+\beta)^{-1-\beta)}\right)+\beta\right)$$

The derivative is negative if

$$\begin{aligned}
\ln\left(4^{(1+\beta)}(2-\beta)^{-2(1+\beta)}(1+\beta)^{-1-\beta)}\right) &> -\beta \\
\Rightarrow \ln\left(4^{(1+\beta)}(2-\beta)^{-2(1+\beta)}(1+\beta)^{-1-\beta)}\right) &> 0 \quad (> -\beta) \\
(1+\beta)(2-\beta)^2 &< 4 \\
\beta^2(\beta-3) &< 0
\end{aligned}$$

As $\beta - 3$ is negative, it follows that $\frac{d\ln(\hat{d}+1)}{d\beta} < 0$ and finally that $\frac{d\hat{d}}{d\beta} < 0$. Hence, the critical value above which an investor chooses JV Export instead of WOS Export decreases as the marketing intensity of an industry increases. Next, we show that the critical distance above which an investor chooses JV HDI instead of WOS Export also decreases in β. The investor chooses JV HDI instead of WOS Export if $d > \tilde{d}$.

$$\tilde{d} = \left(\frac{2}{\delta^{(1-\beta)}}\right)^{\frac{1}{\beta}} - 1$$

The derivative of the logarithmic transformation $\ln(\tilde{d}+1)$ is negative as

$$\frac{\partial \ln(\tilde{d}+1)}{\partial \beta} = \frac{1}{\beta^2} \ln\left(\frac{\delta}{2}\right) < 0, \qquad 0 < \delta < 2.$$

It follows that in the relevant parameter space, $\delta < 2$, JV HDI becomes more likely relative to WOS Export as the marketing intensity β of an industry increases.

We already know that $\frac{\partial \hat{\delta}}{\partial \beta} < 0$ and are left to show that the crucial production cost difference above which JV HDI yields a higher payoff than WOS Export also increases in marketing intensity β. The crucial value $\tilde{\delta} = \left(\frac{2}{(1+d)^{\beta}}\right)^{\frac{1}{1-\beta}}$ results from the same implicit function as $\tilde{d}$ and its derivative is also negative.

$$\frac{\partial \ln(\tilde{\delta})}{\partial \beta} = \frac{1}{(1-\beta)^2} \ln\left(\frac{2}{1+d}\right) < 0, \quad \forall d > 1$$

We already know that $\frac{d\hat{\delta}}{d\beta} < 0$.

A.1.3 Impact of technology

Feasibility of joint ventures WOS Export dominates JV Export if $\gamma(1-\beta) > \beta$. The reason is that the necessary condition $(1+d)^{-(\beta-\gamma(1-\beta)} \geq 1$ $(\geq \frac{\theta_1}{4})$ always holds in the relevant parameter space. Note that $\max_{\beta\in(0,1)} \theta_1 = 4$.

Furthermore, WOS HDI dominates JV HDI if $\gamma(1-\beta) > 1/2$. The reason is that the necessary condition $(1+d)^{-(1-2\gamma(1-\beta))} \geq 1$ $(\geq \frac{\theta_2}{4})$ holds in the relevant parameter space. Note that $\max_{\beta,\gamma\in(0,1)} \theta_2 = 4$.

Moderate technology intensity Next, we consider cases in which JV Exports are feasible. JV HDI dominates JV Export if cost differences exceed $\hat{\delta}$ which

is implicitly defined by

$$\hat{\delta}^{(1-\beta)(1-\gamma)} = \frac{\theta_1}{\theta_2} \ ,$$

where $\theta_1 = \beta^\beta(2-\beta)^{2-\beta}(1+\beta)$, and $\theta_2 = (2-\gamma(1-\beta))\,(1+\gamma(1-\beta))^{1+\gamma(1-\beta)}(1-\gamma(1-\beta))^{1-\gamma(1-\beta)}$. The crucial production cost difference $\hat{\delta}$ increases in γ which can be seen from the derivative of the logarithmic transformation.

$$\frac{\partial \ln(\hat{\delta})}{\partial \gamma} =$$
$$\frac{1}{(1-\gamma)^2(1-\beta)(2-\gamma(1-\beta))}$$
$$[\ln\left(\frac{\theta_1}{\theta_2}\right)^{2-\gamma(1-\beta)} + \ln\left(1-\gamma(1+\beta)\right)^{(1-\gamma)(1-\beta)(2-\gamma(1-\beta))}$$
$$+\ln\left(1+\gamma(1+\beta)\right)^{-(1-\gamma)(1-\beta)(2-\gamma(1-\beta))} + (1-\beta)(1-\gamma)] \geq 0 \qquad \forall \beta, \gamma \in (0,1)$$

Hence, less foreign production is observed as technology intensity increases in case of joint ventures. JV Export dominates WOS Export if distance exceeds $\hat{d} = \left(\frac{4}{\theta_1}\right)^{\frac{1}{\beta-\gamma(1-\beta}})$.

The crucial distance above which JV Export is optimal increases in γ.

$$\frac{\partial \ln(\hat{d}+1)}{\partial \gamma} = \frac{1-\beta}{(\beta-\gamma(1-\beta))^2} \underbrace{\ln\left(\frac{4}{\theta_1}\right)}_{>1} > 0 \qquad \forall \beta, \gamma \in (0,1)$$

Hence, less joint ventures are observed as technology intensity increases in case of exporting.

JV HDI dominates WOS HDI if distance exceeds $\bar{d} = \left(\frac{4}{\theta_2}\right)^{\frac{1}{1-2\gamma(1-\beta)}} - 1$.

The crucial distance $\bar{d}$ in case of technology intensive industries is larger than one which is the threshold value in case technology is not relevant. Hence, less joint ventures are observed as technology intensity increases in case of horizontal investments.

Next, we compare the payoff functions in case of WOS Export and JV HDI. JV HDI yields higher payoffs than WOS Export if distance exceeds $\tilde{d} = \left(\frac{4}{\delta^{(1-\beta)(1-\gamma)}\theta_2}\right)^{\frac{1}{\beta-\gamma(1-\beta)}} - 1$.

Proof of Proposition 3 In case of high technology, i.e. if $\gamma(1-\beta) > \beta$, JV Export is dominated by WOS Export. JV HDI may still occur as long as $\gamma(1-\beta) < \frac{1}{2}$. The crucial difference is that the exponent of $\tilde{d}$ turns out to be negative in these cases. Therefore, we find that WOS Export yields higher payoffs than JV HDI if distance *exceeds* $\tilde{d}$. In this case, distance has an overall negative

effect on joint ventures. However, even if the overall effect is negative there exists a range in which JV HDI is optimal for intermediate ranges for distances $d \in (\bar{d}, \tilde{d})$ if production cost advantages δ are larger than $\bar{d} + 1$.

A.2 Appendix to Chapter 3

Proof to Assumption 2 Assumption 2 is necessary to make outsourcing a viable option. The reason is that the axis intercept of $\Pi^V_{|e_m=1,e_n=0}$ is not less than the one of Π^O. Consequently, Π^O is only viable if its slope is steeper than the slope of $\Pi^V_{|e_m=1,e_n=0}$.

We show this by contradiction. If the axis intercept of integration is larger than the one of outsourcing this requires

$$\begin{aligned} -\delta\psi - c &< -\frac{\bar{\pi}}{\Delta\pi}\psi + l - c \\ \left(\frac{\bar{\pi}}{\Delta\pi} - \delta\right)\psi &< l \\ \underbrace{\frac{\bar{\pi}(1-\delta)}{\Delta\pi}}_{>0} &< \underbrace{l - \frac{\underline{\pi}}{\Delta\pi}\psi}_{<0} \end{aligned}$$

The right hand side of the above inequality is negative because of Assumption 1 while the left hand side is positive. Hence, the inequality can never be fulfilled. It follows that $\Pi^V_{(1,0)}$ dominates Π^O if Assumption 2 does not hold because the slope of the former is steeper in that case.

Comparative static results Assumption 2 guarantees that Π^O_F has a steeper upward slope than Π^V_H. As profits are linear in R we only observe in-house production if $l - c_F - \frac{\bar{\pi}\psi}{\Delta\pi} < -\delta_H\psi - c_H$. It follows that $-\delta_H\psi - \Delta c - l + \frac{\bar{\pi}\psi}{\Delta\pi} > 0$ and, consequently, that the partial derivative $\frac{\partial R_A}{\partial \rho_F}$ is negative.

A.3 Appendix to Chapter 4

A.3.1 Country classification

Former European Union member states (EU 15) comprise the following countries: Austria, Belgium, Denmark, Finland, France, Germany, Greece, Ireland, Italy, Luxembourg, Netherlands, Portugal, Spain, Sweden, and United Kingdom.

New European member states (EU 10) comprise the Czech Republic, Cyprus, Estonia, Latvia, Lithuania, Hungary, Malta, Poland, Slovenia and Slovakia. Candidate countries include Bulgaria, Romania and Turkey plus Croatia. North America includes United States and Canada.

A.3.2 Summary statistics

Table A.1: Summary statistics

Name	Mean	Std. Dev.	Min.	Max.
WOS	0.8087886	0.3934889	0	1
Experience	5.668646	1.605783	1	7
Culture	0.3064133	0.4612775	0	1
Corruption	0.3729216	0.4838689	0	1
Contract	0.2969121	0.4571690	0	1
R&D	2.906295	2.930506	0.10	11.80
Capital	58.76589	34.12473	31.80556	384.1667
Investment	15.57209	10.32629	9.8	56.6
EU 15	0.2505938	0.4336126	0	1
EU 10	0.1555819	0.3626740	0	1
CIS / Russia	0.0653207	0.2472377	0	1
US / Canada	0.2007126	0.4007715	0	1
Asia / Pacific	0.2114014	0.4085451	0	1
Latin America	0.0771971	0.2670626	0	1
Africa	0.0391924	0.1941678	0	1

Summary statistics are provided for the 842 observations that enter the regression and not the complete data set.

Table A.2: Summary statistics - Continued

Name	Mean	Std. Dev.	Min.	Max.
Sales S	0.0356295	0.1854747	0	1
Sales M	0.2874109	0.4528238	0	1
Sales L	0.5023753	0.5002915	0	1
Sales XL	0.1745843	0.3798368	0	1
Textile	0.0320665	0.1762815	0	1
Chemistry	0.067696	0.2513728	0	1
Plastics	0.0950119	0.2934056	0	1
Metal	0.1223278	0.3278588	0	1
Machinery	0.2969121	0.457169	0	1
Transport	0.0605701	0.2386818	0	1
Paper	0.0344418	0.1824695	0	1
Electronic	0.2137767	0.4102147	0	1
Furniture	0.0344418	0.1824695	0	1
Other	0.0427553	0.2024253	0	1

Summary statistics are provided for the 842 observations that enter the regression and not the complete data set. Sales are measured in millions of Euro. Sales S: < 2.5, Sales M: $2.5 - 25$, Sales L: $25 - 250$, Sales XL: > 250.

A.3.3 Estimation results

Table A.3: Joint venture vs Foreign subsidiary - Regions

Variable	(I)	(II)	(III)	(IV)	(V)
EU 10	0.732**	0.747**	0.758**	0.781***	0.782***
	(0.314)	(0.309)	(0.308)	(0.302)	(0.300)
CIS / Russia	-1.031***	-1.112***	-0.963***	-1.046***	-1.092***
	(0.310)	(0.334)	(0.320)	(0.339)	(0.345)
US / Canada	0.123	0.063	0.136	0.068	0.055
	(0.244)	(0.249)	(0.246)	(0.251)	(0.253)
Asia / Pacific	-1.334***	-1.453***	-1.339***	-1.460***	-1.488***
	(0.219)	(0.234)	(0.224)	(0.234)	(0.236)
Latin America	-0.258	-0.448	-0.264	-0.466	-0.481
	(0.379)	(0.389)	(0.380)	(0.392)	(0.395)
Africa	-0.674	-0.728*	-0.627	-0.695*	-0.718*
	(0.410)	(0.401)	(0.389)	(0.396)	(0.391)

Logit estimates (Foreign subsidiary=1, Joint venture=0). Robust standard errors in parentheses. ***, **, and * denote significance at the 1, 5, and 10 percent levels, respectively. Reference group is EU 15.

Table A.4: Joint venture vs Foreign subsidiary - Industries

Variable (I)	(II)	(III)	(IV)	(V)
Textiles	0.150		-0.121	-0.043
	(0.684)		(0.669)	(0.664)
Paper	0.653		0.656	0.759
	(0.703)		(0.696)	(0.724)
Chemicals	-0.814*		-0.786**	-0.847**
	(0.441)		(0.395)	(0.387)
Plastics	-0.354		-0.355	-0.300
	(0.497)		(0.472)	(0.459)
Metal	0.602		0.594	0.650
	(0.531)		(0.499)	(0.489)
Machinery	0.796**		0.725**	0.755**
	(0.400)		(0.368)	(0.372)
Transport	-0.223		-0.147	-0.172
	(0.487)		(0.471)	(0.440)
Furniture	0.574		0.504	0.530
	(0.636)		(0.628)	(0.656)
Other	-1.034		-1.040	-1.070*
	(0.690)		(0.646)	(0.646)

Logit estimates (Foreign subsidiary=1, Joint venture=0). Robust standard errors in parentheses. ***, **, and * denote significance at the 1, 5, and 10 percent levels, respectively. Reference group is manufacture of electrical and optical equipment.

Table A.5: Joint venture vs Foreign subsidiary - Probit

Variable	(I)	(II)	(III)	(IV)	(V)
	basicNo	basic	corrNo	corr	cont
Experience	0.094**	0.093**	0.094**	0.094**	0.093**
	(0.044)	(0.044)	(0.046)	(0.045)	(0.044)
R&D	0.071*	0.074	0.077**	0.075	0.075
	(0.038)	(0.049)	(0.037)	(0.047)	(0.047)
Investment	-0.025***	-0.018	-0.026***	-0.020*	-0.018*
	(0.009)	(0.011)	(0.009)	(0.011)	(0.011)
Sales S	-0.609**	-0.664**	-0.660**	-0.706**	-0.719**
	(0.290)	(0.284)	(0.294)	(0.286)	(0.293)
Sales M	-0.146	-0.106	-0.132	-0.101	-0.109
	(0.168)	(0.166)	(0.168)	(0.167)	(0.166)
Sales XL	-0.134	-0.147	-0.196	-0.211	-0.175
	(0.175)	(0.195)	(0.181)	(0.199)	(0.193)
Culture			-0.322**	-0.324**	-0.313**
			(0.140)	(0.140)	(0.143)
Corruption			-0.260*	-0.184	
			(0.135)	(0.129)	
Contracts					-0.236*
					(0.139)
Constant	0.846***	0.674*	1.074***	0.923***	0.896***
	(0.286)	(0.345)	(0.300)	(0.345)	(0.341)
No. of obs.	842	842	842	842	842
Log likelihood	-369.6369	-351.2922	-361.1782	-345.1246	-344.3678
Pseudo R^2	.1003659	.145014	.120953	.1600248	.1618666

Probit estimates (Foreign subsidiary=1, Joint venture=0). Robust standard errors in parentheses. ***, **, and * denote significance at the 1, 5, and 10 percent levels, respectively. Adjusted for 334 firm clusters. McFadden's R^2 is reported, also known as likelihood-ratio index. Reference group for sales dummies is Sales L.

A.3.4 Trade and investment

Table A.6: Trade vs Investment - Regions

Variable	(A)	(B)	(C)	(D)	(E)
EU 10	-0.079	-0.080	-0.097	-0.101	0.421*
	(0.091)	(0.092)	(0.091)	(0.092)	(0.231)
CIS / Russia	-0.543***	-0.535***	-0.508***	-0.514***	0.265
	(0.133)	(0.135)	(0.134)	(0.136)	(0.273)
US / Canada	0.420***	0.422***	0.419***	0.412***	0.120
	(0.071)	(0.071)	(0.072)	(0.071)	(0.248)
Asia / Pacific	0.126*	0.138*	0.113	0.118	0.258
	(0.076)	(0.078)	(0.077)	(0.079)	(0.223)
Latin America	-0.030	-0.050	-0.022	-0.056	0.078
	(0.113)	(0.112)	(0.117)	(0.115)	(0.409)
Africa	-0.474***	-0.462***	-0.502***	-0.512***	0.518
	(0.166)	(0.168)	(0.169)	(0.170)	(0.391)

Logit estimates (Investment=1, Trade=0). Robust standard errors in parentheses and adjusted for firm clusters. ***, **, and * denote significance at the 1, 5, and 10 percent levels, respectively.

Table A.7: Trade vs Investment - Industries

Variable	(A)	(B)	(C)	(D)	(E)
Textiles		-0.265		-0.227	
		(0.308)		(0.307)	
Paper		0.311		0.329	
		(0.347)		(0.348)	
Chemicals		0.326		0.350*	
		(0.206)		(0.206)	
Plastics		0.608***		0.617***	
		(0.209)		(0.209)	
Metal		0.349		0.331	
		(0.232)		(0.234)	
Machinery		0.242		0.251	
		(0.161)		(0.163)	
Transport		-0.334*		-0.138	
		(0.199)		(0.171)	
Furniture		0.021		0.068	
		(0.267)		(0.261)	
Other		-0.144		-0.087	
		(0.308)		(0.307)	

Logit estimates (Investment=1, Trade=0). Robust standard errors in parentheses and adjusted for firm clusters. ***, **, and * denote significance at the 1, 5, and 10 percent levels, respectively. No industry dummies are included in specification (A), (C), and (E).

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