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A WORD OF GRATITUDE…

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INTRODUCTION

Marketing in Turbulent Times

One of the most important and interesting business developments in recent years has been the emergence of rapidly changing markets, characterized by an increasing level of *turbulence*. Illustrative in this respect is the following quote by Gary Hamel, writer for Fortune magazine (www.fortune.com/fortune/conferences/litt/program.html):

> *"Change has changed. It lurches, spins and doubles back on itself. It is disruptive, unexpected and discomforting. Few companies were built to thrive in such a discontinuous world."*

This increasing market turbulence is often linked to a number of recent marketing trends. A first remarkable trend that we recognize is the intensified competition, as evidenced by such phenomena as growing market saturation, promotional wars, and thousands of new product introductions launched each year (Bayus and Putsis 1999; Heil and Helsen 2001; Leeflang and Wittink 1996; Thomas 1996). As markets become increasingly mature, companies essentially compete for market share, where gains in firm sales come at the expense of their main competitors. Such a situation evokes increasing retaliatory behavior on the part of the market players to preserve their market shares. Thomas (1996) claims in this respect that competition has fundamentally changed, and he examines a variety of factors related to e.g. the intensity of the reactions, the type of competitive instruments used, or the increasing variance in firm performance, to assert that a 'hypercompetitive shift' has taken place.

Second, recent developments in information technology and the emergence of the Internet are thought to have fundamentally changed a number of general economic forces (Alba et al. 1997; Ghosh 1998; Zettelmeyer 2000), and to further contribute to the increasing turbulence in many markets. The Internet may not only change the manner in which people shop, but also the way businesses are organized and products are distributed (Alba et al. 1997). The progress in information technology creates growing market uncertainty, and most managers experience tremendous difficulties managing the organizational changes it produces in their firm (Barnett and Freeman 2001).

Third, the increasing globalization of the business environment is also associated with growing turbulence in today's markets. Limited growth prospects in the home market put a lot of pressure on companies to modify their (marketing) strategies and to also serve remote markets. Gielens and Dekimpe (2001), for instance, reported that the world's 100 largest retailers are growing twice as fast abroad as domestically, with the 35 largest global retailers entering, on average, one new market each year. The importance of these global trends for marketing is obvious, and the topic has recently attracted quite some research interest (Gielens and Dekimpe 2001; Steenkamp and Ter Hofstede 2002).

Finally, following the recent changes in the aggregate economic conditions, the Marketing Science Institute makes an explicit link between turbulent environments and economic contractions (Marketing Science Institute 2002). In general, economic downturns have been recognized to depend to a large extent on changes in consumers' attitudes and expectations, which, in turn, have serious implications on their purchasing behavior (Katona 1975). Changing buying habits by millions of people at about the same time will ultimately cause firms', and even industries' sales to be affected in a major way. Firms, in response, tend to make substantial modifications in their strategies, even though they are often at a loss as to what these changes should ideally entail (Mascarenhas and Aaker 1989; Shama 1993).

Previous trends are merely some of the developments that have been recognized in the marketing field as important sources/drivers of the increasing market turbulence. But irrespective of its source, turbulence can be responsible for considerable changes in the market, and may trigger major modifications in companies' activities (Mullins, Ruekert and Walker 1995). Therefore, in marketing, questions related to 'marketing in turbulent times' are highly relevant, and deserve further research attention.

So far, a number of academic articles have been devoted to the topic of turbulent markets. Glazer and Weiss (1993) formally define turbulence as an environment "with considerable uncertainty and unpredictability," "in which rapid, continual and simultaneous *shifts* in key environmental variables is the norm," and "that displays dramatic increases in the number of events that occur within a given period" (p. 509-510). In addition, still according to Glazer and Weiss, turbulence is often associated with "high-technology" products and information technology (Glazer and Weiss 1993, p. 509). In their marketing article on the process of planning business activities, Moorman and Miner (1998) recognize that market turbulence is an important factor discouraging formal planning, and define turbulence as "exogenous shocks or demand shifts that come along more rapidly" (Moorman and Miner 1998, p. 5). Also in the strategy literature, multiple studies have been written on environmental change and market/organizational turbulence (e.g. Eisenhardt 1989; Ginsberg and Abrahamson 1991; Greenwood and Hinings 1996; Zajac and Shortell 1989). Eisenhardt, for instance, claims that turbulent markets are markets characterized by "high velocity", "high rates of change" (Eisenhardt 1989; Eisenhardt and Brown 1998). Fredrickson and Mitchell (1984) and Dekimpe and Hanssens (2000), on their part, talk about "unstable" markets. In addition, Brakman, Leeflang and Sterken (1999) and Leeflang (2000) refer to market turbulence in terms of "important and considerable movements in the market", and discuss various drivers of turbulence in today's markets, related to, amongst others, demographic, technological and ecological developments.[1]

Based on this literature, there seems to be no uniformity in the definition of 'market turbulence'. Not surprisingly, there's also little agreement on how to *measure* environmental turbulence. Both perceptual and objective measures have been proposed to quantify the extent of turbulence. Moorman and Miner (1998), for instance, operationalize the degree of environmental turbulence for a firm using a seven-point Likert scale, where responding managers can rate how they perceive the level of change an action causes on (i) their team, (ii) their firm, and (iii) external sources (customers, suppliers, distributors). Similarly, Rhyne (1985) uses executives' perception (assessed on a five-point scale) on (i) the complexity in the planning process and (ii) the volatility of the environment, to quantify the extent of environmental turbulence. Other researchers have used the concept of volatility to quantify the level of turbulence or uncertainty in the environment (see e.g. Maltz and Kohli 2000; Srivastava, Shervani and Fahey 1998). Maltz and Kohli (2000), for instance, gauge the level of perceived internal volatility using a five-point Likert-type scale reflecting the respondents' perceived rate of change in terms of personnel, structure and rules.

Bishop, Graham and Jones (1984), in contrast, propose objective measures to derive the volatility in demand. They use four summary statistics: (i) the standard deviation (which measures the dispersion around the mean), (ii) the skewness (which measures deviations from symmetry, and which can indicate the presence of extreme decreases/increases in demand),

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[1] Ecological developments refer to the increasing production and consumption of goods where the use of scarce natural resources, waste, and pollution in the production process is minimized.

(iii) the mean of the absolute values of percentage changes over the period, and (iv) the mean of the percentage changes associated with each year's decrease in demand.

Volatility may not capture all aspects of market turbulence. Dekimpe and Hanssens (1995a; 2000), for instance, assess the level of turbulence based on the duration of the effect using persistence estimates. Alternatively, in a study by Dess and Beard (1984), the authors quantify the level of turbulence using secondary data obtained from the U.S. Bureau of Economic Analysis. Their measure of environmental turbulence in a given industry reflects (i) the impact of all other industries on the output in a given industry, (ii) the relative power of certain factors on industry output, (iii) the proportion of industry shipments sold to intermediate markets, and (iv) the proportion of industry shipments sold for investments. Beesley and Hamilton (1984), on their part, measure industry turbulence as the sum of the number of new entrants and the number of firm exits while controlling for the number of initial establishments in that industry. Finally, many academics and business people have associated turbulence with an economic contraction (Marketing Science Institute 2002). They use developments in the macro economy as reflected in the evolution of different economic indicators to assess the level of turbulence in the market (see e.g. the National Bureau of Economic Research (www.nber.org/cycles.html) for a procedure to date different business cycle phases). In sum, a variety of metrics (both perceptual and objective) have been proposed to quantify the level of turbulence or uncertainty faced by a given firm or industry.

This lack of agreement stands in sharp contrast with the growing consensus among both marketing practitioners and researchers that the marketing discipline has often relied on the assumption of a stable, continuous environment. Wind and Robertson (1983), for example, state that "*marketing's focus has been on short-run forecasting and optimization procedures, while assuming an essentially stable, continuous environment*" (p. 13). Similarly, marketers, thus far, have made extensive use of formal (marketing) planning that assumes a high degree of continuity and stability (Glazer and Weiss 1993; Moorman and Miner 1998). Moreover, most marketing-response knowledge has been accumulated on databases that were assumed to be stable (Dekimpe and Hanssens 2000). As a result, marketing has derived substantial knowledge about marketing-mix manipulations in a stable market that essentially assumes that whatever happened in the past will continue in the future. Therefore, based on current marketing studies, relatively little is known on how these same marketing instruments function in a turbulent environment, characterized by rapid and/or fundamental changes. For this reason, Wind and Robertson (1983) deplore that the marketing field may have little to offer under changing market conditions.

In this dissertation, we will focus on marketing problems in a turbulent environment, where the market is not stable, and where certain major events can induce considerable change in established business activities. Specifically, we recognize that, occasionally, companies are confronted with periods of substantial turbulence that entail major environmental and organizational changes, and where current marketing knowledge seems to offer little guidance. In doing so, we aim to partially fill the before-mentioned gaps in marketing knowledge. Conceptually, we first develop a framework to describe turbulence in the environment, which we believe can be helpful in identifying and addressing marketing problems where the stability of the environment is no longer guaranteed. In this framework, we first identify a number of "levels of turbulence". This classification, inspired by the work of De Meyer, Loch and Pich (2002), distinguishes between (i) market variation, (ii) foreseen turbulence, (iii) unforeseen turbulence, and (iv) disruptive turbulence. Next, we show how these classes are intrinsically linked to three underlying "turbulence dimensions", i.e. the nature of the outcome, the nature of the input shock, and the scope of the output reaction; and indicate how recent time-series developments can be used to study marketing problems with a varying degree of market turbulence. These time-series techniques are persistence modeling, structural-break unit-root analysis, and filtering techniques that also allow to isolate the cyclical variations in the series under study, as well as some recent statistics to quantify the potentially asymmetric nature of the time series. We elaborate on this turbulence classification in Chapter 1 of this dissertation. Next, we provide three marketing illustrations of turbulent environments dealing, respectively, with (i) the introduction of an Internet channel addition, (ii) durables' sensitivity to business-cycle fluctuations, and (iii) the relation between aggregate advertisings and the business cycle. We briefly delineate the substantive problem addressed in each of these essays, which will be discussed in full detail in Chapters 2–4 of this work.

ESSAY 1:

How Cannibalistic is the Internet Channel? A study of the Newspaper Industry in the United Kingdom and the Netherlands.

In the current frenzy surrounding e-commerce, a lot of brick-and-mortar firms are wondering how to fully capitalize on the opportunities offered by the Internet to inform, interact, and transact with their customers (Alba et al. 1997). Today, we observe an increasing number of firms operating through both conventional and online stores, and many more are expected to do so in the near future. An online channel can only enhance a company's value if it is able to generate *incremental* revenues or decrease its costs. This implies that the success of an Internet channel addition will not only depend on its potential to generate revenues online, but that managers should also take into account its impact on company's existing operations as obtained through their conventional channels (often referred to as side-effects or spillovers). With respect to online revenues, Internet stores appear to have some very promising *future* prospects. At present, however, they seem to go through a transition period where they still face difficulties in generating sufficient online income. In the meantime, the fear of getting ruined through cannibalization losses has deterred many firms from already deploying the Internet as a distribution channel (Frazier 1999). Similar to the considerations of Glazer and Weiss (1993), the uncertainty or turbulence present in this marketing problem is induced by an important technological innovation that is thought to harm current performance in an unpredictable way.

But do Internet channels really cannibalize firms' entrenched channels, or is this widely held assumption exaggerated, as suggested in a recent study by Biyalogorsky and Naik (2003)? While the latter study mainly focused on the instantaneous influence, we will apply recent structural-break time-series econometrics (Ben-David and Papell 1995, 1998) to quantify the impact of an Internet channel addition on the *long-run* performance evolution of a firm's established channels. Looking at the long-run impact from an additional online channel is especially relevant as the general use of the Internet is growing steeply in most countries (Hoffman and Novak 2000). Using a database of 85 Internet channel additions over the last ten years in the British and Dutch newspaper industries, we will try to find out whether the often-cited cannibalization fears are indeed justified, or whether the destructive nature of the Internet on present performance has been largely overstated.

ESSAY 2:

Weathering Tight Economic Times: The Sales Evolution of Consumer Durables over the Business Cycle.

Business-cycle fluctuations can be among the most influential determinants of firms' general activity and performance levels (Shama, 1978; Clark, Freeman and Hanssens 1984). Still, only little research in marketing has been devoted to the sensitivity of (marketing) performance and support variables to *cyclical variations* in the economy, i.e. the variations related to the different phases of the business cycle (Marketing Science Institute 2002). This general ignorance of business-cycle fluctuations in marketing is surprising, since they are of real practical relevance to (almost) every business. Recessions may not only affect both consumers and business activities as a whole, they also seem to trigger significant and important changes in companies' marketing and strategic variables, that can *"strongly impact the extent of economic downturn on the firm, and influence its odds of a timely and complete recovery"* (Pearce and Michael 1997, p 301). The Marketing Science Institute recognized that, thus far, little scientific research seems to exist on the role of marketing activities during economic contractions, and in response, the institute launched a call for papers to encourage marketing researchers to do more research in this area (Marketing Science Institute 2002).

In our second essay, we will determine in more detail to what extent the diffusion of consumer durables is sensitive to cyclical fluctuations, and if so, whether they are also characterized by some kind of asymmetry often encountered in macro-economic time series. The findings from this study will have clear implications for understanding (i) the impact of economic downturns on consumers' purchase behavior, as well as (ii) the adjustments in marketing strategy needed to mitigate the resulting performance fluctuations. Using US data on multiple consumer durables, we will develop both a number of empirical generalizations on the cyclical sensitivity of durable purchases, and test a variety of hypotheses related to what factors may drive the extent of business-cycle fluctuations in their sales patterns.

ESSAY 3:

Advertising and the Macro-Economy: Have we Missed the Business-Cycle Relationship?

History learns that the advertising industry is hit especially hard by economic contractions, as companies tend to severely cut their advertising budgets when times turn bad (Picard and Rimmer 1999). This observation is at odds with the general finding that advertising can be an important demand-stimulating factor, so that it often raises the question whether advertising may serve as a counter-cyclical instrument to keep sales up in the downturn. So far, evidence seems to exist that maintaining or increasing advertising during the contraction can benefit individual firms (industries) (Srinivasan, Lilien and Rangaswamy 2002), but it is not yet clear to what extent such effects are obtained at the expense of the competing firms (industries), or whether advertising is also able to boost total demand for goods and services during the downturn.

This issue especially concerns policy makers and regulators that, for many decades, have looked for possibilities to control, or at least dampen, severe business-cycle fluctuations. It is also a major issue for the advertising industry that continues to suffer tremendous losses during economic contractions. Therefore, in the third essay, we seek to investigate whether aggregate advertising can influence the general economic activity, and offset severe downswings in the economy. To do so, we consider how the demand for advertising is related to the state of the economy, and determine whether cyclical fluctuations in aggregate advertising can influence those in the business cycle.

As such, contrary to previous essays where the impact of external events on business activities is examined, in the third essay, we study whether marketing activities can, in turn, have an influence on the overall economic environment.

In the empirical essays of this dissertation, a substantial marketing problem will each time be studied, where we will assess the influence of certain marketing or environmental changes on some relevant performance and/or marketing variables. Specifically, in Essay 1, the introduction of an Internet channel by a company is an example of a high-technology development that was recognized by Glazer and Weiss (1993) as an important source of turbulence in the economic environment. In Essay 2 and Essay 3, market turbulence is induced by business-cycle fluctuations, which are according to the Marketing Science Institute (2002) responsible for a high level of uncertainty in the market. In addition, based on our turbulence classification (see Chapter 1), the problems studied in these essays can be characterized by a level of market turbulence that we label, respectively, unforeseen turbulence (Essay 1), and disruptive turbulence (Essay 2 & 3). Finally, to study each of these empirical essays, we introduce and apply recent time-series approaches such as Structural-Break Unit Root tests (Essay 1), time-series filters (Essay 2 & 3), and asymmetry statistics (Essay 2 & 3).

Determining the nature (size, duration, …) of the impact of turbulence-inducing events is crucial, as managers' response to fundamental changes has been shown to depend on how they perceive its meaning and impact on their specific business (Dutton and Duncan 1987). Consequently, reliance on wrong and/or misleading information regarding the state of the environment and its impact on present and future performance may result in costly marketing mistakes. Based on a large-scale survey from companies in different economic sectors, Shama (1993) found that almost all responding *managers* modified their marketing strategy following an important change in their environment, whereas, at the same time, most companies indicated they did not use any systematic procedure to determine the nature of the impact of such changes on their business. Marketing *academics* have also been criticized that, too often, they make abstraction from the impact of general economic conditions in their studies (Devinney 1990). This approach is only defendable under certain (quite) restrictive conditions: the focus is on the short-run and the environment is essentially a stable and continuous one (Wind and Robertson 1983). Marketers, however, increasingly recognize that the marketing environment has lately been characterized by rapid changes and substantial turbulence, where appropriate research evidence to guide managers' decisions is often missing.

We hope, through this research, to contribute to the toolbox managers have available to study marketing problems in a turbulent environment, and through the various findings obtained from the three case studies, to also provide a number of substantive insights to the marketing discipline.

CHAPTER 1:
TURBULENT MARKETS - A UNIFYING CLASSIFICATION

Far too often, marketers suffer from an all-or-nothing view, in which future events result in either stable and predictable changes, versus fully turbulent and completely unpredictable outcomes. We believe that managers' understanding of their environment, and their subsequent responses to it, can be improved by a more careful classification of their market according to its level of turbulence. Inspired by De Meyer, Loch and Pich (2002) who discuss various levels of project uncertainty, we propose a similar hierarchical classification to distinguish four different types of turbulence: (i) market variation, (ii) foreseen turbulence, (iii) unforeseen turbulence, and (iv) disruptive turbulence.

(i) Market variation

Market variation represents the lowest level of market turbulence, and is defined as a market where *frequent, regular, events influence performance randomly, but within a 'predictable' range*. A typical example of such an environment is described in Leeflang and Wittink (1992; 1996; 2001), where the authors analyze a Frequently Purchased Consumer Goods (FPCG) market. These markets are characterized by frequent promotional activities like temporary price reductions, features, and other promotional initiatives, that tend to change the relative position of the brands temporary, while in the long run, market shares stay the same (Bass and Pilon 1980; Dekimpe and Hanssens 1995b; Lal and Padmanabhan 1995). As such, in spite of the intense promotional activity, market shares seem to fluctuate in such a way that the long-run equilibrium position between brands is fairly stable.

(ii) Foreseen turbulence

On the other hand, certain promotional activities do seem to be able to cause permanent changes to the long-term market equilibrium. In the study by Nijs et al. (2001), for instance, the researchers point out that price promotions, under certain conditions, have the potential to permanently increase total category demand in the industry. Similarly, Dekimpe and Hanssens (1995a) illustrate that advertising can influence firm performance permanently. Put differently, certain marketing activities seem to disturb the long-run equilibrium position between brands. As the long-run equilibrium of the performance series is affected, this clearly reflects a higher level of turbulence than described under the market variation scenario. However, the events that cause this turbulence are fairly regular, recurrent events, and may therefore, in themselves, be more easily foreseen and anticipated than the irregular events discussed next. We label such a situation as "foreseen turbulence", that represents an environment characterized by *frequent regular events that influence performance, but in a more unpredictable way.*

(iii) Unforeseen turbulence

Occasionally, a market may be hit by a special type of event that is much larger and less frequent. An example of such a major event could be the entrance of a new competitor, or the introduction of a major new product in the category. This event has the potential to induce a significant change in the incumbents' performance, and both its occurrence and implications are mostly unpredictable. In our classification scheme, this level of market uncertainty is labeled "unforeseen turbulence", which we define as *one or more major, hard to foresee influences from which the impact is difficult to predict*. Kornelis (2002) finds, for instance, that a late entrant in the advertising industry significantly changed the competitive structure in the sector, and was able to expand total category demand. In another empirical application, Pauwels and Srinivasan (2003) examine the impact of store brand entry, and demonstrate their permanent influence on the performance of the established national brands. Finally, in the study by Wichern and Jones (1977), it was found that a revolutionary advertising campaign, where Proctor & Gamble used the American Dental Association's endorsement of Crest, structurally changed the competitive position of the two leading brands (Crest and Colgate) in the category. In all three studies, the event responsible for the turbulence was a major, infrequent happening with the potential to structurally change the market, and as such, hard to foresee a priori. Because of this higher level of uncertainty on the input side, and the potential structural change resulting from it on the output side, a higher level of turbulence arises vis-a-vis the aforementioned "foreseen turbulence" scenario.

(iv) Disruptive turbulence

So far, environmental changes had implications for at most one industry. But whenever multiple industries are hit simultaneously and profoundly, we classify the turbulence as "disruptive turbulence". In this environment, *the event(s) have the potential to completely alter current market principles across a broad range of categories/industries*. An obvious example of disruptive turbulence is the emergence of an economic contraction that is characterized by a significant decline in the aggregate output across many sectors together (Stock and Watson 1999). Estelami, Lehmann and Holden (2001), for instance, document that economic fluctuations are responsible for significant changes in consumer price knowledge, and they indicated that price consciousness, in general, is higher during economic contractions. This makes consumers unwilling to pay for price differences in a number of product categories, and the demand for these products becomes considerably more price elastic. Similarly, during economic contractions, even if consumers' income and market prices remain largely unaffected, the mere change in their attitude can already trigger important reductions in their expenditures (Katona 1975).

The above classification seems to be driven by three considerations:[2]

- The outcome of an event may become more or less (un)predictable,
- The nature of the input can be more or less aberrant,
- The scope of the effect may or may not be limited to one particular industry.

At the lower levels of market turbulence, the main distinction between "market variation" and "foreseen turbulence" lies in the *nature of the outcome*, which represents the first dimension along which we will characterize the level of turbulence. Specifically, in market variation, the outcome varies temporarily, but eventually, it respects a long-run equilibrium level. In case of foreseen turbulence, in contrast, the output changes permanently, i.e. there is no tendency to return to previously-held equilibrium positions. Thus, turbulence can be characterized by the (un)predictability of the outcome it creates.

Still, both these types have in common that the events responsible for the environmental turbulence are frequently occurring and fairly regular events such as price promotions, advertising increases, etc… They can be distinguished from "unforeseen turbulence" by the *nature of the input*, or the event that is responsible for the change in the environment (Perron 1994). In case of unforeseen turbulence, a major, mostly uncontrollable and infrequent event is responsible for the increased uncertainty in the market. The nature of the input shock is

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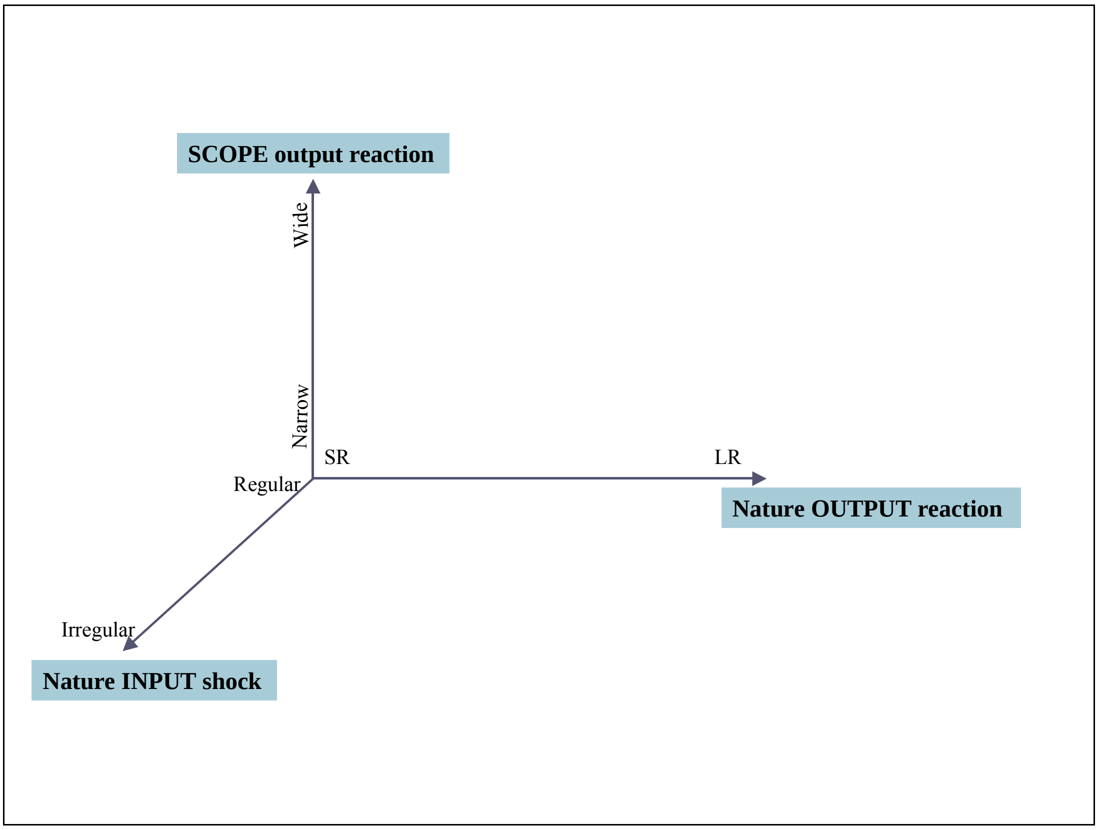
[2] Obviously, other classifications are possible, and we refer to Spruijt (1998) and Courtney (2001) for some illustrative examples. Spruijt (1998) distinguishes between three hierarchical levels of turbulence, which he labels as (i) low, (ii) moderate, and (iii) high levels of turbulence. In contrast, Courtney (2001) argues that uncertainty or turbulence for the firm can take one of four general forms: (i) a clear single view of the future, (ii) a limited set of alternative future outcomes, (iii) a range of possible future outcomes, and (iv) true ambiguity, without even a range of possible future outcomes.

therefore considered the second dimension along which we will characterize environmental turbulence.

The last dimension along which we will distinguish the level of market turbulence is the *scope of the output reaction*. Specifically, "disruptive turbulence" is marked by its widespread impact on multiple industries together, while previous levels of turbulence are more limited in scope. This characterization of turbulence along these three dimensions is visualized in Figure 1.1.[3]

Figure 1.1: Characterization of turbulence



As pointed out in the introduction, many marketing studies essentially assume a high degree of continuity, and can be situated in the centre of the three dimensions. In our discussion of the four levels of market turbulence (i – iv), we made references to the studies by Bass and Pilon (1980) and Leeflang and Wittink (1992; 1996; 2001) as being illustrative of such an environment. Dekimpe and Hanssens (1995a) and Nijs et al. (2001) pointed out that

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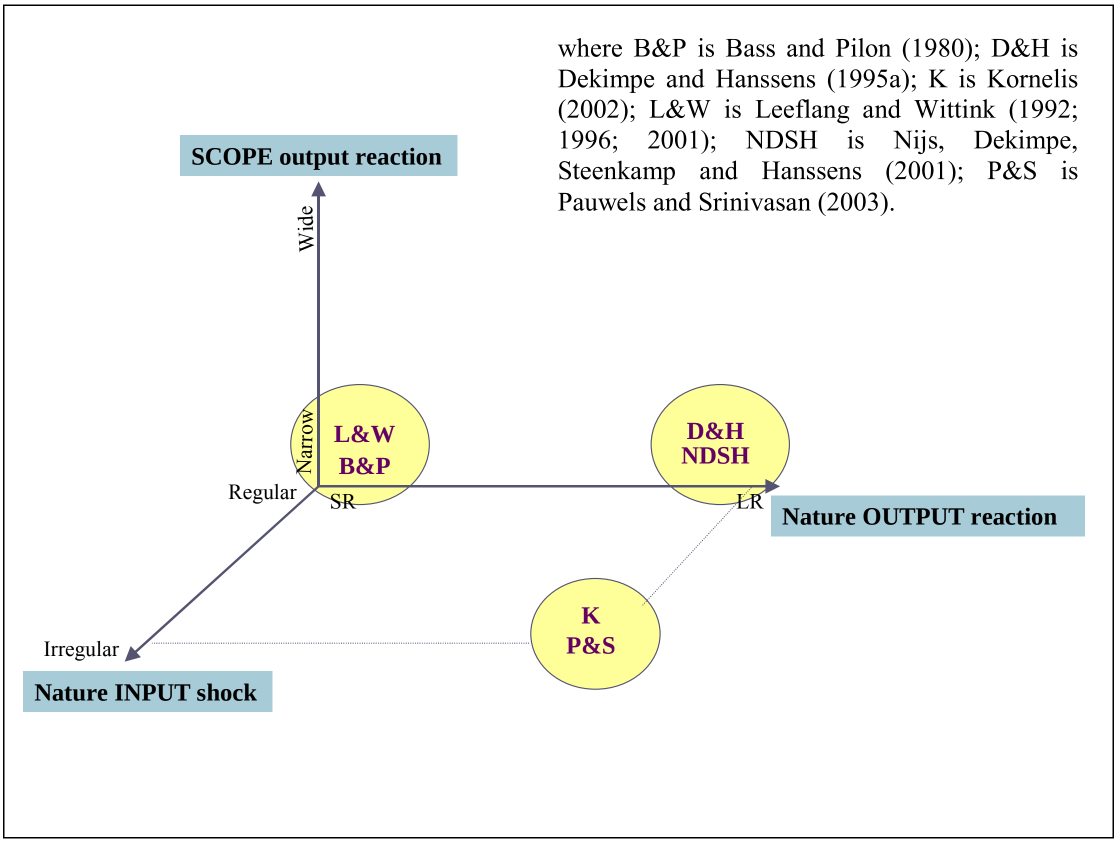
[3] These dimensions need not necessarily be orthogonal, as one may expect that very dramatic events (input dimension) are more likely to also have a long-run impact (output dimension) across multiple players or industries (scope dimension).

regular marketing activities can, in some instances, have an unpredictable long-run performance outcome, and are therefore associated with a higher level of market turbulence as described by the “output reaction”-dimension. The studies of Kornelis (2002) and Pauwels and Srinivasan (2003) illustrate an environment where a major and infrequent event is responsible for turbulence in the market, and can be described according to the “input shock”-dimension. In Figure 1.2, we graphically position the aforementioned studies along the three “turbulence” dimensions that were identified.

Figure 1.2: Positioning of current marketing studies in our turbulence framework



In our first empirical essay, the introduction of an online channel can be considered as a major event that may influence a firm’s performance permanently. Thus far, only few marketing studies have analysed a turbulent market were multiple industries are affected simultaneously, as described by the third dimension of output “scope”. Both essays 2 & 3 deal with the impact of business-cycle fluctuations on multiple industries. In Essay 2, we assess its impact on several durable good industries, while Essay 3 assesses the impact of advertising on most industries in the economy, as reflected in the nation’s GDP.

Recent time-series developments offer various concepts that allow one to operationalize the aforementioned dimensions, and, hence, to identify the level of turbulence that characterizes a certain environment. In subsequent sections, we will consider for each dimension what time-series techniques may be used, and illustrate how established marketing knowledge, as well as our three empirical essays, made (will make) use of these techniques.

DIMENSION 1: The nature of the OUTPUT reaction

As argued before, most marketing studies assume a high degree of continuity and stability (Dekimpe and Hanssens 2000; Wind and Robertson 1983). Even though the (marketing) variables in these studies fluctuate around a known long-run equilibrium level, temporary deviations occur. Such series are not perfectly predictable; still, one does not update the long-run forecast levels after a short-run disturbance to such a market environment. On the other hand, regular marketing activities may, in some instances, have a long-run impact, in that they alter the long-run evolution in the market (Dekimpe and Hanssens 1995a; 1995b), creating a permanent deviation from previously held equilibrium levels.

Time-series analysis distinguishes in this respect between *stationary* and non-stationary or *evolving* series. Conceptually, level or trend stationarity implies that even though the outcome may not be perfectly known at every point in time, the outcome will eventually return to a fixed mean or predetermined trend. As such, any shock to the market can cause at most a temporary deviation from existing equilibrium levels (Enders 1995). Such an environment was illustrated earlier with the work of Leeflang and Wittink (1992, 1996, 2001), but is also described in various other empirical studies by e.g. Bass and Pilon (1980) and Lal and Padmanabhan (1995), among others.

In contrast, evolving variables are those that do not return to their historical or predetermined level, but instead wander freely in one direction or another after a "disturbing" event. The resulting long-run outcome will therefore become unpredictable (Enders 1995). This concept of non-stationarity was first applied in marketing by Dekimpe and Hanssens (1995a) to determine whether marketing activities have the potential to influence performance (output) permanently. The authors found in their application that advertising can have a permanent trend-setting effect on sales. Other examples of an uncertain long-run market outcome due to marketing activities are described in e.g. Bronnenberg, Mahajan and Vanhonacker (2000), Dekimpe and Hanssens (1999), Nijs et al. (2001), Simon (1997), or Steenkamp et al. (2003).

To empirically distinguish between stationary and evolving time series, unit root testing is often used (Enders 1995). To illustrate these concepts, consider the following autoregressive model of order 1 [AR(1)]:

$$S_t = c + \phi S_{t-1} + e_t \tag{1.1}$$

with S_t representing sales. Using the lag operator L ($LS_t = S_{t-1}$), this model can be rewritten as follows:

$$(1 - \phi L)S_t = c + e_t \tag{1.2}$$

In this example, the following two scenarios are possible. First, the series is stationary if $|\phi| <1$. In this case, using backward substitution, Eq. 1.1 becomes:

$$S_t = [c/(1-\phi)] + e_t + \phi e_{t-1} + \phi^2 e_{t-2} + ... \tag{1.2a}$$

In stationary series, every unexpected shock that enters the model in the error term will die out gradually, and its influence is only temporary. As such, shocks in the environment cause temporary deviations in the series, but eventually their effect dies out and the series returns to its equilibrium or mean level. In contrast, an evolving series is a series that contains a unit root in the autoregressive polynomial of Eq. 1.2, i.e. $|\phi| =1$, and which can be described as follow:

$$S_t = [c + c + c + ...] + e_t + e_{t-1} + e_{t-2} + ... \tag{1.2b}$$

In Eq. 1.2b, the series has no fixed mean and every change in the environment continues to influence the sales variable in all future periods. As such, market turbulence can induce a shock in the series that has a long-run or persistent impact on the series, and can therefore change the outcome in an *unpredictable* way. To illustrate the impact of unit roots on the forecasting performance, consider the following example taken from Dickey, Bell and Miller (1986, p. 14), who made forecasts based on the following two models.

$$(1 - 1.8L + 0.81L^2)(S_t - 100) = e_2 \tag{1.3}$$

$$(1 - 1.8L + 0.80L^2)(S_t - 100) = e_2 \tag{1.4}$$

Eq. 1.3 represents a stationary model, and can be rewritten as $(1-0.9L)^2(S_t - 100) = e_2$. Forecasts made from this stationary model converge to the series' mean of 100, the forecasting standard error converges to the series' standard deviation of 23. In contrast, Eq. 1.4 is a non-stationary model, and, in rewriting the model, can be shown to contain a unit root: $(1-0.8L)(1-L)(S_t - 100) = e_2$. The forecasts made from this non-stationary model converge to 163, but, as the standard error will diverge to $+\infty$, the long-run evolution of the series becomes unpredictable.

In sum, change that is hard to predict heightens the level of environmental turbulence (see also Dess and Beard 1984).[4] When describing the environment according to the nature of the outcome of certain events, we recognize that in certain instances, change produces only a short-run influence that eventually disappears. Such a short-run change is responsible for less uncertainty or turbulence than in case the event changes the outcome permanently, because a long-run impact means that there is no longer a fixed outcome level, as every change continues to influence the environment in all future periods.

Based on these concepts, Dekimpe and Hanssens (1995b) classified over 200 performance series according to their time-series nature (stationary vs. evolving). Their results indicate that market shares are most often stationary, as 78% of all market share series did not contain a unit root. In addition, Nijs et al. (2001) examine the effect of price promotions on category sales in 560 FPCG categories, and found that 98% of all primary demand series were stationary. This means that most marketing series seem to have a fairly predictable outcome, and may also support the overwhelming reliance of previous marketing studies on a stable environment. Still, even though stationarity is by far the dominant market scenario, non-stationarity is present as well, and cannot be ignored a priori in marketing settings. Note also that, although we only dealt with smaller and fairly regular marketing interventions, they may, in some instances, already influence the outcome permanently.

DIMENSION 2: The nature of the INPUT shock

Most regular or frequently-occurring marketing shocks may not be exceptional enough to create permanent effects. Therefore, we introduced a second dimension along which we can characterize turbulence, and that involves the nature or type of the input shock responsible for the uncertainty in the market. Perron (1994) pointed out that one should distinguish between two types of ‘input’ shocks. Many events studied in marketing represent smaller shocks that are quite frequently occurring and deemed regular. These shocks are expected to correspond to more regular marketing interventions such as price promotions or advertising activities as described in studies by e.g. Bolton (1989), Dekimpe et al. (1999), Mela, Jedidi

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[4] Moreover, Srivastava, Shervany and Fahey (1998) stress that more predictable firm cash flows streams will have a higher net present value, and create more shareholders’ value. In this respect, the level of (un)predictability also has clear financial implications for the company.

and Bowman (1998), Neslin, Powell and Stone (1995), and Steenkamp et al. (2003). These activities are less likely to change the nature of the data-generating process, and can be studied by means of the time-series techniques presented before. On the other hand, markets are occasionally confronted with events that are much larger and that occur only rarely or exceptionally. Such an input may, but not necessarily have to (!), result in a much more profound impact, in that the nature of the underling data-generating process is altered. In that case, parameter values also change, making forecasts even more difficult. As such, we consider the nature of the input shocks a second important dimension along which we can describe marketing turbulence.

In marketing, previous research has considered the impact of certain major events such as the entrance of an important new brand (Mahajan, Sharma and Buzzell 1993; Pauwels and Srinivasan 2003), a major, sustained change in the marketing-mix strategy by a company (Ailawadi, Lehmann and Neslin 2001; Mulhern and Leone 1990), a revolutionary advertising campaign (Wichern and Jones 1977), or the impact of an external event such as a patent infringement on the sales growth of new products (Mahajan, Sharma and Wind 1985). Still, marketing research on those types of environmental changes is fairly scarce (Ailawada, Lehmann and Neslin 2001).

Appropriate time-series techniques to examine those kinds of events are intervention analysis (Box and Tiao 1975), which later evolved into the now-popular structural-break methodology (Perron 1989). Of specific interest to us are the so-called structural-break unit root tests, as they allow to combine both identified dimensions: they can characterize an event according to both the unique nature of the input and the nature of the output reaction. In a macro-economic application by Ben-David and Papell (1995), for instance, the authors use the test for structural change to determine empirically the impact of a sudden major event on the long-run steady-state growth in the economic series. For some of the countries studied, this important event is related to one of the two World Wars, for others, the event is associated with the great crash of 1929.

In a first empirical essay of this dissertation, we will adopt the *structural-break methodology* to examine the introduction of an additional, unique type of distribution channel, namely an electronic or online channel. Specifically, we study the introduction of an online newspaper, and will determine empirically its impact on the revenues obtained through the firm's established (offline) distribution channels. This marketing problem can be characterized according to the exceptional and rare nature of the input shock, and corresponds to the class of unforeseen turbulence introduced before. The structural-break unit root methodology is described in more detail in Essay 1.

DIMENSION 3: The SCOPE of the output reaction

Finally, we describe the nature of the environment with respect to the scope or scale of the impact from an event. Typically, the impact of marketing activities is assessed within one industry, and cross-industry influences from marketing activities are implicitly expected (or assumed) to be absent.[5] Yet, certain changes in the environment have the potential to influence multiple industries or markets simultaneously. The most obvious example of this type of market turbulence is the occurrence of a widespread economic contraction that can be responsible for a dramatic drop in the performance of many industries together.

The scope of the effect refers to the range of the impact of certain developments across multiple industries, and should be distinguished from the nature of the impact (i.e. the first dimension in our framework). The latter is related to the persistence of the effect, and thus, indirectly, to the predictability of the outcome within a given industry.

Cyclical fluctuations in the economy induce changes in multiple industries simultaneously, and are, according to our third dimension, wide in scope. Given the typical length of an average economic contraction in the 20th century (i.e. 11 months; Jacobs 1998), one cannot consider the impact of the contraction to be a short-run effect. Moreover, following the definition of Lucas (1977), such business-cycle fluctuations should also be clearly distinguished from the general long-run evolution of the underlying variable(s). As such, along the first dimension of turbulence, the duration of the impact could be classified as medium term (i.e. in between the short and long run). In a similar way, we can characterize the occurrence of an economic contraction along the second dimension in our framework. Business-cycle fluctuations have been defined as major, recurrent events (Stock and Watson 1999) that may therefore not be considered unique in the strict Perron-sense. Yet, business-cycle fluctuations involve major, uncertain developments that occur unexpectedly, and that have the potential to considerably change current market behavior. Similar to their position on the first dimension, they can be classified in between the regular and irregular extremes on the second input-dimension.

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[5] Some exceptions are, e.g. Nijs (2001) and Walters (1991) who study cross-category promotional influences. Still, they also focus their attention to a very limited set of complementary and/or substitute categories in a FPCG setting.

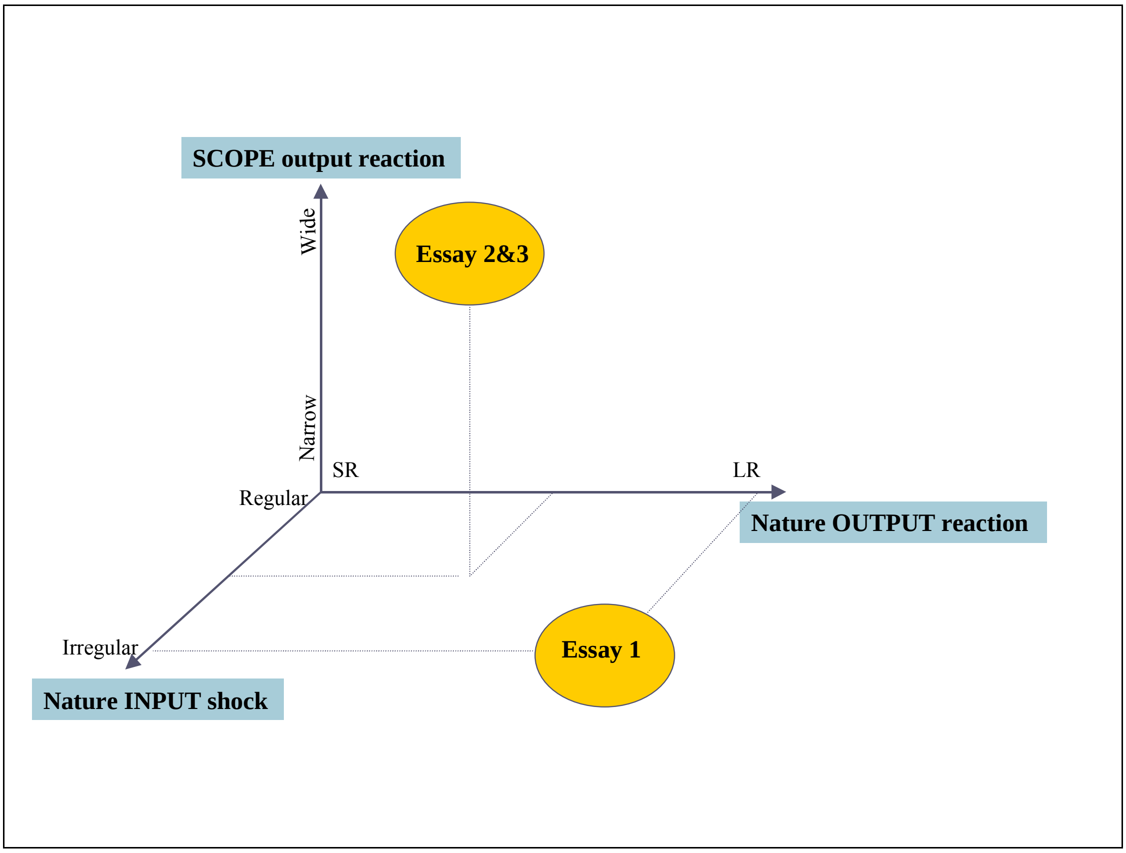
Stock and Watson (1999) stress that business cycles can be described by their recurrent pattern, even though they are not periodic (which makes them quite hard to measure and predict). In addition, business-cycle fluctuations may translate into different patterns in different types of series. For instance, in specific industries such as the durable-good industries, business-cycle fluctuations are known to be much more severe (Cook 1999; Essay 2), whereas aggregate economic fluctuations may also have a delayed impact on some other variables, as was found for the demand for advertising that seems to lag the business cycle by several months (Simon 1970). In the economics literature, some new time-series developments have been introduced that allow researchers to capture the periodic nature of the business-cycle fluctuations in a series while respecting the special features associated with them (Baxter and King 1999; Stock and Watson 1999). More specifically, these time-series methods are based on *filtering* techniques that permit the extraction of only part of the information (i.e. variation) from the series, while variation that comprises other properties of this series is to a great extent removed (Baxter 1994). For instance, a filter designed to extract the cyclical fluctuations in a variable will have to capture all information in the series related to the business cycle, while removing both the short-run and long-run fluctuations in the respective series. In this way, the filter is able to extract the variation that can be attributed to the business cycle. At the same time, it can account for certain features of the series (for example, its stationary vs. evolving nature of it, the units of the series (e.g. percentages, hours, levels)), while preserving other properties, such as potential asymmetries in the series.

The focus of the second and third empirical essay in this dissertation is on the impact of business-cycle fluctuations on performance variables and marketing activities. Given that economic contractions occur only rarely, marketers typically have little experience on how to adjust their activities at that time, and at present, marketing scientists offer only little guidance on how marketing and performance variables could and should behave under these circumstances (Marketing Science Institute 2002; Shama 1993). In Essay 2, we determine the influence of business-cycle fluctuations on the sales evolution of multiple consumer durables. In addition, we examine the way in which certain marketing activities such as pricing are modified in response to the economic contraction, and how these changes amplify or attenuate the cyclical sensitivity of the durables' sales pattern. In Essay 3, we derive the impact of economic contractions on the aggregate demand for advertising, and assess whether the total demand for advertising can, in turn, influence the extent of economic ups and downs. The appropriate time-series techniques to study business-cycle fluctuations in variables are introduced and discussed in more detail in both empirical essays.

As indicated before, most current marketing research focuses on regular, smaller, changes in the environment, which tend to cause only short-run market changes that are more limited in scope. They can be situated in the center of our three-dimensional classification presented in Figure 1.2. Recent time-series applications of non-stationary or evolving marketing series have produced some new insights into the long-term effect of fairly regular changes, but whose effect is still limited to a single industry or segments within that industry.

The focus of the empirical essays in this dissertation will be on environments characterized by higher levels of market turbulence, in that they have a particular irregular type of input shock (Essay 1), or where the outcome of the reaction affects multiple industries (Essay 2 and 3). Hence, the specificity of our essays can be situated along the second and third dimension of our framework, as graphically illustrated in Figure 1.3.

Figure 1.3: Positioning of the three essays in our turbulence framework



With these three essays, we hope to contribute to the discussion of marketing in turbulent times, and illustrate how recent time-series econometrics can be applied to study some relevant marketing problems in turbulent environments.

CHAPTER 2:
HOW CANNIBALISTIC IS THE INTERNET CHANNEL? A STUDY OF THE NEWSPAPER INDUSTRY IN THE UNITED KINGDOM AND THE NETHERLANDS

Abstract

During the past decade, irrational exuberance has turned into a possibly equally irrational pessimism about what the Internet can accomplish. The fear of getting ruined through cannibalization losses has recently deterred many firms from deploying the Internet as a distribution channel. But do Internet channels really cannibalize firms' entrenched channels, or is this widely held assumption exaggerated? To answer this question, we apply recent structural-break time-series econometrics to quantify the impact of an Internet channel addition on the long-run performance evolution of a firm's established channels. Using a database of 85 Internet channel additions over the last ten years in the newspaper industries of the U.K. and the Netherlands, we find that the often-cited cannibalization fears have, at least in this information-goods industry, been largely overstated. The Internet therefore need not be disruptive to established companies and channels. This does, however, not imply that firms enjoy free play in setting up Internet channels. In cases where the newly established Internet channel too closely mimics the entrenched channels, substantial cannibalization is more likely to take place.

Keywords: Internet channel, Cannibalization, Structural-break time-series analysis

2.1 INTRODUCTION

For decades, the increasingly diverse needs of an ever more fragmented market have compelled firms to increase their product variety. Recently, firms are also turning to a second strategy to better address these diverse consumer needs: they increase their channel variety. Both strategies are risky, however, in that a new product or channel may cannibalize the sales of existing products and channels. While many marketers consider cannibalization when assessing the (potential) success of new product introductions (e.g. Mason and Milne 1994; Reddy, Holak and Bhat 1994), there is hardly any knowledge about channel cannibalization. This may explain why Frazier (1999, p. 232) recently observed that "the ultimate effect [of increasing channel variety] on … product sales is … unclear". This lack of research on channel cannibalization is surprising, especially since the issue has become so pertinent through the recent frenzy surrounding Internet channel additions. Specifically, absent scientific research, and after the first Internet euphoria settled down, practitioners now "widely *assume* that the Internet is cannibalistic [and] will replace all conventional ways of doing business" (Porter 2001, p. 73, italics added).

This fear that the Internet is cannibalistic has rapidly pervaded the trade press, and is shared by both resellers and manufacturers. Resellers take the stance that the manufacturer who disintermediates by going online is stealing sales that are rightfully theirs. They regard the Internet as a disruptive force that will cannibalize their business, even to the extent that they are made obsolete. In turn, resellers' cannibalization fears have alarmed manufacturers, many of whom now view Internet channels as a significant source of channel conflict that may cause resellers to provide lower support for the manufacturer's products, or even to discontinue their distribution (Frazier 1999). In a recent large-scale survey of Belgian firms, Konings and Roodhooft (2000) find that of all firms that have access to the Internet, only 15% use that site as an additional channel to actually sell products online. In the U.S., recent estimates indicate that over 40% of all businesses do not yet sell online (www.nua.com/surveys), a number that increases to over 70% when excluding the largest businesses (Washington Post 2001). The fear of upsetting their entrenched channels through cannibalization has deterred many of these firms from deploying the Internet as a distribution channel (Gilbert and Bacheldor 2000). Other manufacturers have taken their fear one step further. Levi Strauss, for example, already withdrew its Internet channel after one year, mainly because of backlash from resellers and out of fear of getting ruined through cannibalization losses (Dugan 1999).

In sum, many assume that the Internet is cannibalistic and will eventually replace conventional ways of doing business. Is this widely held assumption correct or exaggerated? Moreover, if cannibalization exists, is the downturn in performance of a permanent nature? These questions, in essence, are the focus of the current study. To answer these questions, we propose recent structural-break time-series econometrics to quantify the impact of an Internet channel addition on the long-run performance evolution of the firm's established channels. Our subsequent empirical application is situated in the newspaper industry. Based on a careful investigation of the cannibalization effects for 85 Internet channel additions over the last ten years in the British and Dutch newspaper industries, we attempt to provide empirical generalizations as to the magnitude and nature (permanent vs. temporary) of online cannibalization effects. The newspaper industry offers an interesting setting to test the validity of the cannibalization assumption because publishers have taken the lead in exploiting the Internet as a new distribution channel. As such, the publishing industry tends to "act as the pacesetter for the information society" (European Commission 1996, p. 1), and may foreshadow trends that will occur more slowly in other industries.

2.2 LITERATURE REVIEW

Although there is surprisingly limited empirical work on channel cannibalization, several researchers have expressed their concern about the cannibalization hazards companies face when they add an Internet channel to their entrenched channels (e.g. Alba et al. 1997; Brynjolfsson and Smith 2000; Coughlan et al. 2001). Both the academic and the trade press typically proclaim cannibalization effects to be present, as is reflected in the following quotes:

> *"Established businesses that over decades have carefully built brands and physical distribution relationships risk damaging all they have created when they pursue commerce in cyberspace."* (Ghosh, Harvard Business Review 1998, p. 126)

> *"Call it survival by suicide. ... Today's corporate leaders are building separate new e-enterprises designed to compete head-on with the mother company."* (Useem, Fortune 1999, p. 121)

The fear for online channel cannibalization is nourished by four observations. First, sales may shift from the entrenched channels to the new Internet channel when the latter provides more appealing features to the target audience, such as a quasi-unlimited amount of information on product attributes, increased customization, time savings, etc. (Alba et al.

1997). Second, the Internet is likely to increase the power of the consumer, as price comparisons across firms can be performed quickly and easily. The resulting increase in price competition may explain why online prices for homogenous products are often found to be lower than those in conventional outlets (Brynjolfsson and Smith 2000), which may cause sales to shift even further. Third, total sales may also decrease when consumers buy less through the new channel than through their old channel, e.g. when there are less impulse purchases through the Internet (Machlis 1998). Fourth, existing channels may view the new Internet channel as unwelcome competition. When this happens, the firm's entrenched channels may lose motivation, and can reduce their support for the firm's products or even discontinue their distribution. This may, in turn, result in more brand switching towards the firm's competitors, and hence decreased total sales (Coughlan et al. 2001).

Unfortunately, in spite of the above theoretical observations, and at a time when there is much debate about Internet channel additions in the popular press, empirical evidence on the performance effects of Internet channel additions is still lacking, with the exception of Geyskens, Gielens and Dekimpe (2002) and Ward and Morganosky (2000). However, the former application, which is also situated in the pace-setting newspaper industry, focuses on the total value implications of Internet channel additions (as measured by stock market returns), while the separate revenue impact of cannibalization is not explicitly considered nor quantified. In the multiple-industry study by Ward and Morganosky (2000), cannibalization is proxied by relating consumers' self-reported channel usage to information search in particular product categories. Specifically, consumers were asked to check whether or not they (i) bought and (ii) searched for information on the product within the past six months from online outlets, catalogs, and/or retail stores. Since online product information search generated offline sales but not vice versa, the authors conclude that online channels do not cannibalize offline sales. Unfortunately, their cannibalization measure is very crude and makes abstraction of the *magnitude* of the cannibalization effect. Moreover, the above two studies approach cannibalization solely as a short-run phenomenon, a characteristic they share with the empirical *product* cannibalization literature. This short-term focus of existing studies is likely to contribute to managerial myopia (Dekimpe and Hanssens 1999). Clearly, if shortsightedness is to be avoided, empirical studies that derive the long-run impact of (Internet) channel additions are essential. Or, as Frazier pointedly put it: "models need to be developed to help determine when multiple channels need to be relied on [since] the *ultimate* effect on *long-term* product sales is […] unclear" (1999, p. 232, italics added).

To this extent, we examine whether the long-run evolution of the incumbent channels' revenues is affected. Specifically, recent advances in time-series econometrics will be used to determine whether the Internet channel addition caused *either* a persistent growth slowdown *or*, in the absence of any growth impact, a sustained level drop in the company's traditional revenue streams.

2.3 METHODOLOGY

Over the last few years, time-series concepts such as unit-root and cointegration tests, error-correction models, and impulse-response and persistence estimates have become popular in the marketing literature to quantify the long-run impact of price promotions (Nijs, Dekimpe et al. 2001; Srinivasan, Popkowski Leszczyc and Bass 2000), advertising expenditures (Dekimpe and Hanssens 1995a), and distribution changes (Bronnenberg, Mahajan and Vanhonacker 2000). All of these studies, however, look at the over-time performance implications of *regular, small* shocks, such as an unexpected one-cent price reduction, a one-unit/one-period increase in advertising spending, or a gradual increase in distribution coverage. *All these small shocks are assumed not to change the underlying data-generating process* (Pesaran and Samiei 1991).

The marketing event we consider, i.e. the addition of an Internet channel, is not quantifiable in a similar, continuous way. Yet, its impact on performance may well be substantial (Hanssens, Parsons and Schultz 2001, p. 293), and can even change the underlying data-generating process. Dekimpe and Hanssens (2000, p. 191), for example, point out that "the constant parameter assumption in many persistence-based models may no longer be appropriate to test the long–run implications of Internet-related decisions". We therefore extend the aforementioned studies to explicitly account for the fact that the event of interest may represent a different kind of shock to the system, in that it is (i) large, (ii) infrequent, and (iii) may structurally alter the long-run properties of the time-series (Balke and Fomby 1991), causing a different steady-state growth (or decline) path to emerge (Ben-David and Papell 1995; 1998).

Specifically, we start our testing procedure with the structural-break unit-root test, as described in Perron (1989; 1994):

$$Y_t = \alpha + \beta T + \left[\theta DU_t + \gamma DT_t + \delta D(TB)_t\right] + \rho Y_{t-1} + \sum_{i=1}^{k} c_i \Delta Y_{t-i} + \sum_{s=2}^{S} \eta_s SD_{st} + \varepsilon_t \qquad (2.1)$$

with Y_t the log-transform of the performance measure of interest,[6] T a deterministic trend variable, SD_{st} a set of seasonal dummy variables, ε_t a series of white-noise residuals, and DU_t, DT_t and $D(TB)_t$ three structural-break dummy variables, discussed in more detail below. Making abstraction of the terms between square brackets, Eq. 2.1 becomes the well-known Augmented Dickey-Fuller (ADF) test.[7] The lagged first differences are added to ensure that the residual series is indeed white noise, while the parameter ρ is the key parameter of interest to separate (level or trend) stationary ($\rho < 1$) from evolving, unit-root ($\rho = 1$) series.[8]

We extend the standard ADF test with three dummy variables to allow the exogenous event of interest, i.e. the Internet channel addition, to cause a structural change in the growth rate and/or level of the conventional channel's performance. As is common in the structural-break literature (see e.g. Ben-David and Papell 1995; 1998), we allow for a structural change in the trend function of the data-generating process, and do not account for changes in e.g. the model's autoregressive parameters or error variance. This approach is completely in line with the intervention-analysis approach of Box and Tiao (1975),[9] in that extraordinary events are separated from the regular noise function, and modeled as a change (intervention) in the deterministic part of the time-series model (Perron 1994). Denoting TB as the potential break date, the dummy variable DT_t takes the value of $t\text{-}TB+1$ when $t \geq TB$, and zero otherwise. As such, it allows for a change in the growth rate of the trend curve at the time of the channel addition. DU_t, which is a step dummy variable that takes on the value of one when $t \geq TB$ and zero otherwise, is used to allow for a level shift at the time of the introduction, while $D(TB)_t$ is a pulse dummy taking the value of one when $t = TB$ and zero otherwise. This third dummy variable is only added to ensure that the test statistic on ρ remains invariant in finite samples to the value of the change in the intercept under the null hypothesis of a unit root (Perron 1994), but has no substantial interpretation in our context.

When $\underline{\rho < 1}$, the unit-root null-hypothesis is rejected and hypotheses tests concerning the other parameters can be carried out using conventional t and/or F tests (Holden and

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[6] This transformation is common practice in time-series analyses, as it allows reducing potential heteroskedasticy in the data. Moreover, the first difference of the log-transformed series provides a good measure for the growth rate of the original series (Franses and Koop 1998).

[7] See Enders (1995) for a general discussion, and Nijs et al. (2001) for a recent marketing application.

[8] Following Perron (1989; 1994), a general to specific recursive procedure is used for selecting the truncation lag parameter k. Starting with k equal to 8, it is successively reduced until a model is found where the last lag is significant, while the one-higher lag is no longer significant. If no lags are significant, k is set to zero. Following common practice (Perron 1989; Zivot and Andrews 1992), the criterion for testing the significance on the last lag is set to 1.60.

[9] See e.g. Leone (1987) for a marketing application.

Perman 1994; Perron 1994). When γ is significant and negative, the introduction of the new Internet channel has a cannibalizing effect in that it initiates a decline (when β was equal to zero) in the performance evolution of the conventional channel, slows down its growth (in case $\beta > 0$), or accelerates an already ongoing decline (for $\beta < 0$). The most dramatic change occurs if $|\gamma| > |\beta|$ with $\beta > 0$ and $\gamma < 0$, in which case the sign of the growth path would be reversed after the Internet channel addition, a situation referred to as a growth meltdown (rather than a mere slowdown) by Ben-David and Papell (1998).

The coefficient γ, however, measures only the *immediate* impact on the series' growth rate. To quantify the full, *long-run* growth impact, we rewrite Eq. 2.1 as:

$$Y_t = \alpha + \beta T + \theta DU_t + \gamma DT_t + \delta D(TB)_t + \sum_{i=1}^{k+1} a_i Y_{t-i} + \sum_{s=2}^{S} \eta_s SD_{st} + \varepsilon_t \tag{2.2}$$

and compute the difference between the long-run growth (ΔY_{LR}) of this autoregressive series before and after the Internet-channel addition:

$$\Delta_{\text{LR, after}}\,\mathrm{Y} - \Delta_{\text{LR, before}}\,\mathrm{Y} = \frac{\beta + \gamma}{1 - \sum a_i} - \frac{\beta}{1 - \sum a_i} \tag{2.3}$$

The long-run, or *steady-state,* growth rate of a series is time-subscript independent, and is obtained as $\lim_{t \to \infty} \Delta \mathrm{Y}_t$. Assume, for ease of exposition, the following first-order autoregressive process with normal starting conditions $Y_0 = 0$ and with the error term omitted:

$$Y_t = \alpha + \beta T + a_1 Y_{t-1} \tag{2.4}$$

In this stylised example, it is easy to show that ΔY_1, ΔY_2, ΔY_3, … equal $[\alpha + \beta]$, $[a_1\alpha + (1 + a_1)\beta]$, $[a_1^2\alpha + (1 + a_1 + a_1^2)\beta]$, … Looking in steady state, i.e. letting $t \to \infty$, a long-run growth rate of $\beta/(1 - a_1)$ is obtained. When working with higher-order autoregressive models, this expression for long-run steady-state growth generalizes to $\beta/(1 - \sum a_i)$ (see Ben-David and Papell 1995 for a formal treatment). Similarly, once the trend break dummy DT_t in Eq. 2.2 becomes effective, the 'new' steady-state growth rate becomes $(\beta + \gamma)/(1 - \sum a_i)$. Standard errors on (the difference in) these steady-state growth rates can subsequently be derived using the well-known delta-method.

When $\gamma/(1 - \sum a_i)$ is not significant, the traditional channel does not experience a long-run growth slowdown because of the Internet channel addition, but its level may be reduced permanently. To assess whether, in the absence of a growth change, cannibalization effects show up in the form of a level drop, we re-analyze Eqs. 2.1 & 2.2 without DT_t, and test for the significance of θ. Depending on the value of the autoregressive parameters a_i ($i = 1, \ldots, k+1$)

in Eq. 2.2, part of this initial loss may either become persistent, or the initial loss may even be intensified in subsequent periods. Using a similar logic as before, this long-run effect can be shown to equal $\theta/(1-\sum a_i)$.

When $\rho = 1$, the unit-root null hypothesis is not rejected, causing t_θ and t_γ to no longer be asymptotically normally distributed (Holden and Perman 1994; Perron 1994). We therefore follow Ben-David and Papell (1998) and Franses (1998), in that we first impose the unit root found through Eq. 2.1, and estimate the following equation in first differences:

$$\Delta Y_t = \alpha + [\gamma DU_t + \theta D(TB)_t] + \sum_{i=1}^{k} a_i \Delta Y_{t-i} + \sum_{s=2}^{S} \eta_s SD_{st} + \varepsilon_t \qquad (2.5)$$

The γ parameter associated with the step dummy DU_t then gives the immediate impact on the growth rate, while the θ parameter associated with the pulse dummy $D(TB)_t$ quantifies immediate level shifts (see also Balke and Fomby 1991). The corresponding long-run effect on the steady-state growth rate can then be shown to equal $\gamma/(1-\sum a_i)$ (Ben-David and Papell 1998). In the absence of any growth impact, we again impose a common slope for the trend function before and after the Internet channel introduction, i.e. we re-analyze Eqs. 2.1 & Eq. 2.5 without DU_t, and test for the significance of $\theta/(1-\sum a_i)$. This parameter allows testing whether cannibalization effects show up in the form of a persistent level drop.

In sum, long-run cannibalization effects will be quantified through the decline in the traditional channels' steady-state *growth rate*, or, in the absence of any growth impact, through the size of the persistent reduction in their performance *level*.

2.4 DATA

Our empirical application is situated in the newspaper industry. This industry offers an interesting setting to test the validity of the cannibalization assumption for two reasons. First, cannibalization is particularly imminent when *information* products are delivered online (Shapiro and Varian 1999). Speed of delivery, easy search facilities, and customization options tend to increase the value of the information product in the online channel over existing offerings through traditional channels. Second, whereas the newspaper industry shares the above characteristic with other information goods industries, it has the additional cannibalization-prone characteristic that most publishers are still reluctant to charge for their online editions. As such, any switching between conventional and online channels should negatively affect circulation revenue. Moreover, the newspaper industry represents an old and mature industry, where competition is mostly a zero-sum game (Abbring and Van Ours 1994). Cannibalization fears when going online are therefore even more realistic (see e.g. U.S. Department of Commerce 1998).

Cannibalization losses may be reflected in a net reduction in either one of the newspaper's existing income streams: circulation revenue obtained from the number of copies sold and advertising income (Abbring and Van Ours 1994). With respect to circulation, Mitchell (2001) reports that 50% of all publishers fear that their Internet operations may inflict long-run harm on their print business. Gilbert (2001), on the other hand, argues that, if positioned correctly, print and online versions may actually operate in a complementary way, in that the latter may attract new readers not currently subscribing to the print edition. A similar uncertainty exists on the extent of cannibalization that will arise in the advertising arena. First, newspapers' advertising incomes are positively correlated with the size of their subscription base, for which the impact is (as argued before) still unclear. Second, Silk, Klein and Berndt (1999) argue that newspapers are a potentially vulnerable medium to lose their advertisers to the Internet, even though the extent of this loss will again depend on the relative positioning of both media.

Data were collected for 85 online newspaper introductions in two European countries, the U.K. and the Netherlands. Information on the online introduction dates were gathered by contacting each individual newspaper, and extensively validated through both newspaper archive searches and the Dow Jones Interactive Publication Library. The earliest launch dates were November 1994 and July 1995, whereas the latest launches took place in October 1999 and April 2000 for the U.K. and the Netherlands, respectively.

Circulation data were collected for 67 daily U.K. newspapers that went online within the available data period. Circulation is expressed as the average number of copies sold daily. The data are obtained from the 'Audit Bureau of Circulations' (ABC). We have 138 monthly observations for 12 national and 55 regional publications (January 1990 until June 2001). On average, 42 (minimum = 20; maximum = 79) observations are available after the introduction date of the online version.

Advertising revenues from the traditional paper edition were obtained from 18 Dutch newspapers that introduced an online version of their paper within the considered time period. The data are expressed in constant guilders and were provided by the 'Bureau voor Budgetten Controle' (BBC). For both national (nine) and regional newspapers (nine), we have 130 monthly observations (January 1990 until October 2000). On average 41 (minimum = 6; maximum = 63) observations are available after the introduction date of the online version.

2.5 EMPIRICAL RESULTS

Cannibalization losses may be reflected in a net reduction in one (or both) of the newspapers' two existing income streams: circulation and advertising income. We first discuss findings on the circulation data (Section 2.5.1), followed by the results for advertising (Section 2.5.2). Section 2.5.3 provides several robustness checks on our main findings.

2.5.1 Circulation results

The unit-root null hypothesis is rejected in 14 instances based on the regular ADF test (using the conventional 5% significance level), and in five additional cases when allowing for a structural break at the time of the Internet channel addition. This confirms prior simulation evidence in Perron (1989) that a failure to account for a major exogenous event tends to bias regular unit-tests towards non-rejection of the null hypothesis.

Long-run, steady-state, growth rates are summarized in column 2 of Table 2.1, and were derived based on the parameter estimates in Eq. 2.2 for the 19 level/trend stationary series, while Eq. 2.5 was used for the 48 unit-root series. Given our interest in the presence of cannibalization, directional (one-sided) tests are used.[10]

[10] Note that we also need one-sided p-values as input for our subsequent meta-analysis (Rosenthal 1991).

Table 2.1: Long-run performance implications of an Internet channel introduction

	Circulation		***Advertising***	
	Impact on Steady State Growth	*Impact on Steady State Level*	*Impact on Steady State Growth*	*Impact on Steady State Level*
Sample size (n)	67	52	18	16
# negative impact	35	26	11	7
# significant negative impact (5%)	**5**	**4**	**1**	**0**
# positive impact	32	26	7	9
Average negative impact	-.0014	-.0128	-.0065	-.0231
Average positive impact	.0018	.0130	.0030	.0671
Overall average	.0002	.0001	-.0030	.0276
Rosenthal test on cannibalization	p = .94	p = .58	p = .13	p = .98

Steady-state growth rates showed a significant decline after the Internet channel introduction in only five series (i.e. a mere 7% of cases). Even though our main interest lies in cannibalization, it is worth noting that in ten instances a positive steady-state growth-rate change was observed ($t > 1.64$). Interestingly, the newspaper with the largest positive significant break is the Financial Times, the only English newspaper focusing almost exclusively on economic issues. This finding is in line with Pauwels and Dans (2001), who argue that economically-oriented newspapers are likely to experience positive spillover effects from an online channel addition. The average long-run growth impact across all 67 newspapers indicates a small but positive effect, obtained from about an equal number of negative (35) and positive (32) changes that are also approximately equal in absolute value (-.0014 and .0018).[11]

One could argue that the power of each of the individual tests may not be excessively high. Yet, we concur with Dekimpe et al. (1999, p. 280) that the *combined* evidence of no growth slowdown in more than 90 % of the instances is very strong evidence. On the other hand, one might still object, based on analyses of the parameter sign, that even though there are only 5 significant growth slowdowns, the number of negative changes is quite substantial (35). We therefore conducted a meta-analysis to test for the presence of cannibalization using the one-sided *p*-values associated with the change in the long-run growth rate after the Internet channel introduction, using the method of adding weighted *Z*'s (Rosenthal 1991). This offers a stronger test for the presence of cannibalization than the significance of the individual impact estimates. Indeed, when the impact on many newspapers is weak (e.g. $p < .20$) but in the same direction, case-by-case tests would not reveal any significant cannibalization impact to worry about. Still, the *collective* evidence, as reflected in the meta-analysis, would suggest a highly significant effect (see Rosenthal 1991 for technical details, or Dekimpe et al. 1997 for a marketing application). However, also the collective evidence showed no support for the presence of a significant cannibalization threat in the newspapers' circulation-revenue growth ($p = .94$).

Cannibalization may not only result in a *growth* slowdown, however. It may also show up in a *level* drop. The 52 series where the |*t*-statistic| on γ was smaller than 1.64 in Eq. 2.2, were therefore re-analyzed after imposing a common pre and post growth-rate (i.e. we deleted

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[11] Interestingly, most of the circulation series showed a negative evolution, both before and after the Internet channel addition, supporting common wisdom that the newspaper industry is an industry in decline (Abbring and Van Ours 1994). A significant negative trend break in such series indicates that the introduction of a new Internet channel accelerates an already ongoing decline (rather than slowing down its growth).

DT_t from Eq. 2.2 and DU_t from Eq. 2.5), and we tested for the significance of $\theta/(1-\sum a_i)$ (column 3, Table 2.1). Four significant negative level shifts were found. When focusing on the average level impact across all 52 series, a pattern quite similar to that of the growth rate change can be observed. Again, a very small average positive effect is found, based on an equal number of negative (26) and positive (26) values that are also almost equal in absolute size (-.0128 and .0130). Moreover, the Rosenthal test did, once more, not reveal a significant level drop (p = .58).

2.5.2 Advertising results

As with the circulation data, most advertising series are classified as having a unit root: based on the structural-break (regular) test, the unit-root null hypothesis was rejected in 4 (3) instances. Long-run, steady-state, growth rates are summarized in column 4 of Table 2.1. Of the 18 cases examined, only one experienced a significant reduction in steady-state growth rate ($\gamma/(1-\sum a_i)$ = -.0051; t = -2.27).[12] Even though only one newspaper experiences a significant long-run growth slowdown, the number of negative long-run growth-rate changes is substantial (11). Moreover, the average growth impact across *all* 18 observations is negative (-.0030). However, as with the circulation data, also the collective evidence from the Rosenthal test did not reveal a significant cannibalization effect (p = .13).

The 16 newspapers with a |t-statistic| for γ less than 1.64 in Eq. 2.2, i.e. whose long-run growth was not affected by the Internet channel addition, were subsequently re-analyzed after imposing a common slope. None of the newspapers experienced a significant reduction in their steady-state performance level because of the Internet channel addition (column 5, Table 2.1). Also the meta-analysis did not reveal such an effect (p = .98).

2.5.3 Robustness checks

Based on this individual and collective evidence, we can conclude that the fear for cannibalization in terms of the newspapers' circulation and advertising income appears to be overrated. To assess the robustness of this substantive conclusion, we conducted a number of validation checks. Specifically, we (i) assessed the sensitivity of our results to the level of

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[12] For one newspaper, a marginally significant growth *increase* is observed ($\gamma/(1-\sum a_i)$ = .0066; t = 1.67). Again, this is the most economically oriented newspaper of our sample, offering further support to the aforementioned conjecture of Pauwels and Dans (2001).

temporal aggregation in the data, (ii) tested whether the finding of no cannibalization was driven by the lack of sufficient post-event data, and (iii) correlated the growth and/or level changes with the stock-market reactions reported in Geyskens et al. (2002).

2.5.3.1 Sensitivity to the level of temporal aggregation

Prior research has demonstrated that both unit-root tests (Pierse and Snell 1995) and inferences about the autoregressive parameters (Rossana and Seater 1995) may be sensitive to the level of temporal aggregation in the data. Following Nijs et al. (2001), we doubled our temporal aggregation level from a monthly to a bi-monthly level.

Our substantive results were not affected. In terms of the circulation data, the same outcome was obtained for the structural-break unit-root tests in more than 80% of the cases. Seven newspapers were found to have a significant negative growth-rate change in the bi-monthly series (as opposed to five when working with monthly data), and the collective evidence was again very similar: the average change in steady-state growth is approximately twice as large as for the monthly analysis (-.0029 versus -.0014 for the negative changes, and .0036 versus .0018 for the positive changes), while the Rosenthal test, in accordance with the monthly analyses, showed no significant impact, neither for the trend breaks (p = .99) nor for the level shifts (p = .89).

For the advertising data, none of the unit-root test outcomes was affected. In terms of their long-run growth rate, a significant growth slowdown was found for the same newspaper, with the change in its steady-state growth rate (-.0089) about twice the change in its monthly growth rate (-.0051). As before, the average change in growth rate across all 18 observations is approximately twice as large as for the monthly analysis (-.0111 vs. -.0065 for the negative changes, and .0085 versus .0030 for the positive changes), and the meta-analytic Rosenthal test continued to show no significant impact (p = .24). As for the level shifts in advertising income, we again found none of the individual level shifts to be significantly negative, and the meta-analytic test result was again not significant (p = .97).

2.5.3.2 Sensitivity to the timing of the Internet channel introduction

One could argue that for the more recent Internet channel additions, insufficient post-event data points were available to detect cannibalization. As indicated before, on average, 42 post-event circulation observations (minimum = 20; maximum = 79) were available, and 41 post-event advertising observations (minimum = 6; maximum = 63). If the argument above would be valid, however, we would expect more evidence of cannibalization in those series that experienced the Internet channel addition earlier. Two test procedures for this contention were implemented, a regression of the long-run growth-rate/level changes against the introduction time of the Internet edition, and a split-half analysis.[13]

For the circulation series, we first ran a regression of, respectively, the change in long-run, steady-state, *growth* rate (using all 67 observations) and of the change in long-run *level* (based on the 52 observations mentioned earlier) on the time of the Internet channel introduction. No significant relationship was found ($\beta = -2.53*10^{-6}$, $p = .89$ and $\beta = -1.96*10^{-4}$, $p = .36$). Second, the Rosenthal test was conducted on two subsamples, constructed according to a median split on the entry-timing variable. Again, in none of the analyses, any collective evidence of cannibalization was found, neither in terms of a growth slowdown ($p = .99$ for early entrants, and $p = .49$ for late entrants) nor in terms of a level reduction ($p = .72$ for early entrants, and $p = .63$ for late entrants).

In terms of the newspapers' advertising figures, the same two test procedures were applied. The regression against the time of entry did not find any positive relationship between the timing of the Internet channel introduction and the change in either long-run growth (based on 18 observations) or long-run level (based on 16 observations). Rather, the slope coefficient for the long-run growth rate turned out to be negative rather than positive ($\beta = -2.62*10^{-4}$, $p = .014$) and the long-run level shifts showed again no relation ($\beta = 7.39*10^{-5}$, $p = .95$). Similarly, the Rosenthal test on the subsamples of early, respectively, late entrants was never significant, neither in terms of their steady-state growth rate ($p = .18$ for early entrants, and $p = .26$ for late entrants), nor in terms of their long-run level ($p = .69$ for early entrants, and $p = .99$ for late entrants).

2.5.3.3 Linkage with the stock-market reaction to the Internet channel introduction?

Geyskens et al. (2002) argue that Internet channel additions may have value-enhancing (e.g. demand expansion, higher prices, and lower physical-distribution and/or transaction costs), as well as value-destroying (e.g. *cannibalization*, lower prices, and higher costs) effects. They test their framework in the same industry through a financial event study. Arguing that financial markets are efficient and therefore should reflect all relevant

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[13] No heteroscedasticity was found using the White test. We therefore applied OLS instead of WLS (see Nijs et al. 2001 for a similar approach).

information about these various factors, they report (i) a positive average stock-market reaction around the event date, as reflected in a cumulative average abnormal return (CAAR) around the event day of .71%,[14] and (ii) a mixture of both positive and negative CAARs when looking at the individual newspapers.

Across the two countries considered in our study, 44 newspapers also appeared in the Geyskens et al. (2002) sample. Based on those 44 observations, a significant positive correlation is found between these newspapers' CAARs and their change in steady-state growth rate (Pearson correlation coefficient = .33, p = .029). Of the newspapers that received a positive (negative) stock-market reaction, 64 % (63%) were characterized by a positive (negative) change in their steady-state growth. This result is encouraging, especially when considering that the cannibalization threat is just one of the many value enhancing/destroying factors identified in the conceptual framework of Geyskens et al. (2002), all of which are supposedly reflected in the ultimate stock-market reaction. The relationship between the CAARs and the level shifts is weaker, resulting in an insignificant correlation (p = .41).

2.6 DISCUSSION

During the past decade, irrational exuberance has turned into a possibly equally irrational pessimism about what the Internet can accomplish. The fear of getting ruined through cannibalization losses has recently deterred many firms from deploying the Internet as a distribution channel. Caught up in this general fervor, others have already withdrawn their Internet channels only shortly after having established them. But do Internet channels really cannibalize firms' entrenched channels? Or is this widely held assumption exaggerated and are practitioners making fundamental mistakes by shying away from this new channel? Unfortunately, this issue of high managerial importance has barely been touched on in empirical research. The time has come to move away from jumping to the presumption that the Internet is automatically cannibalistic and see the Internet for what it is.

Using a database of 85 Internet channel additions over the last ten years in the British and Dutch newspaper industries, we find that the often-cited cannibalization fear has been largely overstated. Relatively few newspapers in our sample experience a significant drop in their circulation or advertising revenues. This result may imply that there is only little overlap between customers using the traditional channel and those preferring the online channel.

[14] The event window considered was [0,1] days.

Indeed, a number of researchers have recently argued that the readership profile of online newspapers tends to be younger, higher educated, mainly male and more technology oriented than the majority of the print readers (e.g. Nicholson 2001; Pauwels and Dans 2001). Similarly, the overwhelming majority of online advertisers are not print advertisers. Key advertising customers in print are local department stores, grocery chains, and retail clients, whereas most Internet advertising is placed by sellers of computer-related products and services (Gilbert 2001; Silk, Klein and Berndt 2001a).

Still, this does not imply that firms have free play in setting up Internet channels. An appropriate positioning is still called for, as recently argued by, among others, Gilbert (2001) and Silk et al. (2001a). Indeed, when the new channel is positioned as too close a copy (substitute) to its traditional counterpart, cannibalization will more likely take place. Support for this contention is found when comparing newspapers that experienced significant cannibalization losses in their circulation revenues (9) with those that did not (58) in terms of product similarity (overlap) between the online and print version of the product. Data on product similarity were obtained by contacting the newspapers' webmasters, and asking them to indicate the percentage overlap between the online and print version of the newspaper at the time the Internet edition was first launched, an operationalization also adopted in Gilbert (2001). A *t*-test on the difference in mean similarity across both groups strongly indicates that newspapers' circulation revenues are more likely to get cannibalized when there is a high overlap between their online and offline versions (mean similarity is 78% for cannibalized newspapers versus 45% for non-cannibalized newspapers; $p = .0008$).

In sum, our conclusions are encouraging. The threat of cannibalization appears to be considerably lower than widely assumed. The Internet rarely cannibalizes traditional channels. The Internet therefore need not necessarily be disruptive to established companies and channels. Too often, change is confused with disruption. Disruption means invalidating or making substantially less important the advantages of incumbents (Bower and Christensen 1995). The Internet does not invalidate the importance of entrenched distribution channels. Firms can have both together, and can even create some synergies from a diverse, yet well positioned, channel portfolio.

Limitations and further research. The present study has various limitations, which offer immediate avenues for future research. First, we treated the potential break date as exogenous, i.e. we made full use of prior (managerial) knowledge on the timing of the event. This practice has been criticized as it would allow the researcher to "cherry-pick" the most convenient location of a potential break (see e.g. Christiano 1992). In our case, however, the managerial information on the timing of the event came from a truly exogenous source, and is objectively known in the market. As such, it was by no means a "convenient", ex post (e.g. after a visual data inspection) choice on the part of the authors (see Perron 1994 for an extensive discussion on the topic). Still, one could let the data suggest endogenously the most likely break date (as advocated, for example, in Vogelsang 1997 or Zivot and Andrews 1992), and see whether the Internet channel introduction coincides with (or is located closely to) this break point. Second, even though no significant relationship was found between the occurrence of cannibalization and the length of the time period after the event, care should be exerted when extrapolating our findings too far outside the sample range. Specifically, our conclusions are based on the assumption that no other, not yet anticipated, technological discontinuity will take place, while the constant-parameter assumption for the autoregressive parameters of the model does not take into consideration that, as multiple years pass by, both on- and offline readerships may eventually start to become closer (Silk et al. 2001a). Third, there is the issue of external validity. We conjecture that in the absence of cannibalization effects in the cannibalization-prone newspaper industry, the widely claimed cannibalization threat would also appear to be overrated for other, less vulnerable, industries. Yet, we do fully acknowledge that our sample is limited to firms from a single industry. Given that this industry may have some peculiarities, such as the possibility to consume the product (information) in bits and pieces "without destroying" the original physical piece, we strongly suggest for future research to explore to what extent our results are generalizable to other industries. Fourth, the non-availability of data on both revenue streams for the same set of newspapers prevented us from analyzing the interaction that is to be expected between circulation and advertising (Abbring and Van Ours 1994). Finally, given that cannibalization effects are largely absent, future research could analyze how firms can achieve positive spillover effects from an Internet channel edition, as was obtained in our sample for the more economically-oriented newspapers.

CHAPTER 3:
WEATHERING TIGHT ECONOMIC TIMES: THE SALES EVOLUTION OF CONSUMER DURABLES OVER THE BUSINESS CYCLE

Abstract

Despite its obvious importance, not much marketing research focuses on how business–cycle fluctuations affect individual companies and/or industries. Often, one only has aggregate information on the state of the national economy, even though cyclical contractions and expansions need not have an equal impact on every industry, nor on all firms in that industry. Using recent time-series developments, we introduce various measures to quantify the extent and nature of business-cycle fluctuations in sales. Specifically, we discuss the notions of cyclical volatility and cyclical comovement, and consider two types of cyclical asymmetry related, respectively, to the relative size of the peaks and troughs and the rate of change in upward versus downward parts of the cycle. In so doing, we examine how consumers adjust their purchasing behavior across different phases of the business cycle. We apply these concepts to a broad set (24) of consumer durables, for which we analyze the cyclical sensitivity in their sales evolution. In that way, we (i) derive a novel set of empirical generalizations, and (ii) test different marketing theory-based hypotheses on the underlying drivers of cyclical sensitivity.

Consumer durables are found to be more sensitive to business-cycle fluctuations than the general economic activity, as expressed in an average cyclical volatility of more than four times the one in GNP, and an average comovement elasticity in excess of 2. This observation calls for an explicit consideration of cyclical variation in durable sales. Moreover, even though no evidence is found for depth asymmetry, the combined evidence across all durables suggests that asymmetry is present in the speed of up- and downward movements, as durable sales fall much quicker during contractions than they recover during economic expansions. Finally, key variables related to the industry's pricing activities, the nature of the durable (convenience vs. leisure), and the stage in a product's life cycle tend to moderate the extent of cyclical sensitivity in durable sales patterns.

Keywords: Business cycles; Sales evolution; Consumer durables; Time-series econometrics.

3.1 INTRODUCTION

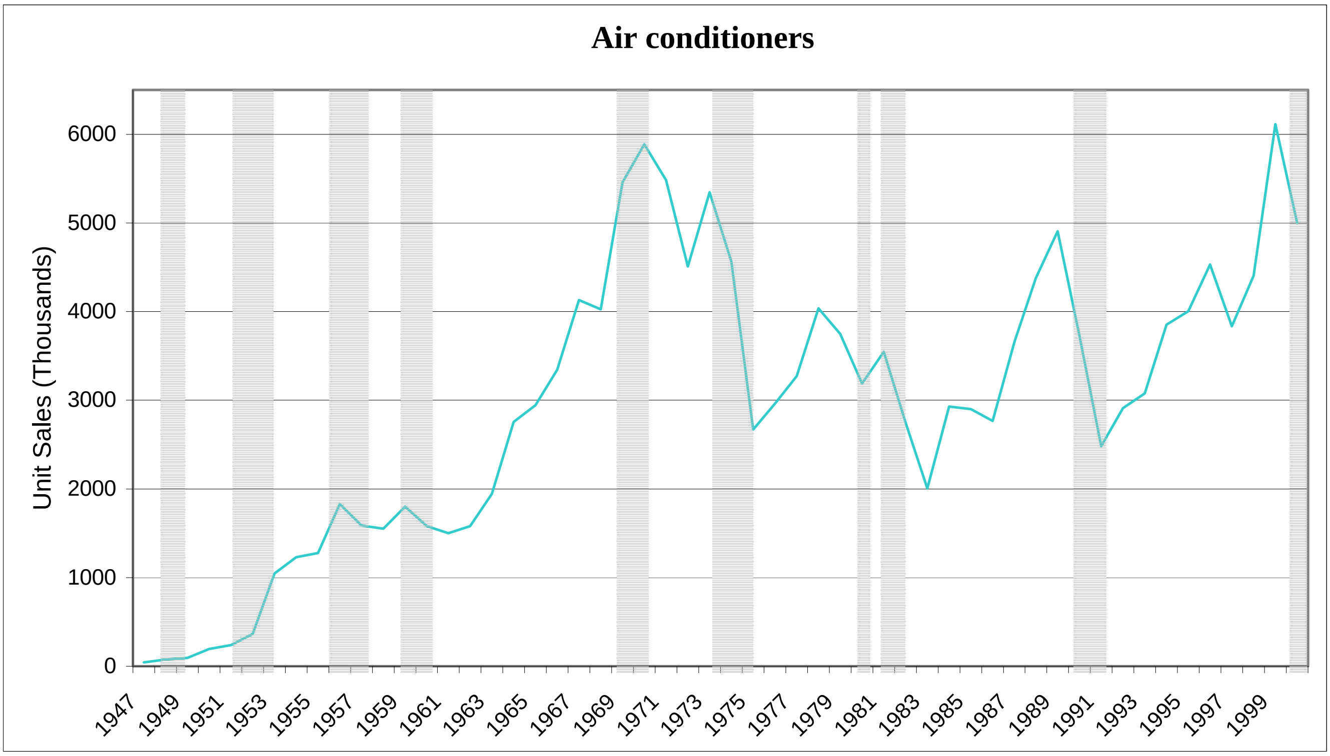
The renewed fear for a widespread economic downturn reminds companies that macro-economic developments can be among the most influential determinants of a firm's activities and performance. In a recent *Business Week* survey, US companies report profits that are up to 30% down from previous year, with an especially dramatic drop in sectors such as telecommunication, computer technology and pharmaceuticals (August 5, 2002, p. 60). Similarly, *The Economist* reports that US retail sales dropped 3.7% in November 2001, the sharpest month-to-month decline since 1992 (March 9, 2002, p. 4). Given the size of these reductions, it should come as no surprise that management feels the heat to actively respond to such economic downturns. Shama (1993), for example, found that almost all managers he surveyed modify their marketing strategy in response to economic contractions. Still, most companies also indicated *they did not use any systematic procedure to determine the impact of such economic contraction on their specific business*. Put differently, while companies feel a strong need to make some changes to their marketing tactics and strategies in economic downturns, they are often at a loss on how to adequately assess the impact of these contractions. Yet, how they perceive the environmental threat posed by a downturn will drive to a considerable extent whether and how they will adjust their behavior (Dutton and Duncan 1987).

In the academic marketing literature, one occasionally accounts for *long-run evolutions* in macro-economic variables generally associated with demand (e.g. Dekimpe and Hanssens 1995a; Franses 1994). Much less attention has been devoted to the sensitivity of performance and marketing support to *cyclical variations* in the economy.[15] In a recent review of three leading marketing journals (Journal of Marketing, Journal of Marketing Research, Marketing Science), Srinivasan, Lilien and Rangaswamy (2002) found only three publications on a topic related to economic contractions, with the most recent one published in 1979. This general neglect of business-cycle fluctuations in the marketing literature is surprising, as they may affect both consumers' and companies' activities. In this paper, we aim to address that gap by introducing various measures to quantify the extent and nature of business-cycle fluctuations in durable sales patterns;

[15] Cyclical variations in the economy have been studied extensively by macro-economists, but these studies concentrate on aggregate economic variables such as GDP, while we concentrate on individual durable categories. Marketing papers considering the effect of cyclical variations in the economy include Clark, Freeman and Hanssens (1984), Coulson (1979), Cundiff (1975), Devinney (1986), and Yang (1964).

specifically, the notions of cyclical volatility, cyclical comovement and cyclical asymmetry are introduced. We will apply these measures to the sales of a broad set of consumer durables, for which we analyze the cyclical sensitivity in their sales evolution over several decades. Our choice to analyze consumer durables is motivated by the fact that these are expected to be particularly sensitive to cyclical expansions and contractions (Cook 1999; Katona 1975).

Figure 3.1: Postwar sales evolution of US air conditioners[a]



[a] The grey bars represent the officially registered contractions in the US economy during the observed time period, as identified by the NBER's Business Cycle Dating Committee (www.nber.org/cycles.html).

As a case in point, we present in Figure 3.1 the over-time US sales of air conditioners. The grey bars in Figure 3.1 represent the officially registered contractions in the US economy during the observed time period, as identified by the NBER's Business Cycle Dating Committee (www.nber.org/cycles.html), and widely used in many economic studies (see e.g. Christiano and Fitzgerald 1998; Cogley 1997).[16] Figure 3.1 shows clear

[16] A contraction, according to the NBER's Business Cycle Dating Committee, is defined as a period of significant decline in economic activity, reflected in a substantial reduction in such variables as total output, income, unemployment, and trade. Specifically, the NBER identifies a month when the economy reaches a

evidence of a strong cyclical influence on durable sales over time. Indeed, almost every time the economy suffers a contraction, sales drop significantly, while expansions are generally associated with increasing industry sales. For instance, during the early 1990s, the contraction caused sales to drop from 4,904 thousand units (in the 1989 peak period) to only 2,481 thousand units at the end of the contraction in 1991. Moreover, during this same contraction, another interesting characteristic is observable. In less than 2 years, air conditioner sales fell to almost half its pre-1990 level, while it took more than 7 years to recover from that loss (the initial peak of 4,904 thousand units was not attained until 1999). Similar patterns can be observed during the contractions of 1973 and 1981. Based on these observations, cyclical fluctuations in durable sales seem to be *asymmetric* between contractions and expansions: sales clearly drop very fast, compared to a slower upward adjustment in subsequent years. The question then arises whether these observed patterns are idiosyncratic to this specific durable, or whether they reflect a more general characteristic in durable sales evolutions. If so, what is it that causes and explains this asymmetry?

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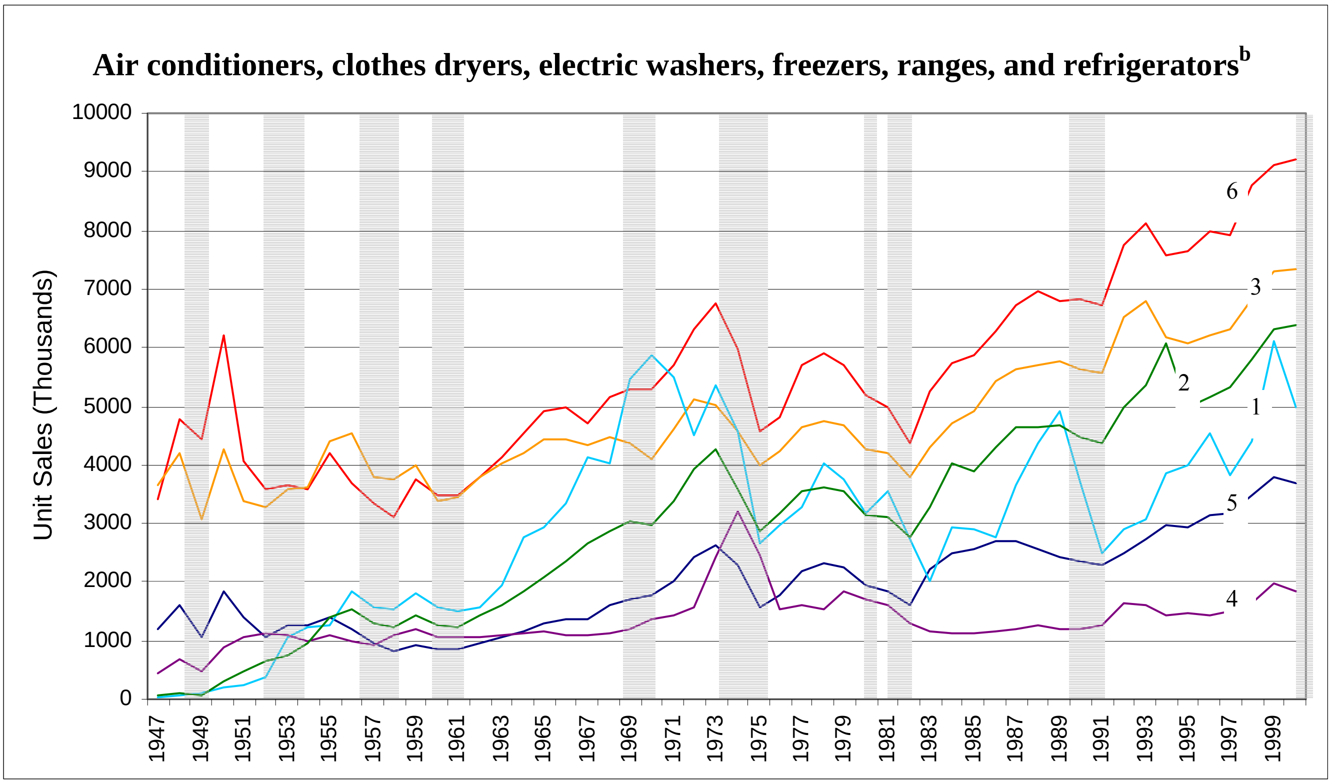
peak of activity and a later month when the economy reaches a trough. The time in between is defined as the contraction (www.nber.org/cycles.html).

Figure 3.2: Postwar sales evolution of multiple consumer durables[a]



[a] The grey bars represent the officially registered contractions in the US economy during the observed time period, as identified by the NBER's Business Cycle Dating Committee (www.nber.org/cycles.html).
[b] With: [1] Air conditioners; [2] Clothes dryers; [3] Electric washers; [4] Freezers; [5] Ranges; [6] Refrigerators.

In Figure 3.2, we add the US sales evolution of clothes dryers, electric washers, freezers, ranges, and refrigerators, and observe a comparable cyclical behavior. Still, it is also apparent from Figure 3.2 that there is some variation across the different sales patterns. Cyclical sensitivity seems to be more pronounced in air conditioner sales, while freezers and ranges tend to be less affected. In combination, Figures 3.1 and 3.2 provide us with informal evidence on the existence of (i) a strong cyclical sensitivity in durable sales, (ii) asymmetries in up- and downward sales adjustments, and (iii) variability in cyclical sensitivity across durable industries.

The main purpose of this study is to provide a rigorous analysis of business-cycle fluctuations in durable sales. In particular, we first provide two metrics to quantify the sensitivity of sales (or marketing support) series to business-cycle fluctuations. Next, we determine how to best characterize the asymmetry we might observe in this cyclical behavior. Finally, we assess a number of factors that may explain the variation in cyclical sensitivity across the different durables under investigation. Three key empirical results emerge from our analysis. First, we find that cyclical fluctuations in durable sales are, on average, much more pronounced than in the general economic activity. This calls for a more explicit consideration of cyclical variability in durable sales evolutions than traditional response and diffusion models have done. Next, the combined evidence across 24 durables suggests that their sales fall quickly during contractions, while adjusting more slowly during expansions. Finally, industry price volatility, the nature of the price reactions, the type of product and the stage in the product life cycle are found to moderate the observed extent of cyclical volatility.

The remainder of the paper is organized as follows. In Section 3.2, we describe how consumers and companies may respond to business-cycle fluctuations. Next, we introduce the methodology (Section 3.3), describe the data set (Section 3.4), and apply the method to a broad set of consumer durables (Section 3.5), which allows us to derive various Empirical Generalizations (EGs) on durables' business-cycle sensitivity. In Section 3.6, we introduce a number of variables that may moderate the observed extent of cyclical sensitivity in sales. All results are extensively validated in Section 3.7. Finally, Section 3.8 summarizes our main findings, and concludes with suggested areas for future research.

3.2 DRIVERS OF CYCLICAL SENSITIVITY

Cyclical sensitivity in durable sales can be attributed to consumers' typical purchase adjustment decisions for durable goods across up- and downturns, which can be attenuated or reinforced by company reactions. We elaborate on these two drivers of cyclical variability, after which we discuss apparent differences in cyclical sensitivity across industries.

3.2.1 Consumer-related drivers of cyclical sensitivity

Consumers' actual purchase decisions depend to a considerable extent on their *ability* to acquire the product, as reflected in their income level (Katona 1975; Mehra 2001). Since income developments move in the same direction as developments in the aggregate economy, contractions can decrease consumption through a decline in consumers' wealth (Stock and Watson 1999). Still, people's *attitude* and expectations are found to contribute to cyclical fluctuations in excess of the impact of actual changes in their income level (Katona 1975). Hence, even if their income remains largely unaffected, mere changes in the consumers' attitude during a contraction can already trigger important reductions in their expenditures. This is especially the case in the context of consumer durables, which are expected to be more vulnerable to business-cycle fluctuations for a number of reasons.

First, at the individual level, durables have been shown to have an income elasticity in excess of one (Fortune 1979), implying that customers' purchase decision of these products is quite sensitive to reductions in their ability to purchase, as reflected in their average income level. Second, consumers who want to restrict their purchases during an economic contraction find it more difficult to cut back on most frequently purchased consumer goods (FPCGs), because these purchases have, in many respects, become habitual. Therefore, consumers' ability to constrain their outlays for FPCGs is limited, while discretionary expenditures on durables are often the first to be reconsidered (Katona 1975). Third, while expenditures on many non-durables (such as food or clothes) are seen as necessary, expenditures on durables are often outlays of choice. As there is no pressing need to buy these durables at a particular moment in time, consumers can more easily postpone their acquisition when they are confronted with unfavorable economic prospects (Cook 1999). Fourth, purchasing a durable can be considered an investment decision on the part of the consumer. Durables often involve more expensive products that are commonly bought on credit; but once obtained, the consumer benefits from the product's utility over an extended period of time (Cook 1999; Darby 1972; Horsky 1990). Moreover, consumers incur a certain amount of risk and uncertainty, both in terms of the technical reliability of the good and in terms of the benefits they will be able to obtain from it, and these future-oriented considerations are found to be incorporated in the consumers' current purchase decisions (Lemon, White and Winer 2002; Rust et al. 1999). As such, consumers are more inclined to acquire durable goods during favorable economic times. Faced with adverse economic conditions, consumers tend to postpone the acquisition, while current owners of durables may try to lengthen the lives of their product by repairing rather than replacing them (Bayus 1988; Clark et al. 1984).

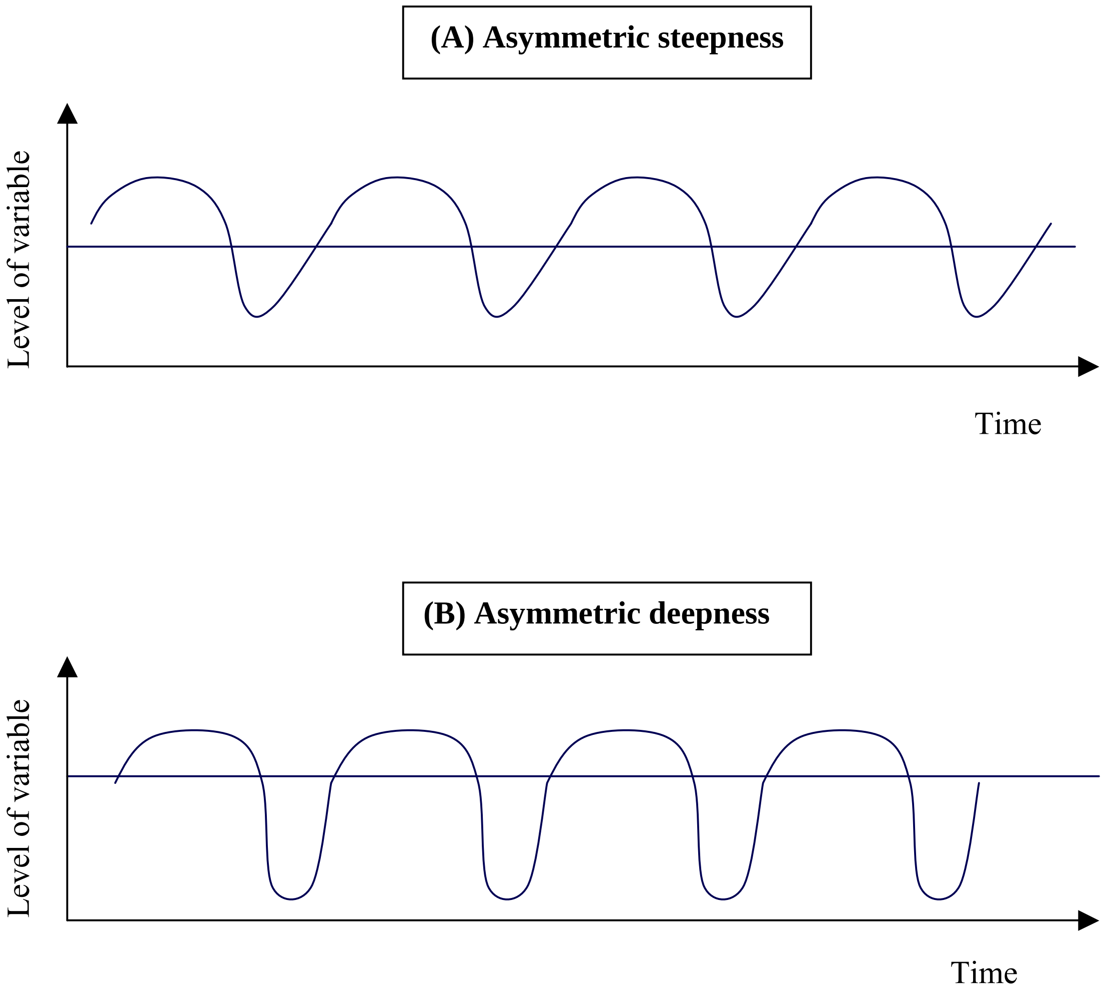
Purchase postponement may not only contribute to the existence of cyclical sensitivity, it may also cause the cyclical fluctuations to become *asymmetric* in nature (Gale 1996). During contractions, the consumers' willingness to buy decreases sharply, as people get a strong incentive to delay their spending and wait for better times (Gale 1996). Moreover, as consumer wealth is expected to reach its lowest level right after the downturn, it can be expected that consumers postpone their purchases further, even when the economy starts to recover, to take full advantage of the anticipated increase in future income and wealth (Caballero 1993; Gale 1996). As such, consumers' downward adjustments during contractions tend to occur quickly, while their upward adjustments may be subject to some delay. When this process occurs across many individual decision makers that are all subject to similar market signals, asymmetries are expected to also be present in aggregate sales (Katona 1975). Thus, postponing purchases prolongs the recovery from a contraction (slow adjustment), which causes the cyclical fluctuations in expenditures to evolve *asymmetrically* across expansions and contractions.

Asymmetric adjustments may also arise from the way consumers gain or lose trust (or confidence) in the economic climate. This confidence has been shown to be an important driver of consumers' purchase behavior (see e.g. Kumar, Leone and Gaskins 1995). During economic contractions, consumer trust is typically lost very easily. In contrast, research on the development of trust indicates that a breach of trust causes a sustained stretch of doubt among people, so that it may take a longer time to restore it (Holmes and Rempel 1989; Nooteboom, Berger and Noorderhaven 1997). In addition, consumers' negative expectations tend to be prolonged by a tendency to focus primarily on the negative aspects surrounding them, as people seem to interpret information in a way that confirms their pessimistic attitudes or beliefs (Kramer 2002; Zand 1972). Accordingly, consumer confidence will only be gradually restored during an expansion. Consumers' attitude changes may therefore contribute to a swift downward sales adjustment during a contraction, and a more gradual increase during economic expansion periods.

Asymmetry in sales may not only manifest itself in a differing *speed* of adjustment, but also in the *extent* or level of sales drops versus peaks. Behavioral theories posit that consumers react more extensively to unfavorable changes or losses than to comparable gains (Thaler 1985; Tversky and Kahneman 1991). The implications of loss aversion on consumer purchase behavior were initially considered in the context of price changes (see e.g. Krishnamurthi, Mazumdar and Raj 1992; Mayhew and Winer 1992, Putler 1992). However, other manifestations of asymmetric consumer response include their reaction to product quality changes (Hardie, Johnson and Fader 1993), and both expected wage changes (Shea 1995) and changes in their income level (Bowman, Minehart and Rabin 1999). Therefore, when families experience or expect a deterioration in their wage/income, caused by a negative shift in the economy, they are likely to considerably reduce their spending level, while upward adjustments tend to trigger more moderate reactions during business-cycle expansions.

Asymmetries in different phases of the business cycle have long been the object of interest to economists (see e.g. DeLong and Summer 1986a; Neftçi 1984; Sichel 1993). Sichel (1993) distinguishes in this respect between two different types of cyclical asymmetry that could exist either separately or in combination: steepness asymmetry and deepness asymmetry. Our previous discussion offered a behavioral rationale for both phenomena, which are illustrated graphically in Figure 3.3.

Figure 3.3: Steepness and deepness asymmetry



Most previous empirical research has focused on what Sichel labels *steepness* asymmetry, which refers to cycles where contractions are steeper than expansions. Steepness thus pertains to the speed or rate of change with which an industry (or the economy as a whole) falls into a contraction compared to its speed of recovery. If purchase postponement and trust breakdown indeed slow down the speed of recovery, durable sales should exhibit such asymmetric steepness. On the other hand, *deepness* asymmetry is defined as the characteristic that troughs are deeper, i.e. further below mean or trend, than peaks are tall. Deepness asymmetry is consistent with consumers' more extensive reaction to contractions than to the corresponding expansions. Industries where one or both types of asymmetry are present, will suffer more during contractions than they benefit during expansions: sales will fall *faster* (steepness asymmetry) and/or *further* (deepness asymmetry) during contractions than they increase during expansion periods.

3.2.2 Firm-related drivers of cyclical sensitivity

The above patterns may be reinforced or attenuated by the marketing activities of the players in the market. Mascarenhas and Aaker (1989), for example, find evidence that firm strategies differ significantly over business-cycle stages. Companies' main strategic reaction to economic downturns has been documented to be one of cutting costs of all kinds, especially those that do not immediately increase sales revenue (Dobbs, Karakolev and Malige 2001). This has been criticized as it may further reduce consumers' propensity to buy during unfavorable economic conditions, and even endanger the company's survival potential (*The Economist*, March 9, 2002 pp. 12-14). Some managers not only *reduce* budgets, they also tend to *reallocate* marketing funds to those activities that are prone to generate short-term cash flows. For example, marketing managers have been found to use significantly more coupons and price promotions during contractions to keep their sales up (de Chernatony, Knox and Chedgey 1991; Goerne 1991). So, apart from cutting total marketing budgets during contractions, managers may also redirect budgets to those activities that are better able to generate immediate income.

While this tends to be the dominant reaction pattern, other firms are known to follow an opposite strategy, i.e. to *increase* their spending, especially on advertising. Empirical evidence exists that companies that view the downturn as an opportunity, and develop aggressive advertising responses to it, can improve their performance, even during the contraction (Dhalla 1980; Rigby 2001; Srinivasan et al. 2002). Similarly, a recent PIMS-based study revealed that such firms were not significantly less profitable during contraction periods, while they outperformed their competitors during recovery (Hillier 1999).

A similar ambiguity exists with respect to the adopted pricing practice. Some have argued that during contractions, prices should move down (Green and Porter 1984; Tirole 2001, p. 252), while others have argued the opposite (see e.g. Rotemberg and Saloner

1986).[17] Ball and Mankiw (1994), in turn, argue that price rigidity tends to be asymmetric, i.e. prices are more flexible when going up than when going down, which may amplify consumer-related asymmetric sales adjustment.

3.2.3 Industry heterogeneity in cyclical sensitivity

Business-cycle fluctuations have been studied extensively at the macro-economic (national) level. Using postwar US data, Stock and Watson (1999) examined the empirical relationship between aggregate business cycles (reflected in GDP) and various aspects of the macro economy, such as aggregate production, interest rates and employment. Englund, Persson and Svensson (1992), on their part, studied cyclical fluctuations on a comparable set of Swedish macro-economic variables. Other studies focused on business-cycle patterns across countries (see e.g. Backus and Kehoe 1992; Mills 2001; Christodoulakis, Dimelis and Kollintzas 1995).

However, there is increasing evidence that contractions observed at the national level need not be representative for what happens at a more disaggregate, industry level (Berman and Pfleeger 1997; Jacobs 1998; Shama 1993). It has been argued that in a national downturn, only 60% of all industrial sectors are actually in a downturn (*The Economist*, March 9, 2002 p. 5). Some industries, such as the advertising industry, are known to be hit particularly hard during contractions. The health-care industry, in contrast, seems to benefit from unfavorable economic perspectives (Berman and Pfleeger 1997). While this variability was also apparent in Figure 3.2, little is known on what drives differences in cyclical variability across industries, or, in our case, across different durable categories. In Section 3.6, we will provide an exploratory analysis on some of these drivers.

3.3 METHODOLOGY

Our research methodology consists of two stages: (i) extracting the business-cycle component, and (ii) quantifying the sensitivity of the performance pattern to business-cycle fluctuations.

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[17] We refer to Section 3.6 for a more elaborate argumentation on this issue.

3.3.1 Stage 1: Extracting the business-cycle component

Since firms' reactions to sales fluctuations are heavily dependent on how these are perceived and understood (Dutton and Duncan 1987), it is crucial for management to know *to what extent the sales variations they experience can be attributed to business-cycle fluctuations*. Therefore, we first disentangle to what extent over-time fluctuations in sales can be interpreted as business-cycle fluctuations.

In this paper, we adopt the Band-Pass filter formalized in Baxter and King (1999), and applied in Cogley (1997), Mills (2001) and Stock and Watson (1999) among others, to isolate the business-cycle component in each individual series. Based on the observation from many NBER researchers (see e.g. Burns and Mitchell 1946; Christiano and Fitzgerald 1998) that US business cycles typically last between 1.5 and 8 years, the underlying idea of the Band-Pass filter is to pass through all components of the time series with periodic fluctuations between 6 and 32 quarters. Given that we will work with annual data (see Section 3.4), the band-pass filter will admit periodic components between 8 and 32 quarters, rather than between 6 and 32. This is because the 'Nyquist frequency', i.e. the highest frequency about which we have direct information, corresponds to a component of two years in duration when using annual data (see Granger and Hatanaka 1964; Vilasuso 1997 for technical details).

The Baxter and King filter originates in the theory of spectral analysis.[18] Still, we will undertake our filtering entirely in the time domain. We refer to the original study of Baxter and King (1999) for a detailed discussion on both the design of the filter in the frequency domain, and its translation back into the time domain in the form of a symmetric (in terms of leads and lags) moving-average filter. An 'ideal' or optimal band-pass filter would isolate only those components in the series that lie within the specified periodicity range. Such an ideal filter, however, would require an infinite-order moving average, so that in practice an approximation is needed. The proposed approximation is based on a symmetric 3-year centered moving-average transformation, where the weights are chosen to approximate as close as possible the optimal filter. For *annual* data, this approximate filter can be shown to equal (see Baxter and King 1999 for details):

$$c_t = 0.7741 y_t - 0.2010(y_{t-1} + y_{t+1}) - 0.1351(y_{t-2} + y_{t+2}) - 0.0510(y_{t-3} + y_{t+3}), \quad (3.1)$$

[18] See Bronnenberg, Mela and Boulding (2002) or Parsons and Henry (1972) for marketing applications of the spectral approach to time-series analysis.

where y_t is the original series in year *t*, and c_t the cyclical component to be used in further analyses.[19]

This filter has several appealing features: (i) it extracts the specified range of periodicity, while leaving key properties (such as asymmetries) of the original series unaffected; (ii) it does not introduce a phase shift, in that it does not alter the timing of the cycles, so that contraction and expansion dates in the filtered series correspond to the same dates as in the original series; (iii) it removes unit roots up to the second order, and eliminates quadratic deterministic trends (Baxter and King 1999). The latter property is especially relevant in our study. Indeed, according to the product-life-cycle hypothesis, product performance goes through distinct stages, and modeling a category's sales evolution from onset, over maturity, and into eventual decline often requires the inclusion of a higher (likely second) order deterministic or stochastic trend (Franses 1994). In addition, earlier research confirms that sales series often contain a unit root, while the likelihood of finding non-stationarity increases when the considered sample period becomes longer (Dekimpe and Hanssens 1995b). In this study, we consider sales patterns over multiple decades, which makes a filtering procedure that can properly handle unit root series more appealing; (iv) finally, the method is operational and easy to implement, thereby satisfying an important decision-calculus criterion (Little 1970).

Even though this specific filter has been used extensively in the (macro)-economic literature (see e.g. Baxter and King 1999; Cogley 1997; Stock and Watson 1999; Vilasuso 1997), one should keep in mind that every filter involves some subjectivity. We will therefore validate our substantive conclusions by also implementing another procedure frequently used to isolate the cyclical component, i.e. the Hodrick and Prescott (HP)-filter. We refer to Section 3.7 for a more detailed discussion of this validation exercise.

In the second stage, four summary statistics are derived from the cyclical component (c_t) isolated in Stage 1. They parsimoniously describe the *extent* and *nature* of the cyclical sensitivity in a given series. Specifically, we consider the extent of cyclical

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[19] Note that, because of leads and lags in Eq. 3.1, 6 observations are lost in the derivation of the cyclical component. No such loss is incurred in the Hodrick-Prescott (HP)-filter introduce in Section 3.7 to validate our findings.

volatility and cyclical comovement (Stage 2a), and examine the two aforementioned kinds of cyclical asymmetry (Stage 2b): deepness and steepness asymmetry.

3.3.2 Stage 2a: Quantifying the extent of cyclical sensitivity

To quantify the extent or severeness of the cyclical variations, we (i) look at the durables' cyclical variability (volatility), and (ii) examine their degree of cyclical comovement with the general economic activity. *Cyclical variability* is quantified through the standard deviation of the isolated cyclical component $\sigma(c)$ (see e.g. Hodrick and Prescott 1997; DeLong and Summer 1986b for a similar operationalization). Since these standard deviations are comparable across series only when the series have the same unit, we analyze the series in logarithms, so that the units (when multiplied by 100) represent percentage deviations from the series' growth path (Stock and Watson 1999, p. 29).

Cyclical volatility focuses on the size of the ups and downs at business-cycle periodicities, but is not concerned with the synchronized nature of this pattern with the overall economic cycle. This property is captured through the notion of *cyclical comovement*, which measures the extent to which business-cycle fluctuations in the economy as a whole translate into cyclical fluctuations in a specific durable's sales performance. We operationalize the concept by regressing the cyclical component of the durable series ($c_{i,t}$) on the cyclical component in real GNP ($c_{i,t}^{GNP}$) (this approach is conceptually similar to Stock and Watson, 1999, who use corr($c_{i,t}, c_{i,t}^{GNP}$) as comovement statistic).[20]

$$c_{i,t} = \alpha_i + \beta_i \, c_{i,t}^{GNP} + \mu_{i,t}, \qquad (3.2)$$

Although the business cycle technically is defined through a comovement across many sectors in the economy, fluctuations in aggregate output are at the core of the business cycle, and the cyclical component of GNP is therefore a useful proxy for the overall business cycle. Note also that because of the nature of Eq. 3.2, i.e. both $c_{i,t}$ and $c_{i,t}^{GNP}$ represent percentage deviations, β_i can be interpreted as an elasticity, making the comovement measure comparable across different industries.

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[20] We regressed the cyclical component of the durable on the cyclical component of GNP over the corresponding time period, and added a durable-specific subscript to $c_{GNPi,t}$ to indicate differences in sample length.

Although both statistics describe the extent of business-cycle sensitivity in durable industries, they approach cyclical sensitivity from a distinct, yet complementary, perspective. Cyclical volatility ($\sigma(c)$) is a univariate concept, and measures the size of the deviations from the series' growth path occuring at business-cycle periodicities. This statistic is always positive (≥ 0), and larger values indicate a larger degree of variability in the cyclical component of the series. The extent of cyclical variability *within* a series, however, is not fully informative on how these fluctuations *relate* to the *overall* economic activity, a key defining characteristic of the business cycle (Christiano and Fitzgerald 1998). Indeed, large (univariate) cyclical swings may be either procyclical (when changes occur in the same direction as the aggregate economy) or countercyclical (in case movements are in the opposite direction). Also, univariate variability does not reflect the extent to which a durable's cyclical fluctuations tend to be synchronized with the ones in more general economic indicators. The comovement elasticity (β_i), in contrast, quantifies both the *sign* of this relationship, and the extent to which overall economic expansions and contractions *translate into* attenuated ($|\beta_i| < 1$) or amplified ($|\beta_i| > 1$) cyclical swings in the sales of a specific durable.

3.3.3 Stage 2b: Identification of cyclical asymmetries

Following the pioneering work of Sichel (1993), we derive cyclical (a)symmetries based on the third-order moment, i.e. the skewness statistic, of the filtered series. First, if a time series exhibits *deepness* asymmetry, it should exhibit *negative* skewness relative to the mean or trend, indicating that it should have (i) fewer observations below its mean or trend, with (ii) a larger (absolute) average value compared to the observations above. Such behavior is illustrated in Figure 3.3, panel B. To construct a formal test for deepness asymmetry, the following coefficient of skewness is computed:

$$D(c_t) = \frac{\left[T^{-1} \sum_{t=1}^{T} (c_t - \bar{c})^3 \right]}{\sigma(c)^3}, \tag{3.3}$$

where $\bar{c}$ is the mean of the cyclical component c_t, $\sigma(c)$ its standard deviation, and T the sample size (Sichel 1993).

Second, if a time series exhibits *steepness* asymmetry, its first difference, representing the slope or rate of change, should exhibit *negative* skewness. As such, decreases in the series corresponding to contractions should be larger, but less frequent, than the more moderate increases during expansions. We refer to Figure 3.3 (panel A) for a graphical illustration of this behavior. The formal test statistic for steepness asymmetry is based on the coefficient of skewness for Δc_t, the first difference of the cyclical component:

$$ST(\Delta c_t) = \frac{\left[T^{-1} \sum_{t=1}^{T} (\Delta c_t - \overline{\Delta c})^3 \right]}{\sigma(\Delta c)^3}, \qquad (3.4)$$

where $\overline{\Delta c}$ and $\sigma(\Delta c)$ are, respectively, the mean and standard deviation of Δc_t (Sichel 1993).[21]

3.4 DATA

The data involve postwar annual US time series of unit sales for 24 consumer durables. Sales patterns for some of these durables were already presented in Figures 3.1 and 3.2. As illustrated in Table 3.1, the durables cover a wide range of household appliances such as blenders, dishwashers and steam irons, while also including leisure goods such as (color and black & white) TVs.

[21] To determine the significance of both test statistics, asymptotic standard errors are derived as follows. For deepness asymmetry, we regress $z_t = (c_t - \bar{c})^3 / \sigma(c)^3$ on a constant, the significance of which corresponds to the significance of D(c_t). Indeed, the coefficient estimate associated with the constant equals the deepness statistic, and the corresponding standard error measures its statistical reliability. Since the observations on c_t are serially correlated, the correction suggested by Newey and West (1987) is implemented in the derivation of the standard errors. Asymptotic, Newey-West corrected, standard errors for the steepness statistic can be calculated using a similar procedure, but with $z_t = (\Delta c_t - \overline{\Delta c})^3 / \sigma(\Delta c)^3$.

Table 3.1: Description of the dataset

Category	Years studied	Launch year[a]	Average price (in $)	Price range (in $)
Range	1947 - 2000	1908	657	338 – 1022
Refrigerator	1947 - 2000	1914	819	479 – 1190
Vacuum cleaner	1947 - 1984	1911	240	148 – 355
Electric washer	1947 - 2000	1921	614	265 – 885
Air conditioner	1947 - 2000	1934	728	236 – 2044
Black & white TV	1947 - 2000	1946	429	33 – 2039
Freezer	1947 - 2000	1935	767	231 – 1487
Electric bed cover	1947 - 1980	1940	82	37 – 191
Clothes dryer	1947 - 2000	1937	545	221 – 960
Dishwasher	1947 - 2000	1940	651	265 – 1198
Disposer	1947 – 2000	1938	230	72 – 563
Steam iron	1947 - 1985	1938	52	30 – 76
Blender	1948 - 1985	1937	83	22 – 157
Built-in range	1954 - 2000	1953	588	349 – 1070
Corn popper	1954 - 1985	?	24	17 – 34
Can opener	1958 - 1985	1956	36	16 – 91
Color TV	1960 - 2000	1954	821	146 – 2206
Oral hygiene device	1963 - 1985	1955	34	20 – 62
Electric knife	1964 - 1985	?	38	19 – 82
Water pulsator	1966 - 1985	1966	39	24 – 107
Hair setter	1968 - 1985	?	38	24 – 69
Microwave oven	1970 - 2000	1967	545	165 – 1282
Trash compactor	1971 - 2000	?	337	216 – 639
Calculator	1972 - 1987	1972	100	21 – 508

[a] Details on the specific operationalization of this variable are given in measurement appendix A.

The data span several decades, ranging between 16 (1972 – 1987) years for calculators and 54 (1947 – 2000) years for durables such as ranges, refrigerators and electric washers, with an average (median) duration of 39 (39) years. Based on US national statistics from the NBER (www.nber.org/cycles.html), the postwar data period considered was characterized by 10 complete business cycles, with an average duration of about 5 years; the longest recorded cycle being 10 ½ years. As such, all durables analyzed cover multiple business cycles. From Table 3.1, it can also be seen that there were a number of new introductions across the sample period; the current data therefore offer a mix of both more recent and more established durables, which can be expected to be in different stages of their life cycle (earliest introduction = 1908; latest introduction = 1972).

The data reflect *total* sales at the product-category level, and therefore comprise both trial and replacement purchases. Accordingly, for durables introduced earlier, replacements are likely to make up a larger portion of their current sales, and to constitute a major part of the total durable performance (Bayus 1988; Steffens 2001).

In addition to unit sales data, sales were also available in retail value ($ sales), which allowed us to derive over-time unit prices. These prices were adjusted for inflation using the US Consumer Price Index (CPI).[22] As can be seen in Table 3.1, the 24 durables exhibit considerable variability in terms of average prices (most expensive durable = color TVs ($821); least expensive durable = corn popper ($24)).

Real GNP is a good proxy for overall economic activity, and thus a useful benchmark for comparisons across multiple series (DeLong and Summer 1986b).[23] As such, the same summary statistics introduced in Section 3.3 will be used to assess the cyclical sensitivity of US postwar real GNP. Data on annual US real GNP (1947 – 2000), measuring the nation's general economic activity, was obtained from the US Census Bureau (Statistical Abstract of the United States: 2001).

3.5 EMPIRICAL RESULTS

Business-cycle sensitivity was argued to manifest itself in the extent of cyclical variations, as reflected in (i) cyclical volatility and (ii) cyclical comovement, as well as in the presence of one or both types of cyclical asymmetry. First, we discuss the main results related to cyclical volatility in durable sales. Comparing these results with the cyclical volatility in GNP gives an indication as to whether durable goods are more or less sensitive to business cycles than the general economic activity. Next, we report on the extent to which durables move together with the aggregate cycles, reflected in their cyclical

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[22] Source: US Census Bureau, Statistical Abstract of the United States: 2001.

[23] Obviously, one could use other macro-economic indicators such as national income (Nicosia 1974), disposable income (Chowdhury 1994), savings (Taylor and Weiserbs 1972), interest rates (Mankiw 1985) or the index of consumer confidence (Allenby, Jen and Leone 1996), which remains an important area for future research.

comovement. As indicated before, the extent of cyclical volatility and their level of comovement with GNP are derived on log-transformed data to obtain comparable units across the various series of interest (see Stock and Watson 1999 for a similar practice). Finally, we assess both types of cyclical asymmetry, which were argued in Section 3.2 to reflect consumers' purchase adjustment decisions for durables across economic up- and downturns, and which could be amplified/attenuated by the firms' marketing actions.

3.5.1 Quantifying the extent of cyclical sensitivity

The key findings related to the extent of cyclical sensitivity are summarized in Table 3.2.

Table 3.2: Results on the extent of cyclical sensitivity

	Average size (median)	Range	# Durables > 1
Cyclical volatility			
Durables	0.091 (0.096)	0.017 – 0.162	23[b]
GNP	0.021 (0.020)	0.019 – 0.028[a]	NA[c]
Comovement	2.013 (2.204)	-0.176 – 3.619	20[d]

[a] Since the volatility for the respective durables was derived over different time periods, we assessed the volatility in GNP over the corresponding sample periods. The range in GNP thus reflects the difference in the stability of the economy across different time periods.
[b] Represents the number of durables where the ratio of an individual durable's cyclical volatility to the cyclical volatility in GNP, over the corresponding sample periods, is larger than 1.
[c] NA = Not Applicable.
[d] Represents the number of durables with a comovement elasticity in excess of 1.

A first substantive conclusion is that consumer durables are affected more by business-cycle fluctuations than the overall economic activity, reflected in real GNP. Based on the ratio of an individual durable's cyclical volatility to the cyclical volatility in GNP, i.e. $\sigma(c_i)/\sigma(c_i^{GNP})$, we find that in only one out of 24 cases (calculators), durables have a ratio smaller than 1, meaning that in only one case the cyclical volatility is smaller than the one observed in GNP over the corresponding time horizon. Focusing on the volatility across all 24 durables, we find an average value of 0.091 (9.1%), ranging from 0.017 (1.7%) for calculators to 0.162 (16.2%) for black & white TV. In contrast, cyclical volatility in postwar real GNP is, on average, only 0.021. *Durables are therefore, in terms of their cyclical volatility, more than four times as sensitive to business-cycle fluctuations than the general economic activity*. This calls for a more explicit consideration of the cyclical variability in the sales evolution of consumer durables in both market response and diffusion models. As for the former, two recent surveys (Hanssens, Parsons and Schultz 2001; Leeflang et al. 2000) do not report on any study which explicitly considers business-cycle fluctuations when analyzing sales patterns. A similar observation applies in the context of diffusion models, where neither Mahajan, Muller and Bass (1990) nor Rogers (1983) identify any study which accounts for a durable's excessive business-cycle sensitivity.[24]

Business-cycle fluctuations in durable sales move closely together with the aggregate cycle. Based on Eq. 3.2, we find that all durables except one (calculators) have a positive β-coefficient, meaning that economic contractions (expansions) cause durable sales to drop (rise). In addition, the overall degree of comovement is high, as 20 durables have a comovement elasticity larger than 1, implying that general business-cycle swings get amplified in the context of durable sales. The average degree of comovement between durable goods and the business-cycle component in GNP, as measured by β_i, is 2.013, ranging between –0.176 (calculators) and 3.619 (trash compactors). *This again confirms that, compared to GNP, durables are affected much harder during contractions*.

Although cyclical volatility and comovement focus on business-cycle sensitivity from a different point of view, we do find that, for durable industries, results from both statistics are fairly congruent. The correlation between both summary statistics is positive and significant 0.57 (p<0.01). If we classify, using a median split, the 24 durables into four cells based on their cyclical volatility and comovement, we find that 20 out of 24 durables are located in the diagonal cells, as their above (below)-median volatility corresponds to an above (below)-median comovement elasticity.

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[24] So far, international studies on the diffusion of consumer durables have occasionally accounted for the different countries' macro-conditions, as reflected in their GNP/capita, urbanization rate, etc (see e.g. Dekimpe, Parker and Sarvary 2000; Helsen, Jedidi and DeSarbo 1993). However, only cross-sectional variation along those dimensions was considered, in that only information on a single year (Dekimpe et al. 2000) or the average across a number of years (Helsen et al. 1993) was used. The over-time variation in these macro-conditions, however, was still ignored.

3.5.2 Identification of cyclical asymmetries

Based on the skewness analyses, we find that only five of the 24 (log-transformed) series (a mere 21%) have the expected negative sign for the deepness statistic, and in none of these five cases did the statistic turn out to be significant. The deepness statistic also exhibits a positive average value of 0.43. *Therefore, our results indicate that there is little, if any, evidence of deepness asymmetry in durable sales*. Steepness asymmetry, on the other hand, is found to be more prevalent: 18 out of 24 series (75%) have the expected negative sign for the steepness statistic, and also the average value for asymmetric steepness is negative (-0.39). However, for only one durable (steam irons), the steepness statistic was found to be significant at a 10% significance level.

Even though the log-transform is called for when deriving the extent of cyclical sensitivity, it may distort one's inferences about the (a)symmetric nature of a given time series (see e.g. Atkinson 1985; Burbidge, Magee and Robb 1988; Ruppert and Aldershof 1989).[25] However, comparable results were obtained when testing for asymmetries on the original (non-transformed) data: few series (seven) have a negative sign for the deepness statistic, and the average value for the deepness statistic is 0.45. In contrast, 20 out of 24 series did have the expected negative value for the steepness statistic, resulting in a mean value of –0.40. None of the individual cases was significant at conventional significance levels.

As it has been argued that the power of each of the individual skewness tests tends to be rather low (see e.g. Mills 2001; Razzak 2001; Verbrugge 1997), especially when working with annual data, we conducted a meta-analysis to derive the combined evidence of cyclical asymmetry *across* all 24 durables. To do so, we used the one-sided p-values associated with the deepness and steepness statistic, applying the method of adding weighted Z's (Rosenthal 1991). This should offer a stronger test for the presence of cyclical asymmetries than the individual impact estimates.

The meta-analysis confirmed the absence of any deepness asymmetry in the sales evolution of the consumer durables at hand (p=0.96). For steepness asymmetry, on the other hand, *the collective, meta-analytic result indicated significant evidence of steepness*, with the null hypothesis of symmetry rejected at a 5% significance level (p=0.03). These results suggest that *expenditures on consumer durables will not necessarily fall more*

[25] To avoid this potential distortion, we will report on the (a)symmetric nature of the original series in both the meta-analytic and validation exercises.

extensively, even though they will do so faster, during contractions than they increase during expansionary periods. This observation is consistent with the general prediction that households tend to postpone durables' acquisition in response to negative wealth shocks (Cook 1999; Clark, et al. 1984; Caballero 1993), and corroborate with Gale's (1996) theoretical finding that purchase postponement causes sluggish adjustment.[26]

3.6 MODERATOR ANALYSES

Our earlier results found durable sales to be affected to a much larger extent by business-cycle fluctuations than the general economic activity. It is interesting to note, though, that there exists quite some variation in this cyclical sensitivity across the 24 durables studied (see Table 3.2; range cyclical volatility = 0.017 – 0.162; range cyclical comovement = -0.176 – 3.619). Analyzing this cross-sectional variation in cyclical volatility and comovement can provide us with additional insights into how and why buying patterns for durables are altered in response to aggregate economic fluctuations. We do not perform a second stage analysis on the asymmetry statistics because, individually, almost none of the durables experienced significant deepness or steepness asymmetry. In addition, a formal chi-square homogeneity test (Rosenthal 1991) revealed that there was not enough variation present in the effect sizes of deepness and steepness to be further explored (i.e. no significant heterogeneity is found among the 24 deepness ($\chi^2(23) = 6.09$; $p = 0.99$) and steepness ($\chi^2(23) = 4.22$; $p = 0.99$) statistics).

To that extent, we will explore in subsequent analyses the relationship between the observed extent of cyclical sensitivity (reflected in cyclical volatility and comovement) and (i) industry price reactions, (ii) the extent of price stability, (iii) the product's expensiveness, (iv) the nature of the durable (convenience vs. leisure), (v) the state of the economy during launch, and (vi) the importance of replacement buying. First, we provide some prior expectations as to the expected sign of these relationships, followed by a description of the adopted testing procedures, and a discussion of the empirical findings. We refer to measurement appendix A for a discussion on the specific operationalization that was adopted for each of the constructs.

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[26] As for GNP, we find no evidence of asymmetry, with average values for the deepness (mean $D(c_t)$ = -0.06), and steepness (mean $ST(c_t)$ = -0.18) statistics approximating a perfectly symmetric distribution (where skewness = 0). DeLong and Summer (1986a) as well as Sichel (1993) also failed to detect any evidence of steepness asymmetry in US GNP, while Sichel found very weak evidence of deepness asymmetry in (quarterly) postwar GNP.

3.6.1 Prior expectations

Industry price reaction. Industry price reactions to business-cycle fluctuations can either reinforce or attenuate cyclical sensitivity in sales by, respectively, increasing or decreasing prices during contractions. To structure our discussion, we first consider the direction of price changes during contractions, after which we assess the impact of such price reactions on the extent of cyclical sensitivity observed in durable sales patterns.

Normative arguments on the nature of price changes during a contraction have been made in both directions. The established view in the industrial-organization literature is based on the work by Green and Porter (1984), who show that lower prices should occur when demand is unexpectedly low. Firms then switch from collusive, high prices to lower, competitive prices because they attribute the lower profits (caused by lower demand) to cheating on the part of their rivals (Green and Porter 1984; Tirole 2001, p. 252). Rotemberg and Saloner (1986) challenged this view, and argued that, especially during high-demand periods (booms), it is more beneficial to undercut on the high collusive price, implying that collusion will be less likely to be sustained. This leads to lower competitive prices during expansions and higher collusive prices during contractions. Moreover, Marn, Roegner and Zawada (2003) argue that increasing prices (p) during a contraction allows companies to offset revenue losses ($p.q$) caused by reduced sales (q) levels. Empirical analyses on the issue predominantly support the existence of higher prices during contractions (conform Rotemberg and Saloner's view) (see e.g. Backus and Kehoe 1992; Rotemberg and Saloner 1986; Rotemberg and Woodford 1999).

The direction of price changes may, in turn, influence the extent of business-cycle fluctuations in durable sales patterns. Increasing prices during contractions can be expected to further reduce consumers' propensity to buy durables at that time, suggesting that industries tend to enhance cyclical sensitivity in their performance (Frantzen 1986).

Industry price stability. Bishop, Graham and Jones (1984) underscore the importance of a flexible pricing system to quickly and adequately respond to changing market conditions such as economic contractions, so that swings in performance can be reduced. Industries where prices are more flexible, as reflected in a higher over-time price variability, can more easily implement price adjustments in response to economic fluctuations. In contrast, industries characterized by sticky prices (lower price variability) are more likely to leave prices at suboptimal levels during contractions (Ball and Mankiw 1994; Tinsley and Krieger 1997). Such a rigid pricing practice is expected to further reduce output during contractions, and to amplify cyclical swings in durable sales (Frantzen 1986).

Expensiveness. For more expensive durables that represent an important share of the household budget, consumers' relative willingness and ability to pay decreases more substantially during contractions due to the shrinking of their income (Horsky 1990). Indeed, such a purchase would put a more severe burden on the family in already unfavorable economic conditions. Households are therefore expected to refrain sooner from buying expensive durables during contractions than they do for less expensive ones (Cook 1999).

Type of product. Time-saving convenience goods may be less sensitive to economic fluctuations than leisure durables, because they more easily become a necessity for the consumer, as they can substitute for otherwise labor-intensive household activities (Horsky 1990; Parker 1992; Tellis, Stremersch and Yin 2003).

State of the economy during launch. Devinney (1990) and Clark et al. (1984) argue that it would be unwise to introduce new durables during an economic contraction unless the product is truly superior, so that consumers are willing to buy it even during an economic contraction. We will test whether any initial superiority is able to protect the durable in subsequent periods, causing a reduced cyclical sensitivity.

Importance of replacement buying. Replacement purchases occur not only because of product failure. Durables may also be replaced for other reasons, such as the availability of new and/or improved features, or changing styles, tastes and fashion (Bayus 1988; Steffens 2001). This suggests that consumers tend to be quite flexible in changing the timing of a replacement purchase. When faced with worsening economic conditions, owners of durables can be expected to prolong the lives of their existing products, and hence to postpone their replacement. Therefore, replacement purchases can be argued to be more sensitive to cyclical variation than trial purchases. On the other hand, accustomization may cause replacement purchases to be less sensitive to business-cycle fluctuations than trial purchases. Consumers may become habituated to the durables they currently own, in which case adverse economic conditions become less likely to prevent them from replacing the goods in case of product failure (Kamakura and Balasubramanian 1987). Moreover, the considerable risk associated with trial purchases may induce consumers to delay an *initial* acquisition during economic contractions, which could cause business-cycle fluctuations to be more pronounced in trial purchases (Parker and Neelameghan 1997).

3.6.2 Testing procedure and empirical findings

To determine the direction of price changes during economic contractions, we regress the cyclical component in each durable's price ($c_{P_{i,t}}$) on the cyclical component of *total* US expenditures on durables (c_t^{TOTDUR}), an aggregate series covering the expenditures on *all* consumer durables in the US, as published by the Bureau of Economic Analysis (www.bea.doc.gov). Total US expenditures on durables (which encompasses much more than even the combined sales of our 24 durables) was used rather than a given durable's sales pattern to avoid potential endogeneity problems. Indeed, the 24 durables included in our study represent only 8% of the total outlays spent on consumer durables by US households over the last 54 years (with a range from 0.8% to 19% across the different years). The following equation is estimated for each of the 24 durables:

$$c_{P_{i,t}} = \gamma_i + \delta_i \, c_t^{TOTDUR} + \mu_{i,t}\,, \tag{3.5}$$

for $t = 1,\ldots,T_i$, with T_i the sample size (number of observations) for durable i. 24 such regressions are estimated, after which a meta-analysis is performed on δ_i to quantify the overall direction of price changes across industries. A negative δ_i-value in Eq. 3.5 is consistent with a price increase during contraction periods. In line with most previous research, most durable industries indeed seem to *increase* prices during an economic contraction, while decreasing prices during an expansion. For 19 out of 24 durables, δ_i was negative, and the subsequent meta-analysis on the combined significance of a negative price reaction indicated strong support for a consistent negative δ across all durables (p=0.01). This result is in line with the findings of e.g. Backus and Kehoe (1992), and Woodford and Rotemberg (1999), who also found prices to increase during economic contractions.

Such countercyclical pricing is likely to induce an enhanced cyclical sensitivity in durable sales. To test this conjecture, we include the estimated δ_i as an explanatory variable in a regression framework, and determine if industries that price more countercyclical (more negative δ_i) are indeed characterised by a higher degree of cyclical sensitivity.

The impact of these industry price reactions on the extent of cyclical sensitivity, along with the impact of price stability, expensiveness and nature of the durable, is derived by regressing $\sigma(c_i)$ (cyclical volatility) and β_i (comovement elasticity) against, respectively, δ_i (as estimated in Eq. 3.5), PRice VOLatility, EXPENSiveness and product TYPE. This results in the following test equation:

$$\begin{bmatrix} \sigma(c_i) \\ \beta_i \end{bmatrix} = \begin{bmatrix} a_1 \\ a_2 \end{bmatrix} + \begin{bmatrix} b_{1,1} & b_{1,2} & b_{1,3} & b_{1,4} & b_{1,5} \\ b_{2,1} & b_{2,2} & b_{2,3} & b_{2,4} & 0 \end{bmatrix} \begin{bmatrix} \delta_i \\ PR\ VOL_i \\ EXPENS_i \\ TYPE_i \\ \sigma(c_i^{GNP}) \end{bmatrix} + \begin{bmatrix} \mu_{1,i} \\ \mu_{2,i} \end{bmatrix}, \qquad (3.6)$$

for i = 1 … 24. Because the values for the dependent variables are characterized by differing degrees of estimation accuracy, OLS may yield biased estimates if heteroscedasticity is present. However, based on the White test, no heteroscedasticity was found in any of the individual regressions, and we therefore applied OLS instead of WLS (see Narasimhan, Nelsin and Sen 1996 or Nijs et al. 2001 for a similar approach). δ_i is also an estimated parameter used as a predictor variable; the associated parameter estimate in Eq. 3.6 can therefore be expected to be biased towards zero, which makes our results conservative (Leeflang and Wittink 2001). Since the dependent variable $\sigma(c_i)$ is obtained for individual durables across different time periods, we include the cyclical volatility of GNP over the corresponding period to control for a potentially confounding impact of the overall economic stability in the considered time span. Due to the nature of the comovement statistic (i.e. derived by a regression on $c_{i,t}^{GNP}$ in Eq. 3.2), there is no need to also include this control variable in the second equation of 3.6. Finally, to capitalize on potential efficiency gains from a joint estimation, we determine the impact of the respective covariates on $\sigma(c_i)$ and β_i simultaneously using Seemingly Unrelated Regression (SUR).

As expected, industries which increase prices more during economic contractions (more negative δ_i), are found to suffer from a higher cyclical volatility in sales, as $b_{1,1}$ turns out to be negative and significant ($b_{1,1}$ = -0.06, p=0.02).[27] The same result holds with respect to cyclical comovement, where $b_{2,1}$ is –2.23 (p=0.02). These results suggest that increasing prices during contractions tends to enhance the cyclical sensitivity in sales fluctuations, as argued by Frantzen (1986).

We also find support for an important role of industry price volatility on cyclical sensitivity in sales. Industries with more flexible price adjustments are characterized by a

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[27] p-values are one-sided for the directional expectations formulated in Section 3.6.

reduced cyclical volatility, as reflected in the negative and significant value for the $b_{1,2}$-estimate ($b_{1,2}$ = -0.39, p=0.04). Similarly, industries where swift price adjustments occur are found to have a lower comovement elasticity ($b_{2,2}$ = -16.36, p<0.01). Thus, price inertia amplifies cyclical sensitivity in sales, a result consistent with our prior expectation.

In sum, irrespective of how cyclical sensitivity was operationalized, both propositions related to industry pricing activities were found to have a significant impact. As such, companies seem able to limit the impact of business-cycle fluctuations in their sales pattern through an appropriate pricing strategy. Specifically, unlike their current (price increasing) reaction during economic contractions, companies should decrease prices when they are confronted with an economic contraction to keep sales up, and implement such changes quickly.

The parameters $b_{1,3}$ and $b_{2,3}$, measuring the impact of expensiveness on, respectively, cyclical volatility and cyclical comovement, turned out to be positive, but failed to reach significance (i.e. $b_{1,3}$ = 0.01, p>0.10; $b_{2,3}$ = 0.20, p>0.10). Hence, we find no support for the contention that consumers especially refrain from buying more expensive durables during unfavorable economic times.

Convenience goods are found to be less volatile than leisure goods, as the $b_{1,4}$-estimate associated with the 'type'-dummy turned out negative and significant ($b_{1,4}$ = -0.04, p=0.04). A negative parameter estimate was also obtained when using the comovement elasticity as dependent variable, but this estimate failed to reach significance ($b_{2,4}$ = -0.36, p>0.10). We therefore conclude that there is partial support for the proposition that time-saving convenience goods are less sensitive to business-cycle fluctuations than their leisure counterparts.

To assess the impact of the economic condition during product launch, a 'state of the economy'-dummy variable is added to Eq. 3.6. As described in Appendix A, we lose four observations due to missing information on the state of the economy during launch. Immediate inclusion of this variable would have left us with fewer observations to estimate the impact of the aforementioned covariates, and hence reduce the power of their tests. In spite of that, the substantive results with respect to industry price reactions, price volatility, expensiveness, and type of durable remained similar when estimated on the 20 (rather than 24) durables for which the state of the economy-dummy is known. As for the latter, we find that the parameter estimates are not significant (b_1 = -0.01, p>0.10; b_2 = 0.28, p>0.10). More research is needed, however, to assess whether this lack of empirical support is due to the absence of the presumed superior quality during product launch, or whether any initial superiority failed to carry over in subsequent contraction periods.

For more mature durables, a larger component of total sales is due to the replacement of existing units (Bayus 1988; Steffens 2001). We therefore run our cyclical sensitivity analysis separately on the early vs. later half of the sample period (cfr. Clark et al. 1984). For those durables introduced most recently, however, it could be argued (i) that insufficient data are available to conduct a split-half analysis, and (ii) that they have not yet reached maturity. They could therefore be tought of as being less suited to assess the impact from the importance of replacement purchases, dominant in further stages in the PLC. As such, we exclude the five durables where less than 25 years of sales data are available.[28] We subsequently regressed all resulting 38 (19 durables x 2) volatility/comovement statistics on a dummy variable (PLC_j), taking the value of 1 in the later stage of the durables' life cycle and 0 otherwise.

$$\begin{bmatrix} \sigma(c_j) \\ \beta_j \end{bmatrix} = \begin{bmatrix} c_1 \\ c_2 \end{bmatrix} + \begin{bmatrix} d_{1,1} & d_{1,2} \\ d_{2,1} & 0 \end{bmatrix} \begin{bmatrix} PLC_j \\ \sigma(c_j^{GNP}) \end{bmatrix} + \begin{bmatrix} \upsilon_{1,j} \\ \upsilon_{2,j} \end{bmatrix}, \qquad (3.7)$$

for $j = 1 \ldots 38$. Again, when we assess the impact of the moderator on cyclical volatility ($\sigma(c_j)$), we control for the general economic stability through $\sigma(c_j^{GNP})$, and estimate Eq. 3.7 using SUR. We find empirical support that a later stage in the PLC is associated with lower cyclical volatility ($d_{1,1}$ = -0.02, p=0.04).[29] When regressing the PLC-dummy on the cyclical comovement statistic, the $d_{2,1}$–estimate was again negative, but failed to reach statistical significance ($d_{2,1}$ = -0.53, p>0.10). We thus find partial evidence that replacement purchases are less sensitive to business-cycle fluctuations. This result is consistent with our argumentation that currently owned durables may have become indispensable, and, in case of product failure, consumers are more willing to replace them even during an economic contraction. More excessive sensitivity to business-cycle fluctuations in case of trial purchases underscores further the importance of considering such fluctuations in new product diffusion models, as these models are intended to capture the dynamics in trial purchases.

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28 Specifically, calculators, electric knives, hair setters, oral hygiene devices and water pulsators are excluded from the analysis.

29 For the impact of the importance of replacement buying, we did not postulate a directional proposition, so the reported p-values for this moderator are two-sided.

3.7 VALIDATION

We validate our results in several ways. First, we assess the representativeness of our sample, and compare our substantive findings on the extent of cyclical sensitivity to the ones obtained when analyzing *total* US expenditures on consumer durables. Next, we evaluate whether our asymmetry findings, both in terms of deepness and steepness, can be replicated when adopting a non-parametric testing procedure instead of the parametric skewness approach applied thus far. Finally, we assess to what extent our findings are idiosyncratic to the specific filtering procedure that was adopted to extract the cyclical component from the different sales series. Specifically, the Hodrick-Prescott (HP) filter is introduced as an alternative to the Baxter and King approach adopted in previous sections.

3.7.1 Representativeness of the consumer durables in our sample

The 24 durables included in our analysis involve mainly household appliances. Apart from these appliances, consumers spend a considerable part of their budget on other durables, such as motor vehicles and furniture. To assess whether our empirical generalizations (based on 24 durable series) are representative for the broader set of durable goods typically bought by households, we additionally analyze the cyclical sensitivity in *total* US expenditures on durables (see Section 3.6 for a more detailed discussion of this variable).

The results are very comparable. The cyclical volatility statistic for the aggregate durable series is 0.053. Comparing this value to the volatility in GNP reported in Section 3.5 confirms our earlier observation that business-cycle fluctuations are more strongly pronounced in the context of consumer durables. This finding is in line with the conclusion of Cook (1999) and Hodrick and Prescott (1997), who also study the evolution of *aggregate* US expenditures on durables. Cook (1999) plotted the cyclical component of US expenditures on both durables and non-durables, and concluded based on a visual inspection of the graph that the former are more vulnerable to business cycles. Hodrick and Prescott (1997), on their part, found that postwar consumer durable expenditures are more than three times as volatile as real GNP. In addition, the mean cyclical comovement derived from the total US expenditures on durables is 2.007, and closely corresponds to the average comovement statistic derived from the 24 durables in our dataset (2.013).

Also the skewness results for total US expenditures on durables confirm our earlier findings. There is again no evidence for deepness asymmetry, as the mean deepness statistic is rather low (mean $D(c_t)$ = -0.16). The steepness statistic for the aggregate series had an average value of –0.43, close to the average value across our 24 durables (-0.40).

In sum, these results support the contention that the combined evidence from our 24 consumer durables is indeed generalizable to expenditures on other durable goods in the market.

3.7.2 Alternative asymmetry test: non-parametric triples test

While frequently used and intuitively appealing, the parametric approach proposed by Sichel (1993) to test for cyclical asymmetries has been criticized in that it may lack power to reject the null hypothesis of symmetry (Razzak 2001; Verbrugge 1997). Low power is certainly a problem for temporally aggregated data, as aggregation may dampen the cyclical properties of the series, and the lack of evidence of asymmetry could therefore be an unfortunate statistical artifact (Mills 2001). DeLong and Summer (1986a), for instance, tested for asymmetries in US unemployment rates using both quarterly and annual data. Based on the magnitude of the skewness statistic, the annual data suggested as much asymmetry as their quarterly counterparts, but skewness in the annual data turned out to be insignificant.

Even though our meta-analytical procedure already corrects to some extent for the potentially low power of each individual test, we also applied the non-parametric triples test proposed by Verbrugge (1997) and Razzak (2001), which has been argued to be more powerful. We refer to Appendix B for a more detailed exposition on the nature of the triples test.

The asymmetry results based on this non-parametric test are very similar to the results described in Section 3.5. With respect to *deepness* asymmetry, five durables had the expected negative sign, close to the seven durables based on the parametric test for deepness. Also the meta-analysis confirmed our conclusions reached before: deepness asymmetry was again strongly rejected, with a (meta) p-value of 0.99. In addition, the *steepness* results from the triples test support our earlier findings. As before, most durables (17) had a negative skewness statistic. However, we now find that three of these steepness effects are statistically significant (i.e. trash compactors, $p<0.05$; steam irons and electric knives, $p<0.10$), which is in line with the presumably higher power of the test. As before, we are able to reject the null hypothesis of symmetry against the asymmetric steepness alternative based on the meta-analysis (p=0.02).

In sum, it is fair to say that the results from the parametric skewness analysis closely coincide with the results based on the non-parametric triples test.

3.7.3 Robustness with respect to the filtering technique

As indicated in Section 3.3, a crucial issue is how to extract the cyclical component in the time series. The empirical literature on business cycles contains a wide variety of competing filtering methods, which may result in a somewhat different cyclical component (Cogley 1997), and hence, may also affect the subsequent inferences on the extent and potentially asymmetric nature of the series' cyclicality. We will therefore validate our substantive findings through the well-known Hodrick-Prescott filter, which has a long tradition in the economics literature as a method for extracting business cycles (see e.g. Backus and Kehoe 1992; Cook 1999; Holly and Stannett 1995).[30, 31]

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[30] In the marketing literature, two well-known and frequently used detrending procedures are (i) a prior regression on a linear trend (see e.g. Lal and Padmanabhan 1995), and (ii) the first-difference filter (see e.g. Dekimpe and Hanssens 1995a). Both filters are less suited to extract the cyclical component from a series. Removing a linear trend is inappropriate when the series contains a unit root (Baxter and King 1999; Tinsley and Krieger 1997), a property many marketing time series have (Dekimpe and Hanssens 1995b). The first-difference filter reweighs periodic fluctuations at different frequencies. Specifically, this filter tends to put a higher weight on the short-term, irregular, component, while down-weighting both the business-cycle component of interest and the long-run component (Baxter 1994).

[31] For technical details, we refer to the studies of Hodrick and Prescott (1980; 1997).

Table 3.3: Summary empirical results

Table 3.3A: Extent of cyclical sensitivity

	BP-filtered data	HP-filtered data
Cyclical volatility		
Average (median)	0.091 (0.096)	0.174 (0.180)
Range	0.017 – 0.162	0.077 – 0.322
Comovement		
Average (median)	2.013 (2.204)	1.957 (1.790)
Range	-0.176 – 3.619	-1.668 – 5.271

Table 3.3B: Deepness asymmetry

		BP-filtered data		HP-filtered data	
		Parametric test: **Skewness statistic**	Non-parametric test: **Triples test**	Parametric test: **Skewness statistic**	Non-parametric test: **Triples test**
Sample size		24	24	24	24
# negative		7	5	5	6
# negative	sign (5%)	0	0	0	0
	sign (10%)	0	0	0	**1**
Meta-analysis		*p* = 0.96	*p* = 0.99	*p* = 0.96	*p* = 0.99

Table 3.3C: Steepness asymmetry

		BP-filtered data		HP-filtered data	
		Parametric test: **Skewness statistic**	Non-parametric test: **Triples test**	Parametric test: **Skewness statistic**	Non-parametric test: **Triples test**
Sample size		24	24	24	24
# negative		20	17	15	17
# negative	sign (5%)	0	1	0	0
	sign (10%)	0	**3**	0	0
Meta-analysis		*p* = **0.03**	*p* = **0.02**	*p* = 0.20	*p* = **0.09**

Detailed results are provided in Table 3.3. In accordance with our earlier findings, we again observe that consumer durables are more sensitive to cyclical fluctuations than GNP. The cyclical volatility for all durables increases somewhat, with an average increase of 0.083 (average volatility BP-filtered series = 0.091; average volatility HP-filtered series = 0.174) (see Table 3.3A). At the same time, the HP-filtered volatility in GNP is also slightly higher (BP-filtered GNP volatility = 0.021; HP-filtered GNP volatility = 0.029). As such, based on the HP-filtered data, consumer durables are found to be, on average, six times more volatile than GNP, compared to a ratio of 4.28 for BP-filtered series. The conclusions with respect to cyclical comovement were not affected by the adopted filtering technique either. If we extract the cyclical component using the HP-filter, 22 durables had a positive comovement elasticity, compared to 23 durables using the BP-filtered data. In addition, the majority of the durables (18) had a β_i-coefficient larger than one (compared to 20 durables when using the BP-filter), and the average comovement elasticity remains high (mean BP-filtered comovement statistic = 2.013; mean HP-filtered comovement statistic = 1.957).

The skewness results based on HP-filtered series reveal the same general patterns as before: only a minority of the durables has a negative deepness statistic (Table 3.3B), while the majority of the durables has a negative steepness statistic (Table 3.3C), a pattern observed for both the parametric and the non-parametric procedures described before. Based on the meta-analyses in Table 3.3B, we once more reject the deepness asymmetry hypothesis overwhelmingly (parametric p=0.96; non-parametric p=0.99). The meta-analytical results also confirm our earlier conclusion that steepness asymmetry is present. We find weak support for such asymmetry in the HP-filtered data based on the skewness statistic (p=0.20), while the more powerful non-parametric triples test rejects the null hypothesis of symmetry at the 10% significance level (p=0.09).

Finally, we also assess the stability of the results from the moderator analysis to the filtering procedure adopted. When working with the HP-filtered cyclical component, the same substantive findings are obtained. We again find collective evidence of higher prices during economic contractions. In addition, the cyclical sensitivity is found to be higher for leisure durables, when companies increase prices more during contractions and when prices display more inertia, while cyclical sensitivity becomes less severe as a later stage in the PLC, dominated more by replacement purchases, is obtained.

3.8 DISCUSSION

Business cycles can have a profound impact on many companies and industries. Still, not much prior research has systematically considered the extent and nature of cyclical sensitivity in marketing performance. This general neglect of the business-cycle impact in the marketing literature, which was also deplored in a recent call for papers by the Marketing Science Institute (2002), is surprising. Indeed, many managers admit to adjust their marketing practices during contraction/expansion periods (Shama 1993), while also the consumers' confidence in the state of the economy, as well as their subsequent purchasing patterns, are described as very cyclical in numerous business-press articles (see e.g. *Business Week*, August 5, 2002; *The Economist*, March 9, 2002). In addition, this sensitivity can vary widely across both firms and industries.

In this paper, we investigated how business-cycle fluctuations affect sales in various durable industries. First, behavioral theories were discussed that may explain cyclical sensitivity in durable purchases. In addition, we also elaborated on multiple reactions on the part of the companies that might amplify or attenuate the cyclical movements in their sales.

Specifically, we introduced four summary statistics to systematically quantify the extent and nature of business-cycle fluctuations on the sales evolution of 24 consumer durables. We showed that, on average, consumer durables are much more sensitive to business-cycle fluctuations than the general economic activity, as expressed in an average cyclical volatility of more than four times the one in GNP. In addition, durables have a mean cyclical comovement elasticity in excess of 2, so that every percentage decrease in the cyclical component of GNP translates in a drop in the cyclical component of durable sales by, on average, more than 2%. We further analyzed various reasons that may underlie this substantial vulnerability of durables to business-cycle fluctuations. First, we found that consumers tend to postpone their purchases, as evidenced by the presence of asymmetric steepness in durable sales. Second, companies' pricing practices were found to amplify the cyclical sensitivity in durable sales, as companies tend to increase prices during an economic contraction, while decreasing them during an expansion. Indeed, business-cycle fluctuations in sales patterns were more pronounced in those industries where such price reactions were larger. In addition, we found evidence for a higher cyclical sensitivity in industries characterized by sticky (inert) pricing practices. Hence, durable industries that are less used to adjust their prices tend to be hit harder by economic downturns. As such, companies have two immediate strategies at hand to reduce their cyclical sensitivity; i.e. to quickly adjust prices in a cyclical (rather than the usual/observed countercyclical) way. Third, the nature of the durable turned out to be important as well. We found leisure goods to be more sensitive to business-cycle fluctuations than convenience goods. Managers should also be aware that intrinsic cyclical fluctuations are likely to become less pronounced in later stages of the product's life, i.e. as replacement purchases become a more substantial fraction of total sales. This observation underscores the importance of having a diversified offering with products in different stages of their life cycle (Harrigan and Porter 1983).

Limitations and further research. Our analysis is subject to a number of limitations that open immediate avenues for further research. First, we limited the analysis to 24 durable goods, and further research should consider other, durable and non-durable, industries. In particular, it would be interesting to study business-cycle sensitivity in industrial markets, where every change in the demand for consumer goods may cause larger changes in the *derived* demand for factors of production of those goods (Bishop et al. 1984). This phenomenon is comparable to the 'bullwhip' effect in the supply-chain literature (see e.g. Hanssens 1998; Lee, Padmanabhan and Whang 1997). Second, our methodological procedure starts by extracting from the sales series those fluctuations that are related to business cycles. Previous research has pointed out that the choice of filtering technique may influence the findings (Cogley 1997). Although we cannot fully account for this caveat, we did validate our findings using an alternative filter; still, more extensive validation exercises may be feasible along this dimension. Cogley (1997), for instance, proposes to detrend macro-economic series by regressing them on aggregate consumption expenditures for non-durables.

Third, the temporal aggregation level of our data can have some limitations. As different up- and downward phases in the business cycle can also be (partly) present within one year, certain fluctuations in sales may be masked when analyzing yearly data. In addition, as suggested by DeLong and Summer (1986a), temporal aggregation may affect the power of our tests. In the analysis, we tried to accommodate for this in two ways: (i) we performed a meta-analysis that offers a stronger test for the presence (absence) of cyclical asymmetry than the individual impact estimates, and (ii) we validated our asymmetry results using a more powerful non-parametric test. Still, it would be beneficial to reconsider the topic using temporally more disaggregate data. Moreover, when using data at a level of temporal aggregation smaller than one year, the Baxter and King filtering procedure (albeit with somewhat different weights than the ones given in Eq. 3.1) is able to also identify and suppress fluctuations in the series that occur with a periodicity smaller than 2 years (see Baxter and King 1999, and Vilasuso 1997 for more details). This should allow for a better approximation of the range of business-cycle periodicities of 1.5 to 8 years identified by the NBER than when working with annual data.

Fourth, one could argue that our results may be confounded by gradual and/or cyclical quality improvements over time. We believe, however, that the confounding impact from durable quality improvements is rather limited. Long run or gradual quality improvements, as reflected in a durable's changing mean replacement age, may indeed be present (Steffens 2001). However, our filtering approach removes all long-run developments from the series in a way that they do not intervene with our cyclical findings (see our discussion on the advantages of the Baxter and King filter in Section 3.3). Alternatively, one might argue that consumers may switch to lower quality (cheaper) products during economic contractions. Yet, we still find empirical evidence that average prices paid increase during contractions, suggesting that our current conclusion may be a conservative one.

Fifth, we only focused on one country, the US, so it is not yet clear whether our results are generalizable to other countries. Sixth, we focused on industry-level sales. Shama (1993), however, pointed out that even within one industry, companies may both be affected differently and respond differently to business-cycle fluctuations. More research is needed on the cyclical sensitivity of performance at the company level, where appropriate strategic modification during contraction/expansion periods may give some companies a competitive advantage (see e.g. Srinivasan et al. 2003). Finally, we also advocate going into more detail on the potential moderating role of other key marketing variables, such as advertising and promotional activities.

CHAPTER 4:
ADVERTISING AND THE MACRO ECONOMY: HAVE WE MISSED THE BUSINESS-CYCLE RELATIONSHIP?

Abstract

Numerous studies have documented that advertising can be an important demand-stimulating factor, both at the secondary and the primary demand level. As such, it is not surprising that there has also been quite some interest in the relationship between aggregate advertising (i.e. total advertising expenditures in a country) and the status of the economy as a whole, as reflected, e.g., in its GDP. Previous studies, however, have mostly been concerned with advertising's short-run impact on the economy, or searched for a long-run equilibrium relationship between them. Still, a key question of interest to policy makers and regulators, whether advertising can influence the business cycle and act as a counter-cyclical instrument, has received less attention. Given that the same relationship between advertising and the economy does not necessarily hold across the short, cyclical, and long run, we explicitly consider whether aggregate advertising can influence economic contractions and expansions, and determine if it could be used to mitigate severe downswings. To do so, we use data over multiple decades from the Netherlands, and search for a relationship between the cyclical fluctuations in aggregate advertising and the business cycle. We find that aggregate advertising expenditures do not temporally precede the cyclical fluctuations in the national economy, while business-cycle fluctuations induce important changes in the demand for advertising.

Keywords: Business cycles; Aggregate advertising; Time-series econometrics.

4.1 INTRODUCTION

Every time the economy enters a downturn, the advertising industry is captivated by how this will affect its own performance. In the past, economic contractions have often led to a dramatically reduced demand for advertising space, causing a substantial number of media failures and considerable mergers, while millions of employees lost their job through layoffs in the sector (Picard and Rimmer 1999; Ducoffe and Smith 1994). In 1974-1975, for instance, the contraction caused a reduction in annual US advertising volume of 3.3%, even though actual income fell by only 1.89% (Dhalla 1980). Similarly, in the contraction between 1990 and 1991, Roark and Stone (1994) noticed that US economic activity dropped by approximately 2%, while newspaper advertising expenditures fell, on average, by 5%. The same type of disproportionate advertising reductions were observed in the United Kingdom over the period 1960-1991, where the decline during the contraction periods in real per capita advertising was almost three times as large as the concurrent reductions in income and consumption (Chowdhury 1994). These figures not only illustrate that advertising expenditures tend to be cut during business-cycle contractions, they also suggest that cyclical variations in advertising expenditures are more pronounced than the corresponding variations in the general economic activity.

Several explanations have been advanced to explain the considerable drop in the demand for advertising during economic contractions. First, a substantial number of firms relies on an organizational rule of fixing the advertising budget as a proportion of sales or profits; hence, advertising will automatically be reduced as the economic climate deteriorates (Ashley, Granger and Schmalensee 1980; Hulbert 1981). Second, managers are found to significantly change their strategies over the business cycle, with an emphasis on cutting costs in an attempt to break-even when times turn bad (Dobbs, Karakolev and Malige 2002). Managers may also reduce their advertising support when they feel that their past advertising expenditures have an impact that lingers over time. Hence, they may believe that even when they do cut advertising, there will still be some positive impact from past advertising activities. Moreover, companies not only reduce their budgets, they also reallocate marketing funds to those activities that are prone to generate more immediate revenues, favoring such activities as price promotions and couponing over advertising (de Chernatony, Knox and Chedgey 1991; Ducoffe and Smith

1994). This, in turn, will result in a disproportionate reduction in the demand for advertising space during contractions.[32]

In spite of these explanations, it remains surprising to find such a radical advertising retrenchment during contraction periods, especially since advertising has repeatedly been found to be an important demand-stimulating factor, not only at the brand/firm (e.g. Leone 1995; Lodish et al. 1995), but also at the industry level (e.g. Bardsley and Olekalns 1999; Leeflang and Reuyl 1985). If the same demand stimulating power would exist at the aggregate (or national) level, decision makers, through their advertising retrenchment behavior during contractions, would have *accentuated* business-cycle fluctuations (Dean 1951; Jacobson and Nicosia 1981; Kaldor 1951). However, the nature of this aggregate relationship is not yet well established.

Peel (1975), for instance, demonstrated, using 2 alternative consumption functions, that a £1 increase in quarterly UK advertising can increase consumption with £1.64 and £2.15 in the short run, while the long-run impact was estimated to be £8.29 and £4.48, respectively. Similarly, based on annual data from the US, Taylor and Weiserbs (1972) find that a one dollar per capita increase in advertising reduces per capita savings by about $4.1, and expands per capita consumption by, on average, $4.6 in the current period, and $7.9 in the long run.[33] This suggests that advertising significantly affects the economy through savings and consumption. Jacobson and Nicosia (1981), on their part, detected a significant impact from the previous year's aggregate advertising on current consumption levels, while Seldon and Jung (1995) found this influence to last for several years.

Previous findings, however, conflict with those of various other studies who found no such positive impact from advertising on the aggregate economy. Ashley et al. (1980), for instance, used the concept of Granger causality to determine the direction of influence between aggregate advertising and consumption. They provide evidence that the fluctuations in consumption induce changes in aggregate advertising, while past advertising spending does not

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[32] While this tends to be the dominant reaction pattern, firms occasionally follow an opposite strategy, and *increase* their spending, especially on advertising (Hillier 1999; Srinivasan, Lilien and Rangaswamy 2002).

[33] These figures suggest much larger elasticities than the ones typically reported in the marketing literature (see e.g. Hanssens et al. 2001, Leeflang et al. 2000). Even though one could argue that (i) previously reported advertising effectiveness estimates are primarily derived for mature Frequently Purchased Consumer Goods (FPCG), and (ii) that aggregate advertising expenditures may contain a substantial fraction of expenditures for new and high tech products where advertising may be more effective (see e.g. Lodish et al. 1995 for new products, or Horsky and Simon 1983 for high tech products), more research is needed to assess the face validity of the elasticities implied by Peel (1975) and Taylor and Weiserbs (1972).

help in forecasting current consumption. Also, Schmalensee (1972) found aggregate advertising to lag behind various components of GNP, and he concludes that advertising does not affect total consumer expenditures, while changes in national advertising can be well explained by changes in consumer spending. Finally, Quarles and Jeffres (1983) inferred from their cross-sectional data that advertising is not able to alter people's spending and saving habits, as advertising has no predictive power in a model where income is related to aggregate consumption.

Part of this ambiguity in previous research has been argued to arise from the fact that various studies looked at different time periods (e.g. 1948-1960 in Blank (1962), vs. 1956-1975 in Ashley et al (1980)); different countries (e.g. US in Jacobson and Nicosia (1981), vs. UK in Chowdhury (1994)); differences in the temporal aggregation level of the data (e.g. annual data in Seldon and Jung (1995), quarterly data in Didow and Franke (1984), vs. monthly data in Verdon et al. (1968)); and differences in the nature of the macro indicators that were studied (e.g. consumption in Schmalensee (1972), savings in Taylor and Weiserbs (1972), GDP in Chowdhury (1994), GNP in Nicosia (1974) and Verdon et al. (1969), and income in Jung and Seldon (1995)). See Kornelis (2002) for a review of these studies.

Yet, we believe that also differences in the considered time horizon of the relationship could be responsible for the current opposing findings. Ashley et al. (1980), Didow and Franke (1984) and Jacobson and Nicosia (1981), for instance, focused on the short run, while Chowdhury (1994), Hamada (1999), Jung and Seldon (1995) and Seldon and Jung (1995) examined the long-run relation between aggregate advertising and the economy. Still, the short-term and long-term relationship between variables is not necessarily identical. Indeed, there is growing empirical evidence that the nature of the relationship between economic variables can differ substantially at different periodicities. Baxter (1994), for instance, investigates the link between real exchange rates and real interest rate differentials using quarterly data from 1973 until 1991. Because interest rate theories predict that real exchange rates and interest rates can temporarily deviate from their long-run relationship, she expected a strong relationship between both variables in the medium and long run, while only a weak relationship in the short run. These considerations motivated her to isolate low, medium and high periodicity components within the series (corresponding to long-run, cyclical and short-run fluctuations), and to analyze the relationship between exchange rates and interest differentials separately across these three periodicities. The empirical findings confirm that there is essentially no relationship between these variables in the short run, while a strong relationship could be established in the medium and long run.

In the study by Vilasuso (1997), the author examines the importance of internal cash flow (or liquidity) in business investment decisions. Under regular circumstances, determinants such as firm profits, equipment costs and interest rates are found to dominate firm investment decisions (Bernanke 1983; Jorgenson 1971). The researcher finds, however, that although cash flow appears relatively unimportant in explaining regular business investment decisions, it turns out to be an important factor in explaining the variation in firm investments over the business cycle. Similarly, Erol and Balkan (1991) observe that the relationship between money supply and stock returns differs across the short, medium and long run. Finally, in a marketing study by Bronnenberg, Mela and Boulding (2002), the authors examine competitive price interactions that occur with different periodicities. They find significant competitor interactions across all different time horizons. However, competitors' reactions to short-term price reductions, which appear quite common, are negatively related across competitors, suggesting cooperative behavior. They differ from long-run price changes that are less frequent and positively related, suggesting competitive behavior.

In sum, all these studies suggest that, given the potential sensitivity of the conclusions to the time horizon considered, it is important to look at the appropriate periodicity before drawing a conclusion on the type of relationship between variables.

Also in our setting, one may well conceive different relations at distinct periodicities or time horizons. Ashley et al. (1980), Lambin (1976), and Leeflang and Reuyl (1985; 1995), for example, have argued that firm advertising merely causes a (short-term) *shift* in demand across products and industries, rather than an increase in the combined consumption. This would suggest the absence of any aggregate (short-run) effect. Still, an increased exposure to advertising messages has been argued to slowly raise the aspirations of the average consumer to higher consumption levels, and to increase their propensity to consume (Brack and Cowling 1983; Metwally and Tamaschke 1981).[34] A rise in the consumers' aspiration level is not so much the outcome of the present level of advertising, but rather of the cumulative impact of advertising exposure over more extended periods of time. As a case in point, Seldon and Jung (1995) found that the effect of aggregate advertising on consumption lingered for about nine

[34] Advertising is viewed as a major force in creating a consumption-oriented life style. It is assumed to not only affect the consumer directly, but also indirectly through its impact on the consumption behavior of others.

years. Given the possibility of a substantial (cumulative) lagged impact from advertising on the economy, absence of a short-run impact may well hide a relationship taking place at a much slower pace.

Alternatively, Ando and Modigliani (1963) argue in their life-cycle view of consumption (i.e. people allocate all income over their lifetime) that long-term consumption is bounded by the consumer's wealth. This would imply that advertising is *not* able to raise the total sum of consumer expenditures over their life span, so that a long-run influence from aggregate advertising on the economy is expected to be absent. Still, this does not rule out that aggregate advertising influences the economy by shifting consumer expenditures for shorter time periods. Jacobson and Nicosia (1981) and Jung and Seldon (1995) suggest that advertising can induce consumers to increase current consumption at the expense of future consumption (i.e. savings). As such, a demand increase is 'borrowed' from subsequent periods, while the total impact from shifting their expenditures cancels out (is nullified) over longer planning horizons. In that way, advertising may affect business-cycle fluctuations, while, at the same time, there need not be a long-lived effect from advertising on the economy.

In sum, weak relations in the short and/or long run do not necessarily rule out that aggregate advertising can influence the business cycle, since slowly moving long-run variations or highly irregular short-run fluctuations in advertising and the macro indicators may obscure the relationship at business-cycle periodicities. Similarly, being able to establish a short- and/or long-run relationship between aggregate advertising and the economy does not automatically make advertising an appropriate tool to combat economic contractions. After all, the effectiveness of advertising in doing so also depends on the *speed* with which it can produce results (Dean 1951). Making abstraction of the efficiency of advertising relative to other policy instruments, very long response lags make advertising unattractive in dampening contractions occurring at business-cycle periodicities. Finally, if the impact of aggregate advertising is very brief, it will be harder to raise aggregate demand over the entire length of the contraction.

So far, several of the studies that have analyzed the relationship between aggregate advertising and the macro economy did do so by looking for a long-run equilibrium relationship, and tried to determine whether aggregate advertising had a sustained impact on the economy (Chowdhury 1994; Hamada 1999; Jung and Seldon 1995). Jung and Seldon (1995), for instance, did find a long-run equilibrium relationship among aggregate advertising and aggregate consumption, and established an impact from advertising on consumption. These long-run findings made them conclude that advertising also offers an opportunity to manage business-cycle fluctuations through a counter-cyclical policy. In contrast, the focus of Ashley et al. (1980) was on the short run, as they analyzed immediate growth rates obtained by differencing the data. They find that advertising and consumption are related, even though the empirical causality runs exclusively from consumption to advertising. Based on these short-run analyses, they conclude that it will be implausible to think that advertising decisions can stabilize cyclical fluctuations in the economy. One should be careful, however, to make such cyclical inferences from, respectively, long-run and short-run variations/analyses, especially since the relationship between aggregate advertising and the economy need not be the same across each planning horizon, as argued above.

The purpose of this study is to re-analyze the link between aggregate advertising and the business cycle. Specifically, we address the following central question: does aggregate advertising influence the business cycle? This research question has excited regulators and policy makers for many decades, and intrigued the advertising industry that continues to suffer tremendous losses during several downturns.

To study this topic, we first review current research evidence, and emphasize the dynamic nature of the relationship between advertising and the economy. Next, we introduce a methodology that is able to limit the analysis to only those fluctuations that can be attributed to business-cycle fluctuations. Specifically, we extract the fluctuations in each of the series that occur at business-cycle periodicities. This allows us to get a less confounded picture of the *cyclical* relationship, if it exists, between advertising and the economy. If a cyclical relation is obtained, we assess whether advertising temporally precede cyclical fluctuations in the general economy. The key finding from our empirical analysis is that advertising does not Granger cause the business cycle, while we find that business-cycle fluctuations induce important changes in the demand for advertising.

The remainder of this paper is organized as follows. In the next section, we review current research evidence on the topic, with a focus on the direction of influence between advertising and the economy. In Section 4.3, our methodological approach is introduced, which breaks down into a number of subsequent stages: (i) extracting the business-cycle fluctuations, (ii) examining the presence of a cyclical relationship, and (iii) testing for the direction of causality. Section 4.4 discusses the data. Empirical results are summarized in Section 4.5, after which some validation tests to assess the robustness of our findings are carried out (Section 4.6). Finally, we end with a discussion of our substantive findings in Section 4.7.

4.2 CAN ADVERTISING INFLUENCE THE BUSINESS CYCLE?

To influence the business cycle, it is not sufficient to establish a significant cyclical relationship between aggregate advertising and the economy. The mere finding that advertising is related to the business cycle, does not rule out that it are the advertising decisions that depend on the market outcome, or one may even conceive a two-directional feedback relationship among both variables (Hanssens, Parsons and Schultz 2001).

Early evidence on the nature of the relationship was provided by studies based on the behavior of aggregate advertising at cyclical turning points, which was initially analyzed graphically. Borden (1942) and Blank (1962) both concluded, based on a graphical analysis, that peaks in national advertising generally follow the peaks in the business cycle by several months. Also Yang (1964) concluded that, because advertising lagged the general business activity, the causality runs from sales to advertising.

Because a visual graphical analysis does not provide any formal statistical test on the nature of the relationship, subsequent studies started to use correlation-based approaches to infer the influence from aggregate advertising on the economy. Metwally and Tamaschke (1981) initially estimated a single-equation model to assess whether advertising intensity is a significant determinant of the propensity to consume. From this model, the authors concluded that an increase in national advertising would indeed increase the propensity to consume. Quarles and Jeffres (1983), on the other hand, estimated regression models on cross-sectional data from 53 countries. From these regressions, they found that advertising could not improve models that relate income to consumption, and the authors concluded that advertising does not influence aggregate consumption.

Over time, researchers were getting concerned that the graphical and correlation-based approaches used thus far might fail to capture the complexity of the relationship between advertising and the economy. Indeed, correlation does not imply causation (Hanssens et al. 2001), and it may well be that the correlation between advertising and the macro variables does not arise because advertising influences the economy, but rather that the economy is responsible for the changes in the demand for advertising. To correct for a potential simultaneity bias, Taylor and Weiserb (1972) re-estimated their regression model using two-stage least squares after they found a significant relationship between advertising and savings. Still, they continued to infer that advertising had a significant impact on aggregate savings. Similarly, Metwally and Tamaschke (1981) used, in addition to their single equation model, a system of structural equations to test the hypothesis that advertising intensity and the propensity to consume are related simultaneously.

However, a more prevalent approach is to work with time series data, and to focus on the temporal precedence of events when considering causal relations. One of the first studies in this tradition is the work by Verdon et al. (1969), who examined correlation coefficients between advertising and GNP, as well as between advertising and industrial production, at various leads and lags. The correlations were large and significant, indicating that advertising and the economy are indeed related; but since these correlations showed no clear pattern, the authors remained inconclusive on the direction of influence in the relation. In a later paper, Schmalensee (1972) estimated consumption equations without advertising, and subsequently included past, current and future period advertising. When he compared the models' performance, it appeared that a model with future advertising generally outperformed the models with current and past advertising only, which made him conclude that the influence ran from consumption to advertising.

The temporal ordering of events and the empirical distinction between leading and lagging variables is also at the core of the Granger causality definition (Granger 1969). The Granger causality testing approach was implemented, e.g., in Ashley et al. (1980) and Jacobson and Nicosia (1981) to examine the relationship between aggregate advertising and the economy. Even though the notion of Granger causality has its limitations (see Bult, Leeflang and Wittink 1997; Granger 1969; and Hanssens et al. 2001 for a review), it represents an operational and testable definition to infer empirical causation. The application of Ashley et al. (1980), for instance, provided evidence that advertising does not Granger cause consumption, while fluctuations in consumption induce change in the demand for advertising.

Following the influential work of Ashley et al. (1980), many other studies have (re-) examined the dynamic relation between advertising and the macro economy using the Granger approach (Chowdhury 1994; Hamada 1999; Jacobson and Nicosia 1981; Jung and Seldon 1995; Seldon and Jung 1995). These techniques have become even more popular due to some recent advances in time series analysis, with well-known techniques such as cointegration testing and VAR/VEC modelling.[35] Indeed, Engle and Granger (1987) showed that if two variables are cointegrated, there exists Granger causality in at least one direction. Cointegration and VAR/VEC modeling techniques were applied by Chowdhury (1994), Jung and Seldon (1995), and Seldon and Jung (1995) to examine the nature of the relationship between advertising and the economy. Chowdhury (1994), for instance, failed to find any evidence of a long-run equilibrium relationship between aggregate advertising and six alternative macro economic variables, even though in the short run, advertising appears to Granger cause both savings and investment decisions. In contrast, in the studies by Jung and Seldon (1995), and Seldon and Jung (1995) a cointegration relationship could be established between advertising and consumption, and subsequent Granger causality tests revealed a two-way causality between both aggregate variables. A priori, one could wonder whether large and significant advertising effects will be detected when taking into account that disaggregate advertising elasticities have typically been found to be small and/or insignificant (see Lodish et al. 1995, or the review in Hanssens et al. 2001). However, we feel this is a worthwhile exercise as (i) the aforementioned elasticities were mainly derived for mature FPCGs (see before); (ii) there is inconclusive evidence in previous studies, both with respect to the existence and the causal nature of the aggregate relationship (Hanssens et al. 2001 p. 179, would classify this as a level 0 knowledge where only the relevant information set is known); and (iii) these previous elasticities were often derived for the short- or long-run horizon, while we are interested in the cyclical relation between aggregate advertising and the economy. This cyclical or medium-run relationship has, to the best of our knowledge, not yet been investigated.

In this paper, we will follow this tradition of applying the Granger causality definition to empirically assess temporal precedence and infer Granger causality. However, our approach will differ in three important ways from previous applications. First, we will assess the direction of Granger causality in the cyclical relationship between aggregate advertising and the macro economy, after extracting (filtering) the cyclical fluctuations from both series. The main reason for doing so is the general finding that the same relationship between variables does not necessarily hold across different time horizons, while thus far, studies have only considered how advertising and the economy relate in, respectively, the short and the long run. Second, we will adopt a systematic testing procedure that allows one to distinguish between five alternative scenarios that can occur in a bivariate relation. Specifically, with this procedure, we

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[35] VAR stands for Vector Autoregressive; VEC denotes Vector Error-Correction.

will discriminate between the following five relations: (i) a two-directional feedback relationship, (ii-iii) one of two types of unidirectional relationship, (iv) a contemporaneous relation, and (v) independency. The approach is in line with the conceptual testing procedure adopted in the papers by Chen and Lee (1990) and Chen and Wu (1999), and will be discussed in more detail in Section 4.3. The main reason for using a sequential testing procedure is that, in previous studies, researchers did not always consider all five possible scenarios, and consequently, the actual testing procedure that was used may, in some instances, have affected the findings. Third, in estimating the models, we account for the problem of serial correlation that may arise from our adopted methodological approach. More formally, the prior use of a moving-average type filter to extract the business-cycle fluctuations in the regression variables, and the inclusion of leading and lagging variables in the test equations, may induce serial correlation in the error terms.

4.3 METHODOLOGY

As indicated before, previous research has adopted a variety of techniques to study the relationship between aggregate advertising and the economy. A number of studies searched for a long-run equilibrium relationship through cointegration testing (e.g. Chowdhury 1994; Jung and Seldon 1995; Seldon and Jung 1995). Other studies focused on the short-run association, and analyzed immediate growth rates obtained by differencing the data (e.g. Ashley et al. 1980; Jacobson and Nicosia 1981). Neither approach, however, is really suited to study the *cyclical* relationship between the variables of interest.

Cointegration, for instance, restricts attention to the common long-run trend pattern in the series, and is appropriate to quantify a long-term equilibrium relationship among the variables (Powers et al. 1991). In so doing, cointegration testing examines only part of the information in the series, i.e. the long-run or low-periodic movements, while additional information as reflected in fluctuations with a higher periodicity, is discarded (Atesoglu and Vilasuso 1999). The existence of a cointegration relation also implies that the series are linked in the long run, even though this equilibrium need not hold in every period. Temporary deviations from the target level may occur; yet, the series tend to adjust back to their long-run equilibrium in subsequent periods. Information on this dynamic adjustment pattern within the system, along with the short-run relationships among the variables, is captured in an error-correction model (Engle and Granger 1987). As such, the cointegration and error-correction approach essentially describes the short- and long-run relations among two or more variables, which may well differ across both planning horizons. However, these models may still be inappropriate to determine how the series are related over the business cycle, as the evolution takes place at a pace that is typically located somewhere in between that of the short and the long run.

On the other hand, the first-difference operator, generally used in the presence of a unit root extracts primarily short-run fluctuations within the series, while cyclical and long-run variations are to a great extent removed (Baxter 1994; Englund, Persson and Svensson 1992). As a result, the relation between differenced variables can reveal how they relate in the short run. But, since the first-difference operation transforms the time series in a way that emphasizes the short-run fluctuations while down-weighting fluctuations with low (i.e. long run) and medium (here, the cyclical) periodicity, it tends to filter out (suppress) those components in the data that are of main interest when investigating advertising's impact on the business cycle (Harvey 1993). As such, when differencing the data, one may miss the true relationship between advertising and aggregate business-cycle fluctuations.

In general, we observe that current research approaches mostly consist of establishing a statistical relationship between aggregate advertising and one or more macro indicators, after which the direction of influence (causality) between them is established (see Section 4.2). We follow a comparable stepwise approach, even though we add an additional preliminary step which we believe is crucial in the derivation of the relationship between advertising and the business cycle: before inferring a multivariate relation, we perform a univariate decomposition of each time series that allows us to break up the total variation within the series according to the periodicity with which the fluctuations are repeated over time. Specifically, we will first use a univariate filter that is able to retain variations due to business-cycle fluctuations, while separating them from the long-run and the short-run variations within that series. This procedure is in line with the conceptual model-building approach of Hanssens et al. (2001, p. 298), who argue that the detection of a relationship among series (the *inter*structure) may be obscured by the existence of within-series patterns (known as the *intra*structure), so that one needs to correctly model the intrastructure before deriving the interstructure. A similar preliminary step was also adopted in Didow and Franke (1984) and Ashley et al. (1980), who used ARIMA models to capture the univariate structure (i.e. the systematic, deterministic and stochastic parts) within the series. Their filtering approach, however, is designed to capture the short-run properties of the data (Canova 1998), but discards the variations at longer periodicities that are of primary concern in our study. In a second step of our methodological procedure, we will assess whether both series are related over the business-cycle, and in step three, we will determine the direction of influence in the relationship based on a sequential testing procedure that is able to distinguish between the five alternative relations listed earlier.

4.3.1 Stage 1: Extracting the business-cycle component

Jonish and Worthley (1973) stress that if the same relationship would exist at all periodicities, it would be no problem to analyze the original series, containing short-, cyclical and long-term sources of variation. But if different relations might exist across different planning horizons (suggesting that the periodicity of the cycle has an influence upon the degree of association between aggregate advertising spending and the general economic conditions), one should analyze the series separately across different periodicities (Baxter, 1994).

Over-time fluctuations in economic series have been argued to generally contain a long-run trending pattern, frequently-occurring short-run fluctuations, and variations related to the business cycle (Harvey and Jaeger 1993; Holly and Stannett 1995). If we can separate those three sources of variation *within* a series, the relation *between* variables can subsequently be analyzed at the time horizon of interest.

Since the focus of this study is on fluctuations related to the business cycle, we first need to specify the time window corresponding to cyclical fluctuations in the data. Once the "business-cycle window" is specified, fluctuations occurring with a higher periodicity are classified as short-run fluctuations, and those fluctuating at a slower pace correspond to the long-run fluctuations. Both will be removed from the series. Many NBER researchers[36] (see e.g. Burns and Mitchell 1946; Christiano and Fitzgerald 1998) specified that business cycles exhibit cycles of varying length that tend to last no less than six quarters (or 1.5 years), and no longer than 32 quarters (or eight years) in duration.

One might argue that these dates are based on the typical length of the US business cycle in the 20th century. However, the same periodicities also form the base in several studies conducted in other countries. Valderrama (2002), for instance, followed these conventions to study the business-cycle properties in a sample of OECD countries. Similarly, Mills (2001) focuses on the business-cycle behavior of macro economic variables in 22 countries across four different continents, and extracts the countries' business cycles in the same way as those in the US.

[36] NBER refers to the National Bureau of Economic Research.

Two widely adopted filtering procedures to isolate cyclical fluctuations from a series are the Band-Pass (BP) filter (Baxter and King 1999) and the Hodrick-Prescott (HP) filter (Hodrick and Prescott 1997). In the context of this study, we adopt the BP-filter because, unlike the HP filter, the Band-Pass filter is able to remove the short-term variations from the data that fluctuate with a periodicity of less than six quarters, and that have clearly nothing to do with the business cycle (Baxter and King 1999; King and Rebelo 1993; Stock and Watson 1999). In contrast, the HP filter eliminates only the long-run component from the data, which implies that part of the variation that the HP filter attributes to the cyclical component should, in fact, be attributed to the high periodicity or short-run 'noise' in the data (Canova 1998). Given that the nature of the relation between aggregate advertising and the economy in the short run may differ from the same relationship over the business cycle (see Section 4.1), our preference for the BP filter is obvious. In addition, even though the filter was developed only recently, many researchers such as Cogley (1997), Christiano and Fitzgerald (1998), and Stock and Watson (1999) show a clear preference for the use of this filter, as it mitigates the problem of high frequency noise in the data, one of the main drawbacks of the HP-filter (Baxter and King 1999; Stock and Watson 1999).

The BP-filter, formalized in the study by Baxter and King (1999), *admits* all periodic components between 6 and 32 quarters, while *removing* fluctuations that occur at a slower pace (> 32 quarters), which are the main focus of studies assessing cointegration, as well as fluctuations with higher periodicities (< 6 quarters), as emphasized in studies adopting the first-difference filter. The filter is a centered moving average with symmetric weights. Given that we will work with quarterly data (see Section 4.4), the filter can be shown to equal (see Baxter and King 1999 for details on the filter design):

$$c_t^y = \sum_{i=-12}^{12} w_i \cdot y_{t-i} \ , \tag{4.1}$$

with y_t the (log-transformed) data series in year t, w_i the filter weights at lag length i as described in Table 4.1, and c_t^y the cyclical component to be used in further analyses.[37]

[37] Because of the leads and lags in Eq. 4.1, 24 observations (three years at the beginning of the data sample, and three years at the end) are lost in the derivation of the cyclical component.

Table 4.1: Band-Pass filter weights for quarterly data (Baxter and King 1999)

Weights	Value
w_0	0.2777
$w_1 = w_{-1}$	0.2204
$w_2 = w_{-2}$	0.0838
$w_3 = w_{-3}$	-0.0521
$w_4 = w_{-4}$	-0.1184
$w_5 = w_{-5}$	-0.1012
$w_6 = w_{-6}$	-0.0422
$w_7 = w_{-7}$	0.0016
$w_8 = w_{-8}$	0.0015
$w_9 = w_{-9}$	-0.0279
$w_{10} = w_{-10}$	-0.0501
$w_{11} = w_{-11}$	-0.0423
$w_{12} = w_{-12}$	-0.0119

The BP-filter has several appealing features that are described in more detail in Essay 2 (Section 3.3). Still, one of these properties deserves further attention within the framework of this study. As the BP-filter is a symmetric filter, it does not introduce a phase shift, which means that it does not alter the timing of the cycles, so that contraction and expansion dates in the filtered series correspond to the same dates as in the original series. In this way, the BP filter will not affect the temporal ordering among the variables, and thus, cannot affect our results concerning the direction of (Granger) causality (see also Didow and Franke 1984 for a discussion on causal relations and filtering).

4.3.2 Stage 2: Specification of the cyclical relationship

Both aggregate advertising and GDP are filtered according to Eq. 4.1 before we determine the *cyclical* relationship between them. This approach to establish a cyclical relation is conceptually similar to the procedure of Stock and Watson (1999) and Canova (1998), among others, who specified business-cycle comovement based on the cross correlation of the cyclical component filtered from a variety of aggregate series (e.g. consumption, unemployment rate, consumer price index, interest rates) with the cyclical component extracted from GDP. Similarly, Baxter (1994) filtered exchange rates and interest differentials in order to isolate low-, medium- and high-periodicity components within the respective series, and subsequently analyzed their relation (correlation) separately across the three periodicities. Christiano and Fitzgerald (1998), on their part, obtained their comovement statistics by regressing the cyclical component of a focal series on various leads and lags of the business-cycle component extracted from total hours worked, their measure of the general economic activity.

Our approach is in line with Christiano and Fitzgerald (1998), in that we will estimate the following equation:

$$c_t^{GDP} = c + \beta c_t^{ADV} + \sum_{i=1}^{I} \eta_i c_{t-i}^{ADV} + \sum_{j=1}^{J} \phi_j c_{t+j}^{ADV} + u_t \qquad (4.2)$$

with I and J sufficiently large to capture the dynamic structure within the variables to avoid truncation bias (Hanssens et al. 2001). This model corresponds to the Sims method of testing for Granger causality, making Eq. 4.2 very useful in establishing the direction of temporal ordering between the cyclical fluctuations in aggregate advertising and GDP (cf. infra). Note that a conceptually similar specification with leads and lags was also used recently in the promotional research literature by Macé and Neslin (2000), and Van Heerde, Leeflang and Wittink (2000).

A critical issue in the interpretation of the test equation is the significance of the respective coefficients. However, because of leading and lagging variables in Eq. 4.2, the residuals may not be white noise (Bult et al. 1997; Sims 1972). In addition, the use of the moving average filter (Eq. 4.1) on the variables prior to the regression analysis has been recognized to induce serial correlation in the data as well (Engle 1974). As such, OLS is no longer efficient. To account for this problem, we employ the Yule-Walker estimation method that represents a generalized approach to the treatment of higher order serial correlation.[38] This easy to use estimation method can be shown to yield estimators with lower variance than OLS, and permits conventional statistical tests to be carried out (Theil 1971; Tryfos 1998). In so doing, we avoid the problems of making inferences from serially correlated data.[39]

4.3.3 Stage 3: Testing for the temporal interrelationship

In this study, we are ultimately interested in the empirical causal ordering of the variables. Eq. 4.2 offers the important benefit that it corresponds to the well-known Sims

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[38] The Yule-Walker approach is a special case of the Generalized Least Squares (GLS) estimation method generally used in the presence of correlated disturbances (Leeflang et al. 2000). Details on its implementation can be found in Beamish and Priestley (1981) and Gallant and Goebel (1976).

[39] Note that we do not use the Modified Sims approach as discussed in Bult et al. (1997) and Leeflang et al. (2000), because we preferred the estimation approach to be consistent with the one adopted later in this study to determine the comovement elasticity, where the same problem of serial correlation is present (see Section 4.5). However, we will implement the Modified Sims approach to validate our substantive findings in Section 4.6.

regression method to determine the temporal ordering of the relationship and infer Granger causality (Sims 1972).[40] Thus far, Sims' model has been used to determine the direction of causality in several studies in economics (e.g. Sims 1972; Kamath 1985; Saunders and Tress 1981) as well as marketing (e.g. Aaker, Carman and Jacobson 1982; Batra and Vanhonacker 1988; Jacobson and Nicosia 1981).[41] In the latter application, the authors also tested for empirical causality between aggregate advertising and aggregate consumption, and found that advertising Granger caused consumption.

To establish in Sims' model (Eq. 4.2) that c_t^{ADV} Granger causes c_t^{GDP}, the *lagged* values of c_t^{ADV} should contribute to the prediction of c_t^{GDP}. Alternatively, to conclude that c_t^{GDP} Granger causes c_t^{ADV}, the *leads* of c_t^{ADV} should contribute to the prediction of c_t^{GDP}.[42] As pointed out before, we will follow the conceptual testing procedure proposed by Chen and Lee (1990) and Chen and Wu (1999), and sequentially test for five alternative relations that can be present between c_t^{ADV} and c_t^{GDP}. To implement this procedure, we first distinguish the five relations that can occur between two variables: (i) a 'feedback relationship', where cyclical fluctuations in advertising cause changes in the business cycle while at the same time, business-cycle fluctuations induce changes in the demand for advertising ($c_t^{ADV} \Leftrightarrow c_t^{GDP}$); (ii-iii) one of the two types of the 'unidirectional relationship', or an impact in only one direction ($c_t^{ADV} => c_t^{GDP}$ or $c_t^{GDP} => c_t^{ADV}$); (iv) a 'contemporaneous relation' where cyclical fluctuations in both variables have at most an instantaneous effect (i.e. a short-term relationship within one period) ($c_t^{ADV} \leftrightarrow c_t^{GDP}$); and (v) 'independency', or no relation between both variables ($c_t^{ADV} \Lambda c_t^{GDP}$). These relations are formally defined by Chen and Lee (1990) using the definition of causality originally introduced by Granger (1969). Accordingly, previous relations are still based on the empirical temporal ordering of events that has inspired previous researchers when they inferred the direction of causality.

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40 Henceforth, when we refer to causality, we mean *Granger* causality as defined by Granger (1969).

41 For a review of other empirical approaches to determine the direction of causality, we refer to the work of Hanssens et al. (2001) and Leeflang et al. (2000). However, it has been shown that in large samples, the most popular methods for testing for Granger causality (Haugh-Pierce test, Granger test, and Sims test) perform approximately the same (Geweke, Meese and Dent 1983).

42 With the Sims regression method, it is possible to determine the same causal relations by reversing the dependent and independent variables in Eq. 4.2 (Aaker et al. 1982; Jacobson and Nicosia 1981). In the empirical analysis, we will assess whether the initial results still hold when this alternative or reverse regression model is used.

To detect which of these five dynamic relations applies, the relations are ordered hierarchically, and the testing procedure starts by testing for the most general relation (i.e. the feedback relationship). Once we are unable to find support for this relation, we proceed with the more restricted ones, according to the flow chart presented in Figure 4.1.

Figure 4.1: Flow chart on the alternative relations in a bivariate system

Alternative scenarios	Test equations	Coefficient tests
Feedback relation $c_t^{ADV} \Leftrightarrow c_t^{GDP}$	$c_t^{GDP} = c + \beta c_t^{ADV} + \sum_{i=1}^{I} \eta_i c_{t-i}^{ADV} + \sum_{j=1}^{J} \phi_j c_{t+j}^{ADV} + u_t$	***H₁***: $\sum_{i=1}^{I} \eta_i = 0$ **&** ***H₂***: $\sum_{j=1}^{J} \phi_j = 0$
Unidirectional relation (i) $c_t^{ADV} => c_t^{GDP}$ (ii) $c_t^{ADV} <= c_t^{GDP}$	(i) $c_t^{GDP} = c' + \beta' c_t^{ADV} + \sum_{i=1}^{I} \eta_i' c_{t-i}^{ADV} + u_t'$ (ii) $c_t^{GDP} = c' + \beta' c_t^{ADV} + \sum_{j=1}^{J} \phi_j' c_{t+j}^{ADV} + u_t'$	(i) ***H₁***': $\sum_{i=1}^{I} \eta_i' = 0$ (ii) ***H₂***': $\sum_{j=1}^{J} \phi_j' = 0$
Contemporaneous relation $c_t^{ADV} \leftrightarrow c_t^{GDP}$	$c_t^{GDP} = c'' + \beta'' c_t^{ADV} + u_t''$	***H₃***: $\beta'' = 0$
Independence $c_t^{ADV} \Lambda c_t^{GDP}$	-	-

One of the main benefits of the Sims method is that all five dynamic relations are nested in the regression model presented in Eq. 4.2.[43] As a consequence, the equation can easily be modified to test for more restricted relations by omitting the corresponding predictor variables (see Figure 4.1). More formally, at first, all five relations (i-v) are still possible when we estimate Eq. 4.2. Based on various tests for coefficient restrictions, we will try to eliminate in a sequential way a more general relation against the remaining more restricted ones.

Is a feedback relationship present? We start by examining whether a feedback relationship is present. To conclude that $c_t^{ADV} \Leftrightarrow c_t^{GDP}$, we need to establish that $c_t^{ADV} => c_t^{GDP}$ and, at the same time, there should be a relation in the opposite direction, i.e. $c_t^{GDP} => c_t^{ADV}$. If causality would only be tested in one direction, the researcher could erroneously conclude that unidirectional causality is present, while in reality a feedback relationship may exist between both variables. Hamada (1999), for instance, concluded that a significant impact from advertising on aggregate demand was present, even though he never tested for the existence of an opposite relation. As such, his results cannot exclude the presence of a feedback relationship between both variables.

To empirically test for feedback, we examine *two* sets of restrictions on the coefficients in Eq. 4.2, corresponding to testing for $c_t^{ADV} => c_t^{GDP}$ (i) and $c_t^{GDP} => c_t^{ADV}$ (ii).

(i) To determine that causality runs from advertising to GDP ($c_t^{ADV} => c_t^{GDP}$), we need to reject the formal hypothesis H_1 that $c_t^{ADV} \neq> c_t^{GDP}$. To that extent, we use a Wald test to examine the restriction that the *sum* of all lagged values for c_t^{ADV} in Eq. 4.2 is zero, i.e. $\sum_{i=1}^{I} \eta_i = 0$. The reason for restricting the *sum* of all lags to be zero, i.e. H_1 : $\eta_1 + \eta_2 + \ldots + \eta_I = 0$, rather than restricting all η_i to be jointly zero, i.e. H_1: $\eta_1 = \eta_2 = \ldots = \eta_I = 0$ as applied in marketing studies by Aaker et al. (1982) or Jacobson and Nicosia (1981), is that significant positive and negative lagged values may otherwise compensate each other, while the overall impact can still be zero. Our sum-based approach is in line with the techniques advocated in Nijs et al. (2001), Pauwels and Srinivasan (2003),

[43] This property is not present in some other procedures that are often used to test for Granger causality such as the well-known Granger method, see Hanssens et al. (2001, p. 313 Eq. 7.38).

Srinivasan et al. (2003) and Steenkamp et al. (2003), where Impulse Response Functions are used to determine the incremental net effect of a marketing (re)action, and where positive and negative effects may be partially negated in successive periods. Empirical rejection of the imposed restriction denotes that the constraint $\sum_{i=1}^{I} \eta_i = 0$ is inappropriate, and we conclude that c_t^{ADV} Granger causes c_t^{GDP}.

(ii) Alternatively, to empirically establish that $c_t^{GDP} => c_t^{ADV}$, one should reject the formal hypothesis H_2 that $c_t^{GDP} \neq> c_t^{ADV}$. This is done by using a Wald test to examine the following restriction on the parameter estimates in Eq. 4.2: $\sum_{j=1}^{J} \phi_j = 0$. Rejection of the Wald test statistic implies that $c_t^{GDP} => c_t^{ADV}$.

If we can reject the hypotheses H_1 and H_2 *simultaneously* (i.e. $\sum_{i=1}^{I} \eta_i = 0$ and $\sum_{j=1}^{J} \phi_j = 0$ are not supported by the data), we have empirical support for the presence of a feedback relation ($c_t^{ADV} \Leftrightarrow c_t^{GDP}$), and the procedure ends. In contrast, if the null hypothesis cannot be rejected in at least one of the two instances, the feedback relation is refuted, and we continue with testing for a unidirectional relation.

Is a unidirectional relationship present? In the second step, we test for the presence of a unidirectional relationship between the cyclical fluctuations in aggregate advertising and those in GDP, against the remaining more restricted relations (see Figure 4.1). A unidirectional relation can run either from (i) $c_t^{ADV} => c_t^{GDP}$, or from (ii) $c_t^{GDP} => c_t^{ADV}$. To conclude that causality runs from $c_t^{ADV} => c_t^{GDP}$ (i), we need to be confident that the relation does not run in the opposite direction (i.e. $c_t^{GDP} \neq> c_t^{ADV}$). But the hierarchical nature of the testing procedure already assures that this opposite relationship is absent.[44] As such, the outcome of the first step ensures that we are not confusing a unidirectional relation with a feedback relationship. Alternatively, to establish a unidirectional relationship from $c_t^{GDP} => c_t^{ADV}$ (ii), we should be able to exclude that the relation runs in the other direction,

[44] If this were not the case, we would have established a feedback relationship and the procedure would have stopped after the first step.

and again, the outcome of the previous step already assures that this opposite relationship is absent (i.e. $c_t^{ADV} \neq> c_t^{GDP}$).

To empirically test for the presence of a unidirectional relationship, we proceed as follows. The absence of a feedback relationship in the previous step means that the model in Eq. 4.2 contains redundant parameters. Redundant parameters in the model may reduce the power of the Wald test statistic, and therefore, makes it more difficult to reject the null hypothesis tested (Theil 1957). A more powerful test is obtained when these redundant parameters are eliminated. This results in the estimation of two more restricted versions of the original Sims model tested in Eq. 4.2.

(i) First, if we find in the previous step that the leads in Eq. 4.2 do not contribute to the model, they are considered to be redundant and will be excluded. We can subsequently test whether a unidirectional relation is present from $c_t^{ADV} => c_t^{GDP}$. Specifically, to establish a unidirectional relation from $c_t^{ADV} => c_t^{GDP}$, we need to reject the formal hypothesis $H_1^{'}$ that there is no such relation (i.e. $c_t^{ADV} \neq> c_t^{GDP}$) based on the following (restricted) equation (Eq. 4.3):

$$c_t^{GDP} = c^{'} + \beta^{'} c_t^{ADV} + \sum_{i=1}^{I} \eta_i^{'} c_{t-i}^{ADV} + u_t^{'} \tag{4.3}$$

With the Wald test, we again determine whether $H_1^{'}: \sum_{i=1}^{I} \eta_i^{'} = 0$ holds. If we can reject the test statistic, we conclude that the unidirectional relation $c_t^{ADV} => c_t^{GDP}$ is present.

(ii) Second, if in the previous step, the lags in Eq. 4.2 did not contribute to the model, they will be excluded, and we can continue to test for a unidirectional relation from $c_t^{GDP} => c_t^{ADV}$. To establish that $c_t^{GDP} => c_t^{ADV}$, we need to reject the formal hypothesis $H_2^{'}$ that this relation is not present (i.e. $c_t^{GDP} \neq> c_t^{ADV}$). This comes down to testing $H_2^{'}: \sum_{j=1}^{J} \phi_j^{'} = 0$ in Eq. 4.4.

$$c_t^{GDP} = c^{'} + \beta^{'} c_t^{ADV} + \sum_{j=1}^{J} \phi_j^{'} c_{t+j}^{ADV} + u_t^{'} \tag{4.4}$$

Again, rejection of the Wald test statistic means that the unidirectional relation $c_t^{GDP} => c_t^{ADV}$ is present.

If we cannot reject any of the restrictions implied by $H_1^{'}$ and $H_2^{'}$ in Eqs. 4.3 & 4.4, we conclude that a unidirectional relation is absent, and proceed with the next stage to distinguish between a contemporaneous relation and independence.

Is a contemporaneous relationship present? To conclude that a contemporaneous relationship best describes the relationship between advertising and aggregate economic fluctuations (i.e. $c_t^{ADV} \leftrightarrow c_t^{GDP}$), we need to establish, in addition to the results from previous stages, that c_t^{ADV} and c_t^{GDP} are not contemporaneously independent. This corresponds to looking for an instantaneous relationship between the cyclical fluctuations in advertising and GDP.

To empirically establish a contemporaneous relation, we test a regression model with only an instantaneous effect between c_t^{ADV} and c_t^{GDP}. Specifically, we test the following regression model (Eq. 4.5):

$$c_t^{GDP} = c^{''} + \beta^{''} c_t^{ADV} + u_t^{''} \tag{4.5}$$

The Wald test statistic that H_3: $\beta^{''} = 0$, can provide empirical support for the presence of a contemporaneous relation. More formally, rejection of the test statistic leads us to conclude that advertising and the business cycle are contemporaneously related. In the past, Chowdhury (1994) failed to establish a unidirectional causal relationship from advertising on four out of six macro variables, while unidirectional causality in the opposite direction was absent as well. Still, he did not test for the presence of a contemporaneous relation, so he may have missed an instantaneous effect between these variables.

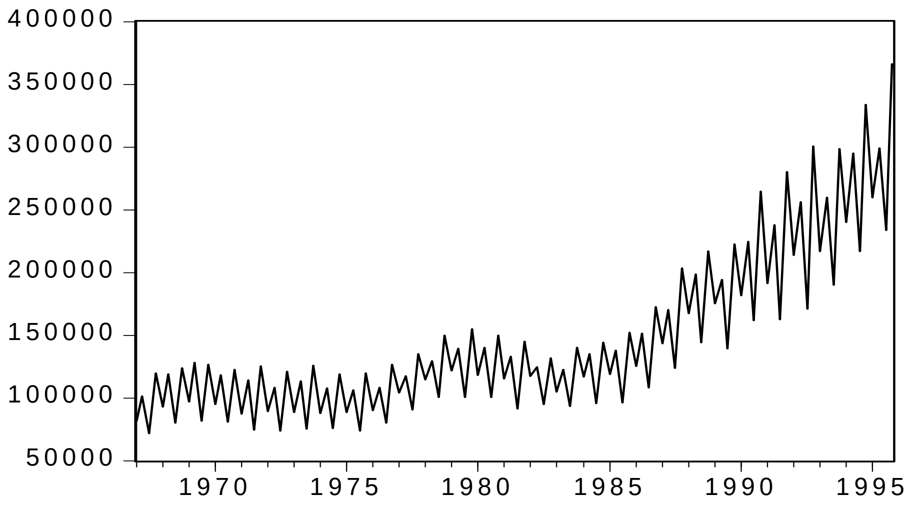
Are both variables independent? Finally, if we are unable to find support for all former scenarios, we conclude that both variables are independent (i.e. $c_t^{ADV} \Lambda c_t^{GDP}$). Specifically, only the inability to reject all former hypotheses in the regression models Eq. 4.2 – Eq. 4.5 allows us to conclude that the variables c_t^{ADV} and c_t^{GDP} are independent.

This testing procedure has several advantages over traditional approaches. First, we consider a complete enumeration of the dynamic relations that can occur between aggregate advertising and the economy, which prevents an ad hoc selection of the relations that are tested. In so doing, the sequential testing procedure avoids the potential bias induced by restricting the causal relation to a single alternative, as is often done in traditional pairwise hypothesis testing (Chen and Wu 1999). Second, the hierarchical nature of the testing procedure makes sure that certain relations are not overlooked, and more restricted relations are only considered in the absence of a more general relationship. For instance, we only test for a unidirectional relationship from advertising to the economy after having established that no feedback relationship is present.

4.4 DATA

Quarterly advertising data from both national and local advertisers were obtained from the Dutch BBC research agency. Advertising data from the same agency have already been used in earlier marketing studies on various topics: e.g. to compare advertisers' intentions with the actual demand for advertising (Alsem and Leeflang 1994), to assess the impact of a major new entrant in the advertising industry (Kornelis 2002), and to study competitive advertising reactions (Steenkamp et al. 2003). Our data involve (deflated) advertising expenditures on branded goods and services in the Netherlands, measured in Dutch guilders, and were available for 29 years (1967:1 – 1995:4). These expenditures cover four key advertising media: daily newspapers, magazines, radio, and television. Total deflated (branded) advertising expenditures in the Netherlands increased by 310% over the considered data period, with an average yearly growth of 4.3%, ranging between –4.7% in 1981 and +15.0% in 1987. A graph of over time (deflated) aggregate advertising expenditures in the Netherlands is shown in Figure 4.2.

Figure 4.2: Aggregate demand for advertising in the Netherlands (1967–1996)*



* Deflated figures in 1000 Dutch Guilders

From 1967 to 1995, the Netherlands went through several economic contractions; as such, the data period covers multiple business cycles, which is necessary for the present analysis (Jacobs 1998). Business-cycle indicators for the Dutch economy are provided by three alternative institutes. The shortest duration of a complete Dutch business cycle as reported by 'De Nederlandsche Bank' (DNB) for the period 1976-1995 was almost 9 quarters, the longest recorded one was about 5 years. Similarly, over the same period, the Centre for Economic Research (CCSO) reports Dutch business-cycle fluctuations of between 6.75 quarters and 5.7 years, while according to the Bureau of Economic Policy Analysis (CPB), Dutch business cycles varied between 9 quarters and 9.6 years. As such, the length of the business cycles in the Netherlands is comparable to the typical length of a US business cycle of between 6 quarters and 8 years as reported in Section 4.3.

In the past, various economic indicators have been used to study the relationship between the overall economic conditions and aggregate advertising, such as consumption (Ashley et al. 1980; Schmalensee 1972), savings (Chowdhury 1994; Taylor and Weiserbs 1972), GDP (Chowdhury 1994), GNP (Nicosia 1974; Verdon et al. 1969), and income (Jung and Seldon 1995; Verdon et al. 1969). We choose to study GDP, because our primary interest is in the impact of advertising on the business cycle. Stock and Watson (1999) recently pointed out that business-cycle fluctuations across many sectors are reflected in aggregate output, so that the cyclical component extracted from (real) GDP is a good proxy for the overall business cycle. Dutch quarterly real GDP, available from 1967:1 to 1995:4, is used as a measure of the general economic conditions in the Netherlands. The GDP data are unadjusted for seasonality, and they are obtained from 'De Nederlandsche Bank' (DNB) (http://www.dnb.nl) (1969:1 - 1976:4) and the Dutch Central Bureau of Statistics (CBS) (http://statline.cbs.nl) (1977:1 – 1995:4).

All series represent monetary values, and were deflated using the Dutch Consumer Price Index (CPI) obtained from the CBS. The data were subsequently log transformed, in which case the cyclical component can be interpreted as percentage deviations from the series growth path (Stock and Watson 1999). Log transformation has the additional benefit that potential heteroscedasticity in the data will be reduced (Franses 1998). Finally, several previous studies worked with annual data (see e.g. Chowdhury 1994; Jung and Seldon 1995). Given that it is reasonable to expect that part of the effect from aggregate advertising, if it exists, could already be achieved within the first year, the availability of quarterly data offers the important benefit that it better allows to disentangle the temporal precedence or direction of causality among the variables than yearly data (Granger 1969; Jacobson and Nicosia 1981). In addition, the BP-filter applied to data at a level of temporal aggregation lower than one year will also suppress fluctuations in a series that are shorter than 1.5 years, and that should not be attributed to business-cycle fluctuations (Baxter and King 1999; Stock and Watson 1999).

4.5 EMPIRICAL RESULTS

As described in Section 4.3, we start our empirical analyses by extracting the business-cycle fluctuations from the series using the BP filter with weights assigned according to Table 4.1. First, some summary statistics regarding the extent of cyclical sensitivity in the series are provided. Next, we report the results of the multivariate analysis, while the final section will present our findings on the (causal) nature of the cyclical relation between advertising and GDP.

4.5.1 Stage 1: Extracting the business-cycle component

Before we move on to the causal relationship between advertising and GDP, we provide some summary statistics on the cyclical components of both series (see Essay 2 for technical details).

Cyclical volatility. Following Hodrick and Prescott (1997) and Stock and Watson (1999), we can quantify the extent of cyclical sensitivity (i.e. cyclical volatility) through the standard deviation $\sigma(c)$ of the cyclical component c_t, isolated in Eq. 4.1. In general, our results indicate that the cyclical variations in advertising are larger than those in the overall economy. Cyclical volatility of aggregate advertising is 3.6%, while cyclical volatility in real Dutch GDP amounts to only 1.5%. As such, based on the cyclical volatility statistics, aggregate advertising is more than two times as sensitive to business-cycle fluctuations than the general economic activity. These figures confirm the anecdotal evidence on the decline in advertising demand during economic contractions presented in Section 4.1.

Instantaneous and dynamic comovement elasticity. As pointed out in Essay 2 (Section 3.3), cyclical volatility is a univariate concept that focuses on the size of ups and downs at business-cycle periodicities, but is not concerned with the synchronized nature of this pattern with the overall economic cycle, as reflected in GDP. This property is captured in Essay 2 through the *cyclical comovement* statistic, which measures the extent to which business-cycle fluctuations in the economy translate into cyclical fluctuations in aggregate advertising. Following the definition in Essay 2, this concept can be operationalized by regressing the cyclical component of advertising (c_t^{ADV}) on the cyclical component in GDP (c_t^{GDP}). The corresponding comovement statistic, however, only looks at the instantaneous effect, while, in Section 4.2, we emphasized the importance of accounting for dynamics in this relation. To account for a delayed effect, we will adopt two separate procedures where dynamics are incorporated into the comovement elasticity.

One way to incorporate such dynamics is advocated in Carpenter et al. (1998), who summarize a complicated lag structure into a single, composite, dynamic regression component. Specifically, to implement this procedure, we determined the weights associated with each time period based on the cross correlation of c_t^{ADV} and c_t^{GDP} at various lags. The maximum lag is taken as the highest lag at which the cross correlation is still significant, while the cross correlation one lag higher becomes insignificant. Next, we normalize the dynamic weights (i.e. the sum of the weights is set to one). Normalization is obtained by dividing the value of each cross correlation by the sum of the value of all other cross correlations accounted for in the dynamic regressor. Finally, we convert c_t^{GDP} to $c_{t\to K}^{GDP}$ using a weighted average of K successive observations. Cyclical comovement is now operationalized by regressing c_t^{ADV} on the *converted* c_t^{GDP}, i.e. $c_{t\to K}^{GDP}$, and the comovement equation becomes:

$$c_t^{ADV} = a + \beta\, c_{t\to K}^{GDP} + u_t \tag{4.6}$$

The main advantage of this approach is that comovement is summarized into a single parameter β, which represents the comovement elasticity. Moreover, the model to derive the elasticity in Eq. 4.6 is similar to the model proposed in Essay 2. The disadvantage of a single component is that we loose insights into the nature of the dynamic effect. Specifically, it remains unclear whether the lagged impact follows, for instance, some kind of a geometric decay, or whether positive and negative lagged values are averaged to arrive at the total comovement elasticity reported in the β coefficient.

Therefore, in a second approach, we determine the comovement elasticity based on the direct inclusion of lagged variables from c_t^{GDP} into the model. The equation then becomes:

$$c_t^{ADV} = a + \sum_{k=0}^{K} \gamma_k\, c_{t-k}^{GDP} + u_t \tag{4.7}$$

Using Eq. 4.7, the total comovement elasticity is obtained by aggregating the instantaneous and lagged coefficients γ_k across K different time lags (see also Van Heerde 1999, p. 82; Macé and Neslin 2000 for a similar operationalization). However, both Eqs. 4.6 & 4.7 are derived from filtered data, so that serially correlated residuals may result in inefficient parameter estimates. As such, we use the same Yule-Walker estimation approach specified before to avoid this problem (see Section 4.3).

Based on the cross-correlogram between c_t^{ADV} and c_t^{GDP}, we find that six significant cross-correlations (related to the instantaneous and five lagged cross correlations) are present, and convert c_t^{GDP} to $c_{t\to 6}^{GDP}$ using a weighted average of six successive observations starting at t.[45] In accordance with the dynamic regression component that summarizes the current and five lagged periods, we also include, apart from the instantaneous effect, five lagged coefficients to determine the comovement elasticity in Eq. 4.7. We find that, irrespective of the operationalization of the statistic, the cyclical comovement elasticity is larger than one (comovement elasticity = 1.49 (using Eq. 4.6) and 1.25 (using Eq. 4.7)). These results are in

[45] We convert c_t^{GDP} as follow: $c_{t\to 6}^{GDP}$ = $0.19\,c_t^{GDP}$ + $0.20\,c_{t-1}^{GDP}$ + $0.20\,c_{t-2}^{GDP}$ + $0.18\,c_{t-3}^{GDP}$ + $0.14\,c_{t-4}^{GDP}$ + $0.09\,c_{t-5}^{GDP}$, where the weights correspond to the normalized cross correlation between c_t^{ADV} and c_t^{GDP} at various lags.

line with the findings from the univariate volatility statistics, and we conclude that cyclical fluctuations in GDP get amplified in the context of aggregate advertising, implying that advertising is affected harder during economic contractions than the economy as a whole.

As c_t^{ADV} is the dependent variable in the comovement models in Eqs. 4.6 & 4.7, it is implicitly assumed that business-cycle fluctuations influence the cyclical fluctuations in advertising (see also Essay 2). For this reason, no lead effects were accounted for in these models. Yet, the validity of this assumption is dependent on the results from our subsequent analyses where we will establish the direction of Granger causality between the cyclical fluctuations in advertising and the economy. We will return to this issue when discussing the results from stage 3.

Cyclical asymmetries. In earlier economic work by for instance Cook (1999), DeLong and Summer (1986a) and Sichel (1993), the authors detected asymmetries in the business-cycle fluctuations extracted from various economic series (e.g. unemployment, consumer expenditures on durables). These asymmetries indicate that the economic variables behave differently across expansion and contraction periods. Asymmetries can relate to the extent of ups and downs in the cycle (i.e. deepness asymmetry), and to the speed or growth rate across upward vs. downward parts of the business cycle (i.e. steepness asymmetry). In Essay 2 it was found that durable goods encounter asymmetric steepness, meaning that durable sales drop faster during contractions than they recover during economic expansion, while deepness asymmetry was absent.

We report summary statistics of skewness to examine the asymmetric nature of the cyclical component in advertising and GDP. In accordance with the results in Essay 2, we report the asymmetries on the non-transformed as well as the log-transformed data. The reason for doing so is that the log transformation can distort the inferences on the (a)symmetric nature of a series (Burbidge, Magee and Robb 1988). For a more elaborate discussion on cyclical asymmetries, we refer to the discussion in Essay 2.

Table 4.2: Summary results for cyclical asymmetries*

	Deepness		**Steepness**	
	Original	Log transformed	Original	Log transformed
Aggregate Advertising	0.14 (0.28)	0.18 (0.37)	-0.27 (-0.36)	-0.09 (-0.20)
GDP	-0.04 (-0.10)	-0.15 (-0.34)	-0.33 (-0.81)	-0.37 (-0.85)

* t-statistic between parentheses

The results with respect to cyclical asymmetries are summarized in Table 4.2, and indicate that no significant business-cycle asymmetries are present in our data. Specifically, deepness and steepness asymmetry was absent in both aggregate advertising and GDP, and transformation of the data did not change these findings. So far, several previous studies examining the properties of the national economy also concluded that evidence of asymmetry in GDP is weak or does not exist (Mills 2001; Razzak 2001). Our study, which is the first to look for asymmetries in aggregate advertising, found a comparable absence in the Dutch advertising market.

4.5.2 Stage 2: Specification of the cyclical relation

Having isolated the cyclical component, we subsequently estimate Eq. 4.2. Five leads and lags are included to capture the dynamics in the model to avoid truncation bias (Hanssens et al. 2001). Based on the cross-correlation analyses reported in footnote 12, we use five leads and lags. This choice is also in accordance with previous studies using the Sims approach, in that they all used as many leads as lags in the model, a number which varied between four (Jacobson and Nicosia 1981) and 12 (Aaker et al. 1982). Also, our choice of five leads and lags is in line with the suggestions of Leeflang et al. (2000) of having at least five observations for each parameter that is estimated.[46] Finally, sensitivity analyses were conducted to assess the dependence of our findings to the lag length chosen, but our substantive conclusions were not affected.

[46] We initially had 116 quarterly observations available for both advertising and GDP (see Section 4.4). In our filtering procedure, we loose three years of data at the beginning as well as at the end of the data sample (i.e. 24 observations are lost due to filtering). In addition, we loose a number of observations in constructing the leading and lagging variables in Eq. 4.2. In a model with five leads and lags, 12 parameters are estimated while 82 observations are available, resulting in an average of 6.8 observations for each parameter estimated.

As argued in Section 4.3, we adopt the Yule-Walker estimation method to account for serial correlation in the data. As our main goal/purpose is to determine the nature of the relationship between advertising and GDP, we will not yet elaborate on the coefficients of the regression model at this stage, but rather use the present model as a starting point in our testing procedure designed to determine the direction of temporal influence (Granger causality), as discussed in the next stage. After having established the most appropriate (extended vs. restricted) model specification, we will interpret the relative size and signs of the coefficients in our model.

4.5.3 Stage 3: Testing for the temporal interrelationship

To explore the *causal* nature of the dynamic relationship between aggregate advertising and the economy, we follow the stepwise approach introduced in Section 4.3.

Is a feedback relationship present? We start by looking for a feedback relation, and estimate Eq. 4.2.[47] To conclude that a feedback relation is present, we need to establish that $c_t^{ADV} => c_t^{GDP}$ and, at the same time, that $c_t^{GDP} => c_t^{ADV}$. To test the former empirically (c_t^{ADV} => c_t^{GDP}), we need to reject H_1 that $c_t^{ADV} \neq> c_t^{GDP}$. This is implemented through a Wald test on $\sum_{i=1}^{5} \eta_i = 0$. To test for the presence of the reverse relation ($c_t^{GDP} => c_t^{ADV}$), we need to reject H_2 that $c_t^{GDP} \neq> c_t^{ADV}$ and use a Wald test on the following restriction: $\sum_{j=1}^{5} \phi_j = 0$. Based on the Wald test, H_1 cannot be rejected ($\chi^2(1) = 0.00$; p=0.96). Also, H_2 cannot be rejected ($\chi^2(1) = 0.18$; p=0.67). The realization of these outcomes (not reject H_1 and not reject H_2), which indicate respectively that $c_t^{ADV} \neq> c_t^{GDP}$ and $c_t^{GDP} \neq> c_t^{ADV}$, assures that a *feedback relation* (that requires rejection of both hypotheses H_1 and H_2) is *inappropriate to describe the current system*.

Is a unidirectional relationship present? We proceed with the next step, where we determine whether a unidirectional relation is present. Because we could not reject H_1 (i.e. $c_t^{ADV} \neq> c_t^{GDP}$) and H_2 (i.e. $c_t^{GDP} \neq> c_t^{ADV}$) in the first stage, redundant parameters appear to be present in the model, and we should still assess whether a unidirectional relationship is

[47] With the Sims regression method, it is possible to also identify the causal relations by reversing dependent and independent variables. In doing so, at the 10% significance level, all substantive findings remain the same.

present using a more powerful test on a model where redundant parameters are no longer present.

First, to establish a unidirectional relationship from c_t^{ADV} on c_t^{GDP}, one needs to reject $H_1^{'}$: $c_t^{ADV} \neq> c_t^{GDP}$ in the restricted Sims model presented in Eq. 4.3. This comes down to testing for the restriction $\sum_{i=1}^{5} \eta_i^{'} = 0$. We find, however, that $H_1^{'}$ cannot be rejected ($\chi^2(1)$ = 0.14; p=0.70), which indicates that there is *no unidirectional Granger causality from* c_t^{ADV} *on* c_t^{GDP}.

Second, to conclude that a unidirectional relation from c_t^{GDP} on c_t^{ADV} is present, $H_2^{'}$: $c_t^{GDP} \neq> c_t^{ADV}$ should be rejected. As such, we estimate Eq. 4.4, and use the Wald test to determine whether $\sum_{j=1}^{5} \phi_j^{'} = 0$. We find that $H_2^{'}$ can be rejected ($\chi^2(1)$ = 14.99; p<0.01) and conclude that a *unidirectional relationship is present from* c_t^{GDP} *on* c_t^{ADV}. This outcome will stop the testing procedure, as a unique relation could be identified.

In sum, our results indicate that the cyclical fluctuations in GDP drive the cyclical fluctuations in advertising, while the opposite relation appears absent. We thus conclude that there is evidence that it are the cyclical fluctuations in GDP that drive the business-cycle fluctuations in aggregate advertising ($c_t^{GDP} => c_t^{ADV}$), while cyclical advertising fluctuations are found to have no impact on the business-cycle fluctuations in the Dutch economy.[48] Remember that in deriving the comovement elasticity (see pp. 23-24), we assumed a unidirectional relation from the aggregate economic conditions on the demand for advertising, which is now confirmed by our findings. As such, the comovement models introduced before are the most appropriate way to describe the cyclical relationship between advertising and the economy.

Our conclusions are in line with the results provided by Ashley et al. (1980), Simon (1970), Quarles and Jeffres (1983) and Schmalensee (1972) who, albeit at different time horizons, also found that advertising does not affect aggregate consumption. Kornelis (2002) in contrast, found a negative relationship between total advertising demand and various Dutch macro economic indicators. However, the author focused on the long-run implications of

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48 Note, as argued before, that these findings do not rule out that aggregate advertising and GDP are related differently in the short run (<6 quarters) or long run (> 32 quarters).

aggregate advertising rather than the cyclical relationship of interest in this study, while also using a more limited data sample (1988:1 – 1998:4) than we used (1967:1 – 1995:4).

As such, it seems that even when advertising shifts purchases between firms or industries, it has no substantive leading influence on the business-cycle fluctuations in the national economy. In contrast, economic expansions and contractions cause important modifications in the demand for advertising. A possible explanation for this finding is that many firms set (part of) their advertising budget according to an organizational decision rule, where they fix (part of the) advertising budget as a percentage of sales or profit (Ashley et al. 1980; Cooil and Devinney 1992; Hulbert 1981; Simon 1970). As such, sales and/or profit reductions caused by an economic contraction induce a reduction in the demand for advertising as well.

Still, this explanation does not clarify why advertising is cut more extensively than the reductions in GDP. Indeed, if advertising is set as a fixed percentage of sales or profit, we would expect a percentage reduction in GDP to translate into at most a one-percentage reduction in aggregate advertising, while we find advertising reductions during contractions that are larger than the ones in GDP based on both the cyclical volatility statistic and the comovement elasticity. One possible explanation for this finding is the reallocation of advertising budgets to other company activities when the economic climate deteriorates, as pointed out by, for instance, de Chernatony, Knox and Chedgey (1991) and Ducoffe and Smith (1994).

Alternatively, Dhalla (1979) found that the amount of cash available to the firm is an important determinant of current advertising expenditures, and can explain about 4% of the variations in national advertising budgets. Given that cash availability is much more sensitive to business-cycle fluctuations than sales and profits, cash flow shortfalls during periods of economic contractions can be responsible for more extensive budget cuts (Dhalla 1979). Similarly, Minton and Schrand (1999) found that firms appear resistant to attract external funds (e.g. loans) to finance advertising activities, so that insufficient cash flows during the downturn may cause major slashes in their media budget.

Another possible explanation for the general finding that advertising reductions exceed reductions in GDP is based on the discussion in Schmalensee (1972). He suggests that the total demand for advertising is heterogeneous, in that a small set of industries accounts for the bulk of the total advertising demand. If those industries that advertise more heavily are also more sensitive to business-cycle fluctuations, it can be shown that, even if the advertising-to-sales ratio in each industry remains fixed across expansions and contractions, aggregate advertising would vary more strongly pro-cyclical (Schmalensee 1972). Empirical evidence exists that durable goods industries are, on average, more than twice as sensitive to business-cycle fluctuations than the general economic activity (see Essay 2), while, according to Metwally (1973), durables also spend a larger percentage of sales on advertising than other industries. In the aggregate, this may be reflected in a reduction in advertising that is more extensive than the changes in the business cycle.

In sum, economic contractions seem responsible for an important decline in the demand for advertising that is typically larger than the reduction in the general economic activity, as reflected in the cyclical volatility and comovement statistics. On the other hand, our findings provided no evidence for a leading influence from aggregate advertising on the business cycle.

4.6 VALIDATIONS

We validate our results in several different ways. We already pointed out earlier in the discussion that the nature of the relationship between c_t^{ADV} and c_t^{GDP} was not affected by reversing the dependent and independent variable in the Sims regression model (see footnotes 9 & 14). Similarly, our findings were not affected by reducing the lag length in the regression models. Still, two additional validation checks were carried out. First, an alternative way to account for the serial correlation problem in the Sims regression model is to include lagged dependent variables in the model. This model is also referred to as the Modified Sims approach (Bult et al. 1997). Therefore, in a first validation, we determine empirically whether the same causal relationship holds when we adopt the Modified Sims approach rather than using the Yule-Walker estimation method. Second, a number of major events have been found to induce important changes in the Dutch advertising industry during the early 1990s (Kornelis 2002). To find out if these events have an influence on our results, we introduce in our analysis a break dummy parameter that is able to control for a potential change in the cyclical relationship between advertising and GDP.

4.6.1 Alternative Granger causality test

In the Modified Sims approach, lagged dependent variables are added as additional explanatory variables to the original Sims model in Eq. 4.2 (Bult et al. 1997; Leeflang et al. 2000). These variables are included to absorb the serial correlation in the residuals, so that they approximate white noise. This Modified Sims model can also nest all five alternative relations between c_t^{ADV} and c_t^{GDP}, and can be adapted in a similar way to test sequentially for feedback, unidirectional relations, contemporaneous relationship or independency. The hypotheses tested in each stage are completely identical to the ones adopted before (see Figure 4.1). The residuals obtained from the Modified Sims models, estimated by OLS, were examined and the Ljung-Box Q-statistic up to lag three revealed that they indeed approximated white noise ($\chi^2(3) = 3.51$; p=0.32).

Given that in the Modified Sims model we are estimating a number of additional regressors, we no longer include five leads and lags as in the main analysis. Indeed, if we require at least five observations for each parameter estimate (Leeflang et al. 2000), we can include at most four leads and lags in the model. Still, our substantive results remained unaffected when adopting this alternative procedure to test for Granger causality. First, given that we cannot reject H_1: $c_t^{ADV} \neq> c_t^{GDP}$ ($\chi^2(1) = 1.34$; p=0.25), but H_2: $c_t^{GDP} \neq> c_t^{ADV}$ could be rejected ($\chi^2(1) = 3.41$; p=0.06), a feedback relationship, that requires the rejection of both H_1 and H_2, could be refuted. This outcome allows us to continue to the next step where we look for a unidirectional relationship. Based on the general model, we were already able to reject H_2, meaning that we can already conclude tentatively that a unidirectional relationship from c_t^{GDP} on c_t^{ADV} is present. Yet, the absence of a significant lagged advertising impact in the general model suggests the presence of redundant parameters, and the lagged c_t^{ADV} variables are excluded from the model. In doing so, we find that, as before, a unidirectional relationship from c_t^{GDP} on c_t^{ADV} could be established ($H_2^{'}$: $c_t^{GDP} \neq> c_t^{ADV}$ could be rejected, $\chi^2(1) = 20.41$; p<0.01), and the test procedure ends. As such, our main findings are not sensitive to the specific procedure used to correct for serial correlation in the test equation to derive the nature of the cyclical relationship between aggregate advertising and the business cycle.

4.6.2 Controlling for the structural change in the Dutch advertising industry early 1990

In the past decade, some important changes have taken place in the Dutch advertising industry. Until 1989, the Netherlands had an exclusive public broadcasting system with a limited number of public channels (van de Wurff and van Cuilenburg 2001). In October 1989, the Dutch advertising market was reformed, leading to a number of major discrete events that were found to have an important impact on the demand for advertising in the Netherlands (Kornelis 2002, Table 4.3). The most important events in the (television) market were the introduction of a number of commercial broadcasters (e.g. RTL4), and an extended and more flexible advertising supply offered by the established public channels (Kornelis 2002).

Given that our longitudinal analysis requires long data series, we would have insufficient data to conduct a split sample analysis (see footnote 12). Instead, we will introduce in the Sims model a break dummy variable that will take the value 1 from October 1989 onwards, corresponding to the date of the aforementioned major events, and assess whether our conclusions still hold (see O' Donovan, Rae and Grimes 2000 for a similar approach).

The results from the regression analysis are very comparable. The break dummy in the regression model turns out to be small and insignificant (parameter estimate < 0.01, p=0.90), which indicates that, although the identified major events may significantly influence the aggregate demand for advertising (Kornelis 2002), they do not affect the cyclical relationship between advertising and GDP. When we determine the dynamic nature of the relationship between advertising and GDP, we find again that a feedback relationship is absent, as we cannot reject H_1: $c_t^{ADV} \neq> c_t^{GDP}$ ($\chi^2(1) = 0.01$; p=0.92), and we are unable to reject H_2: $c_t^{GDP} \neq> c_t^{ADV}$ ($\chi^2(1) = 0.13$; p=0.72). Similar to our main analysis, these results permit us to continue with the next stage of the analysis where we determine whether a unidirectional relationship could be established. Once more, we could not find evidence that a unidirectional relationship was present from c_t^{ADV} on c_t^{GDP} ($H_1^{'}$: $c_t^{ADV} \neq> c_t^{GDP}$ cannot be rejected: $\chi^2(1) = 0.08$; p=0.78), while we do find evidence for a unidirectional relation from c_t^{GDP} on c_t^{ADV} ($H_2^{'}$: $c_t^{GDP} \neq> c_t^{ADV}$ can be rejected: $\chi^2(1) = 17.76$; p<0.01).

As before, our final conclusion indicates that a unidirectional cyclical relationship exists from the business cycle on aggregate advertising. Even though these developments in the Dutch advertising industry can be expected to induce major changes in the structural or long-term demand for advertising, it seems that they are less influential for the demand for advertising during contractions vs. expansions, and do not affect their relationship at business-cycle periodicities.

4.7 DISCUSSION

As the economic climate turns sour, millions of consumers tend to defer their planned purchases till their prospects improve. Thus far, advertising has been found repeatedly to encourage firm and industry demand, so that increasing aggregate advertising during contractions could conceivably convince people to resume their spending, thereby stimulating aggregate demand. These considerations have motivated researchers to examine the relationship between aggregate advertising and the business cycle. Still, previous studies did not explicitly consider the *cyclical* relationship, but rather focused on either the long-run or the short-run associations between both variables, that may well be different.

For this purpose, we apply a methodology that is able to determine the *cyclical* relationship between the variables, and we combine this approach with an improved procedure to identify the causal nature of the relationship between aggregate advertising and the business cycle. Our results indicate that advertising is *not* capable to Granger cause business-cycle fluctuations, while we do find an important leading impact from the general economic conditions on the demand for advertising. Moreover, advertising retrenchments caused by economic contractions appear more extensive than the average reduction in GDP itself, as expressed in a cyclical volatility of more than twice the one in GDP, and a dynamic comovement elasticity that is larger than one.

Limitations and further research. This research has several limitations that offer immediate avenues for future research. First, our empirical findings are obtained for one specific country, the Netherlands, and further research should explore whether the same substantive results also hold in other countries. Second, our empirical analysis indicates that the business-cycle fluctuations are responsible for a considerable modification in companies' advertising activities. Given that contractions are associated with temporary changes in the economic environment (Lucas 1977), it is quite surprising to find that companies also modify their long-run marketing strategies, especially since advertising activities should be viewed as a strategic investment which gradually generates sales revenues over time (Dhalla 1978), and that can have a persistent impact on firm performance (Dekimpe and Hanssens 1995). Moreover, the disproportionate advertising reduction during the downturn remains puzzling and we already speculated on some possible explanations for this finding. Obviously, these issues need further research attention.

Third, we studied the relationship between aggregate advertising and a single macro-economic indicator in a bivariate setting. However, one should keep in mind that the empirical detection of causality between two variables is conditional on the composition of the information set. As such, we could also add in an extended model other macro-economic variables (see, for example, Mankiw 1982) or other marketing-mix variables, such as total promotional expenditures. Fourth, to deflate our data, we adopted the general Consumer

Price Index from the Netherlands. Alternatively, one could use the media deflator to better capture the typical price movements in the media industry. Further research is recommended on the implications of using such an industry-specific deflator.

Fifth, our data have some limitations. Although our quarterly data are better than the yearly data employed in many other studies (e.g. Jacobson and Nicosia 1981; Seldon and Jung 1995), we believe that we could benefit from more disaggregate data, such as monthly data, that allows us to capture dynamic effects taking place within a quarter. In addition, an even longer time series would have been desirable for the following two reasons: (i) the cyclical behavior of economic variables can only be detected in time series that span multiple business cycles, and (ii) our methodological approach 'consumes' many observations, initially in the extraction of the business-cycle component from the series, and subsequently in the estimation of the various leads and lags in the models. Sixth, the present analyses reveal how aggregate advertising and the economy relate over the business cycle, but as pointed out in Section 4.1, this relationship does not necessarily hold across all periodicities. We did not yet explicitly consider the nature of the relationship between advertising and the economy in the short run (< 6 quarters) or long-run (> 32 quarters). Further research is needed to find out to what extent these relations differ from the relationship over the business cycle.

Finally, it is possible to extend the present analysis, and look for the business-cycle relationship across individual media. In doing so, one can examine how advertising media compete over the business cycle. Silk, Klein and Berndt (2001b) find that most advertising media are weak substitutes, but they focused on the short-run competitive interactions between them. However, it is useful to assess whether these competitive dynamics change during economic up- or downturns.

SUMMARY AND CONCLUSIONS

Managers recognize an increasing level of uncertainty or turbulence in their environment (Thomas 1996). These developments pose new organizational challenges and require accommodating managerial skills. In the strategic literature, researchers generally characterize an industry's and firm's environment according to three key dimensions (i) organizational munificence (capacity), (ii) complexity, and (iii) uncertainty (turbulence) (Dess and Beard 1984). Yet, among these dimensions, Anderson and Tushman (2001) pointed out that uncertainty or turbulence is the only environmental dimension associated with organizational mortality, and higher levels of uncertainty are significantly related to an increasing level of firm exit. Therefore, increasing levels of environmental turbulence create more dangerous economic conditions that necessitate closer managerial scrutiny.

Turbulence is, by definition, irregular and erratic (Drucker 1980). As such, managers cannot automatically assume that tomorrow will be an extension of today. On the contrary, they must identify changes, respond quickly, and exploit the opportunities and threats posed by these changes. Yet, even though managers feel a strong need to modify their marketing tactics and strategies under changing market conditions, they are often at a loss on how to adequately assess the impact of a certain event on their business, and even more on how to properly respond.

In general, the marketing discipline has often assumed a high degree of continuity and stability and, as a consequence, seems to offer only little guidance in case companies are confronted with periods of substantial turbulence, i.e. in periods characterized by important environmental and/or organizational changes.

In this dissertation, we attempted to contribute to the discussion on *marketing in turbulent times* in three different ways:

- First, we provided a framework to describe uncertain environments according to three separate 'turbulence' dimensions, related to (i) the nature of the outcome (i.e. short-run vs. long-run outcome); (ii) the nature of the input shock (i.e. regular vs. irregular events); and (iii) the scope of the output reaction (i.e. limited to one industry vs. affecting multiple industries). This framework can be helpful when addressing marketing problems characterized by various types of market(ing) change.

- Second, we showed how a number of recent time-series developments can be used to operationalize the aforementioned turbulence dimensions, and thus, to approach marketing problems with varying degrees of market turbulence. These techniques are persistence modelling, structural-break unit-root analysis, and cyclical filtering that allows to subsequently derive estimates of cyclical volatility, various asymmetry statistics, and cyclical comovement elasticity.
- Third, we presented three marketing illustrations of turbulent environments that can be characterized by a varying level of market turbulence. In these essays, the proposed time-series techniques were used to assess the impact of a certain marketing or environmental change on relevant performance and/or marketing support variables. In so doing, each of these essays provided us with novel insights into the substantial marketing problem that was studied.

In what follows, we briefly summarize the key substantive findings that were obtained in each of these empirical essays (Chapters 2-4).

ESSAY 1:

How Cannibalistic is the Internet Channel? A study of the Newspaper Industry in the United Kingdom and the Netherlands.

In the early stages of the Internet, retailers often refrained from extending their activities online, as they feared that their Internet operations would harm the established offline activities. The introduction of an Internet channel by a company is an example of a high-technology development that represents a major, infrequent, input shock with the potential to fundamentally change the long-run outcome of the firms. Due to the exceptional nature of the event, many managers were concerned about the influence on their companies' established operations. Yet, we find that in the newspaper industry, online editions do not significantly cannibalize the sales obtained by the print version, nor does it induce the advertisers of the paper edition to redirect their activities towards the online medium. Specifically, for the 85 newspapers that were studied, only 10 of them experienced a significant drop in their long-run circulation or advertising revenue pattern. These findings extend the conclusions from Biyalogorsky and Naik (2003), who could not find any *immediate* negative influence in established retail sales from the addition of an online channel.

The results imply that there is only little overlap between customers using, respectively, the traditional and the online channel. Similarly, online advertisers appear dissimilar to the advertisers of the print edition. Still, one note of caution deserves further attention. We find that if the online channel is positioned as too close a copy of the traditional offline channel, cannibalization is more likely to harm the established offline revenues.

In sum, even though the introduction of an online channel represents a major change in the companies' operations, we find that it does not necessarily harm their current performance in a fundamental or persistent way.

ESSAY 2:

Weathering Tight Economic Times: The Sales Evolution of Consumer Durables over the Business Cycle.

Business-cycle fluctuations are responsible for an important decline in general consumer demand, and trigger considerable strategic changes on the part of the company. Decreasing consumption is expected to be especially pronounced in the demand for durable goods, because consumers find it less easy to cut back on their expenditures of more indispensable consumption such as basic food and household products, or fixed outlays on rent. In addition, expenditures on durables are often outlays of choice, and there is no pressing reason to buy them at one particular point in time; as such, their acquisition is more easily postponed until economic prospects improve. In light of the wide scope and scale of the impact from economic contractions on multiple industries, it remains surprising to find only very limited research on marketing in contraction periods.

In the second essay, we studied the impact of business-cycle fluctuations on the sales patterns of 24 consumer durables, and found that these durables are much more sensitive to business cycles than the general economic activity. This contention was supported by two cyclical sensitivity statistics, which indicated, respectively, that durable sales have (i) an average cyclical volatility of four times the one in GDP, and (ii) an average comovement elasticity in excess of two, meaning that every percentage decrease in GDP translates into a drop in durable sales of, on average, more than 2%. In addition, business-cycle fluctuations in durable sales patterns are characterized by asymmetric steepness, meaning that consumers cut back very fast on their expenditures on durables during the contraction, while it takes a lot longer before they resume their regular purchasing patterns when the economy recovers.

When we further analysed potential reasons for the substantial vulnerability of durable sales to business-cycle fluctuations, we found that companies' pricing activities tend to amplify the cyclical sensitivity in durable sales patterns. Apparently, durable prices significantly increase during economic contractions when demand is weak, thereby increasing their sensitivity to business-cycle fluctuations. In addition, more flexible price adjustments decrease cyclical sensitivity. Another factor that is related to the extent of cyclical sensitivity is the nature of the durable, as convenience goods were found to be less sensitive to cyclical fluctuations than "leisure" durables. Finally, later stages in the product life cycle, where a larger portion of total sales is derived from replacement purchases, were found to be associated with less pronounced business-cycle fluctuations.

ESSAY 3:

Advertising and the Macro-Economy: Have we Missed the Business-Cycle Relationship?

In this essay, we examined how aggregate advertising and the economy relate over the business cycle. The nature of this relationship concerns policy makers and regulators, as they have an intrinsic interest in factors that can influence aggregate business-cycle fluctuations, and that can be exploited to control severe downswings in the general economic activity.

In marketing, the demand-stimulating effect of advertising activities is mostly assessed within one industry (Leeflang and Reuyl 1985). In this study, we assessed whether advertising can also have an important leading influence on cyclical fluctuations in other industries (wider scope), as reflected in the business-cycle fluctuations of the aggregate economic activity. Our results indicate that aggregate advertising does not Granger cause cyclical fluctuations in the economy, while we did found an important leading influence from aggregate economic fluctuations on the demand for advertising.

Specifically, cyclical volatility in aggregate advertising induced by economic contractions and expansions is found to be more than twice as large as the cyclical volatility in GDP. Moreover, a reduction in GDP of 1% induced a decline in the demand for advertising of more than 1% in the coming periods. The latter was supported by a dynamic comovement elasticity larger than one.

In sum, due to the growing level of turbulence that we notice in the present business environment, the high degree of continuity or stability often assumed in previous research has become increasingly untenable. Unfortunately, knowledge on marketing issues in turbulent environments is scarce, and more marketing research in this area is called for. We believe that with the present work, we have added to this discussion by (i) introducing a framework for characterizing turbulent markets, (ii) offering appropriate tools to study such environments, and (iii) providing a number of substantive research results on three important marketing problems.

Limitations and areas for further research

Even though we offered new insights that (we feel) contributed to current marketing knowledge, many issues still remain unexplored. This work should therefore be considered the onset of additional research on marketing in turbulent environments. To end our discussion, we would like to highlight some of the limitations of our work, together with a few ideas for future research.

Note that, at the end of every empirical study, we already pointed out a number of limitations, as well as some areas for further research. We refer to these sections for a more detailed discussion on the specific limitations that apply to each of the empirical essays.

First, in the three-dimensional framework that we introduced, we made abstraction of potential interrelations between the dimensions (see Dess and Beard 1984 for a similar approach). As indicated before, these dimensions need not necessarily be orthogonal, and further research is recommended to study whether and to what extent there exist relations between the input, output and scope dimensions that characterize the level of turbulence in the market.

Second, in our turbulence frame, we distinguished two types of input shocks, (i) smaller, frequently occurring, regular shocks, and (ii) large, unique, exceptional events. Even though we recognized that some events may have properties of both extremes, the structural-break method introduced in Essay 1 was able to account for only one major event. Some recent advances on structural-break analysis, however, make it possible to simultaneously allow for multiple breaks in the series (Ben-David and Papell 2000), and are therefore appropriate to assess the impact of events that are still quite exceptional, but not necessarily unique.

Third, in Essay 1, we assessed the impact of the introduction of an Internet channel on the revenues of one particular industry, the newspaper industry. Yet, the emergence of the

Internet is expected to affect many other industries as well. As such, within the context of our turbulence framework, one might consider the impact of this technological discontinuity on multiple industries together, thereby assessing the potential widespread scope of its effect. Similarly, in Essay 2, we examine the impact of business-cycle fluctuations on a number of durable goods industries. Because economic contractions are characterized by a widespread decline in the output of multiple industries together, more research is called for to further explore how an aggregate decline will manifest itself in other industries.

Fourth, it is interesting to note that in Essay 2, we found evidence of asymmetries in sales patterns, while we could not find any asymmetric deepness or steepness in the demand for advertising in Essay 3. This seems to suggest that asymmetries in performance are induced by other factors than advertising. However, one should keep in mind the different aggregation level in both studies (i.e. category level sales in Essay 2 vs. aggregate advertising spending in Essay 3). Still, it would be worthwhile to investigate whether this difference persists if we would analyse advertising expenditures at the corresponding, more disaggregate, industry level. Moreover, in Essay 2 we offered various possible explanations why these asymmetries might arise, and more research is called for to investigate the relative contribution of each of these explanations.

Fifth, thus far, we employed a number of time-series techniques to approach different levels of turbulence in these marketing problems. Without any doubt, these techniques are not the only instruments to study the respective marketing problems. Specifically, analysing these marketing issues with alternative research techniques may contribute to the development of a broader knowledge on the topic, add to the reliability of the research findings, and contribute to the emergence of empirical generalizations on each of these substantive marketing problems.

Finally, in this work, we used three empirical illustrations of marketing problems where an important event had the potential to change the market in a major way. Thus far, we focused on the influence business cycles have in the durable-goods industry and the advertising industry. However, business-cycle fluctuations in other industries may have some peculiar features as well (see e.g. the health care industry, Devlin and Hansen 2001), while research evidence in this area is still very scarce. Obviously, many more substantial events (have) occur(red) in the business environment from which the impact is still unclear. Using our conceptual framework, marketing knowledge appears to be especially scarce on events that can be characterized according to the second dimension, i.e. where the nature of the input shock is quite unique, and the third dimension, i.e. where the scope of the output reaction is broader than one specific industry. Therefore, it would be interesting to extend the marketing field with more research on these types of 'turbulent' events. One relevant area to study is the increasing success of hard discounters, which appears to be *the* key source of turbulence to many managers in the FPCG sector. General economic conditions have been argued to be an important driver of their growing success (Estelami, Lehmann and Holden 2001; Hoch and Banerji 1993), even though clear research evidence on their role is still lacking. Our approach would be well suited to assess whether and to what extent this is indeed the case

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APPENDIX A – Measurement of moderators

Industry price reaction. The price reactions assessed in this study relate to price reactions induced by business-cycle fluctuations. As such, we use the same filtering procedure adopted in Section 3.3 to extract only those price movements that can be related to business cycles. A similar approach to assess the behavior of prices at business-cycle frequencies was adopted by Backus and Kehoe (1992) and Rotemberg and Woodford (1999), among others.

Industry price volatility. Industry price volatility represents the flexibility in durable price adjustments over time. Because price flexibility refers to a company's ability to change prices quickly, we follow Van de Gucht, Dekimpe and Kwok (1996), and capture short-run price variability by the standard deviation of the first difference in real, over-time prices. To control for the differences in absolute price levels, price volatility is derived on log-transformed data. The mean price volatility among the 24 durables is 0.08, ranging between 0.04 (dishwashers) and 0.20 (calculators).

Expensiveness. The expensiveness of a durable is expressed as a percentage of the average annual household income. Following the procedure advocated in Parker (1992), we derive the average annual income of US families by dividing real US GNP by the total number of families in the nation (as published by the US Census Bureau; www.census.gov). Next, deflated durable unit prices were divided by this average annual family income. This yearly value is subsequently averaged over the life cycle of the product. The mean value ranged from 0.05% (corn popper) to 1.94% (refrigerators), with an average across all 24 durables of 0.83%.

Type of product. A dummy variable is used to capture the distinction between time-saving convenience goods on the one hand, and 'amusement-enhancing' or leisure goods on the other hand. The dummy variable takes the value of 1 if the durable is classified as a convenience good, and 0 if it is a leisure good. For the 24 durables considered, two of them are classified as leisure goods: black & white TVs and color TVs (see also Horsky 1990).

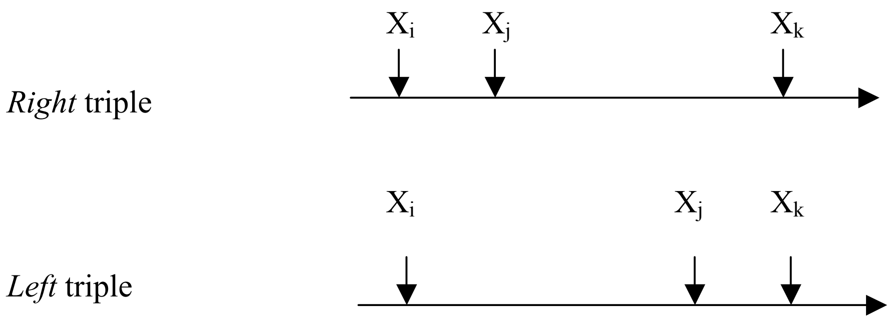
State of the economy during launch. The phase of launch is coded as a dummy variable, taking the value of 1 if the durable's introduction took place during a contraction, and 0 if the introduction took place during an expansion. To determine its value, we compare the durable's launch year, as published in Parker (1992), with the contraction dates proposed by the NBER dating committee (www.nber.org/cycles.html). Some missing launch years are obtained from Agarwal and Bayus (2002) and Golder and Tellis (1997), although for 4 durables (corn poppers, electric knives, hair setters and trash compactors) we could not trace their initial launch year. Any launch year where at least six months are located in a US contraction period (according to the NBER), is considered a *contraction* launch year, else the introduction year is classified as an expansion launch year. Six durables (blenders, built-in ranges, clothes dryers, electric washers, refrigerators, and vacuum cleaners) were introduced during an economic contraction, while the 18 others were introduced during an expansion. This observation is consistent with Devinney (1990), who showed that the number of new product introductions varies systematically over the business cycle, with relatively fewer introductions during unfavorable economic times.

Importance of replacement buying. During later stages in the product life cycle, replacement purchases make up a larger portion of existing sales (Bayus 1988; Steffens 2001). We separate among phases with relatively more first vs. replacement purchases through the durable's phase in the product life cycle, and distinguish between 2 stages, early vs. late (cf. Clark et al. 1984). Specifically, we create a dummy variable to separate both (0 in the early stage, and 1 during the later stage), where the early stage in the durables' life cycle is defined as the first half of the sample period, the later stage is represented by the second half.

APPENDIX B – Non parametric triples test

The parametric skewness-based test proposed by Sichel (1993) has been criticized for having only low power to reject the null hypothesis of symmetry, while being sensitive to outliers (Verbrugge 1997; Razzak 2001). Therefore, a non-parametric triples test, first developed by Randles et al. (1980), and introduced in the economics literature by Verbrugge (1997), has been suggested as an alternative, more powerful test to derive cyclical asymmetry (Verbrugge 1997; Razzak 2001).

A triple of observations (X_i, X_j, X_k) forms a right triple (i.e. is skewed to the right) if the middle observation (X_j) is closer to the smallest observation (X_i) than to the largest observation (X_k). Conversely, a left triple (skewed to the left) is one where the middle observation (X_j) is closer to the larger observation (X_k) than to the smaller observation (X_i). Both triple types are graphically illustrated in the figure below:



This distinction if formalized through the following function:

$$f^*(X_i, X_j, X_k) = \frac{\left[sign(X_i + X_j - 2X_k) + sign(X_i + X_k - 2X_j) + sign(X_j + X_k - 2X_i) \right]}{3} \qquad \text{(B1)}$$

which can be shown to take on the value of 1/3 in case of a right triple, -1/3 in case of a left triple, and 0 in case of a symmetric triple.

To formally test for symmetry in business cycles, one should consider all possible triples from the sample (a sample of size T has $\binom{T}{3}$ combinations), and determine whether most of the triples are right or left skewed. Applying (B1) to all triples, the following (relative) statistic is obtained:

$$\hat{\eta} = \binom{T}{3}^{-1} \sum_{i<j<k} f^*(X_i, X_j, X_k) \tag{B2}$$

which can be shown to equal:

$$\hat{\eta} = \left[(number\ of\ right\ triples) - (number\ of\ left\ triples)\right] \Big/ 3\binom{T}{3} \tag{B3}$$

Obviously, if there are more (less) right triples than left triples, the value for η will be positive (negative), while η will be zero in case of a perfect symmetric distribution. To test $\eta = 0$ against the alternative $\eta < 0$, one uses the following test statistic:

$$\frac{\hat{\eta}}{\sqrt{\hat{\sigma}_\eta^2 / T}} \tag{B4}$$

which can be shown to have a limiting N(0,1) distribution. We refer to the study of Randles et al. (1980) for both a more elaborate discussion/description of the methodology, and for the derivation of $\hat{\sigma}_\eta^2$.

Doctoral dissertations from the Faculty of Economic and Applied Economic Sciences

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