EUROPEAN UNIVERSITY INSTITUTE
Department of Economics

Exchange Rates, Export Pricing and the Frequency of Price Adjustment

An Analysis of Newsstand Prices of Magazines

Alfredo Huertas-Rubio

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"Maynard had prudently arranged with Geoffrey Scott to have a time working alone together at Siena. They then proceeded to stay with the Berensons at Settignano near Florence, where there was a large party of young ladies.

J. M. Keynes to G. Lytton Strachey, 15th April 1906

I've no news unless I describe our way of life. I seem to have fallen in love with Ray a little bit. (...) The comfort here is of course incredible; the cypresses and sun and moon and the amazing gardens and villas in which we picnic every day high above Florence have reduced me to a lump of Italian idleness.

We go to bed later and later and gradually find methods of working fresh meals into the day. Last night it was nearly five before we retired."

R.F. Harrod, *The Life of John Maynard Keynes*. Chapter III: In Quest of a Way of Life, p. 118. London: Macmillan, 1951.

Preface

After much theoretical study, economists have recently switched their interest to the empirical analysis of product markets. This empirical "renaissance" in industrial economics, as was pointed out by Breshnaham and Schmalensee (1987) and Kirman and Phlips (1993), has been made possible by, on one hand, advances in economic theory in the 1980s, which provided sound theoretical foundations, and on the other, by the development of more sophisticated empirical techniques which eased the quantitative analysis of the data, as well as the availability of new and better datasets.

The present dissertation belongs to this new stream of industrial economics, and studies one of those issues which have received both theoretical and empirical attention, namely the transmission of nominal exchange rate fluctuations to import and export prices, also known as *pass-through* from exchange rate changes into prices. Primarily focused on the link between these two variables at aggregate level, this thesis concentrates on the microeconomic aspects of this relationship at firm level, giving more attention to the empirical tests of the explanations in use. These two aspects notwithstanding, it was surely the search of data, needed to produce an empirical work at firm level, which greatly influenced the final direction of this work. At this level of disaggregation, data was not easily available. Nonetheless, Alan Kirman's suggestion, of the possibility of studying the price behaviour of *The Economist* newspaper across countries, decisively pushed this investigation ahead, and was proved to be, as is shown later, a good one.

To this end, a dataset of newsstand prices of nine magazines sold in a number of markets was constructed. At that time, since no other example with the same data existed in the literature, special attention was given to the accuracy of the computations, because comparisons with other analyses were not possible.[1] Then, after some primary concepts on the issue had been assumed, newsstand prices of magazines were used to show what actually happened, clearly and simply. The multimarket nature of the price series, and the fact that, for some markets, prices were reported for several producers, raised some conjectures about the synchronization and size of price adjustments of a multimarket seller across destinations, and the strategic interactions of some firms when operating in the same market.

Since economic thought should to be receptive to new experiments and techniques, this preliminary observation of the data allowed further progress in the theoretical and empirical investigation of the relationship between export prices and exchange rate changes. For example, the extraordinary rigidity of newsstand prices evidenced the fact that, in the event of exchange rate fluctuations, price adjustments take time, or that appreciations and depreciations could yield asymmetric price responses; price rigidity also undermined the application of standard estimation techniques, and switched attention to new methods; furthermore, the small variations of exchange rates in the *EMS* suggested that prices could be irresponsive to these changes. Therefore, without constructing an *ad hoc* model for newsstand prices of magazines, this dissertation largely benefited from previous empirical evidence in both the design of a theoretical framework and the pursuit of a research methodology.

Although the purpose of this dissertation was to study the *pass-through* of exchange rate changes into prices and other related topics, it was not possible to elude some reference to the characterization of the newspaper business. This is a complex industry, where many newspapers owned by the same media group apparently compete against each other. Furthermore, newspapers' earnings come not only from newssstand prices, but also from *advertising* and *subscription rates*, which are important variables in understanding the behaviour of cover prices, as is shown in this dissertation. Nonetheless, since attempts to collect this data were time-consuming and hardly successful, these features could not be incorporated into the analysis of the *pass-through* of exchange rate changes into newsstand prices. Hence, this possibility remains for further development of the theme.

This dissertation is divided in four chapters. Chapter 1, ***Exchange Rate Pass-Through and Traded Goods Prices: A Critical Review***, starts by analyzing the scope of the *Law of One Price*, and reviews a number of theories that relate exchange rate fluctuations with traded good prices. The theories are categorized by the hypothesis they test, placing special emphasis on integrating these explanations into a compact form. Finally, this first chapter organizes the empirical work by the different hypotheses tested, stressing the type and dimensions of the data, the period and the markets involved in these tests.

[1] Later, Ghosh and Wolf (1994) published their study on newsstand prices of *The Economist*.

Chapter 2. *Pricing of Exports and the Cost of Price Adjustment*, presents a model of export price adjustment. The exchange rate is assumed to follow a geometric. *Brownian Motion* stochastic process, which permits us to distinguish between mean and variance fluctuations of the exchange rate. Given the existence of costs of price adjustment, it becomes optimal for the exporter to allow the exchange rate to oscillate between two boundaries, so that they only adjust prices when the exchange rate hits one of these boundaries. Therefore, the model provides some room for sluggish price responses, which permits a distinction between *ex-ante* and *ex-post* price discrimination, when exchange rate changes are passed-through into prices.

Chapters 3 and 4 cover the empirical analysis of newsstand prices of magazines. Chapter 3, *Interview Study on Newsstand Prices of Magazines*, following some recent studies which ask individuals directly about their own actions and opinions of how events actually occur (see Kahneman *et al.* [1986] and Blinder [1993]), shows the results from an interview study of thirty publishers' opinions on pricing issues, such as price stickiness, lags for reactions to economic environment changes, valuation of current pricing theories and exchange rate changes. Most publishers admitted to pursuing infrequent price adjustments, while there was not a clear preference between frequent and small changes in size, and infrequent but large adjustments. Furthermore, *cost-based pricing* and *strategic pricing* theories were largely supported, while the existence of costs of price adjustment, which had received a lot of attention from theorists in recent years, was only considered as moderately important for half of the respondents. Finally, concerning multimarket pricing strategies, publishers recognized each market as independent, which may account for *Pricing-to-Market* across different destinations.

Chapter 4, *A Panel Study of Newsstand Prices of Magazines*, studies the newsstand price series of nine magazines in a number of markets, at two different stages.

1. Following earlier empirical studies of nominal price rigidities, the distribution of the duration and size of price adjustments is characterized across magazines and markets. Then, using a Discrete Dependent Variables method, the setup in Chapter 2 is tested for the case of a closed economy, where inflation, instead of exchange rates, is assumed to follow a geometric *Brownian Motion* stochastic process. At this point, special attention is devoted to explaining the application of this technique to the price adjustment problem and to the arrangement of the dataset for estimation. Some salient results suggest that cumulative rather than current values of covariates explain price adjustments better, and, more importantly, that the boundaries which determine price inaction are not steady and vary across time.

2. In the second stage, some emphasis was placed on how the characteristics of the series (invoicing currency, retail or wholesale prices, level of disaggregation) impose some restrictions on what can be inferred from the data and the econometric implementation adopted. In fact, the price rigidity of the current series gave rise to serious statistical difficulties, which did not allow correct inferences as to the value of the exchange rate pass-through. Nonetheless, these analyses showed some evidence of the incompleteness

of this elasticity, of the existence of import-currency price stabilization, asymmetric pass-through between appreciations and depreciations, and price discrimination across markets not always based on differences in pass-through elasticities among countries. Finally, the same Discrete Dependent Variables experiment was performed for the model of export pricing from Chapter 2. Interestingly, while the dynamics addressed for the closed economy experiment appear to be robust to the introduction of new variables, the motion of inflation in each country proved to be a better indicator of the price adjustment timing than the exchange rate fluctuations, which confirmed import-currency price stabilization and incomplete pass-through.

The dissertation finishes with some stylized conclusions, and suggestions for future developments and research.

London, 1 june 1996.

Chapter 1

Exchange Rate Pass-through and Traded Goods Prices: A Critical Review

" The role of monopolistic and imperfect competition in actual international trade is crucial, may transcend in importance mere transport costs, narrowly defined, and ... needs extensive further examination." P.A. Samuelson, 1952. The Transfer Problem and Transport Costs: the Terms of Trade when Impedements are Absent. *The Economic Journal 62*: pp. 292.

1.1 Introduction

More than two centuries ago, Adam Smith observed that foreign trade was more uncertain than domestic trade. Though today this is less the case, owing to the development of communications, this observation is still valid since foreign trade is subject to the discretional nature of governmental intervention more than domestic trade, and more information is required when different currencies, tax systems, laws and customs are involved in each transaction. Hence, when international trade economists, but not traders and businessmen, have not properly taken into account these factors, economic theory has been proved to yield incomplete answers to some events. This fact has fostered a more deeply investigation of how these factors determine some fundamental events in international trade.

This dissertation deals with one of these events: the **transmission of nominal exchange rates changes to import and export prices, either directly as a major issue in understanding competition in international trade, or as part of a discussion of how exchange rates might affect the trade balance.**

This interaction between exchange rates and prices has has been studied both from the macro and microeconomic perspectives. At a **macroeconomic level**, authors as Branson (1973), Clark (1974), Magee (1973), Kreinin (1977), Spitaller (1980), Cushman (1983), Woo (1984), Baldwin and Krugman (1987), Hooper and Mann (1987), Helkie and Hooper (1987,1989), and Moffet (1989) have examined how the often-told tale of trade balance deterioration and then improvement -the *J*-shaped adjustment path- has not been typically experienced in some economies, namely in the US. To some extent, these studies have undermined the traditional relationship between nominal exchange rates and trade as an important piece of the macroeconomic theory and economic policy, based on the *Purchasing Power Parity* theory. This approach would predict that a depreciation of the domestic currency would imply an increase in exports, a decrease in export prices, a decrease in imports and an increase in import prices, improving the balance of trade, and vice versa for an appreciation. However, the timing and the magnitude of the changes in prices or quantities sold have had different outcomes from those Therefore, macroeconomists turned their attention to the study of this relationship with the purpose of improving the understanding of open economies.

In recent times, the large swings of the US dollar in the 1980s revived the debate not only on the macroeconomic consequences of the less-than-complete transmission of exchange rate changes into prices, but also on the adjustment mechanism itself. At **microeconomic level**, industrial economists have studied the link between exchange rates and prices in order to characterize all the possible competitive scenarios that may explain all different responses of prices to changes in the exchange rate, opening a branch in the economic literature known today as *Pass-through from Exchange Rate Changes into Prices*.[1] Since there has not been found a unique and obvious answer to the diverse relationships between exchange rates and prices, theories have tried mainly to find in the market structures (the goods' and demand's characteristics, and the strategic relationships between firms) an answer of why exchange rate changes have not been fully transmitted into prices. Therefore, these new studies could be ascribed to the new stream of international trade thought which introduces some sort of imperfect competition into the analyses as an essential ingredient, for instance, Helpman and Krugman (1985).

This chapter summarizes the most important models of the exchange rate 'pass-through' issue in both their theoretical and empirical dimensions, and offers a critical view of some concepts and ideas developed around this theme. The chapter is organized as follows: Section 1.2 analyzes the paradigm of the *Law of One Price* equilibrium is analyzed, showing that imperfect competition and product differentiation may prevent the *LOP* from holding. Section 1.3 provides a basic formal definition of the exchange rate pass-through and Section 1.4 summarizes a number of factors that explain departures from the full exchange rate pass-through. Section 1.5 reviews some of the current theories build around these factors, and Section 1.6 organizes the

[1]The term 'pass-through' must be qualified by the variables that are supposed to be related. Therefore, it is important to specify which kind of exchange rate this pass-through actually is, namely, whether into prices, quantities, profits, inputs,...

empirical estimation of the pass-through by the hypotheses tested. The chapter finishes with some concluding remarks.

1.2 An Evaluation of the Meaning of the 'Law of One Price' and its Applicability to Comparisons of Traded Good Prices

1.2.1 The Classical Approach

There exist two basic ways of understanding the relationship between exchange rates and prices in the open economy literature, namely **Classical** and **Keynesian.** The **Classical** one assumes that the equalization of prices of an identical product in geographically separated markets is a fundamental implication of trade theory, what is called the *Law of One Price*, henceforth *LOP*. The *LOP* simply reflects the idea of *arbitrage* on sale prices of a good or a commodity sold in different locations. Homogeneity of the goods, information and perfect competition are necessary for this hypothesis to be satisfied. Algebraically, the *LOP* can be stated as follows. Let $j = 1...J$ represents the number of markets where a particular good is sold. Let the good be produced in market 1, and sold in J markets. Then, the *LOP* simply says that, at any time $t = 1...T$, it holds that

$$P_{11t} = T_{12,t}\ S_{12,t}\ P_{12,t} = T_{13,t}\ S_{13,t}\ P_{13,t} = .. = T_{1j,t}\ S_{1j,t}\ P_{1j,t}. \qquad (1.1)$$

where $P_{11t}, P_{12,t}, P_{13,t}, ..., P_{1j,t}$ are the prices of the good produced in market 1 and sold in markets $j = 1...J$, respectively, expressed in each market's currency units, $S_{12,t}, S_{13,t}, ..., S_{1j,t}$ are the nominal exchange rates, defined as the number of units of market 1's currency per unit of each of the markets $j = 1...J$ currencies and, $T_{12,t}, T_{13,t}, ..., T_{1j,t}$ represent transport, tariffs and transaction costs of trade between the two respective markets.

Like the *Purchasing Power Parity* theory for price levels across countries, the *LOP* is an equilibrium condition. However, given the prices of a good in several markets, the rates implied by the *LOP* for an individual good cannot be interpreted as 'equilibrium rates' towards which actual rates tend to move. Indeed, for individual goods, exchange rates implied by the *LOP* are likely to adjust more to actual rates than the reverse.

Despite the fact that the explicit form of the *LOP* in equation (1.1) may seem innocuous and quite reasonable, it is very interesting to go through the particular assumptions that it relies upon, and therefore, to understand when and how the *LOP* is expected to hold. In fact, when price differentials become too large, or persist for long periods of time to be explained solely by transportation costs or trade taxes as in the expression (1.1), some facts directly related with the applicability of the *LOP* need to be considered:

- **Existence of Organized Markets.** First of all, standard tests of the *LOP* should have been exclusively applied to prices of *commodities or goods traded in organized markets*, because the efficiency in these markets could approximate that of the exchange markets. This extreme has been strongly stressed by authors such as Protopapadakis and Stoll (1983,1986), and Bui and Pippenger (1990), who have called attention to poor tests of the *LOP* when the data used does not correspond to these characteristics.[2] Therefore, an efficient and organized goods markets becomes an essential condition for full satisfaction of the *LOP*, that is, that *arbitrage can really occur.* Other than the market characteristic of the good, the possibilities of arbitrage come mostly linked to legal and technical reasons that have to be known to avoid misleading conclusions from any empirical analysis of the *LOP*. Thus, the *LOP* becomes an equilibrium condition between exchange rates and prices that will be satisfied *if arbitrage could always happen, and no forces could prevent it, and the good were traded in well organized markets* (see Aizenman [1984,1986]).

As a result, the *LOP* has received empirically stronger support for traded goods than for non-traded (see Officer [1986]), and for homogeneous goods rather than differentiated (see Thursby *et al.* [1986]).

Therefore, given that arbitrage can take place, if the *LOP* still does not hold, three further refinements are possible enumerate in order to test the relevance of claiming the *LOP*:

- **Lags and Timing.** Goodwin *et al.* (1990) point out that since trade takes time, the model in (1.1) has to be specified in terms of expected prices rather than contemporaneous prices.

- **Simultaneity bias.** A commonly stressed drawback to the standard approach shown in equation (1.1) is that, while exchange rates can often be assumed to be exogenous to a concrete good price, regression tests of the form given by (1.1) necessarily require that one of the good prices be taken as exogenous. However, prices of some commodities in two trading countries are simultaneously determined regardless of the relative sizes of the countries, because information is shared across markets and because agents operate in more than one market at a time. This simultaneity bias and the lags in trade have been reconsidered by establishing an *ad hoc* direction of trade in the analysis of the *LOP*: Indeed, the standard formulation of the *LOP* above, implicitly referred to the existence of a home and a foreign country. If it is further supposed that the home country is primarily an exporter and the foreign country an importer, it can be assumed that exporters respond to their expectations of prices at the time of delivery in the foreign market, and that this, in turn, influences the price of the good in the domestic market. The result is a new parity relationship between current domestic prices and expected future foreign prices.

- **Uncertainty.** Finally, as Blejer and Hillman (1982) suggest, the more unexpected (and hence uneven) the rate of inflation, the greater the difficulty in discerning, from a given structure

[2] These authors criticize the usage of CPIs and WPIs for testing the *PPP*. Instead, they propose to employ prices of goods sold in organized markets, and underline the fact that indexes such as CPIs measure the movement of retail prices whose fluctuations are poorly related with the variance of exchange rates and prices of commodities. WPIs, as Stigler and Kindahl (1970) point out, 'are dominated by posted or published prices that do not reflect actual transactions and, as a result, they seriously underestimate short-run variability in prices. Even when WPIs reflect actual transactions, they often are not determined in highly organized markets like the exchange market'.

of relative prices, the commodity-arbitrage opportunities which may be expected to persist, and those transient opportunities which do not warrant a firm's incurring the fixed costs of arbitrage. This argument simply states that the possibility of arbitrage depends also on the arbitragers' expectations on the exchange rate, its actual volatility, and other costs associated with discovering and taking advantage of price differentials.

Then, summarizing, the comparison of traded good prices when the *LOP* is supposed to hold is subject to the following characteristics:

1. The degree of the goods' homogeneity;
2. The existence of organized and efficient markets;
3. Some sort of intertemporal price linkages;
4. The feasibility of arbitrage between markets;
5. The size of the transaction costs involved and the exchange rate expectations that can make profitable such 'sunk-arbitrage costs'.

Therefore, it would not be very precise to speak about the *LOP* and the prices of *Audi* cars or *The Economist* magazine across markets, however it is more appropriate to do it with the price of coffee or coal, for example.

1.2.2 The Keynesian Approach

As shown above, the **Classical** understanding of the relationship between prices and exchange rates is seriously restricted by a set of conditions that impede a further knowledge of the relationships of prices other than those typically related with the *LOP*. Thus, the alternative **Keynesian** explanation revisited the implications of equation (1.1) and exploited one of the criticisms quoted above, 'that each country is fully specialized in the production of *its own good*, so domestic and foreign products are less than fully homogeneous or substitutable'. Therefore, the new formulation of the relationship between exchange rates and prices would looked like this:

$$S_r = \frac{P_1}{S_{12}P_2}, \tag{1.2}$$

where P_1 and P_2 are the GDP deflators in market 1 and 2, respectively, and S_r is the *relative price of market 1's and market 2's goods*, or *the real exchange rate*. What this alternative explanation proposes is that if the markup of prices over unit labor costs is constant, and wages are fixed, or at least sticky, in markets' currencies, then prices will also be given. Thus, exchange rate movements would change relative prices *one-for-one*. The notable gain of this formulation is that it describes better what happens with manufactures, since exchange rate-induced changes in the relative price affect the world distribution of demand and employment, despite the fact that the assumption of a constant markup will be no longer justified, as is shown below, when domestic and foreign firms have strategic interactions, cost effects across markets and face exchange rate uncertainty.[3]

Therefore, it seems clear now that for the case studied in this dissertation, newsstand prices of magazines sold in several countries, the *LOP* does not seem to be a very sensitive equilibrium condition: here, producers decide the retail prices in each market (simultaneously or not), so these prices are not a result of an auction mechanism; there is not an organized market for them; magazines are not fully substitutable; these goods are perishable and any possibility of a successful speculation is hindered, such that arbitrage possibilities will be precluded; and finally, these prices are commonly rigid, which strongly contrast with the volatility of exchange rates, where prices vary *moment-to-moment* in response to fluctuations in supply and demand.

As a conclusion, it may be said that the state of the world has made interesting the study of factors which influence decisively the relationship between prices and exchange rates, other than the one implied by the *LOP*. This interest is not only relevant for industrialists but also for macroeconomists, since the knowledge of the precise mechanism of price adjustment helps greatly to understand the *Purchasing Power Parity* theory of exchange rate determination, and any sort of open-economy link. Therefore, the rest of the chapter summarizes and reviews the most salient factors to be taken into account when exchange rates and goods prices are jointly analyzed.

1.3 A Standard Definition of the Exchange Rate Pass-through into Prices

The impact of currency movements on firms' expected cash flows has received substantial attention recently. In the economics literature, this issue is referred to as **economic exposure** (Shapiro [1986], Lessard and Flood [1987]). The term **exchange rate pass-through** (precise origins of which are unclear) is reserved for the firm's particular sort of response to this exposure. To this economic exposure, a firm may respond *through* any or all of the control variables such as prices, quantities and costs, to cope with this economic exposure. This dissertation focuses precisely on the price responses, and therefore, it studies the **pass-through from exchange rate changes into export and import prices**.

This pass-through is commonly expressed as a simple derivative

$$PT_t = \frac{dP_t}{dS_t}. \tag{1.3}$$

[3] Recall, for example, the experience of the US dollar in the first half of 1980s: the dollar appreciation lowered foreign unit costs in dollars, but price and output adjustments did not occur to re-establish the market equilibrium, which implies that markups varied. Thus, it becomes essential to study the factors that govern these price and output adjustments.

Table 1.1: Cases of Pass-through

DEPRECIATION, $dS_t > 0$	SIGN of dP_t	
SIZE of dP_t	normal reaction (-)	surprising reaction (+)
Complete, $\lvert dP_t\rvert = \lvert dS_t\rvert$	$PT = 1$	$PT = -1$
Incomplete, $\lvert dP_t\rvert < \lvert dS_t\rvert$	$0 < PT < 1$	$0 > PT > -1$
More than Complete, $\lvert dP_t\rvert > \lvert dS_t\rvert$	$PT > 1$	$PT < -1$
APPRECIATION, $dS_t < 0$	normal reaction (+)	surprising reaction (-)
Complete, $\lvert dP_t\rvert = \lvert dS_t\rvert$	$PT = 1$	$PT = -1$
Incomplete, $\lvert dP_t\rvert < \lvert dS_t\rvert$	$0 < PT < 1$	$0 > PT > -1$
More than Complete, $\lvert dP_t\rvert > \lvert dS_t\rvert$	$PT > 1$	$PT < -1$

or in elasticity terms as

$$\epsilon_{P_t} = -\frac{dP_t}{dS_t}\frac{S_t}{P_t}, \tag{1.4}$$

where S_t is the exchange rate, defined as the number of units of the exporter's currency per unit of the importer's currency, and P_t is the exporter's price. For the moment, nothing else is assumed about demand, cost, the stochastic structure of the exchange rate, or the invoicing practice of the firm. In principle, the value and the sign of this elasticity may be anything, thus it is possible to distinguish two different types of pass-through depending on the **size**:

- The pass-through is said to be **complete** if the elasticity above takes the value of one, that is, a depreciation (appreciation) of 20% of the exchange rate yields a decrease (increase) in the export price of the same size; therefore,

- An **incomplete (more-than-complete)** pass-through is characterized when the variation of the export price is less (more) than the variation experienced by the exchange rate,

and two other depending of the **sign** of the change:

- The pass-through is said to be **normal** if a depreciation (appreciation) is followed by a decrease (increase) of the export price;

- The pass-through is **surprising** when exchange rate and price changes move in the same direction, say, for example, a depreciation (appreciation) of the exporters currency is followed by an increase (decrease) in the export price.[4]

[4]Indeed, there is a third case for the sign of change (**perverse pass-through**) but it makes sense only in the case of an international oligopoly model. The basic reference is Hens *et al* (1991), and Kirman and Phlips (1992). I will return to this point later in more detail.

Table 1.1 summarizes the value of the pass-through in the broadest sense. Among all these cases, there is only one that would be compatible with the *LOP*, and that is when the change in the export price is both *normal* and *complete*. For the remaining types, an equilibrium condition other than the *LOP* must be constructed, which is what models of imperfect competition have developed in recent times.

1.4 Exchange-rate Pass-through under Imperfect Competition

Although some earlier studies already focused on the existence of different elasticities of supply and demand for imports and exports (Machlup [1939, 1940], Brown [1942, 1951], Robinson [1947]); administered prices (Smithies [1950], Gray [1965]); uncertainty about competitors' reactions to price changes (Brems [1953], Harrod [1953], Dunn [1970]); and direct cost of making frequent changes or plain inertia (Dunn [1970])[5] as reasons to explain incomplete reactions of prices in the event of exchange rate variations, it is commonly accepted that Rudiger Dornbusch's (1987) seminal paper in the *American Economic Review* set the theoretical basis for most studies of exchange rates and prices. His main contribution was to outline how models of industrial organization could explain different sizes and speeds of price adjustments, which may be summarized as follows:

1. Market integration or separation. "*Is a particular commodity traded in an integrated world market, or are there significant barriers to restrict spatial arbitrage?*"

2. Substitutability of domestic and foreign variants of a product. "*The extent of substitution influences price setting and the output effects of cost and price changes.*"

3. Market organization. "*Is the market perfectly competitive, in which case firms are price takers, or is the market imperfectly competitive or oligopolistic, in which case firms are price setters and may interact in strategic ways?*"[6]

Despite the fact that Dornbusch (1987) erroneously associated imperfectly or oligopolistic market structures with price-setting behaviour of firms (imperfect competition and incomplet exchange rate pass-through may occur when the firms set either prices or quantities[7]), the factors mentioned above express well the essence of models that study the extent to which the exchange rate can fluctuate without inducing proportional fluctuations in the export prices[8].

[5] See Johnson (1967), for a review of some of the earlier literature.

[6] For Dornbusch (1987), a fourth item of relevance was the functional form of the demand curve.

[7] While in the absence of exogeneous uncertainty, firms may be indefferent between setting price and quantity, Klemperer and Meyer (1986) show that, given their conjectures about rivals' strategies, in the presence of uncertainty, three factors may affect firms' preferences between quantity and price as strategic variables: the slope of marginal costs, the effect of the random disturbance on demand, and the curvature of demand. They show that when marginal costs are steep, setting quantity is preferred because *ex post* optimal quantity is relatively stable compared with the output that would result from setting a price and producing to meet market conditions. Furthermore, as is shown later, the invoicing strategy of the firm also influences the decision about the strategic variable: for example, if the foreign demand faced by a firm is very elastic and the firm *has to invoice* their exports in their own currency, fixing quantities is preferred to fixing prices.

[8] Futhermore, Dornbusch (1987) examines price impacts of exchange rate changes using three different models of imperfect competition - a Cournot model for homogeneous products, a variation of the Dixit and Stiglitz (1977) model, and Salop's (1979) competition-in-a-circle for differentiated products. It is shown, in general, that a domestic currency appreciation will lead to a decline in the price of imports (as would be expected), but the extent of this decrease is dependent on the degree of substitutability between products, the relative number of home and foreign firms, and a measure of competition. As a general conclusion, the extent of a price change will lie between those in the cases of a monopolist and perfect competition.

Additionally, but within the same analytical framework of imperfect competition, Kreinin *et al.* (1987) introduced five types of industry characteristics as explanationy variables:

1. Market structure variables.

   (a) *Concentration.* The greater the market concentration in the destination market, the more likely are the foreign producers to observe and react to price changes by rivals and the lesser the exchange rate is passed-through into prices;

   (b) *Advertising.* Its influence is not uniquely defined, since advertising may, on one hand, increase product differentiation and contribute to an incomplete pass-through, or may be informative about competitors' price changes, the sign of this effect in the pass-through being reversed;

   (c) *A country buying its own products.* It can be the case that government spending buys primarily domestic goods, so a large difference between the prices of domestic and foreign supply will be required to induce a switch to foreign goods.

2. Margins. It is possible to distinguish the margins which exist between foreign producers and domestic retailers, from those between these retailers and consumers. Therefore, the larger these margins, the greater producers and/or retailers dominate the pricing decision.

3. Factor Intensity.

   (a) *Capital-sales ratio.* If it is expected that labor-intensive industries are more competitive, the larger the capital-sales ratio of the counterpart industry of the destination country, the greater the exchange rate pass-through of foreign exporters

   (b) *Inputs.* If the counterpart industry of the destination market is intensive in foreign inputs used in intermediate stages, it is more likely that the foreign exporters of finished goods, which use the same inputs, increase the exchange rate pass-through; or put in other words, the elasticity of import prices with respect to the exchange rate is a function of the sensitivity of input prices to exchange rate changes.

4. Cost Variables.

   (a) *Capacity Utilization.* The lower the domestic competitors' capacity utilization, the greater the value these producers are likely to place on sales lost to foreign competitors. Thus, the bend in the demand curve faced by foreign suppliers will be sharper, and the exchange rate changes are less likely to result in price fluctuations.

   (b) *Productivity and Wage Rates.* Gains in productivity per worker may result in a comparative advantage and in a decrease of the extent to which a exchange rate fluctuation is passed-through on prices.

As a corollary of these factors, Knetter (1989,1993) has stressed, that the degree of pass-through ultimately depends on the functional form of cost and demand, particularly on their elasticities with respect to price and exchange rate changes.

Therefore, having listed these hypotheses of incomplete exchange rate pass-through, the rest of the chapter is devoted to study in more depth these models and their tests.

1.5 Review of Exchange Rate Pass-through Theories

1.5.1 Economies of Scale/Scope, Strategic Interaction and Market Structure

Hens *et al.* (1991), Kirman and Phlips (1992), Martin and Phlips (1993), Herguera (1993) and Baniak and Phlips (1994), using the comparative statics for oligopoly methodology developed by Dixit (1986), have analyzed how sensitive the pass-through is to product substitutability and economies of scale and/or scope when firms operate in several markets simultaneously.

The relevance of these analyses is that they study in great detail **the underlying cost and demand interactions of firms that compete in an international scenario**, which always exist despite the theory applied to explain the degree of exchange rate pass-through. These studies start with an international oligopoly model, which I will consider as a benchmark for other models. This setup can be characterized as follows: there are N_1 firms located in market 1, each $n_1 = 1, ..., N_1$, selling $x_{n_1 1}$ and $x_{n_1 2}$ in markets 1 and 2 respectively, and there are N_2 firms located in market 2, each $n_2 = 1, ..., N_2$ selling $x_{n_2 1}$ in market 1, and $x_{n_2 2}$ in market 2. However, for expositional convenience, I consider here instead the duopoly case as in Hens *et al.* (1991) or Kirman and Phlips (1992).

Benchmark Model

Assume that there are only two firms and two markets. Define $n = 1, 2$ such that $n = 1$ denotes the firm in market $j = 1$ and $n = 2$ denotes the firm in market $j = 2$. Thus, the profit function of the firm located in market 1, expressed in market 1 currency, is

$$\Pi_1 = P_1(X_1)x_{11} + SP_2(X_2)x_{12} - c_1(x_{11}, x_{12}) \tag{1.5}$$

where

$$X_1 = x_{11} + x_{21} \quad and \quad X_2 = x_{12} + x_{22}.$$

The inverse demand functions are, respectively, $P_1(X_1)$ and $P_2(X_2)$. The exchange rate S, is the value in market 1's currency of the currency used in market 2. The cost functions are $c_n(x_{n1}, x_{n2})$, with marginal costs $c_n^1, c_n^2 > 0$, where $i = 1, 2$ represents the market. Superscripts denote derivatives with respect to the first and second argument respectively. Hence, the firm located in market 2 has the profit function

$$\Pi_2 = P_1(X_1)x_{21} + SP_2(X_2)x_{22} - Sc_2(x_{21}, x_{22}), \tag{1.6}$$

expressed in market 1's currency. Thus, the market can be described by a set of prices and costs, $\epsilon = (P_1, P_2, c_1, c_2)$. If it is assumed that the inverse demand and cost functions have continuous first and second partial derivatives, and that the profit function is concave in its arguments[9], the *Cournot Nash solution*, in which each firm takes the other firms' strategies as given, is characterized by the maxizing behaviour of the firms:

$$\Pi_1^1(x_{11}, x_{12}, X_1, X_2) := P_1'(X_1)x_{11} + P_1(X_1) - c_1^1(x_{11}, x_{12}) \tag{1.7}$$

$$\Pi_1^2(x_{11}, x_{12}, X_1, X_2) := S[P_2'(X_2)x_{12} + P_2(X_2)] - c_1^2(x_{11}, x_{12}) \tag{1.8}$$

for firm $n = 1$, and

$$\Pi_2^1(x_{21}, x_{22}, X_1, X_2) := P_1'(X_1)x_{21} + P_1(X_1) - Sc_2^1(x_{21}, x_{22}) \tag{1.9}$$

$$\Pi_2^2(x_{21}, x_{22}, X_1, X_2) := S[P_2'(X_2)x_{11} + P_1(X_2) - c_2^2(x_{21}, x_{22})] \tag{1.10}$$

for firm $n = 2$. These conditions allow one to divide (1.8) and (1.9) by S. A change in the exchange rate can therefore be interpreted alternatively as a rotation of a firm's foreign marginal revenue or as a change in the opposite direction of its marginal cost.

Thus, the system of equations

$$\Pi_n^j(x_{n1}^*, x_{n2}^*, X_1^*, X_2^*) = 0 \quad n, j = 1, 2 \tag{1.11}$$

describes the first-order equilibrium conditions, where stars denote equilibrium values of the relevant variables, and it is assumed that the second-order conditions are negative definite, which is assured by the concavity of the profit function $\Pi_n, n = 1, 2$.

This model does not yet have enough structure to predict the consequences of an exchange rate change, so the assumption that this model is stable with respect to a ***natural adjustment process*** is made possible. This embodies the idea that a firm will increase its output if it obtains a positive marginal profit from doing so. This output adjustment process may be written as

$$\dot{x} = \nu(x, e) \tag{1.12}$$

where

$$x = \begin{pmatrix} x_{11} \\ x_{12} \\ x_{21} \\ x_{22} \end{pmatrix} \quad \textit{and} \quad \nu = \begin{pmatrix} \Pi_1^1 \\ \Pi_1^2 \\ \Pi_2^1 \\ \Pi_2^2 \end{pmatrix}. \tag{1.13}$$

Linearising around the equilibrium point x^* gives

$$x = \begin{pmatrix} \dot{x}_{11} \\ \dot{x}_{12} \\ \dot{x}_{21} \\ \dot{x}_{22} \end{pmatrix} = \begin{bmatrix} a_{11} & -c_1^{12} & b_{11} & 0 \\ -c_1^{21} & a_{22} & 0 & Sb_{12} \\ b_{21} & 0 & a_{33} & -Sc_2^{12} \\ 0 & Sb_{22} & -Sc_2^{21} & a_{44} \end{bmatrix} \begin{pmatrix} x_{11} - x_{11}^* \\ x_{12} - x_{12}^* \\ x_{21} - x_{21}^* \\ x_{22} - x_{22}^* \end{pmatrix}. \tag{1.14}$$

[9] See Hens *et al.* (1991) or Kirman and Phlips (1992) for further details of these assumptions.

where

$$b_{nj} := P_j''(X_j^*)x_{nj}^* + P_j'(X_j^*) \quad n, j = 1, 2. \tag{1.15}$$

and

$$a_{11} = b_{11} + P_1'(X_1^*) - c_1^{11}(x_{11}^*, x_{12}^*) \tag{1.16}$$

$$a_{22} = S[b_{12} + P_2'(X_2^*)] - c_1^{22}(x_{11}^*, x_{12}^*) \tag{1.17}$$

$$a_{33} = b_{21} + P_1'(X_1^*) - Sc_2^{11}(x_{21}^*, x_{22}^*) \tag{1.18}$$

$$a_{44} = S[b_{22} + P_2'(X*_2) - c_2^{22}(x_{21}^*, x_{22}^*)] \tag{1.19}$$

Therefore, $\dot{x}$ may be written in short as

$$\dot{x} = A_{(\dot{x}^*)}(x - x^*). \tag{1.20}$$

Stability conditions need to be imposed on each market separately in order to establish the consequences of an exchange rate change. This coefficient matrix A clearly satisfies a necessary condition for stability, i.e., that the trace be negative, since this follows from the fact that the profit function was assumed to be concave in quantities. To justify the use of comparative statics, it is necessary to assume a much stronger condition than stability which is that the that $\dot{x}$ is locally asymptotically stable (the dominant diagonal property which implies that $A_{(\dot{x}^*)}$ is a negative Hadamard matrix, i.e. $a_{ll} < 0$ and $|a_{ll}| > \sum_{l \neq m} |a_{lm}|, l, m = 1, \ldots, 4$). Therefore, to see the overall impact of an exchange rate fluctuation on the system, total differentiation of the first-order conditions given by the system (1.7)-(1.10) gives

$$A_{(x^*)}dx = \gamma_{(x^*)}dS \tag{1.21}$$

where

$$\gamma_{(x^*)} = \begin{pmatrix} 0 \\ \gamma_1 \\ \gamma_2 \\ 0 \end{pmatrix} \quad \textit{with} \quad \gamma_1 = \Pi_1^{2S} = (-1/S)c_1^2(x_{11}^*, x_{12}^*), \quad \textit{and} \quad \gamma_2 = \Pi_2^{1S} = c_2^1(x_{21}^*, x_{22}^*).$$

where Π_1^{2S} and Π_2^{1S} are both interpreted in terms of the marginal cost.

Discussion

Despite this model describes an *ad hoc* adjustment process, it is interesting to notice firstly, that the oligopolistic structure described above, makes enough sense to be taken as a benchmark, and secondly, that exchange rate changes have an effect in both markets. Consequently, these intra- and inter-market interactions permit to reconsider the classification made of the type of the pass-through sign in Table 1.1 as shown in Table 1.2.

Now, the results of the pass-through will depend on some variable demand and cost characteristics:

Table 1.2: Taxonomy of the Pass-through of a Nash-Cournot Oligopoly with strategic and cost effects.

ΔS		COSTS CHARACTERISTICS									
		Independent Markets $c_n^{11} = c_n^{22} = 0$			Economies of Scope $c_n^{12} = c_n^{21} < 0$				Diseconomies of Scale $c_n^{11} = c_n^{22} > 0$		
		no str	comp	subs	no str	comp	subs		no str	comp	subs
							$N_1 > N_2$	$N_1 < N_2$			
Mkt 1	x_{11}	const	-	+	+	+/-	+	+	-	-	+
	x_{21}	-	-	-	-	-	-	-	-	-	
Mkt 2	x_{12}	+	+	+	+	+	+	+	+	+	+
	x_{22}	const	+	-	-	-/+	-	-	+	+	
Sales	X_1	-	-	-	+/-	-	+	-	-	-	
	X_2	+	+	+	-/+	+	+	-	+	+	-
Prices	P_1	+	+	+	-/+	+	-	+	+	+	+
	P_2	-	-	-	+/-	-	-	+	-	-	+
Type of Effect		Nm	Nm	Nm	Nm/Sp	Nm	Sp	Sp	Nm	Nm	Sp

no str.= no strategic effects; **comp**= strategic complements; **subs**= strategic substitutes.
Nm= normal;**Sp**= surprising. N_1 and N_2= number of firms in market 1 and 2, respectively.

- if both firms have a **constant marginal cost** of production, there are no economies or diseconomies of scale: $c_1^{11} = c_1^{22} = c_2^{11} = c_2^{22} = 0$; there are no economies or diseconomies of scope between markets: $c_1^{12} = c_1^{21} = c_2^{12} = c_2^{21} = 0$. Consequently the two markets are independent on the cost side, in the sense that the quantities sold do not affect the marginal cost of quantities sold in the other market, and each market's equilibrium can be determined separately;

- whether cost functions exhibit **economies**: $c_n^{11} < 0, c_n^{22} < 0$; or **diseconomies of scale**: $c_n^{11} > 0, c_n^{22} > 0$, for $n = 1, 2$;

- whether cost functions exhibit **economies**: $c_n^{12} < 0, c_n^{21} < 0$; or **diseconomies of scope**, $c_n^{12} > 0, c_n^{21} > 0$, for $n = 1, 2$. The effect of these characteristics is called, by Phlips and Baniak (1994), the *Firm Specific Effect*;

- whether x_{12} and x_{22}, and x_{11} and x_{21} are **strategic substitutes**, $b_{n2} < 0$ and $b_{n1} < 0$ or **strategic complements**, $b_{n2} > 0$ and $b_{n1} < 0$, which characterizes the *Market Specific Effect*.[10]

Therefore, apart from the direct influences of an appreciation, it is now possible to distinguish two more stages, namely the **income or cost effect**, derived from the cost structure of the firms,

[10] Note that from the traditional point of view of a policy maker, a devaluation should improve domestic firms' competitiveness in international markets and not lead to price increases; that is, they would expect the *Firm Specific Effect* to occur, with domestic firms selling more at home and abroad, and domestic prices going down as well. But it may happen that the *Market Specific Effect* is predominant and domestic sales do not increase as expected.

and the **substitution effect**, directly related to the demand characteristics: selling in market 2 becomes more attractive to firm 1 and x_{12} increases, and selling in market 1 becomes less attractive for firm 2, so x_{21} decreases. This first round corresponds to the the direct effects of γ_1 and γ_2. Secondly, suppose that the cost structure of the firms is characterized by diseconomies of scope, so the direction of the change in quantities described above is reinforced. Finally, observe how the cost effect is spread in each market depending on the demand characteristics: when goods are complements, the direction of the changes addressed above is still the same. However, depending on how much the products are substitutes, and on how small the direct and cost effects are, a surprise reaction, when both prices rise at the event of an appreciation of market 2's currency, would be possible.

Conclusions on the net sign of the pass-through, derived from this duopoly example, can be compared with those obtained when the number of firms in each market increases, as in Kirman and Phlips (1992) or Martin and Phlips (1993). Note that strategic substitutability tends to reduce imports into market 1, x_{21}, (cases 6 and 7 in Table 1.2). Obviously, the total sales in market 1, X_1, is ambiguously determined since domestic producers sell more but imports are reduced drastically. Only if the number of local firms, N_1, in market 1 is large enough compared with the number in market 2, N_2, will sales in market 1 increase, so that the effect of the economies of scope dominates the strategic effect, and a surprising result may appear. As for total sales in market 2, X_2, they will only increase if the number of local firms, N_2, in this market is large enough compared with market 1's, N_1, so that, on aggregate, the effect of economies of scope then dominates the strategic effect. Note that the critical ratio N_2/N_1 decreases with $abs(c^{12})$ and c^2: the smaller the economies of scope, or the relative cost disadvantage of foreign firms, the larger n must be compared to N_2. Clearly, this chain of effects ends up in a concrete level of prices in each market and a particular degree of pass-through.

Note also that the perverse effect reported in Table 1.2 can only happen if there are differences in production technology and firms are quite different. Indeed, Hens *et al* (1991) and Kirman and Phlips (1992) show that if cost functions have economies of scope we might guess that as a reaction to an appreciation of the exchange rate, firm 1 would increase sales in both markets whereas firm 2 would decrease sales in both markets. If the economies of scope are strong enough to outweight the direct effects, then P_2 will increase and P_1 will decrease![11] Therefore, if firms are allowed to have different cost structures, then it will be very difficult to predict the market outcome in terms of quantities and pass-through.

Setting Prices vs. Quantities

Despite thsi example is developed for a Cournot competitive conjecture, and price variations are induced by this quantity setting behaviour of firms, and the taxonomy shown in Table 1.2 is

[11] They also show that this case is not locally asymptotically stable is, instead, stable.

Table 1.3: Competitive Conjectures and Exchange Rate Pass-through.

	PT_{PRICES}		$PT_{QUANTITIES}$	
	sign	**Ranking**	**sign**	**Ranking**
$\Delta Exporters$	↑	*Bert > Cour > Coll*	↓	*Bert > Cour > Coll*
$\Delta Importers$	↓	*Bert > Cour > Coll*	↑	*Bert = Coll > Cour*

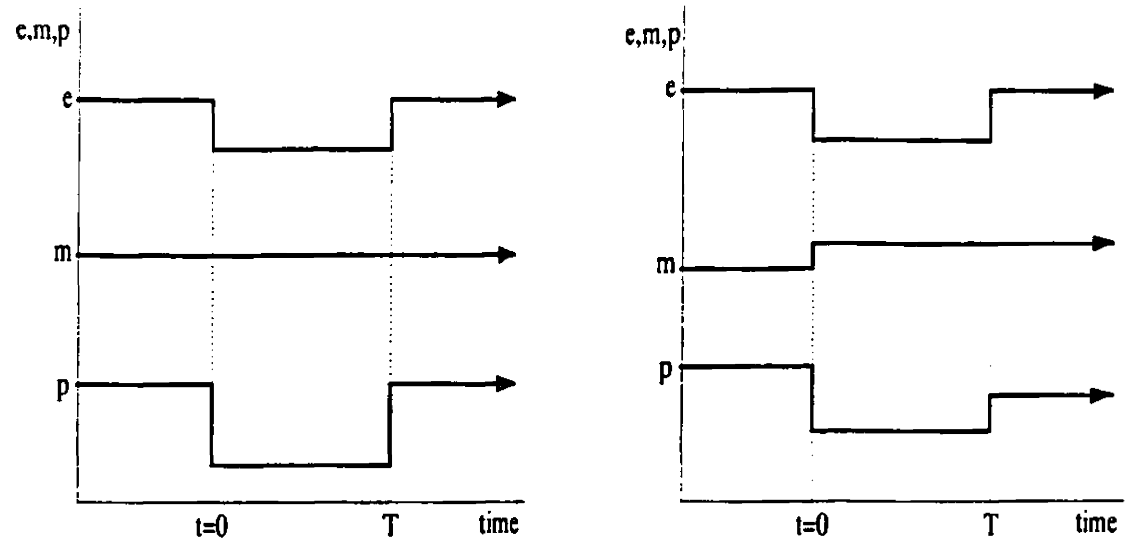
still valid.[12] Martin and Phlips (1993) and Herguera (1993) [13] investigate how the results above are sensitive to different types of **competitive conjectures**. A comparison is shown in Table 1.3. For linear demand structures they conclude that, for **Cournot** competition, the higher the number of firms in the industry, the closer the pass-through will be to the competitive solution: **Bertrand** conjectures imply a constant and more competitive and aggressive adjustment than Cournot conjectures for any market structure, and the **Collusive** case which reflects the belief that market share matters, since each change in the firms' strategic variables is believed to be matched by the rivals, so strategic effect is at its maximum in this case.

Summarizing, the main findings shown in this section refer to some technical details about the cost and demand functions of firms involved in international and symmetric competition. Therefore, none of the reasons mentioned for an incomplete exchange rate pass-through exclude any other explanation of this issue. Rather, they describe, let us say, a inner circle of unavoidable factors that lies in any sort of pass-through model. Sections 1.5.2 to 1.5.5 present some of these models, so it will not be difficult to see how this explanatory complementarity works.

[12] Hens *et al.* show that the absolute value of the complete pass-through elasticity may be different from unity as mentioned in Table 1.1, depending on the market structure and the functional form of the model. For example, they also show that for the duopoly case this absolute value is smaller than 1/3, if demands are linear.

[13] Note that these exercises are constructed for the case of linear (inverse) demand functions and segmented markets from the firm's point of view, hence these conclusions are somewhat weak. Indeed, Hens *et al.* (1991) and Kirman and Phlips (1992) stress the fact that linearity in demand rules out that an exporter with constant marginal costs would reduce its prices by the same percentage as the increase in the exchange rate (it will be by less than half that percentage if demand is linear), and that the assumption of the *separation property* (*i.e.*, $c_n(x_{n1}, x_{n,2}) = c_n(x_{n1}) + c_n(x_{n2})$) neglects the implications of dis/economies of joint production in both markets.

Figure 1.1: Time paths of S, m and P for a small overvaluation, (left-hand side) and for a large overvaluation (right-hand side).



1.5.2 Supply-Side Theories: Hysteresis/Beachhead Models and Bottleneck Effects

Hysteresis/Beachhead Models

In these models, the degree of exchange rate pass-through is based on the **hysteretic** or **beachhead** effects derived from sunk and maintenance cost of entrant firms in foreign markets. The term **hysteresis**, was put forward by Baldwin in 1986[14] and later developed by Baldwin (1988a), Baldwin and Krugman (1989), Dixit (1989a,b), Delgado (1991)[15] and Kasa (1992). This term refers to the permanent changes induced in endogenous variables by a temporary variation in an exogenous variable. In terms of the pass-through, this means that export prices do not revert to their original values either in the short or long run, even though the original cause of the price change is no longer present.

In more detail, this theory is as follows: large movements in the exchange rate, *even if*

[14]The first version came in an *MIT Working Paper* which corresponds with Baldwin (1988b)

[15]This author develops an interesting model where menu costs of price adjustment are the cause of hysteretic effects in nominal quantities. It is described with more detail in Chapter 2.

temporary[16], can lead to a permanent change in the market structure through entry/exit decisions of firms, which, in turn, will itself reflect permanent variations in the observed pass-through. Assume, for instance, that exporters are characterized by sunk market entry costs in order to sell in the domestic market, not all of which can be recovered on exit. These costs would be durable investments in firm and market specific assets such as distribution channels and after sales service networks. The nature of this sunk cost creates an *asymmetry* in entry-exit decisions, causing the exchange rate shifts to have a permanent hysteretic effect on the market structure. Suppose that an appreciation of the domestic currency induced foreign exporters to incur the fixed costs of entry into the domestic market. A prolonged overvaluation of the domestic currency increases the competitiveness and profits of foreign exporters. But, *ceteris paribus*, this will allow more foreign firms to cover their fixed sunk entry market costs, and this persistent increase in the number of foreign firms will entail an increase in the demand elasticity faced by the foreign exporters, which in turn implies a decrease in profit margins. Then, when the exchange rate is still overvaluated and new firms enter into the market, profits must be squeezed because of a reduction in the price expressed in domestic currency. This, in turn, will imply a complete pass-through of the exchange rate variation into the export price. When the overvaluation passes, the domestic value of foreign marginal costs rise but since domestic consumers have tried and become familiar with foreign products, exporters face higher demand curves, and consequently not all of the new entrants will be forced out. Thus, an incomplete exit will appear when the exchange rate overvaluation finishes, which would imply that exchange rate changes are not fully passed-through to prices. Figure 1.1 shows the paths of the nominal exchange rate, S, the number of firms or varieties of a particular product, m, and the import price, P.

Criticisms stress that this explanation fail to capture the importance of the stochastic nature of exchange rates, and consequently, empirical tests commonly reject this hypothesis. For Baldwin (1988b)[17], who assumed perfect foresight, a depreciation, even if temporary, would be sufficient to initialize the entry and exit process described above.

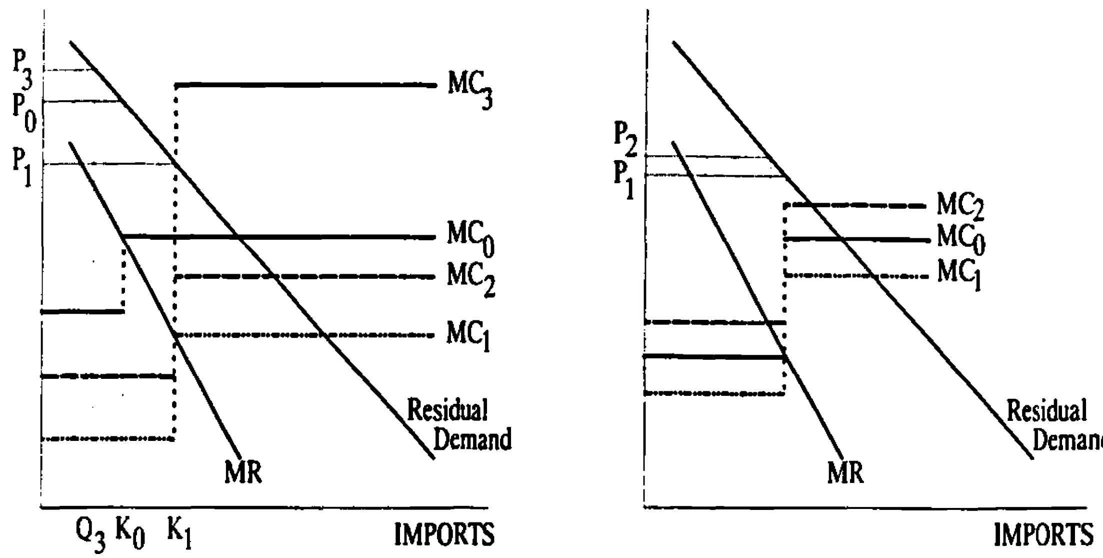
This problem was solved by Dixit (1989a) by allowing for a continuous random walk of the exchange rate (a Brownian motion), and reinterpreting the firms' entry and exit decisions as **investement options**.[18] Within this framework, entry requires the operating profit to exceed the interest on the entry cost, and similarly for exit. The solution of this model establishes a *middle band of exchange rates without entry or exit*, which yields hysteresis. Thus, if there exists a band of inaction, it is possible to obtain interesting conclusions about the exchange rate pass-through into prices: this elasticity is found to be close to one in the phases where exporters enter or exit the market, and incomplete otherwise. Obviously, one of the merits of Dixit's model is that *permanent* exchange rate changes will influence entry/exit decisions in a radically different way than *temporary* ones. These general conditions for entry and exit decisions have received

[16] As is shown below, this characteristic in the exchange rate movement is, instead, fundamental for alternative explanations.

[17] A refinement by Baldwin and Krugman (1989) assumed that the levels of the real exchange rate at successive instants of time were independently and identically distributed, but this did not change substantially the results.

[18] A similar exercise is developed in Dixit (1989b) for prices following this particular stochastic motion.

Figure 1.2: (a) Discontinuous Pass-through and (b) Reversed asymmetry in the bottleneck model.



more empirical support than those addressed by Baldwin (1988b), which failed to capture the inaction band proposed by Dixit,[19] and have been extremely valuable in the development of a theoretical framework of this dissertation, as shown in Chapter 2.

Bottleneck Effects

A variation of the Hysteresis/Beachhead explanation is the so-called **bottleneck** model due to Foster and Baldwin (1986), and also referred to in Krugman (1987). This model focuses on the different aspect of marketing, distribution, and servicing assets. Assume again that firms must incur some market entry costs. Examples of such costs are distribution networks, training of sales and service personnel, and establishment of service centers. In the long run it seems reasonable that these marketing and distribution assets are fully adjustable and, but it is an empirical question if they should be subject to constant returns to scale. However, it can be

[19] For example, profit margins of exporters to the US in the first half of the 1980s did not fall at the event of the appreciation of the dollar. Instead, Froot and Klemperer (1989), using a similar data for a duopoly model of market share, confirm the sunk costs hypothesis as formulated by Dixit.

expected that not all factors involved in distribution are instantaneously adjustable, thus firms face a distribution capacity constraint (marketing bottleneck) in the short run.

Assume a typical monopolistic firm's problem with bottlenecks as it is depicted in Figure 1.2(a). Assume also that the firm has a constant marginal cost of production and distribution, and a constant marginal cost of expansion. The result is a step function for total marginal costs, where the discontinuity occurs at capacity K_0. The height of the step depends on the number of periods the firm expects to use the additional capacity: for shorter usage periods the height will obviously be greater.

Let us assume that the firm is on the brink of expanding. The marginal cost curve is MC_0 which corresponds to S_0, where S is the exchange rate defined as the number of exporter's currency units per unit of foreign market currency. If the exchange rate depreciates enough, for example to S_1, the firm will expand its capacity from K_0 to K_1, shifting the marginal cost curve to MC_1. Thus, as import sales and capacity expand, the appreciation will be passed through to lower prices in a continuous manner. What the bottleneck model points out, then, is that this continuous relationship between the exchange rate and prices will cease when the appreciation reverses. Assume that now the exchange rate appreciates to S_2, so the marginal cost curve shifts up to MC_2. This exchange rate change does not have any effect because the firm is capacity-constrained or, put in other words, the rise of marginal costs from MC_1 to MC_2 is entirely offset by the diminishing returns. The price remains at P_1 and output is constant. It is not until the exchange rate appreciates to S_3, which corresponds to MC_3, that the appreciation will be reflected in a higher export price, P_3, and the output will fall to Q_3.

Plainly, bottlenecks result in discontinuous pass-through behaviour, as was predicted for the hysteresis/beachhead model. However, what is new in this explanation is that the asymmetry in the pass-through is **path dependent**: That is, if the initial conditions had been MC_0 in Figure 1.2(b), a depreciation would have been absorbed by the kink (e.g. MC_1), while an appreciation would have been passed through (e.g. MC_2), to a higher price P_2. Similar to the Dixit (1989a,b) model, it revises in some way the simplistic asymmetry solution obtained in the pioneering model by Baldwin (1988b).

1.5.3 Price Discrimination and Pricing-to-Market

"The phenomenon of foreign firms maintaining or even increasing their export prices to the US when the dollar rose" was named by Krugman (1987) as **Pricing-to-Market**, (henceforth *PTM*). However, *PTM* certainly implies more than an incomplete pass-through, as stated in the last sentence, since it refers to how destination-specific exchange rate changes may affect prices differently across destinations, creating the incentive to re-direct goods from the lower priced markets to the higher priced markets.[20] Broadly speaking, *PTM* denotes a *kind* of multiple price

[20] Nonetheless, transportation costs, imperfect information, tariffs, exclusive licensing and some other regulatory barriers prevent the alignment of manufactures goods prices across markets.

discrimination by destination-specific exchange rate movements.

The main contribution of Krugman (1987) was an inquiry into the characteristics of the market or of the exchange rate changes that would explain this behaviour by firms.

Benchmark Model

The generic *PTM* model can be formulated as follows. Consider only one firm which is assumed to maximize the domestic currency value of its profits.

$$\max \left[\Pi = \sum_{j=1}^{J} \frac{P_{jt} Q_{jt}}{S_{jt}} - C_t \right]. \tag{1.22}$$

where the demand function in country j at time t is given by $Q_{jt} = q_j(P_{jt})$. P_{jt} being the price expressed in the destination market's currency, S_{jt} the destination or foreign market's currency price of the exporter's currency[21]. T denotes the planning horizon of the firm and $C_t = C(\sum_{j=1}^{n} Q_{jt})\kappa_t$ is the cost function with κ_t being a random variable that may shift the cost function (for example, input prices as shown in Section 1.4), both common for all markets $j = 1...J$. This simple problem's first order conditions are

$$P_{jt} = [\frac{\varepsilon_j}{\varepsilon_j - 1}] c_t \kappa_t S_{jt} = (1 + \eta_j) c_t \kappa_t S_{jt}. \tag{1.23}$$

where $c_t = dC_t/dQ_{jt}$. Therefore, the system of equations given by (1.23) implies that price is a markup over marginal costs, with the markup determined by the elasticity of demand in the various destination markets. Therefore, taking logarithms, the pass-through elasticity can be written as

$$\frac{dlnP_{jt}}{dlnS_{jt}} = 1 + \frac{dln\,[(1+\eta_j)c_t\kappa_t]}{dlnS_{jt}}. \tag{1.24}$$

where ε_j is the perceived elasticity of demand and η_j is defined as the markup, in market j.

Discussion

Thus, within this formulation, *PTM* will be characterized by destination-specific markup adjustments at the event of exchange rate changes, so when it is detected on the data, it may provide useful information about the exporters' strategies, the degree of competition, the elasticity of demand and markups with respect to exchange rates, and their allocation possibilities in each market. In fact, this particular setting has been proved very useful because it explains the exchange rate pass-through as a combined response of costs and markups to exchange rate fluctuations, as shown in (1.24). For example, Knetter (1989,1993a,b, 1994a,b) has deeply explored the empirical possibilities of this formulation, establishing clear criteria to isolate price adjustments that arise from supply and demand shocks, and finding that pass-through is largely

[21] Note that here, the exchange rate is defined inversely.

depended on the exporters' perceptions of how demand elasticities change with respect to the price set in the destination market. Since both the theoretical formulation and its empirical implementation have been used in this dissertation, I will later return to this issue in Chapters 2 and 4.[22]

[22] Whether supply-side adjustment costs or demand induced dynamics are more important is likely to be associated with industries' characteristics as Knetter (1993a) points out.

1.5.4 Exchange-Rate Pass-through When The Market Share Matters

Models on market share (Dohner [1984], Krugman [1987], Froot and Klemperer [1989], Ohno [1990]) much resemble much those of sunk investments described in the last section: When firms' profits depend on the market share, the costs of infrastructure in the supply-side models are now translated in terms of purchasing consumer loyalty and future demand. The main difference arises in the way these market investments finally materialize: In all these market-share approaches, prices are the means by which firms make their investments, but since to any price change there is a corresponding quantity change, it could be considered a market-share approach based on quantity setting. As a matter of fact, the essence of this approach is the sequential pattern of firms' decisions rather than the strategic variable.

Benchmark Model

To see how this argument works, assume firms set prices, and think of a two-period optimization problem: first-period prices are real investment expenditures for future profits, so the firms' second-period profits depend on the first-period's market share. Therefore, the pass-through relationship incorporates directly any changes in firms' investment decisions, and any beliefs they hold about the future market conditions, represented by the level of the exchange rate. Thus, market 1's, or the domestic firm's discounted profits and market 2's or the foreign firm's profits are given, respectively, by

$$\Pi^D = \Pi_1^D(P^D, P^F) + \lambda^D \Pi_2^D(\sigma^D(P^D, P^F), S_2) \tag{1.25}$$

and

$$\Pi^F = S_1 \Pi_1^F(P^D, P^F, S_1) + \lambda^F \Pi_2^F(\sigma^F(P^D, P^F), S_2) \tag{1.26}$$

where subscripts $t = 1, 2$ signify first and second periods, superscripts $i = D, F$ mean domestic and foreign firms, P is the price, S is the exchange rate, defined as the price in foreign market's currency of the domestic currency, λ is the discount factor, and σ is the first-period market share. Suppose also that discount factors are inversely proportional to the respective interest rates. If capital is perfectly mobile, domestic and foreign discount factors (or interest rates) will be related to future depreciation according to the uncovered interest parity:

$$\lambda^D = \lambda^F \frac{S_2}{S_1} = \lambda \tag{1.27}$$

Assume also that the domestic market cost is fixed in domestic currency and that the exporter F has constant marginal costs γ^F, that can be expressed in domestic currency units as $c_1^F = \gamma^F/S_1$ and $c_2^F = \gamma^F/S_2$ for the first and the second period respectively. The first order conditions are given by

$$\frac{\partial \Pi^D}{\partial P^D} = \frac{\partial \Pi_1^D}{\partial P^D} + \lambda \left(\frac{\partial \Pi_2^D}{\partial \sigma^D}\right)\left(\frac{\partial \sigma^D}{\partial P^D}\right) \tag{1.28}$$

and

$$\frac{\partial \Pi^F}{\partial P^F} = S_1 \left[\frac{\partial \Pi_1^F}{\partial P^F} + \lambda \left(\frac{\partial \Pi_2^F}{\partial \sigma^F} \right) \left(\frac{\partial \sigma^F}{\partial P^F} \right) \right] \qquad (1.29)$$

As was said before, a lower price increases a firm's first-period market share ($\partial \sigma^i / \partial P^i < 0$), and a larger market share increases second-period profits ($\partial \Pi_2^i / \partial \sigma^i > 0$), so ($\partial \Pi_1^i / \partial P^i > 0$). Thus, it is possible to reach the initial conclusion that firms set lower prices than they would if market shares did not matter. What equations (1.28) and (1.29) say is that firms *balance* the cost of investment in market share through lower prices

$$\frac{\partial \Pi_1^i}{\partial P^i},$$

against the marginal return from this investment tomorrow

$$\lambda \left(\frac{\partial \Pi_2^i}{\partial \sigma^i} \right) \left(\frac{\partial \sigma^i}{\partial P^i} \right).$$

Totally differentiating (1.28) and (1.29), and after some transformations it is possible to write the firm's price in its reduced form as

$$P^i = P^i(c_1^F, c_2^F, \lambda), \qquad (1.30)$$

since c_1^F, c_2^F and λ are the only variables that depend directly on exchange rates. Now, the effect of a change in the exchange rate in period-t can be computed as:

$$\frac{dP^i}{dS_t} = \left(\frac{\partial P^i}{\partial c_t^F} \right) \left(\frac{dc_t^F}{dS_t} \right) + \left(\frac{\partial P^i}{\partial \lambda} \right) \left(\frac{d\lambda}{dS_t} \right). \qquad (1.31)$$

¿From the definitions above is possible to obtain the effect of a current **temporary** exchange rate appreciation of the domestic market

$$\frac{dP^i}{dS_1} = -c_1^F \left(\frac{\partial P^i}{\partial c_1^F} \right) - \lambda \left(\frac{\partial P^i}{\partial \lambda} \right). \qquad (1.32)$$

and that of a **permanent** appreciation

$$\frac{dP^i}{dS_2} = -c_2^F \left(\frac{\partial P^i}{\partial c_2^F} \right) + \lambda \left(\frac{\partial P^i}{\partial \lambda} \right). \qquad (1.33)$$

Discussion

In equations (1.32) and (1.33), it is to distinguish between **cost effects** and **real interest rate effects**:

- **Cost Effects:** In a static model of international competition, prices are unaffected by future costs or discount factors, that is, $\partial P^i / \partial c_2^F = \partial P^i / \partial \lambda = 0$. In such a model, the only effect is the first-period cost effect, $-c_1^F(\partial P^i/\partial c_1^F) < 0$, and the second term in the r.h.s of (1.31) equals zero. However, when market share matters and a two-period equilibrium is studied, the exporter's second period affects both firms' second period profit functions and first period pricing decisions, that is, if a depreciation of the exporter's currency yields a lower second-period cost that increases the marginal value of the market share, then the exporter would increase market-share investment by lowering its price in the first period. Therefore, the second-period cost effect on the exporter's price is going to be negative, $-c_2^F(\partial P^F/\partial c_2^F) < 0$, so an expected future (permanent) depreciation lowers P^F; and

- **Real Interest Rate Effect**, which corresponds to the second term in the r.h.s of (1.31). A temporary depreciation makes future profits in the importer's market *less valuable than current profits*, hence the return from market share falls. Thus, if firms invest less, the current prices rise, and profit margins grow. The chain of events can be summarized as follows:

$$\uparrow S_1 \Rightarrow \downarrow \lambda \Rightarrow \downarrow (\partial \Pi_1^i/\partial P^i) \Rightarrow \uparrow P^i \Rightarrow -\lambda(\partial P^i/\partial \lambda) > 0$$

Interest rate effects tend to *increase* import prices when the exporter's currency depreciates. Furthermore,

$$\uparrow (\partial \sigma^i/\partial P^i) \quad or \quad \uparrow (\partial \Pi_2^i/\partial \sigma^i) \quad or \quad \uparrow \lambda \quad \Rightarrow \uparrow \frac{dP^i}{dS_2}.$$

Therefore, it is possible to conclude that under a purely temporary exchange rate change, the real interest rate effect must dominate, if firms' costs are sufficiently low, or a small fraction of the exporter's costs is fixed in its own currency.

Summarizing, *what these models propose is that foreign firms will not try to gain market share by lowering their prices when there is the belief that exchange rate changes are temporary*, so firms will let their profit margins grow and pass-through elasticities will be low. However, if the change in the exchange rate is permanent ($dS_1 = dS_2$), and known with certainty, the interest rate effect is cancelled and the effect is the sum of (1.32) and (1.33), which equals the sum of the two cost effects. Here, the traditional doctrine will be valid and the exporter must decrease their price, since this permanent shift in the exchange rate will probably push firms to compete more vigorously. Both current and future costs for the foreign firms fall, the future becomes more valuable, and a price decrease now could be interpreted as a competitive re-positioning for the future. This would be the case if the pass-through were near to one. When this exchange rate is considered permanent, the average export penetration will be higher, and Baldwin's hypothesis shown above, will hold.

Although focused on the effect of market-share, these explanations have also pointed out the interaction between exchange rate uncertainty and the pass-through. As a matter of fact, it is not by chance that most of the empirical observations of pass-through have been developed since the second half of the 1970s, coinciding with the break in the fixed exchange-rate parities fixed at the Bretton Woods system. Therefore, next section reviews how studies have examined the effect of trend and volatility of exchange rates on firms' adjustment.

1.5.5 Exchange Rate Uncertainty and the Exchange Rate Pass-through

If exchange rates are not treated as completely exogenous, given to the agents, and perfectly known to them, two new directions arise in the study of the pass-through relationship:

- Exchange rate pass-through could be studied within the framework of a general equilibrium model and then endogenizing the level of the exchange rate. However, examples of this direction are scarce in the literature (see Baldwin and Krugman [1989]); and

- The analysis of how the stochastic structure of exchange rates affects the firm's decisions in terms of prices and quantities.

Thus, if a stochastic description of exchange rates is incorporated into the analyses, some new elements arise, summarized as follows:

- Firstly, producers have to set prices or quantities **in anticipation** of exchange rate realizations, otherwise it will be prohibitively expensive for most firms to change their prices with every movement of the value of foreign exchange, yielding some sort of temporary disequilibrium from the frictionless optimal level of prices, sales or profits. Hence, this would support the sequential or dynamic characterization already proposed of the fimrs' adjustment path.

- The effects of exchange rate variations in the **short run** are quite different from those in the **long run**, as referred earlier.

- Thirdly, the notion of pass-through may be different under a regime of **fixed** and **floating exchange rates**[23].

- Finally, uncertainty in exchange rates calls attention to the **firms' attitude toward risk**, and **the choice of the invoicing currency** if firms compete in prices.

Despite the relevance of these remarks, this issue has not received the due attention. Dohner (1984), as already mentioned in Section 1.5.4, develops a dynamic model of pricing by forward-looking, competitive, profit-maximizing exporters, in which consumers adjust slowly to price changes. The level of pass-through is determined by the speed of consumer adjustment and expectations on the duration of exchange rate changes. Firms respond with less of a price change to expected transitory real exchange rate variations than to expected permanent ones since, in the former case, the return to investing in market share is smaller. This opinion was later confirmed by Froot and Klemperer (1989), stressing the fact that exchange rate expectations will play a decisive role in the pricing adjustment process. Finally, Fisher (1989a) elaborates an integrated analysis, including expectations and market structures, which ultimately affect the level of exchange rate pass-through.

[23] I have found quite often in the literature that the terms devaluation/depreciation and revaluation/appreciation respectively, are used without distinction. It seems that different exchange regimes have different stochastic implications for prices, quantities and profits, and therefore, more precision in the language would be welcome.

Benchmark Model

Based on this last Fisher's (1989a) model, assume that the firms are identical, have constant marginal costs and produce a homogeneous good. Now, instead of competing in quantities, assume that firms act as ***Bertrand competitors***, that is, they compete in prices.[24] For simplicity, only the case of two firms, $n = 1, 2$ that sell in both markets, $j = 1, 2$, is studied. Demand in the market $j = 1, ..., J$ is given by $D_j(P_n)$ which satisfies the standard assumptions, and where P_n is the price offered by firm n. If it is assumed that there are no capacity constraints, then a typical profit function for a firm located in market 1 is given by

$$\Pi_1(P_1, S) = \begin{cases} (P_1 - c_1)(D_1(P_1) + D_2(P_1/S)), & \text{if } P_1/P_2 \leq S \\ 0 & \text{if } P_1/P_2 > S \end{cases} \tag{1.34}$$

where Π_1 are the profits in market 1's currency, and S is the realized value of the exchange rate expressed as the price in market 1's currency of the currency used in market 2, and c_1 is the cost. Analogously for firm 2 the profits Π_2 are given by

$$\Pi_2(P_2, S) = \begin{cases} 0 & \text{if } P_1/P_2 \leq S \\ (P_2 - c_2)(D_1(SP_2) + D_2(P_2)), & \text{if } P_1/P_2 < S \end{cases} \tag{1.35}$$

expressed in market 2's currency. It is assumed in this model that the exchange rate follows a process summarized by the density function $f(S)$. Following the usual convention, $F(S)$ can be interpreted as the probability that the event $S \leq \Sigma$ occurs, or that the level of the exchange rate has appreciated at least to Σ, where $F(S)$ is the cumulative distribution function corresponding to $f(S)$.

As is typical in analyses of Bertrand competition, it is assumed that all demand in any market is allocated to the seller offering the lowest price. As stressed before, this would indeed be the case for homogeneous goods and where firms face no capacity constraints. Also, firms must incorporate expectations about the exchange rate when announcing their prices. The nature of contracts in international trade and the current volatility of exchange rates make the assumption about the timing of the firms' decisions a natural one. Hence, when exchange rate uncertainty is introduced into the analysis, it is possible to speak about firm 1's expected profits as

$$V_1 = \int_{(P_1/P_2)}^{\bar{S}} \Pi_1(P_1; S) f(S) dS \tag{1.36}$$

[24] Fisher (1989a) studies a similar model with no capacity constraints and standarized goods which are very strong assumptions in Bertrand competition, since they make the equilibrium outcome close to the competitive one. When capacity constraints exist, some producers may benefit from fixing a price higher than that of their capacity-constrained competitors, (see Tirole [1989], p.314ss), thus incomplete pass-through appears as a common occurrence in international trade. Furthermore, much of the growth in international trade in recent decades has occurred in markets where product differentiation is an important ingredient, and the current international trade environment makes the assumption of no capacity constraints quite suspect. Probably, product differentiation and barriers to trade are a very real part of any oligopolistic international industry and, indeed they serve to create such oligopolies.

where $\bar{S}$ is the highest possible depreciation and the lower limit of integration corresponds to the event, the probability of which is $F(P_1/P_2)$, which occurs when the exchange rate appreciates sufficiently so that the P_1 is no longer competitive with respect to P_2. For firm 2,

$$V_2 = \int_{\underline{S}}^{(P_1/P_2)} \Pi_2(P_2; S)f(S)dS, \tag{1.37}$$

where the lower limit of integration is the highest possible appreciation, and the upper limit again represents the event of the exchange rate depreciating sufficiently that the firms located in market 2 are no longer competitive. Then, it can be said that P_1 and P_2 are the equilibrium strategies if, given common expectations about the exchange rate process summarized by $f(S)$, P_1 maximizes (1.36) and P_2 correspondingly maximizes (1.37).

Discussion

The Bertrand competitive structure described above helps out understanding of how beliefs concerning a floating exchange rate are crucial in the pricing of exports. Nevertheless, note that this model describes a very extreme case, where one firm could supply the total demand of the market. The assumption that products are standarized, so that all market demand will move from one supplier to another in response to a small price difference, is never very plausible, especially in a trade model: As a matter of fact, models of pass-through usually deal with non-homogeneous goods. If this assumption had been removed, firms would have sold some of their production at prices above the competitors', and still have faced some uncertainty. Despite the fact that the former setup may look naïve compared with the complexity introduced into the general oligopolistic model with strategic interactions between firms and dis/economies of scale or scope, note, however, that with this price competition structure a new source of uncertainty appears in the system, namely the **choice of invoicing currency**, as reviewed next. ¿From (1.36) and (1.37) it seems clear that the choice of invoicing currency can determine the nature of the uncertainty that the firm faces from the motion of the exchange rate. In the former exercise, exports in each market were invoiced in their respective home currencies, so the exporter did not suffer any transaction risk, though he faced *demand risk*, since he did not know the price at the time the foreign buyer made his purchases. Conversely, if exporters quote their exports in foreign currency units, this phenomenon would not appear, but there will always be an implicit transaction risk affecting the firms' stream of profits.

Table 1.4: Invoicing strategies and the effects on the trade balance.

	MARKET 1's IMPORTS	
MARKET 1's EXPORTS	**Invoice in Mkt1 Currency**	**Invoice in Mkt2 Currency**
Invoice in Mkt1 Currency	**case 1**	**case 2**
TB in Mkt1 Currency	$(X, M) = const$	$(X, M \downarrow) = \uparrow$
Invoice in Mkt2 Currency	**case 3**	**case 4**
TB in Mkt1 Currency	$(X \downarrow, M) = \downarrow$	$(X \downarrow, M \downarrow) = const$

X = Value of Exports: M = Value of Imports; Mkt1 = market1; Mkt2 = market2: TB = Trade Balance

1.5.6 The Choice of the Invoicing Currency, Hedging and the Exchange Rate Pass-through

In international trade, the choice of invoicing currency and the length of time over which the transactions are spread may change fundamentally how exchange rate fluctuations affect firms' profits. As Magee and Rao (1980a) noted, the problem is nontrivial only if exchange risk exists and the two traditional hedging techniques - forward exchange rate and international borrowing and lending - are too costly to be employed. And provided that optimal hedging policies depend on the underlying degree of exchange rate pass-through dictated by the market structures, this theme becomes more interesting.[25]

An example may well illustrate how the choice of the invoicing currency affects the pass-through in a fundamental way. Assuming that exchange rate fluctuations do not affect the volume of imports and exports of an economy[26], Table 1.4 summarizes the possible outcomes, in terms of value of exports and imports, of different invoicing strategies. Observe that when exports and imports are both denominated in the same currency, the trade balance remains constant. However, if different invoicing strategies are used for imports and for exports, the trade balance may vary, giving some support for the *J-shaped* adjustment path. Therefore, while *sellers* in world markets prefer payments in currencies expected to strengthen, *buyers* will prefer just the reverse, in order to make a capital gain or avoid a capital loss.

Definitions

First, two types of currencies in the pricing of internationally traded goods can be distinguished:

- **A vehicle currency** is a medium of exchange in *interbank clearing* among convertible currencies used because of savings in transaction costs (a single currency is used for economy of

[25] Von Ungern-Sternberg and Von Weizsaecker (1990) study how the cost of coverage required against exchange rate changes is sometimes greater (Cournot, monopolistic competition) and sometimes smaller (perfect competition) than the expected profits. This difference is due mainly to the fact that the impact cost changes have on equilibrium prices differs among market forms.

[26] Similar conclusions can be obtained for variable volumes, and fixing values.

communication): this currency workd as a *numeraire or standard of value* in homogeneous product markets and primary commodities, characterized by being a standard of deferred payment or store of value.

• **A nonvehicle currency** pricing occurs when the currency of the exporter or the importer is used. For manufactured goods, price discrimination across currencies is frequent: here the economic value of continuous price monitoring, as the exchange rate changes, is low: hence, nonvehicle currency pricing, which is not very sensitive to 'small' exchange rate changes, becomes the rule. This is obviously the case of interest. Among these nonvehicle currencies it is also possible to differentiate three categories: **major, symmetric**, and **minor currencies**. For any pair of bilateral trading partners, one of the two currencies is defined as **major** if it is used as the dominant form of pricing for trade in both directions; the other currency is **minor**. Trade between **symmetric currencies** occurs when one country's currency dominates trade in one direction while the other country's currency dominates transactions in the opposite direction.

Furthermore, four pricing options related with the firm's decision problem can be distinguished:

• Firstly, invoicing in the **home, domestic or exporter's currency**. Here, the effective price paid buy the importers or foreign market buyers is the product price converted at the spot exchange rate,[27] and the quantity demanded will be uncertain. In this case, purchasers face the exchange risk.

• Secondly, the **destination, foreign or importer's currency** may be used to denominate exports. Now the price paid by the buyers is certain, as well as the quantity sold, *ceteris paribus* other factors affecting costs and demand. This choice would be equivalent to a quantity-setting strategy. Now, the exporter faces the exchange risk.

• A further possibility is to choose a **third country's currency**, as trading experience of some goods suggests.

• Finally, it might be said that the choice of invoicing currency can be endogenized when it is a part of the **bargaining** between exporters and organized importers or retailers in the destination market, and it is possible to find situations where sales are denominated in more than one currency.

Empirical Investigation

There exists an empirical tradition, started by Sven Grassman (1973a,b) (1976) and followed by Magee (1974), Page (1977), Van Nieuwkerk (1979), Carse *et al.* (1980) and Hung *et al.* (1993) on the composition of export and import contracts. For some time it was believed that trade between developed countries in manufactured products was likely to be invoiced in the

[27] At the date of the purchase, or at the signature of the contract.

exporter's currency, an assertion known as the *Grassman Rule*.[28] However, although this rule imposes the foreign exchange exposure on the importer, it is generally admitted that importers have not hedged this exposure in forward markets. Rather, the empirical evidence neither suggests Grassman's regularity across countries, time and industries nor the predominance of the *hardest* currency between trading partners. What it really emerges is that in practice, exporting (importing) firms set prices either in their own currency or in the buyer's currency. Notice, however, that if the exporter prefers payment in currencies expected to strengthen, the buyer's preference is just the reverse. Furthermore, it seems sometimes the choice depends largely on tradition and institutional factors such as banking services, industry practice, customs, laws and the like.

Theoretical Approaches

Theoretical studies are associated to a series of papers that compare the two invoicing strategies, or a combination of both; see Ethier (1972), Clark (1973), Baron (1976), McKinnon (1979), Magee and Rao (1980a), Mann (1987), Giovannini (1988), Gagnon (1989) and Donnenfeld and Zilcha (1991). In short, their main contributions to the theme are the following:

- Early attempts by Ethier (1972) and Clark (1973) indicated that an exporting firm must determine whether it will invoice its exports in its home currency or in the importer's. They noted that with fixed exchange rates these two invoicing policies were equivalent, but with fluctuating exchange rates the choice of an invoicing strategy was important since it affected the level of trade.

- Baron (1976) compared the invoicing strategies for for a risk-averse exporter. When the degree of exporter's risk aversion increases, Table 1.5 summarizes his main findings for *linear cost and demand functions*. Baron's contributions stress the fact that the invoicing strategies

[28] Grassman (1973a,b)(1976) showed for 1968 that 66% of Swedish exports were denominated in Kroners, 25% in the purchasing country's currency and 9% in a third's country currency; for Swedish imports, 60% were denominated in the selling country's currency, 26% in Kroners, and 15% in a third country's currency. This first study suggested that most of the exports were denominated in the exporter's currency, a practice that the literature soon named the *Grassman Rule*. However, disaggregating by countries, these ratios changed largely. Magee (1974) studied the currency denomination of US imports from Japan and West Germany for 1971 and 1973. He found that for 1971 and 1973, 73% and 81% respectively of German exports were quoted in Deutschemarks. However, the opposite happened with Japanese exports: Only 39% in 1971 and 28% in 1973 were invoiced in Yen. Page (1977) reports that invoicing in the exporter's currency is prevalent for goods with long contractual lags, i.e. machinery, and that there has been a tendency for the exports contracted in the exporter's currency to be negatively related to the inflation rate in the exporter's country. Van Nieuwkerk (1979) showed that for the period 1973-1976, 50% of Dutch exports were quoted in Guilders and 30% of the imports were invoiced in the sellers' currencies. Carse *et al.* (1980) found that British exporters in the 1970s invoiced a 76% of merchandises in Sterling. For UK imports, they found that 51% were denominated in the exporter's currency and 17% in Sterling. Hung *et al.* (1993), for multi-aggregate and multi-market data between 1974-1989, stressed the fact that the US dollar is more widely used in invoicing international trade than any other currency. Even non-US exporters, who tend to invoice in their own currency for exports to other non-US destinations, use the dollar for exports to the US.

Table 1.5: Comparison of invoicing strategies for a risk averse exporter with linear cost and demand functions, **when the exporter's risk aversion increases.**

Invoicing Currency	Price	Output	$E(\Pi)$	σ_Π	$E(U(\Pi))$	elasticity of demand
Importer's	↑	↓	↓	↓	↑	best if elastic
Exporter's	↓	↑	↓	↓	↑	best if inelastic
$P_{exp} - P_{imp}$	+ and ↓					
$Q_{exp} - Q_{imp}$	+ and ↑					

depend upon the elasticity of the purchaser's demand curve, which is directly associated with the type of risk the exporter prefers to face, either in quantities sold (exporter's currency) or in revenues (importer's currency). Knowledge of the cost and demand structures therefore becomes essential in order to determine which strategy is preferred by the exporter.

• Magee and Rao (1980b) suggest that the 'harder' currency is used in commercial transactions because international trade contracts are subject to inflation risks or uncertain exchange rate controls.

• Mann (1987) studies, in a model with linear cost and demand functions, how the degree of pass-through and the share of exchange rate risk between exporters and importers decide the invoicing currency. It is proved optimal for the exporter to direct more output, if this is possible, to a particular market where demand is more independent of exchange rate risk.

• Giovannini (1988) and Donnenfeld and Zilcha (1991) study more general cases for a risk-neutral exporter, demonstrating some interesting hypotheses:

1. When exporter's profit is a concave function of the exchange rate, setting export prices in importer's currency leads to higher expected profits (and the opposite for a concave profit function);

2. Each invoicing strategy implies a different type of risk, in quantities or in revenues. If in quantities, it is useful to think of demand conditions such as those referred to in models of exchange rate pass-through, being at work. If in revenues, one has to consider how correlated are prices and exchange rate surprises if, *empirically*, these surprises account for a large fraction of the observed exchange rate variations.

3. When export prices are quoted in the exporter's currency, any observed deviations from the *LOP* indicate *ex-ante* price discrimination, while when quoted in the importer's, these deviations are the sum of *ex-ante* price discrimination and exchange rate surprises.

An interesting result is that, contrary to the *Grassman Rule*, these studies prove that invoicing in the destination market currency seems to be better when profits are a concave function of exchange rates, which is a condition that assures the existence of a stable equilibrium.

An Endogenous Determination of the Invoicing Currency

The existence of a retailer-importer adds a new dimension to the study of the invoicing decisions of a firm and exchange rate pass-through. Cornell (1980), Magee and Rao (1980a) and Bilson (1983) study an endogenous determination of the invoice composition, when both the exporter and the importer have opposite invoicing objectives and some bargaining power. Briefly, assume that the value of an export expressed in the importer's currency is given by

$$P^{ret} = P_m + SP_x \qquad (1.38)$$

where S is the exchange rate defined as the number of importer's per one unit of the exporter's currency; P^{ret} is the final retail price of the good, which is the sum of P_m units of the importer's currency and P_x units of the exporter's currency. Now consider the importer's unit profit, abstracted from any other influences, as

$$\Pi_m = P^{ret} - P_m - SP_x \qquad (1.39)$$

where P is the retail price in the importer's market. The exporter's unit profit is

$$\Pi_x = P_m/S + P_x - w \qquad (1.40)$$

where w represents the uncertain level of unit costs. In order to avoid the problems associated with Jensen's inequality, the first term in this definition of profit is approximated by the Taylor series expansion around the expected value, $\bar{S}$:

$$\frac{P_m}{S} = P_m - P_x(S - \bar{S}). \qquad (1.41)$$

If risk aversion is introduced, then the firm desires to maximize the level of profit for some given level of risk, which is measured by the variance of profit. The utility functions for the importer and the exporter are then expressed by

$$U(\Pi_x) = \Pi_x - (\gamma_x/2)\sigma^2_{\Pi_x}, \qquad (1.42)$$

and

$$U(\Pi_m) = \Pi_m - (\gamma_m/2)\sigma^2_{\Pi_m}, \qquad (1.43)$$

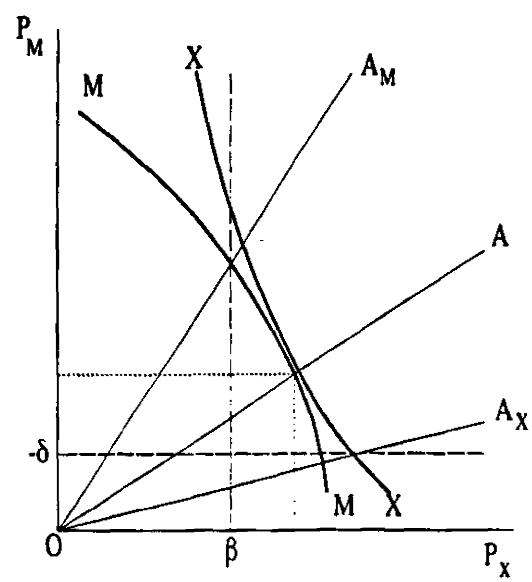
respectively, where the γ's are the degrees of risk aversion. Total differentiation of (1.42) and (1.43) yields the slope of the indifference curves for the importer and exporter:

$$\frac{dP_m}{dP_x} = -1 - \gamma_m\sigma^2_S(P_x - \beta) \qquad (1.44)$$

and

$$\frac{dP_m}{dP_x} = \frac{-1}{1 - \gamma_x\sigma^2_S(P_x + \delta)}, \qquad (1.45)$$

Figure 1.3: The contractual equilibrium in the invoice currency choice model.



where σ_S^2 is the variance of the exchange rate, β is the covariance between the retail price P and the exchange rate divided by σ_S^2, and δ is the covariance between domestic costs and the exchange rate, also divided by the variance of the exchange rate.

If the exporter were risk neutral he would only be interested in the total revenue from the transaction, so the importer would be free to choose any composition between foreign and domestic currencies. In this case, the importer would prefer to have P_x set equal to β, since this would minimize the variance of profit. But as the exporter chooses values of P_x that are different from β, the importer would require an increasingly lower overall price in order to maintain the same level of utility. Furthermore, with the exporter setting, a component denominated in the importer's currency equal to $-\delta$ results in the minimum possible level of profit risk. For example, if inflation were more volatile in the export market than in the import one, or many inputs into the production process are invoiced in the importer's currency, so that, exchange rate changes affect the exporter's costs, then it is likely that the value of δ will be negative. However, if the covariance is close to zero, then the exporter would have a clear preference for invoicing in its own currency.

Figure 1.3 shows how the contractual equilibrium will be reached. The indifference curves are MM and XX for the importer and the exporter respectively. At the optimal point of risk diversification, the slopes of these indifference curves is −1, and the closer (further) these curves are from the origin reflects a higher degree of utility for the importer (exporter). The importer's preference is to pay $O\beta$ in the exporter's currency, while the exporter prefers to receive only $-\delta$ in the importer's. The equilibrium illustrates the case in which both have compromised: P_x^* is greater than β, but P_m^* is also greater than $-\delta$. With the currency composition represented by the ray OA, the importer is paying less in total than there would have at her preferred point, OA_m, and the exporter is receiving more than there would have if the currency composition had been at his preferred point OA_x. At the equilibrium shown in Figure 1.3 it is assumed that the exporter has a greater preference for his own currency than the importer does for the exporter's currency but the importer does have a relatively greater preference for external currency invoicing because the covariance between retail prices and exchange rates is greater than the covariance between production costs and exchange rates.

What are the consequences of this invoicing bargaining for exchange rate pass-through? Looking at Figure 1.3 helps to understand how the effects of changes in the various parameters affecting the invoicing decision and consequently, in the price reaction at the event of an exchange rate variation, work:

- First of all, note that now it is possible to distinguish between **exchange rate pass-through in import** and *in export prices*, since this model separates between **exporter wholesale pricing** and **importer retail pricing**. As will be shown in Chapter 4, this is important when implementing empirical tests of the pass-through relationship.
- Since exchange rate risk pushes the two parties in opposite directions, each towards their own currency, it is clearly not possible to predict the influence of exchange rate variability on invoicing and on pricing.
- Recall that aversion to risk and how exchange rate changes affect firms' profits are fundamental in determining who wants to face the risk and who is willing to pay a premium for not having their revenues subject to uncertainty.

1.5.7 Exchange Rate Pass-through with Costs of Adjustment

Trade normally takes time, and there exists a lag between the information known by a firm and this signal is incorporated into firm's actions. For example, there could be identified at least five lags in the process between changes in exchange rates and their ultimate effects on real trade: lags in *recognition* of the changed situation, in the *decision* to change real variables, in *delivery* time,[29] in the *replacement* of inventories and materials, and in *production*.[30] Indeed, empirical studies have shown that the time it takes for the pass-through to be completed ranges from

[29] Magee (1974) demonstrated that the average contract length is around six months. Therefore, unless there exists a great degree of flexibility in international trade negotiations, it is difficult to see how the real current account can transmit information to the economy about current changes in its competitive position.

[30] Junz, H. and R. Rhomberg (1972).

several months to several years.[31]

Lags are also present in firm's pricing, which have recently proved to be an important piece in the understanding of the relationship between prices and exchange rates. The existence of some degree of price stickiness of goods prices, independently of any sort of consideration of the exchange rate changes is widely agreed upon, see, for example, Stigler and Kindahl (1970), Sheshinski and Weiss (1981), Hall (1984), Carlton (1986), Cecchetti (1986), Dahlby (1992), Lach and Tsiddon (1992), Tommassi (1993). Thus, either if there exists some precommitment on prices for a given period, or nominal prices react slower than exchange rates to economic events, the correlation between deviations from the *LOP* and the nominal exchange rate depend, in a very clear way, on the currency of the exports. Therefore, pricing of multimarket firms cannot be studied independently of the issue of the frequency of price adjustments. The next chapter of this dissertation will set up a model that considers these aspects in more depth.

[31] Spitaller (1980) and Baldwin and Krugman (1987).

1.6 Empirical Evidence on Exchange Rates Pass-through

Interest in international pricing behaviour at a disaggretated level appeared at the beginning of the 1970s in Dunn's (1970) study of oligopoly pricing of traded commodities between Canada and the US from 1952 to 1962. He found that exporters allowed their profits to absorb the effects of exchange rate variations. Since this behaviour would be impossible in perfectly competitive markets, the results of this study suggested that international trade theory would be more realistic if some sort of imperfectly competitive structures were introduced into the analysis. Later, as a result of the multilateral exchange-rate realigments that took place between the first quarter of 1971 - the so-called Smithsonian agreement - and the second quarter of 1973, a renewed interest in studying the consequences of these exchange rate changes in terms of capital flows, trade balance, inflation, and prices at a disaggregated level, appeared. In this respect, *The Effect of Exchange Rate Adjustment* (1974) summarizes some work made in this direction, where four articles by Isard; Rosenberg; Schotta and Trojanowski; and Schwartz and Pérez, dealt empirically with the exchange-rate pass-through into prices, as it is known nowadays. Later, Isard (1977) demonstrated that at a disaggregated level, relative prices of domestic and export goods in an industry vary dramatically and are sometimes correlated with exchange rates. These results, as Dornbusch (1987) documented, are even stronger when we look at more recent data, including the large swings in the dollar exchange rate since the beginning of the 1980s.

This review of the empirical work is organized under the different hypotheses on the relationship between exchange rates and prices presented earlier. The numerous attempts performed show a heterogeneous picture of this issue, which varies with the type of data used, the level of disaggregation, the periods covered, the markets studied and the direction of trade. It is sometimes difficult therefore to rule out a particular exercise or to evaluate the statistical significance of the findings, because, rather than competing, these studies accumulate non-exclusive evidence since the characteristics of this relationship do not normally have an single cause. Needless to say, there could be cases where a particular paper concentrated on more than one of them.

1.6.1 Market Concentration and Barriers to Trade

Most of the studies (See Table 1.6) found that increased industry concentration reduced the effect of exchange rate changes into prices, so the pass-through was expected to be lower, Feinberg (1986) (1989) (1991), Kreinin *et al.* (1987). Furthermore, it is observed that the greater the cost share of imported input, the larger the pass-through, and that for industries of high capital intensity the reverse is true. However, Fisher (1989b) found, for Japanese and German exports in 1984 and 1986, a rather weak correlation between price margins and industry correlation.

Barriers to trade other than market structure have been studied by Richardson (1978), Feenstra (1984), Feinberg (1991), Feinberg and Kaplan (1992) and Aw (1992,1993). Non-tariff barriers implicitly diminish the substitutability of goods, and thus pass-through is expected to be lower. For example, Feenstra (1984) finds that the VERs (Volume Export Restraints) imposed

Table 1.6: Empirical studies on concentration and barriers to trade

	Type of Price	Period, origin/destination	industry
Richardson (1978)	US & Canada prices	1973-1977, arbitrage	22 commodities
Feenstra (1986)	Japanese cars prices to US	1980-81, Japan	cars
Feinberg (1986)	German Import Prices	1977-83, aggregated	41 industries 3-4 digit SIC
Kreinin *et al.* (1987)	US Import Prices	1973-77-80(UK);1979-82(FR); 1976-78(JAP);	77 industries 3-4 digit SIC
Feinberg (1989)	Domestic US Prices	1974-87, aggregated	58 industries 3-4 digit SIC
Fisher (1989b)	Japanese and German Export Prices	1984, 1986; aggregated	9 industries
Feinberg (1991)	US Import Prices	1973-88, aggregated	84 industries 3-4 digit SIC
Feinberg & Kaplan (1992)	Domestic US Prices	1974-87, aggregated	84 industries 3-4 digit SIC
Aw (1992)	Taiwanese Export Prices	1974-85, US	Footwear industry

by Japanese exporters rose prices, and that only 2/3 of these increases in prices were owed to increases in quality, and 1/3 to a net price increase; Aw (1992), reports that for high-quality Taiwanese footwear exports to the US, 16.9% of the markup is explained by the VERs, while low-quality footwear displays a higher competitive behaviour; and Aw (1993) shows that margins above the competitive level may arise from imperfect competition (product differentiation) or the VERs. (Regarding marketing technology constraints, see footnote No.32.)

1.6.2 Pricing-to-Market and Market Power

Price discrimination in general, and Krugman's (1987) hypothesis of *Pricing-to-market* in particular, have been tested by a large number of studies. First of all recall that, as Giovannini (1988) points out, not all evidence on price discrimination corresponds necessarily to an *ex-ante* price discrimination, but also to an *ex-post* process, where exchange rate surprises may yield some price differences across countries where there exists price stickiness. The list of studies quoted here is, however, not exhaustive, since in any empirical analysis of pass-through, price discrimination may be easily detected. Therefore, I quote here only those studies which explicitly test *pricing-to-market* and *market power*.

Analyses in Table 1.8 range from the study of aggregated price series between a pair of countries, such as that of Dornbusch (1987) to disaggregated and multimarket ones, as in Knetter (1993a) and Ghosh and Wolf (1994). In general, these studies have found that when markets are effectively separated, the price for the same product is often different across segments, to exploit all the different characteristics of each market. It is also found that price discrimination is not

Table 1.7: Empirical studies on markups

	Type of Price	Period, origin/destination	industry
Woo (1984)	US import markups	1975-1983, aggregated	non-oil aggregated
Mann (1986)	US export & import markups	1977-80-85, aggregated	18 products 4 digit SIC
Hooper and Mann (1987)	US import markups & prices	1973-89, aggregated	manufactures, 2-4 digit SIC
Baldwin (1988a)	US import markups	1967-87, aggregated	aggregated
Citrin (1989)	US export prices	1974-1989, aggregated	manufactures, excl. machines
Froot & Klemperer (1989)	Foreign exporters markups and prices to US market	1973-87, 10 major industrial partners	aggregated
Kim (1990)	US imports	1968-86, aggregated	non-oil aggregated
Knetter (1994b)	Japanese and German Export Prices	1973-87 (Jap); 1975-87 (Ger): several destinations	18 (Ger) 14 (Jap) industries, 7-digit SIC

only generated by the asymmetry of demand in different markets, but also by the asymmetry of producers and of their relative strengths in each market. Finally, when these characteristics are at work, exchange rate changes are not completely passed through. In many individual cases, the invariance of export prices hypothesis is rejected, which follows from the constant elasticity hypothesis. Therefore, perfect competition and price equalization across buyers is replaced by price discrimination with non-constant elasticities of demand in export destinations. For example, Knetter (1994a) stresses the importance of some sort of imperfect competition when explaining Japanese retail prices differences relative to those of the US, United Kingdom and Canada, for German exports. These studies also show that when the US dollar depreciates, an increase in the US inflation index cannot be blamed on an increase in import prices.

1.6.3 Markup Fluctuations

A direct consequence of imperfectly competitive markets and price discrimination across countries is the variation in the markup when the exchange rate changes. The most well-known examples of this sort of tests are Mann (1986,1987), Citrin (1989) and Hooper and Mann (1989), who examine the effect of exchange rate changes of the US dollar on export and import prices and on profit margins of foreign exporters. They conclude that:

- Foreign exporters to the US market appear to have absorbed the effects of exchange rate changes into their profit margins, indicating an incomplete pass-through, lower than would be predicted in a model where the *LOP* holds. It is also found that German and some Japanese export prices seem to bear a perverse relationship with exchange rate trends.

Table 1.8: Empirical studies on pricing-to-market

	Type of Price	Period, origin/destination	industry
Dunn (1970)	US-Canada relative prices	1950-1962	6 industries
Isard (1974)	US-German relative prices	1968-1973	11 industries
Rosenberg (1974)	US	1969-1973, Japan, UK-EEC	4 steel mill products
Schotta & Trojanowski (1974)	US Retail and Import prices	1969-1972, Japan	SLR cameras and 28 & 25 mm lenses
Schwartz & Pérez (1974)	US import prices	1971-1973, 7 origins	9 industries
Dornbusch (1987)	US-Japan, US-German export & import prices	1980-84, aggregated	2-4 digit SIC
Mann (1987)	US-Japan, US-German	1974-87, aggregated	5 industries, 3 digit SIC
Giovannini (1988)	Japanese domestic & export prices	1973-83, US	Ball bearings, screws, nuts and bolts.
Froot & Klemperer (1989)	Foreign exporters markups & prices to US market	1973-87, 10 major industrial partners	aggregated
Knetter (1989)	US & German export prices.	1977-1986, several destinations	6-10 goods
LeCacheaux and Reichlin (1989)	EEC pre-tax export prices	1982-87, 5 countries EEC	cars
Marston (1990)	Domestic & Export Japanese Prices	1980-87, aggregated 22 countries	17 products 3-4 digit SIC
Kirman & Schueller (1990)	EEC pre-tax export prices	1982-87, 5 countries EEC	cars
Gagnon and Knetter (1991)	Japan, Germany and US export prices	1975-87, several destinations	aggregated cars
Athukorala (1991)	Korean Export Prices	1980-89, aggregated	manufactured products, SIC
Aw (1993)	Taiwanese Export Prices	1974-85, Germany, Hong Kong, S.Arabia, US	Footwear
Knetter (1993a)	US, Uk, Germany and Japan export prices	1973-87 US, Japan; 1974-87 Uk; 1975-87 Germany	52-products, 7 digit SIC
Feenstra *et al.* (1993)	Canada, France, Germany, Japan, Sweden, Uk and US export prices	1970-88, 12 destinations	aggregated cars
Hung *et al.* (1993)	Export Prices, 16 origins	1970-1989, aggregated destinations	Total exports
Ghosh & Wolf (1994)	Uk export prices	1973-1990, 12 destinations	The Economist Newspaper
Balaguer (1994)	Spanish Export Prices	1988-1992, 9 destinations	Ceramic Tiles
Herguera (1994)	Domestic Spanish Prices	1981-91, several origins	20 models of cars
Knetter (1994a)	German Export Prices	1975-87, US, Uk, Japan	37 industries, 7-digit SIC
Knetter (1994c)	German and Japanese Value and Quantity of Export	1973-87, Japan; 1975-87, Germany	18 and 14 industries, resp. 7-digit SIC

Table 1.9: Empirical studies on exchange rate expectations and pass-through

	Type of Price	Period, origin/destination	industry
Froot & Klemperer (1989)	Foreign exporters markups & prices to US market	1973-87, 10 major industrial partners	aggregated
Feinberg and Kaplan (1992)	US relative domestic prices	1974-87, aggregated	84 manu-facturing industries 4 digit SIC

- American exporters appear to be more sensitive to the effects of exchange rate variations (as evidenced by lower fluctuations in both export prices and profit margins), which implies a higher pass-through in their pricing behaviour, and margins relatively stable.

- Most of these studies agree that when profit margins are squeezed because of an unfavourable exchange rate fluctuation, markups tend to be more constant than when fluctuations are favourable. This is another reinforcement of the imperfectly competitive international markets.

The issue of fluctuating markups gives rise to the question of price adjustment asymmetries. Mann's (1986) findings for US prices seemed to support the idea of symmetric responses: Marston (1990) found for Japanese export prices that *Pricing-to-market* was higher for appreciations; Ohno (1990) detected the opposite. Knetter (1994b) finds, for Japanese and German exports, that periods of appreciation of the exporter's currency are characterized by reductions in markups and in the exchange rate pass-through, while when exchange rate depreciates, markups remain constant rather than increase, which indicate that the market share hypotheses of Froot and Klemperer (1989) may well characterize the behaviour of prices in this case: During depreciations firms gain market share. [32] Furthermore, Froot and Klemperer (1989) found also that these fluctuations in the profit margins in the first half of 1980s were due to the exporters' belief in a temporary rather than permanent change in the exchange rates, contrasting with the rejection of Baldwin's (1988b) 'sunk cost' hypothesis for the same data. Baldwin (1988b) predicted that from 1981 to 1985, profit margins should, at some point, have begun falling and should have stopped falling no later than 1987 (recall section 1.5.2). Both studies detected that there was a reduction in pass-through during that period, and that therefore the predicted entry of new firms because of a favourable exchange rate did not imply more competition and profit margins shrank. Either the entry was not so large, or it corresponded to firms with large monopolistic power, or Baldwin's hypotheses are simply not applicable to this case.

Exchange Rate Expectations and Pass-through

[32] Knetter (1994b) also tested the existence of *bottlenecks* which explain the opposite asymmetric behaviour: if sales are constrained by marketing capacity, then exporters should respond to a depreciation by adjusting their markups so as to keep foreign nominal prices constant and clear the market, and thus the pass-through would be rather low. However, during appreciations, less markup adjustment would be required and a larger pass-through would be observed. In fact, Knetter (1994b) did not find much support for this hypothesis.

As mentioned above, Froot and Klemperer's (1989) report on pass-through asymmetries and markup fluctuations was caused by firms' exchange rate expectations change. They use a simple formula to capture this:

$$d_t = \Delta p^j_{nt} - \Delta p^k_{nt} \tag{1.46}$$

where d_t is the difference between variations in sale prices of good n in markets j and k. Then, they estimated

$$d_t = \beta_1 \Delta E_t(\Delta s^{jk}_{t+1}) + \beta_2 \Delta s^{jk}_t + \epsilon^{jk}. \tag{1.47}$$

The coefficient β_1 measures the degree of *pricing-to-market* that occurs in response to an unexpected future variation in the exchange rate. Similarly, β_2 measures the effect of a permanent change in the exchange rate on *pricing-to-market*. Finally, the pass-through from a current exchange rate change, which is expected to be purely temporary is given by $\beta_2 - \beta_1$: if, for example, this difference is zero, there is no *pricing-to-market* in response to temporary exchange rate changes. Following Froot and Klemperer (1989), there is no overwhelming evidence that expected future depreciation influences the degree of *pricing-to-market*. Feinberg and Kaplan (1992) apply a similar regression model, including some other variables, in the fashion of Feinberg's former models, such as seller's concentration, ratio of capital to sales, selling expenses to sales, ratio of foreign input and a proxy for costs. This refinement reinforces the results of Froot and Klemperer, regarding the sensitivity of pass-through to the expected exchange rate. In general it is found that estimates of β_1 are not always of the same sign, but whenever they are statistically different from zero, they are positive: higher expected future depreciation implies increasing prices in the US market relative to other export markets. Estimates of β_2 are usually more than an order of magnitude smaller than the estimates of β_1, and only in one case statistically different from zero. Therefore, with this example, it is not possible to reject the hypothesis that permanent changes in the exchange rate have no effect on the ratio of export prices between countries, which implies that in the long run, and at aggregate level, it can be expected that exchange rate changes will be passed through into import prices one-for-one. In any case, these results on the sensitivity of expected exchange rates are not due to the peculiarities of any measurement of the expected exchange rate.

Finally Feenstra (1989) performs an interesting test on the **symmetry of the pass-through of tariff and exchange rate changes into prices**, for US imports of Japanese cars, trucks and heavy motorcycles between 1974 and 1987, finding that symmetry exists, and thus, that estimates of exchange rate pass-through can be used to predict the effect of changes in tariffs.

1.7 Concluding Remarks

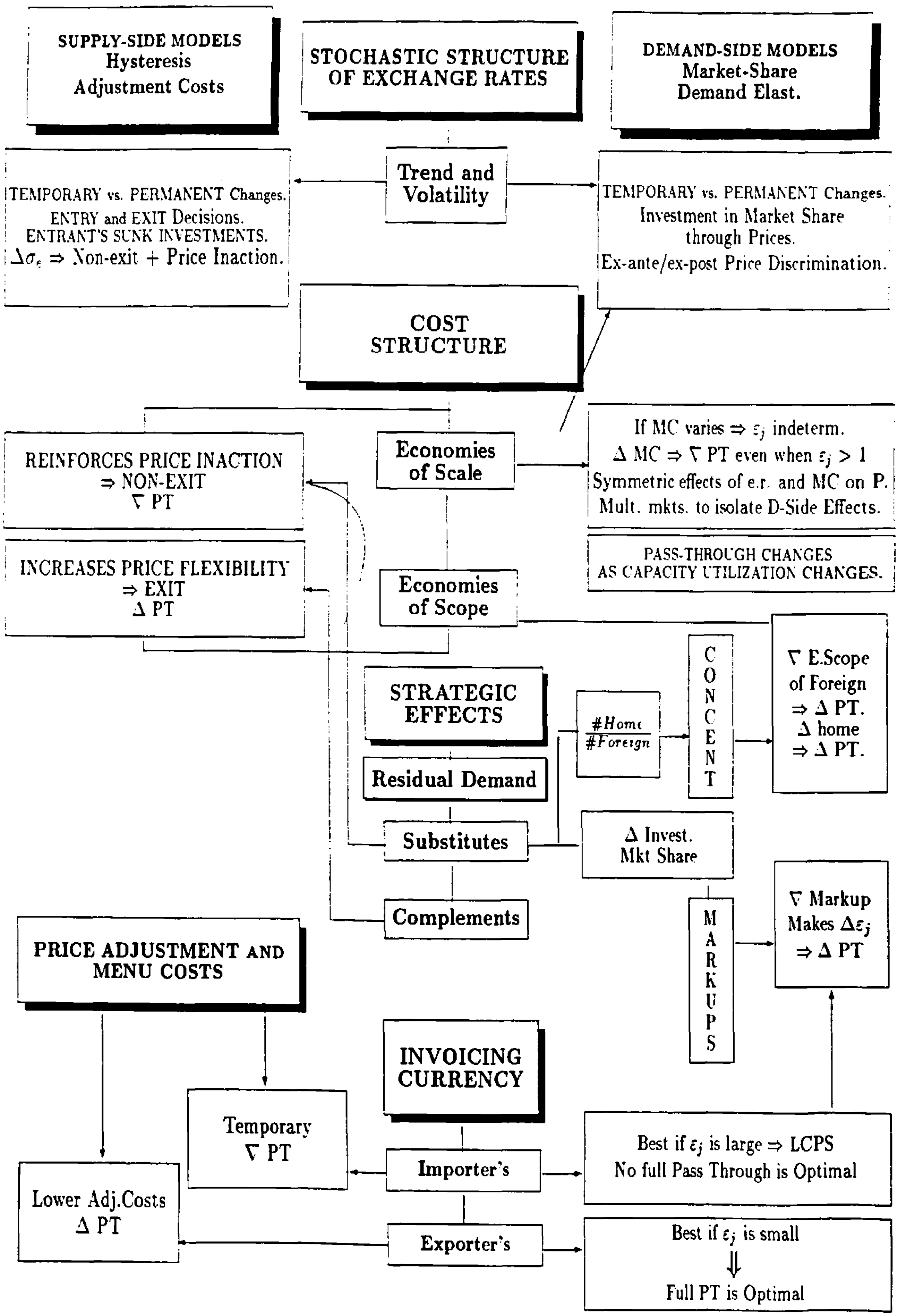
This chapter intends to serve as a useful start in the important task of examining the effects of exchange rate fluctuations on firms that sell home and abroad.

1. The main objective was to provide an integrated vision of the studies on the relationship between exchange rate changes and prices;

2. It was underlined which explanations are strictly exclusive, which are more complementary and which are simply a consequence of a typical firm's strategy;

3. Some technical details about the functional form of cost, demand and profits, that affect decisively the conclusions were also largely stressed;
4. The empirical evidence has strongly supported some sort of imperfect competition in international trade, which endorsed the set of theoretical explanations presented:
5. Price discrimination and variable markups across markets/time appear to be two basic features;
6. However, expectations on exchange rates and the staggered nature of price determination, as Delgado (1991) points out, become a pair of essential factors in understanding ultimately this theme, and open new areas of research.

Figure 1.4: Exchange Rate Pass-through Synopsis



Chapter 2

Export Pricing with Random Exchange Rates and Cost of Adjustment

"Non ex regula ius sumatur, sed ex iure quod est regula fiat". Julius Paulus, *Digests* 50.17.I[1]

2.1 Introduction

"One fundamental microeconomic issue is whether it is possible to provide a deeper explanation of firms' apparent reluctance to change their nominal prices. Of course there are many possible explanations for infrequent changes of pricing strategy, ranging all the way from the purely mechanical tasks of reprinting the catalogs and price stickers to such issues as how to get consensus on change inside the political structure of a firm. It is unfortunate that so little attention has been given to characterizing the circumstances that give rise to high and low levels of nominal price inertia. Progress in this dimension calls for more detailed empirical work and for increased understanding of the manner in which corporations actually arrive at pricing decisions."

This recent claim of Caplin (1993, p. 21), apart from stressing the relevance of the analysis of nominal price decisions, provides motivation for the study the pricing strategies of firms which sell at home and abroad, since it makes clear that this topic not only embraces the analysis of how market structures affect the transmission of exchange rate changes into export prices, as shown in Chapter 1, but also how the price adjustment mechanism works, in a *world* far from the frictionless and perfect information one. Although it could be expected that the strategic interactions between traders, the nature of competition, the number of domestic and foreign competitors, the product's attributes, and the demand and cost structures faced by the firms

[1] *What is right is not derived from the rule but the rule arises from our knowledge of what is right.*

may be sufficient to define the size and the speed of this adjustment in nominal terms, there could be distinguished three factors in the firm's environment that affect explicitly the transmission of economic events into price adjustments. These factors, even though they are diverse and have different policy implications, are operationally identical in the sense that they necessarily predict some degree of price inertia:

1. A class of models stipulates the existence of a set time period with fixed or otherwise predetermined, nominal prices. This period of fixed nominal prices is usually called the **contract period**, so the question consists in what determines the length of this contract, the behaviour of prices within this period and how successive contracts are formed and linked, (see Gray [1978], Dazinger [1983] and Dye [1985]).[2]

2. Another factor is the **stochastic structure of the exchange rates**. As shown in Chapter 1, a number of authors (Dohner [1984], Baldwin and Krugman [1989], Dixit [1989a], Fisher [1989a], and specially, Froot and Klemperer [1989]) have stressed that since exchange rate variations in the short-run are different from those in the long-run, agents' beliefs when anticipating these exchange rate realizations may yield some degree of price inertia.[3]

3. Finally, there exists a debate as to whether or not supply-side adjustment costs in general, and the **cost of nominal price adjustment** in particular, may yield nominal price inaction (Sheshinski and Weiss [1977,1983,1992]). Common sense might suggest that the marketing of a product often entails lumpy and, more generally, non-differentiable adjustment costs which may preclude the possibility of changing the price continuously as the economic environment - exchange rates, inflation, wages, demand, costs - changes, even if these changes are presumed to be permanent. Thus, it is possible to state that the microeconomic adjustment cost functions are often *kinked* at the non-adjustment point, so decisions taken by microeconomic units are made at discrete points in time, and standard optimization rules in these circumstances have to be applied cautiously.

These issues show that the firm may be constrained to accepting a pricing policy characterized by a sequence of finite intervals, during which nominal price is held constant, followed by discrete price adjustments, and will tolerate, within certain bounds, the existence of a *subjective disequilibrium* between *nominal* and *unconstrained or frictionless optimal prices* in order to save the costs of adjustment (see Bertola and Caballero [1990]), or prevent a reversal of the economic conditions, which would also imply additional costs. Therefore, the pricing strategy applied by the exporter would be characterized by an *idle* state, when the price remains unchanged, and by an *active* state, when the price is adjusted. However, the problem here arises when the state variables which determine the motion of the unconstrained optimal price are non-stationary, and explaining the transition between different regimes becomes difficult.

Nonetheless, the arguments enumerated above concerning price inaction should be subject to empirical testing. While the stochastic structure of exchange rates has been extensively studied

[2] For example, Ehremberg *et al.* (1984) and Cecchetti (1987) report no relationship between contract duration and inflation. The apparent reason is that longer contracts usually have better indexation provisions.

[3] A "classical" example of this is the explanation of the incomplete exchange rate pass-through in the U.S. during the first half of the 1980s, based on the hypothesis that these U.S. dollar fluctuations were interpreted as temporary rather than permanent by the non-U.S. exporters (see Froot and Klemperer [1989]).

in the literature,[4] tests for both *contracts* and *adjustment costs* have not been sufficiently developed. In this respect, Blinder (1993)'s interview study on firms' opinions about the causes of price rigidity, together with a similar experiment presented in the next chapter of this dissertation, perhaps constitute the unique examples in this direction. However, while both articles suggest that the costs of price adjustment are relatively important, despite the fact that these costs have been subject to some criticism[5], explanations for price inaction based on the existence of explicit contracts score differently in each study (they receive more support in Blinder [1993]). Thus, rather than providing a solid support for any of the theories mentioned, this evidence calls for a further investigation into the existence of these hypotheses, since these experiments, even though they are plausible, are still modest in their scope. It is because of this that the assumption of the existence of costs of adjustment should be understood in some cases more as an operational statement (which helps to explain the observed nominal price rigidity) rather than well-established fact.

Considering factors 2 and 3 in the list above, this chapter is devoted to the construction of an explanation of the reaction of nominal export prices when **both** exchange rate changes follow a Brownian motion stochastic process, **and** some costs of adjustment exist. For expositional purposes, this model is introduced at different stages of complexity, separating in each case the sources of price rigidity and incomplete pass-through. These stages may be characterized as follows:

1. Section 2.2 presents a deterministic and frictionless standard multi-market monopoly model is formulated.

2. Section 2.3 replaces the assumption of deterministic exchange rates by a Brownian Motion stochastic structure. The section presents a dynamic model of an exporter who fixes prices *costlessly*, sells all their production in several markets, and whose demand depends on the nominal price. Thus, compared with the static optimization results of Section 2.2, the exporter now would choose a price that does not simply equate marginal revenue and marginal costs, but one that also takes also into consideration the value of the option to postpone the price adjustment in the event of each of the contingencies of a exchange rate rise or fall.

3. Based on this specification, Section 2.4 allows for the existence of cost associated with price adjustments. This section also devotes some lines to the seminal model of Sheshinski and Weiss (1977) with deterministic state variables and cost of price adjustment, to show how only this last characterize the discrete price setting.

4. Finally, given the difficulties in providing an analytical solution to the problem, some comparative numerical results for the parameters of interest are performed. The chapter concludes by addressing some lines for further research.

[4]See Krugman (1991), who originally related the idea of a Brownian motion stochastic structure to exchange rates with the target zones mechanism, and Svensson (1992).

[5]Tommasi (1993) observes that folk theories that rely on *adjustment* or *information costs* are not unequivocally satisfactory explanations of the relationship between prices and inflation in high inflation economies, so pricing technologies that minimize such costs are used. See also Section 3.2.

2.2 Multi-market Monopoly Frictionless Pricing

Starting from a standard and non-restrictive characterization of a multimarket producer (see, for example, Knetter [1993b]), consider a firm that produces goods for sale in J separate markets, indexed by j. Let the firm possess sufficient monopoly power to set the nominal price of its output in each market, so there exist no intermediaries which could act as a hedge against movements in exchange rates, thus stabilizing the export price. The firm, therefore, maximizes value of the flow rewards in domestic currency, given by

$$\max_{P_{jt}(j)} \sum_{j=1}^{J} f(P_{jt}(j), S_{jt}), \tag{2.1}$$

where

- $P_{jt}(j)$: nominal price charged by the exporter in market j, at time t and expressed in the market's (j) currency, P_{jt} for short.
- $Q_{jt} = q_j(P_{jt})$: quantity demanded at time t in market j.[6]
- S_{jt}: nominal exchange rate, expressed as the foreign currency price of the exporter's currency, which is distributed with mean μ_j and variance, σ_j^2, and known with certainty[7].
- $C_t = c_t(\sum_{j=1}^{J} Q_{jt})\kappa_t$: operating cost, where $c_t = dC_t/dQ_{jt}$ is the marginal cost, with κ_t being a random variable that may shift the cost function (for example, input prices as shown in Section 1.4), both being common for all markets $j = 1...J$.
- $W_{jt}(j) = P_{jt}/S_{jt}$: implicit price charged by the exporter, that is, the export nominal price expressed in the exporter's currency, such that the firm is concerned with its receipts in its own currency, W_{jt} for short.
- $f(S_{jt}, P_{jt}) = f(W_{jt}) = Y_{jt} - C_t$: flow payoff function, where

  $$Y_{jt} = Q_{jt}\frac{P_{jt}}{S_{jt}} = Q_{jt} \cdot W_{jt}$$

  is the operating revenue, and Y, C are bounded; $Y, C \rightarrow \mathcal{R}_+$; $Y_p, C_p < 0, Y_{pp} < 0, C_{pp} = 0$, where the subindexes denote a derivative.

[6]This functional form implies that the quantity demanded remains constant while the nominal price is unchanged. Two natural extensions, however, appeal to this case: Firstly, Sheshinski and Weiss (1977,1983,1992) show, it is also possible to assume that demand rather depends on real prices, that is, $Q_{jt} = q_j(P_{jt}e^{-x_j})$, where x_j is the rate of inflation in market j.

[7]Instead of nominal rates, it is also possible to use *real* - discounted by a price deflator - and *effective protective* exchange rates. This last rate was used by Balassa (1965,1970) and Corden (1966), and is the percentage increase in value added in the production of a good that is made possible by the tariff structure relative to the situation in absence of tariffs, but with the same exchange rate. This measure of the exchange rate stresses the role of these taxes in the effect of changes in the exchange rate on exports and imported inputs. Therefore, exchange rate adjustments should be discounted in this case from the effective protective rate to get an idea of their link with costs and profits.

The first-order condition for profit maximization imply that $Y_p = C_p$ at any time, which yields

$$P_{jt}^{*} = [\frac{\varepsilon_j}{\varepsilon_j - 1}]c_t\kappa_t S_j = (1 + \eta_j)c_t\kappa_t S. \tag{2.2}$$

where P_{jt}^{*} denotes the optimal frictionless price in market j, denominated in market j's currency: $\varepsilon_j = -(\partial Q_{jt}/\partial P_{jt})(P_{jt}/Q_{jt})$ is the elasticity of the foreign demand curve as perceived by the firm; and η_j denotes the markup. Since the firm converts its receipts into its own currency, the optimal W_{jt} can be expressed as

$$W_{jt}^{*} = [\frac{\varepsilon_j}{\varepsilon_j - 1}]c_t\kappa_t = (1 + \eta_j)c_t\kappa_t. \tag{2.3}$$

Therefore, provided that

- The distribution of exchange rate changes is known with certainty, and:
- Price adjustments do not involve any cost,

the exporter would continuously follow this price path. For notational reasons, to determine the exchange rate pass-through differentiate the expression (2.3) in logarithms, to obtain

$$\frac{\partial ln W_{jt}^{*}}{\partial ln S_{jt}} = \frac{\partial ln\,[(1 + \eta_j)c_t\kappa_t]}{\partial ln S_{jt}} = \frac{\partial ln\,[(\varepsilon_j/\varepsilon_j - 1)c_t\kappa_t]}{\partial ln S_{jt}}. \tag{2.4}$$

The system of equations given by (2.3) indicates that the implicit price received by the firm in its own currency is given by a markup over marginal costs, with the markup determined by the elasticity of demand in the various destination markets at each time. Since exchange rate changes drive a wedge between the price paid by the buyers in their respective currencies, P_{jt}, and the price perceived by the firm, W_{jt}, markups may vary depending on how these fluctuations are passed through into destination prices.

As Knetter (1993b) points out, equation (2.4) is sufficient to address three major aspects of the exchange rate pass-through:

1. With both constant marginal costs and elasticity of demand, the exporter will fully pass-through exchange rate changes into prices;
2. If costs are constant, the elasticity of the demand determines the pass-through: for demand schedules more elastic than the constant elasticity one, pass-through will be larger;
3. If marginal costs are unknown, or vary as capacity utilization changes, demand elasticities cannot be inferred from the knowledge of the pass-through. Recall from Section 1.5.1 that, when marginal costs were not constant, the interaction of *market* (demand) and *firm* (supply) specific effects yielded a range of possible reactions summarized in the taxonomy of Table 1.2.

From equation (2.4), it can be observed that the parameters of the exchange rate distribution (mean or standard deviation) may affect the exporter's receipts W_{jt} in two ways: First, by changing marginal cost through variations in input prices or quantities; and second, by affecting the elasticity of demand or, equivalently, the elasticity of the markup. Observe that while the first factor would spread equally across all markets, the second effect is country-specific. As a matter of fact, in order to maximize profit in either an integrated world market or in segmented export markets (possibly as applicable to most manufactured goods as to newspapers), *firms may adjust markups in response to exchange rate changes*, which is what Krugman (1987) denotes, as shown in Section 1.5.3, *Pricing-to-market*, a destination-specific markup adjustment when exchange rate changes. Therefore, the combined sensitivity of costs and markups to exchange rate fluctuations ultimately determines the pass-through of exchange rate changes from the exporter to the importer.

Hence, two expressions of pass-through elasticity can be obtained:

- One for the **mean** of the exchange rate distribution,

$$\frac{\partial lnW^*_{jt}}{\partial ln\mu} = \frac{\partial lnc_t\kappa_t}{\partial ln\mu_{jt}} + \left[1 - \eta_{jt}\frac{\partial ln\eta_{jt}}{\partial ln\mu_{jt}}\right], \text{ and;} \qquad (2.5)$$

- and another for for the **variance**,

$$\frac{\partial lnP^*_{jt}}{\partial ln\sigma^2_{jt}} = \frac{\partial lnc_t\kappa_t}{\partial ln\sigma^2_{jt}} - \left[1/2 - \eta_{jt}\frac{\partial ln\eta_{jt}}{\partial ln\sigma^2_{jt}}\right].^{8} \qquad (2.6)$$

These two expressions give an idea of how prices move in the event of exchange rate changes:

1. A change in the mean of the exchange rate represents a change in export competitiveness through a variation of the markup. Equation (2.5) shows that, for example, a depreciation of the exporter's currency (improved competitiveness for the exporter), should lead to a fall in the optimal implicit price W^*_{jt}.
2. However, equation (2.6) indicates that the higher the variance of exchange rates or the higher the likelihood that economic conditions will reverse, the less important changes in markups become, and the less likely the firm is to react to this eventual depreciation, such that export prices, in the currency of the destination market, will be stabilized.
3. Furthermore, considering the effect of a specific exchange rate variation in the markup, or equivalently, the induced destination price change on the elasticity of demand, the

[8] As in Feenstra *et al.* (1993) or Knetter (1991, 1993b), it is possible to express these equations in terms of the sensitivity of the elasticity of demand, with respect to changes in the destination price, as

$$\frac{\partial lnP^*_{jt}}{\partial ln\mu_{jt}} = \frac{\partial lnc_t\kappa_t}{\partial ln\mu_{jt}} + \left[1 - \frac{1}{(\epsilon_{jt}-1)}\frac{\partial ln\epsilon_{jt}}{\partial lnP^*_{jt}}\right],$$

and

$$\frac{\partial lnP^*_{jt}}{\partial ln\sigma^2_{jt}} = \frac{\partial lnc_t\kappa_t}{\partial ln\sigma^2_{jt}} - \left[1/2 - \frac{1}{\epsilon_{jt}-1}\frac{\partial ln\epsilon_{jt}}{\partial lnP^*_{jt}}\right].$$

However, when the firm invoices its exports in the destination currency, it seems more intuitive to formulate the problem as in (2.5) and (2.6).

standard picture of why exchange rate pass-through into prices could be incomplete can be obtained: Observe that if the elasticity of markups decreases (increases) as the exchange rate increases,[9] then the pass-through is less (greater) than complete. In other words, if markups, as perceived by the exporter, becomes more (less) convex when exporter's currency depreciates, then the optimal markup charged by the exporter will fall (rise).

These explanations have mainly focused on demand considerations when measuring the exchange rate pass-through into prices. However, exchange rates may affect costs in two different ways. First, it is possible that some cost shocks, summarized in κ_t, involve imported inputs. If this is the case, equation (2.4) will have to take into account the derivative of these shocks with respect to exchange rate fluctuations. Nonetheless, the model would predict a common effect across markets. Second, and possibly more interesting, if the assumption of constant marginal costs does not hold, then, as Knetter (1989) pointed out, any measure of the exchange rate pass-through will become extraordinarily complex.

Therefore, it is possible to summarize the pricing policy of this characterization as follows:

Proposition 1 *When there are no costs of price adjustment and the distribution of the exchange rate is known with certainty, the optimal pricing policy will be to adjust prices continuously to peg W^*_{jt}, given by equation (2.3).*

The importance of this Proposition is that the degree of exchange rate pass-through induced by a particular market structure can be detected without incurring biases owed to lagged responses derived from uncertain exchange rates, or costly price adjustment. Therefore, the remainder of this chapter studies an extension of the model presented in this section when these assumptions are relaxed.

[9]Equivalently, if the elasticity of demand decreases (increases) as price decreases.

2.3 Multi-market Monopoly Frictionless Pricing under Stochastic Exchange Rate Changes

Based on the previous formulation, this section investigates what happens when the exchange rate changes are uncertain, and exporters maximize their future stream of profits. Consider the program given by

$$\max_{P_{jt}(j)} E_0\left\{ \int_0^{\infty} \exp^{-\delta t} \sum_{j=1}^{J} f(\, P_{jt}(j), S_{jt}\,)\, dt \right\}, \tag{2.7}$$

where E_0 denotes the expectation conditional on the information at $t = 0$. New definitions are needed:

- δ: real interest rate, assumed to be constant and independent of calendar time (discount rate).
- S_{jt}: exchange rate, defined as before, but assumed to follow a geometric Brownian motion stochastic process[10]:
$$\frac{dS}{S} = \mu dt + \sigma dZ \tag{2.8}$$
where $\mu \in \mathcal{R}, \sigma \in \mathcal{R}_+$ are constants, and dZ is the increment of a standard Wiener Process, uncorrelated across time and satisfying
$$E(dZ) = 0, \quad E(dZ^2) = dt.$$
By the standard theory of Brownian motion (see Dixit [1993]), it turns out that $\ln S_{jt}$ is normally distributed with mean $S_{j0} + (\mu - \frac{1}{2}\sigma^2)t$ and variance $\sigma^2 t$, where S_{j0} is the initial value of the exchange rate. Then, for the standard properties of the lognormal distribution, $E(S_{jt}|S_{j0}) = exp(\mu t)$. Thus, μ is the *trend* growth of the exchange rate, and for convergence it is assumed that $\mu < \delta$.
Therefore, since the purpose of this chapter is to characterize a control problem and the implicit price W_{jt} is identified as the regulated variable, then it can be written that $\ln W_{jt}$ is normally distributed with mean $W_{j0} + (-\mu + \frac{1}{2}\sigma^2)t$ and variance $\sigma^2 t$, where W_{j0} is the initial value of the implicit price. Similarly, for the standard properties of the lognormal distribution, $E(W_{jt}|W_{j0}) = exp(-\mu t)$.

For the assumptions of the model, the simpler case of a single foreign market is studied first. Henceforth, variables without subscripts refer to this single destination. Let the outcome of the maximization problem in (2.7) for this foreign market j be written as $\nu = V(P, S) \equiv V(W)$. Since the exporter's concern is their foreign receipts in their own currency, the problem is formulated in a more compact way on the variable W. Furthermore, given that S and W follow a Brownian motion, when relating changes in ν to those in the exchange rates, or equivalently, in the implicit prices, the rules of conventional calculus that would simply suggest $E[d\nu = V_w(W)]$, turn out to be wrong, because the variances of the increments in either S or W are linear in t.[11]

[10] Following Dixit (1989a, 1993a), this is a good first approximation of the dynamics of exchange rates.
[11] See Dixit (1993a) and Dixit and Pyndick (1994) for further details.

Then, over an interval of time (or implicit prices/exchange rate values) where the nominal price remains unchanged and, assuming that $V(W)$ is twice continuously differentiable, its evolution is given by Itô's Lemma,

$$dV(W) = [-\mu W V_w(W) + \frac{1}{2}\sigma^2 W^2 V_{ww}(W)]dt + \sigma W V_w(W)dZ, \tag{2.9}$$

where the first and the second term of the r.h.s. of (2.9) are the mean and the variance of $dV(W)$ respectively, and V_w denotes the derivative of the value function with respect to W.

Given these definitions, note that the argument of the maximization problem, the $\{P_{jt}\}$ process for market j, depends on the information structure generated by the $\{W_{jt}\}$ process.[12] The aim is to choose a sequence of prices $\{P_{jt}\}$ over time, so as to maximize the expected net present value of the payoffs, such that the exporter's policy could be represented by a sequence of a finite number of stopping times in any bounded interval, and corresponding nominal price controls over W:

$$\Psi = \{\{t_\tau, P_{jt_\tau}\}; \{t_{\tau+1}, P_{jt_{\tau+1}}\}; ...; \{t_{\tau+n}, P_{jt_{\tau+n}}\}; ...\},$$

where $t_{\tau+n}$ denote the points in time at which the firm plans to adjust its nominal price. Therefore, for characterizing an optimal sequential price adjustment under uncertainty, *dynamic programming* appears to be a useful tool.[13] This technique consists of breaking a whole firm's payoff flow (or the whole sequence of price decisions) into just two components: the current payoff flow at the existing price, and a valuation function that encapsulates the consequences of all subsequent decisions, starting at the payoff flow that results from the current price.

Thus, when prices are constant, $V(W)$ satisfies the Hamilton-Jacobi-Bellman Principle of Optimality:

$$\frac{E[dV(W)]}{dt} + f(W) = \delta V(W), \tag{2.10}$$

such that $V(W)$ satisfies the following differential equation

$$-\mu W V_w(W) + \frac{1}{2}\sigma^2 W^2 V_{ww}(W) + f(W) - \delta V(W) = 0, \tag{2.11}$$

which implies that the expected gains, $E[dV(W)]/dt$, plus the current flow payoff, $f(W)$, should be equal to the riskless gross return, $\delta V(W)$. The idea behind this decomposition is that an optimal pricing policy has the property that, whatever the initial price from where the problem starts, the remaining price adjustments constitute an optimal policy with respect to the subproblem starting at the payoff resulting from the initial price. Here, the optimality of the remaining price adjustments in the future are subsumed in the $E[dV(W)]/dt$, so only the immediate control remains to be chosen optimally.

Since expression (2.10) is a linear differential equation, its solution can be expressed as the sum of two parts: the general solution for the homogeneous equation, that is, omitting the flow

[12] This simply says that decisions on adjusting prices may only depend on the parameters and on the past history of $\{W_{jt}\}$, not on its future realizations. As $\{W_{jt}\}$ follows a Brownian motion which is a Markov process in levels, decisions can in fact be based only on current observations.

[13] See Dixit and Pyndick (1994) for a comprehensive study of decisions under uncertainty.

payoff $f(W)$, and any particular solution for the whole equation. Trying a solution of the type W^{ξ} for the homogeneous part of (2.10), substitution yields

$$\psi(\xi) = \frac{1}{2}\sigma^2\xi(\xi - 1) - \mu\xi - \delta = 0. \tag{2.12}$$

Two economically natural assumptions are needed to locate the roots of this equation: $\delta > 0$ ensures convergence of the expected present value of a constant flow, and $\delta > \mu$ guarantees the convergence of the expected present value of W itself. Therefore, $\psi(0) = -r < 0$ and $\psi(1) = -(\delta + \mu) < 0$. Since $\psi''(\xi) = 2 > 0$, one root must be greater than 1 (call it β), and the other must be less than zero (call it $-\alpha$). Thus, $\psi(\xi)$ is positive when ξ is in the interval $(-\alpha, \beta)$, and negative outside, so convergence requires that ξ lie on this interval (see Dixit [1993b]). Hence, equation (2.10) has a general solution of the form

$$V(W) = B_1(P)W^{-\alpha} + B_2(P)W^{\beta} + \frac{QW}{\delta + \mu} - \frac{C}{\delta}, \tag{2.13}$$

where $B_1(P)$ and $B_2(P)$ are the constants of integration to be determined from the boundary conditions. To interpret (2.13), note that the last two terms of the r.h.s. are

$$F(W) = E\left(\int_0^{\infty} \exp^{-\delta t} f(W)\right) dt = \frac{QW}{\delta + \mu} - \frac{C}{\delta}, \tag{2.14}$$

where $F(W)$ denotes the expected discounted value of the flow rewards when no price regulation is executed. Thus, when the exporter's currency appreciates, $\mu > 0$, (depreciates, $\mu < 0$), the current flow payoff would temporarily decrease (increase). Therefore, the first two terms of the r.h.s. of (2.13) must represent the additional value of the option to increase, $B_1(P)W^{-\alpha}$, or decrease, $B_2(P)W^{\beta}$, the price.[14]

To determine the two parameters $B_1(P)$ and $B_2(P)$, the two regimes (price action/price inaction) must be linked, and the optimal transitions from one to the other, considered. Let W_i (W_d) be the *lower (upper) trigger implicit price*, at which is optimal to *increase (decrease)* the nominal price, $dP > 0$ ($dP < 0$), such that nominal price inaction is optimal as long as W is above (under) W_i (W_d). From the Bellman equation, W_i and W_d must satisfy a pair of conditions for the optimal price exercise: the *value-matching* conditions

$$V(W_i) = V(W_R), \tag{2.15}$$

and

$$V(W_d) = V(W_R), \tag{2.16}$$

and the *high-order contact* or *smooth-pasting* condition

$$V_w(W_i) = V_w(W_R) = V_w(W_d) = 0. \tag{2.17}$$

[14] To get a better idea of the factors that affect the value of the option to postpone a price adjustment, note that, although the postponement of a price change gives up the period's revenue, it saves the costs associated with that decision. What is even more important, waiting between price decisions allows a separate optimization in each of the contingencies of a exchange rate rise and fall, whereas immediate and instantaneous price adjustments must be based on only the average of the two exchange rate fluctuations. This ability to tailor action to contingency gives value to the extra freedom of waiting. In technical terms, (see Dixit and Pyndick [1994]), this corresponds to the maximum of a convex function so, by Jensen's Inequality, the average of the separate maxima is greater than the maximum of the corresponding averages.

where W_R denotes the implicit price after a price adjustment has been exercised, henceforth, the *reset implicit price*.

Recapitulating, the stochastic optimal control problem consists of maximizing the value of the firm (2.7) subject to the the *value-matching* [(2.15) and (2.16)] and the *smooth-pasting* conditions (2.17), which contain five equations that determine the optimal values of the three control parameters, $\{W_i, W_R, W_d\}$ and the two constants, $B_1(P)$ and $B_2(P)$, of the homogeneous part of the solution of the value function. Hence, the model endogenizes the sluggish responses of prices to exchange rate fluctuations. The existence of this optimal policy has been proved by, among others, Constantinides (1976), Constantinides and Richard (1978), and Dixit (1993a,b).

Therefore, at the critical points of the problem, the value of the firm $V(W)$ can be written out in terms of the functional form of the general solution (2.13):

$$V(W_i) = B_1(P)W_i^{-\alpha} + F(W_i), \tag{2.18}$$

$$V(W_R) = B_1(P)W_R^{-\alpha} + B_2(P)W_R^{\beta} + F(W_R), \tag{2.19}$$

$$V(W_d) = B_2(P)W_d^{\beta} + F(W_d). \tag{2.20}$$

Firstly, observe that at the trigger point W_i (W_d), as W decreases (increases), the value of increasing (decreasing) the nominal price dominates the value of the opposite price adjustment, such that $B_2(P)W_d^{\beta}$ ($B_1(P)W_i^{-\alpha}$) is negligible. Secondly, at the common reset point W_R, both price options are, *a priori*, valuable. However, if the W process has, for instance, a strong negative trend and rarely goes to levels where the option to decrease is exercised, then the $B_2(P)W_d^{\beta}$ term in (2.19) should be ignored. Finally, but not less important, note that when a price adjustment is exercised, $V(W_i)$ and $V(W_d)$ are known by the exporter, but $V(W_R)$, the termination payoff, is based on an expectation. **Therefore, despite the absence of costs of adjustment, both the degree of risk aversion of the exporter and the evolution of information represented by the motion W until the price is changed, are sufficient to characterize a non-instantaneous price response.**

Replacing (2.18)-(2.20) in (2.15)-(2.17) and arranging terms, the optimality conditions can be written in matrix form, such that the *value-matching* conditions appear as

$$\begin{pmatrix} W_R^{-\alpha} - W_i^{-\alpha} & W_R^{\beta} \\ -W_R^{-\alpha} & W_d^{\beta} - W_R^{\beta} \end{pmatrix} \begin{pmatrix} B_1(P) \\ B_2(P) \end{pmatrix} = \begin{pmatrix} F(W_i) - F(W_R) \\ F(W_R) - F(W_d) \end{pmatrix} \tag{2.21}$$

and the *smooth-pasting* conditions become

$$\begin{pmatrix} -\alpha(W_R^{-\alpha-1} - W_i^{-\alpha-1}) & \beta W_R^{\beta-1} \\ \alpha W_R^{-\alpha-1} & \beta(W_d^{\beta-1} - W_R^{\beta-1}) \end{pmatrix} \begin{pmatrix} B_1(P) \\ B_2(P) \end{pmatrix} = \begin{pmatrix} F_w(W_i) - F_w(W_R) \\ F_w(W_R) - F_w(W_d) \end{pmatrix} \tag{2.22}$$

and

$$-\alpha B_1(P)W_R^{-\alpha-1} + \beta B_2(P)W_R^{\beta-1} + F_w(W_R) = 0. \tag{2.23}$$

Solving for $B_1(P)$ and $B_2(P)$, a nonlinear system can be obtained to yield $\{W_i, W_R, W_d\}$.

Owing to the complexity of the analytical solutions derived from the system (2.21)-(2.23), this may be numerically approached, as the literature normally proposes (see, for example, Dixit

[1989a,b], Delgado [1991], Dixit and Pindyck [1994]), to get an intuitive idea of the properties of the results.[15]

The model highlights some fundamental transmission mechanisms for the two components of the exchange rate to the nominal export prices, and shows that when this rate is assumed to follow a particular stochastic structure as the Brownian motion, **waiting to see if these fluctuations consolidate becomes a valuable action**. While a preliminary characterization of the problem in static terms[16] only proves how trend and volatility interact when firms pass-through exchange rates into prices and, depending on their risk aversion and market structure, what is the margin between marginal revenue and costs, the dynamic programming used here adds an intertemporal dimension to the optimal pricing response, which changes this simple rule. To see this, observe that **now, when a price is adjusted, it should be set to that for which the expected present discounted value of the difference between operating marginal revenue and cost over the period until the price is newly changed equals the marginal cost derived from a reversal of the stochastic conditions addressed for the exchange rate**. As shown, this idea is behind the decomposition formally stated in the Bellman's Principle of Optimality in (2.10), which stated that the price chosen at a time t, maximized both the inmediate payoff flow $f(W)$ and the future uncertain payoffs $E[dV(W)]/dt$, where the remaining price adjustments were subsumed in this value. Next, let us take a step further by assuming that price decisions are costly.

2.4 Multi-market Monopoly Pricing under Stochastic Exchange Rate Changes with Cost of Adjustment.

2.4.1 Kinked Costs of Price Adjustment and Price Inertia

The literature on the cost of price adjustments is large (see, for instance, Barro [1972], Sheshinski and Weiss [1977], [1979], [1983], Rotemberg [1982a,b], Akerlof and Yellen [1985a,b], Mankiw [1985], Caplin and Spulber [1987], Cooper and John [1988]) and mainly stresses the following facts:

1. Apart from the discussion as to whether or not costs of adjustment are **observable** (see Carlton [1986], Slade [1991], Blinder [1993])[17] or **binding** (see Tommasi [1993]), if they exist, they are basically believed to take two forms (see Cecchetti [1986]):

    - **Administrative:** the cost of determining and implementing the new price (both the new price sheets, which have to be constructed and the pure fact of the "revision of a price", even if the price is not finally adjusted, are "resources and time-consuming"

[15] This exercise will be performed in the next section of this chapter.

[16] See Mann (1987).

[17] A study by Slade (1991) on the pricing of crackers by grocers in Vancouver, provides some estimates of the implied magnitude of the costs of price adjustment. She found that the expected cost of adjustment constituted 4 percent of weekly sales, a figure which is quite large, and which could be subject to errors. However, Slade's (1991)'s major contribution is that these costs can be estimated with a well-specified model.

activities for the firm). These costs are generally believed to take the form of a *lump-sum*.

- **Informational**: the cost imposed on the firm's customers, and associated with a possible loss of sales to competitors and an unfavourable reaction by consumers, such that it could be suggested that certain adjustment costs can be endogenous to a concrete market scenario: For example, it can be concluded that the more competitive the market, the less expensive it is to change a price. Furthermore, price information must be conveyed to buyers, and this may cause distrust in the sellers if prices change often; and if prices change frequently, search costs increase. These costs are assumed to be *proportional* to the size of the price adjustment.

2. Some sort of **asymmetry between costs derived from upward and downward price movements** exists: prices normally prove to be more rigid in the second direction, so this asymmetric behaviour has important consequences for export price adjustment, and could be associated with pass-through asymmetries between exchange rate appreciations and depreciations, as is shown later.

3. Given these costs of adjustment, since firms live in an inflationary environment with real adjustment costs, their pricing policies can be characterized basically by the **frequency** and the **size** of price changes. The way in which these two magnitudes are combined is still an open question.[18]

¿From the articles mentioned above, Sheshinski and Weiss (1977) possibly constitute the first attempt to formalize the effects of costs of adjustment into pricing. Despite their model was built for a closed-economy case where the motion of profits was governed by the inflation, their findings pointed out that the existence of costs of price adjustment were sufficient to yield a pricing policy characterized by discrete changes. Thus, **the price inertia detected when exchange rate changes were uncertain studied in the last section, would be reinforced by assuming costly price adjustments. Note that this separation is crucial to understand properly the source of price rigidity.**

In this respect, recall that some studies (Dixit [1989a,b], Delgado [1991]) do not stress this distinction, and create the false belief that a policy characterized by discrete actions results basically from both uncertainty on the state variable and costs of adjustment. In reality, this policy may be obtained by each factor independently.

2.4.2 The Model

Based on Scarf's (1959) seminal article on the optimality of *(s,S)* policies in the dynamic inventory problem, a series of seminal papers by Sheshinski and Weiss (1977, 1983, 1992) have

[18] Rotemberg (1982a) suggests that customers prefer stable price paths with small adjustments to those with large infrequent jumps which would imply that exchange rate changes are pass-through into prices in the short-run. A counter-argument by Okun (1981) says that the cost of changing a nominal price may be an increasing function of the frequency with which the price is adjusted, and matches better with reality. Nevertheless, whether or not costs are invariant to the size or frequency of price variation and whether or not the longer the period a price remains unchanged, the larger the price adjustment will be, are still empirical questions.

analyzed the effects of adjustment costs on firms' pricing policies. Their main finding points out that these costs, in a inflationary environment, yield a pricing policy characterized by impulse controls or discrete price changes, and some predetermined bounds within which the real price (index or reference variable and equivalent to W in our model), which depends on inflation (state variable, or S_{jt} in our model), fluctuates without exercising any nominal price control. Comparative statics showed the existence of a relationship between changes in inflation and the size and frequency of price changes which were endogenously determined by the model. Furthermore, in spite of their first exercise being purely deterministic, they proved later that the conclusions obtained were robust for the case of a stochastic motion of the reference variable.

Inspired by these explanations, this section develops a model similar to those proposed by Sheshinski and Weiss, but with three differences: first, being W the state variable, the model allows for upward and downward price controls;[19] second, the particular choice of stochastic process, i.e. a Brownian motion; and third, the type of adjustment costs.[20]

Following from the frictionless formulation set up in Section 2.3 for only one destination market, let price controls have an associated cost, which is assumed to take two forms, and be different depending on whether they are associated with price increases or decreases. Following Dixit (1993a), these can be written as follows:

$$\begin{aligned} A_i &= a_i + b_i(W_I - W_i) \qquad dP > 0 \\ A_d &= a_d + b_d(W_d - W_D) \qquad dP < 0 \end{aligned} \tag{2.24}$$

where

- $a_i(a_d)$: lump-sum component which implies a range of inaction and sudden jumps when the extremes of this range are reached;
- $b_i(b_d)$: linear components of the adjustment costs for a price increase (decrease), which indicate that controls aim at points where the marginal benefits of further change fall to the level of their marginal costs. Therefore, upward and downward controls do not necessarily have a common reset point, so there is not a unique *reset implicit price*, W_R, but rather two, depending on the trigger point reached. Thus, we can distinguish between the *lower*, W_I, and *upper*, W_D, *reset implicit prices*, with $W_I \neq W_D$, and;
- $(W_I - W_i)$ and $(W_d - W_D)$: size of the respective control over W, when exercised.

Indeed, if it is assumed that the return points $W_I(W_D)$ are the industry equilibrium prices, while W evolves without exercising any control, customers may penalize the exporter by withdrawing their patronage at a rate proportional to the distance $(W_I - W_i)$ or $(W_d - W_D)$, which ultimately implies that exchange rate pass-through in the short-run is also costly.

By pursuing a policy Ψ such as the one described in Section 2.3, the objective of the exporter cannot be simply characterized by the maximization of the expected discounted value of the flow

[19] Sheshinski *et al.* (1981) also studied both controls for the case of a deflation.

[20] Sheshinski and Weiss (1983) study Two-State Markow Chains and Renewal Processes as special cases of stochastic processes, and lump-sum costs.

payoff function $f(W)$, as was shown above. Now, the maximand, starting at a $W_{jt} \in (W_i, W_d)$, is written as follows:

$$\max_{P_{jt}(j)} E_0 \left\{ \int_0^{\infty} \exp^{-\delta t} \left(\sum_{j=1}^{J} f(P_{jt}, S_{jt})\, dt - [I_j(dP_{jt} > 0)A_i - I_j(dP_{jt} < 0)A_d] \right) \right\} \tag{2.25}$$

where I_j is a latent or dummy variable defined as follows

$$I_j = \begin{cases} 1 & \text{if } P_{jt+1} \neq P_{jt} \\ 0 & \text{if } P_{jt+1} = P_{jt} \end{cases} \tag{2.26}$$

Now, the behaviour of the firm when the price is changed would be slightly different from that described in the conditions (2.15)-(2.17). For the case of a price increase, ($dP > 0$), the existence of costs of adjustment implies that the *value-matching* condition becomes,

$$V(W_i) = V(W_I) - A_i, \tag{2.27}$$

which states that the value of the function after an increase in the nominal price must be greater than the value of the function before by an amount equal to the costs of increasing the price or, in other words, that the value of the option to increase a price must be equal to the value of the *asset* being acquired when the price is adjusted *minus* the cost of exercising that option: and the *smooth-pasting* condition

$$V_w(W_i) = V_w(W_I) = b_i, \tag{2.28}$$

which says that the slope of the value function before a nominal price is increased should be equal to the slope after the change, and that this marginal benefit should be equal to the marginal cost of increasing the price. Equivalently for a price decrease, ($dP < 0$),

$$V(W_d) = V(W_D) - A_d \tag{2.29}$$

and

$$V_w(W_d) = V_w(W_D) = -b_d. \tag{2.30}$$

Proceeding as in the last section, at the critical points of the model, the value function of the firm, $V(W)$, can be written in terms of the functional form of the general solution (2.13):

$$V(W_i) = B_1(P)W_i^{-\alpha} + F(W_i), \tag{2.31}$$

$$V(W_I) = B_1(P)W_I^{-\alpha} + B_2(P)W_I^{\beta} + F(W_I), \tag{2.32}$$

$$V(W_D) = B_1(P)W_D^{-\alpha} + B_2(P)W_D^{\beta} + F(W_D), \tag{2.33}$$

$$V(W_d) = B_2(P)W_d^{\beta} + F(W_d). \tag{2.34}$$

As in the former case, substituting and arranging terms, the optimality conditions can be rewritten in matrix form. Thus, the *value-matching* conditions are

$$\begin{pmatrix} W_I^{-\alpha} - W_i^{-\alpha} & W_I^{\beta} \\ -W_D^{-\alpha} & W_d^{\beta} - W_D^{\beta} \end{pmatrix} \begin{pmatrix} B_1(P) \\ B_2(P) \end{pmatrix} = \begin{pmatrix} F(W_i) - F(W_I) + a_i - b_i(W_i - W_I) \\ F(W_D) - F(W_d) - a_d + b_d(W_D - W_d) \end{pmatrix} \tag{2.35}$$

and the *smooth-pasting* conditions become

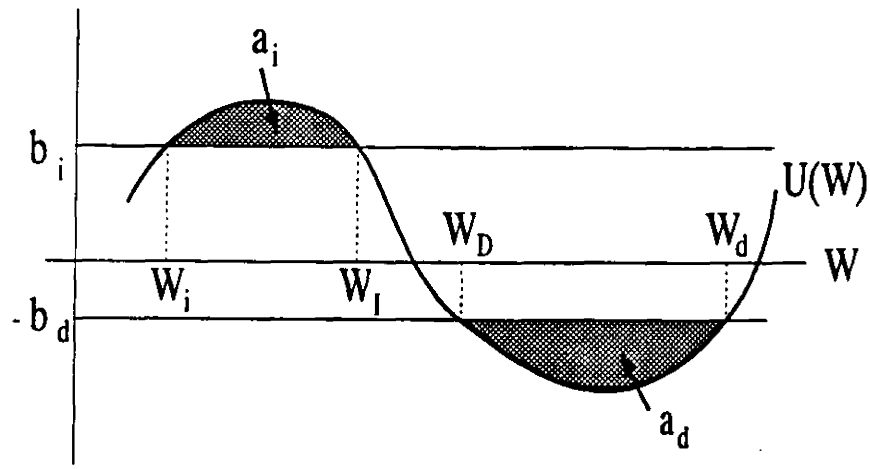
$$\begin{pmatrix} -\alpha(W_I^{-\alpha-1} - W_i^{-\alpha-1}) & \beta W_I^{\beta-1} \\ \alpha W_D^{-\alpha-1} & \beta(W_d^{\beta-1} - W_D^{\beta-1}) \end{pmatrix} \begin{pmatrix} B_1(P) \\ B_2(P) \end{pmatrix} = \begin{pmatrix} F_w(W_i) - F_w(W_I) \\ F_w(W_D) - F_w(W_d) \end{pmatrix} \tag{2.36}$$

and

$$\begin{pmatrix} -\alpha W_i^{-\alpha-1} & 0 \\ 0 & \beta W_d^{\beta-1} \end{pmatrix} \begin{pmatrix} B_1(P) \\ B_2(P) \end{pmatrix} = \begin{pmatrix} -F_w(W_i) + b_i \\ -F_w(W_d) - b_d \end{pmatrix}. \tag{2.37}$$

Therefore, solving for $B_1(P)$ and $B_2(P)$, a nonlinear system can be obtained to yield $\{W_i, W_I, W_D, W_d\}$.

Figure 2.1: Optimal Regulation.



2.4.3 Optimal Reset Strategy

Since an explicit characterization of the solutions involves complex algebra, a heuristical approach is used here to approximate the timing of the exporter's decisions and to compare the size of their price responses with those of a frictionless situation. To see this, define

$$U(W_i) = V(W_i) - V(W_I) = F(W_i) - F(W_I) + B_2(P)W_I^{\beta} \qquad (2.38)$$

and

$$U(W_d) = V(W_d) - V(W_D) = F(W_d) - F(W_D) - B_1(P)W_D^{-\alpha}; \qquad (2.39)$$

and note that U(W) satisfies

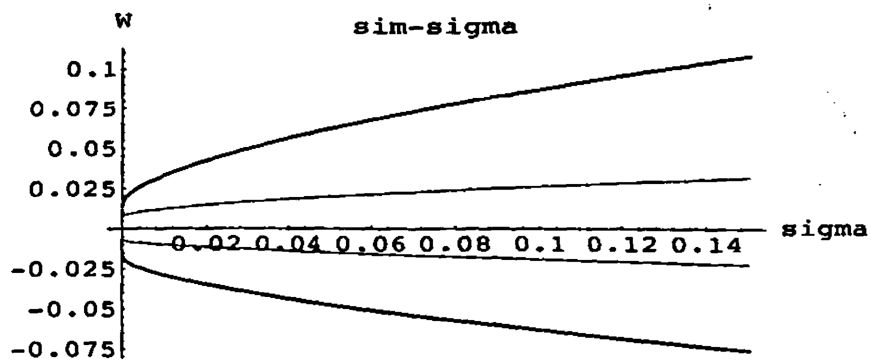
$$-\mu W U_w(W) + \frac{1}{2}\sigma^2 W^2 U_{ww}(W) + (QW - C) - \delta U(W) = 0. \qquad (2.40)$$

Therefore, the *value-matching* and the *smooth-pasting* conditions can be written in terms of $U(W)$ as

$$U(W_i) = -A_i,\ U(W_d) = A_d \quad \text{and} \quad U_w(W) = b_i,\ U_w(W_d) = -b_d. \qquad (2.41)$$

¿From (2.31) and (2.34), it is possible to construct the shape of $U(W)$, as shown in Figure 2.1. If the flow payoff function $f(W)$ is concave and well-behaved, as the maximization problem requires, then $V(W)$ inherits this concavity. Over the range (W_i, W_d), the function $U(W)$ can be interpreted as the exporter's incremental value from adjusting a price. Furthermore, since the optimal control should do better than if no control were exercised, the parameters $B_1(P)$ and $B_2(P)$ must be positive. Observe that $W^{-\alpha}$ and W^{β} are both convex, so when W — W_i, that is, W decreases, the value of the option to increase the nominal price must grow, and $B_1(P)W^{-\alpha}$ dominates $B_2(P)W^{\beta}$ in (2.13); and similarly, when W — W_d, the value of the option to decrease the nominal prices rises, and $B_1(P)W^{\beta}$ dominates $B_2(P)W^{-\alpha}$. In this case, the term $F(W)$ is relatively more important for the middle values of the implicit price W. Consequently, for this

Figure 2.2: $W_d(W_D)$ and $W_i(W_I)$ when the variance of the exchange rate (σ) increases from 0 to 0.15.



configuration, $U(W)$ must be concave at W_i and convex at W_d. Using this argument in (2.11) yields

$$QW_i > C + (\delta + \mu)A_i \tag{2.42}$$

and

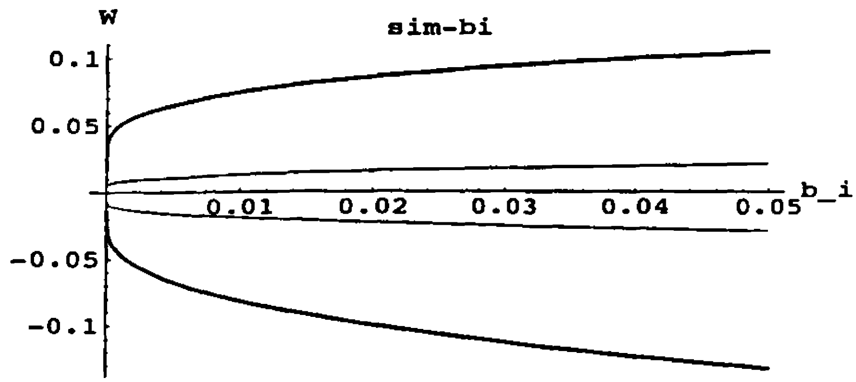
$$QW_d < C - (\delta + \mu)A_d. \tag{2.43}$$

These two expressions show that both uncertainty and costs of adjustment create a range of price inaction, such that the expected discounted value of marginal revenue minus marginal production costs, over the period until the price is changed again, must equal the marginal costs of either price increases or decreases in the future, given the expectation about the motion of W. **Therefore, at these trigger points, the nominal price response would reset W to a level that, additionally to the factors addressed in (2.3), takes into consideration the expectation of the consequences of future actions.**

Given two extreme pricing policies, one determined for instantaneous price adjustments and the other characterized for no-price adjustment at all, it is possible to write the following statement:

Proposition 2 *Provided W follows (2.3), let $V^M(W)$ denote the value function by integrating (2.7); $V^f(W)$, the value function when exchange rate changes are stochastic but price adjustments are costless; $V^c(W)$, the value function under stochastic exchange rate changes and costly price adjustments; and $V^m(W)$, when no price adjustment is exercised, so the process continues according to its given probabilistic law of the motion, and it is obtained by integrating (2.7) for P constant. If $\delta > \mu$, the pricing policies for $V^f(W)$ and $V^c(W)$ exist, such that $V^m(W) < V^c(W) < V^f(W) < V^M(W)$, because adding uncertainty and adjustment costs cannot increase the value of the program, so the integral will be finite. Furthermore, these values are unique if $F(W)$ is concave.*

Figure 2.3: $W_d(W_D)$ and $W_i(W_I)$ when the linear component of cost of price increase (b_i) grows from 0 to 0.15.



2.5 Numerical Results

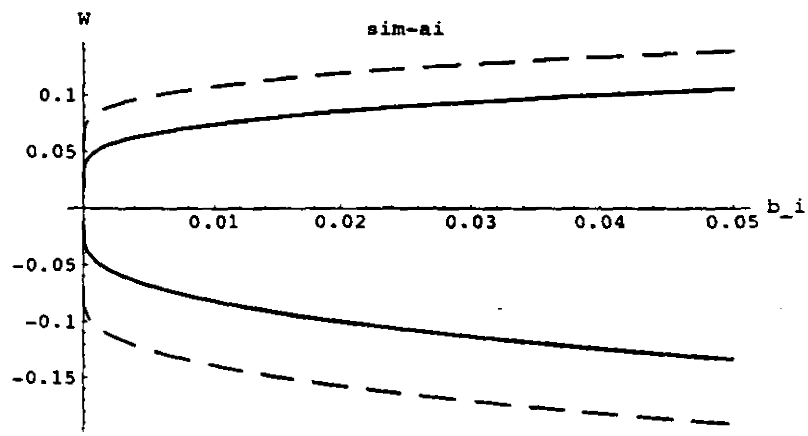
Given that it was not possible to obtain closed-form solutions for W_i, W_I, W_D, W_d, and owing to the complexity of the expressions obtained from (2.35)-(2.37), a numerical solution was necessary to establish the relationship between the parameters of interest and the trigger and reset points. Since Dixit (1989a,b), Delgado (1991) and Dixit and Pyndick (1994) show that, for this type of exercise, results depend on the starting values of the parameters, a special emphasis was devoted to choosing *reasonable* initial values, firstly, to ease comparisons with these studies, and secondly, to prevent abnormal outcomes.

As starting conditions, an appreciation of the exporter's currency with low variance, small costs of adjustment, and a competitive environment were assumed. Furthermore, the demand function was assumed to have a linear form. Starting numerical values of the parameters are specified in the box below:

$\mu=0.05$	$\sigma=0.1$	$\delta=0.1$	$a_i=3$	$b_i=0.03$	$a_d=1$	$b_d=0.01$	$\alpha=100$	$\beta=1.3$	$\rightarrow \varepsilon=30$

Following Rose's (1992) use of *Mathematica* packages for bounded stochastic processes, this sensitivity analysis was performed for three different factors that affect the determination of the trigger and reset prices, and the timing between price changes, as shown in the last section: namely, the parameters of the stochastic distribution of exchange rates, μ and σ, the costs of adjustment, $a_i(a_d)$ and $b_i(b_d)$, and the elasticity of the markup with respect to exchange rate changes or the elasticity of demand, ε. The procedure was to study how a range of variation for these factors affected the gap between W_i and W_d, and, consequently, the nominal price stickiness.

Figure 2.4: W_d and W_i when the lump-sum component of the cost of price increase (a_i) grows from 10 to 15.



2.5.1 Stochastic Distribution of Exchange Rates

As shown in equation (2.6), when the exchange rate volatility increased, the exchange rate process became more uncertain and the expected exchange rate pass-through decreased. Therefore, the way in which the trigger (W_i, W_d) and the reset (W_I, W_D) points behave in the event of an increase in the volatility of the exchange rate (or the implicit price), from zero to 0.15 (which implied a standard deviation of 38% a year) was studied first. Bold lines in Figure 2.2 show the evolution of the W_i and W_d, while the thin ones depict the corresponding values of W_I and W_D. Trigger and reset functions were normalized to zero to ease the exposition of the results. Some facts can be derived from this figure:

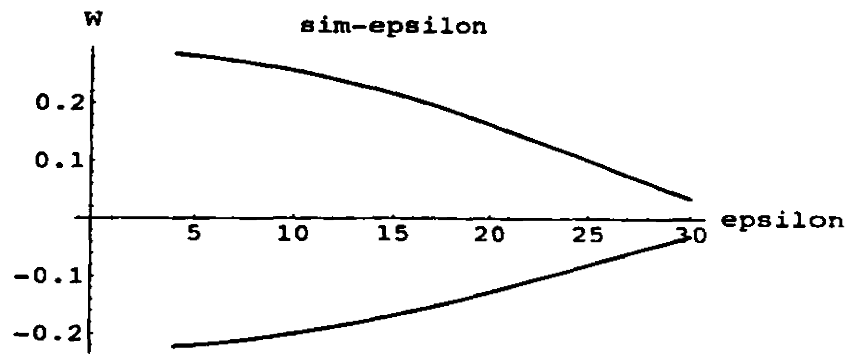
1. As exchange rate volatility grows, the expected rate of growth of the process decreases, since S_{jt} was distributed with mean $S_{j0}+(\mu-1/2\sigma^2)t$. Consequently, *both* trigger functions increase, which coincides with the predictions of Mann (1987).

2. This increment is not uniform. Since an increasing σ *softens* the exchange rate trend, the trigger boundary for price increases (as results from a positive μ) widens more than the opposite boundary, yielding some sort of asymmetry between price adjustments of different signs.

3. However, the reset points fluctuate less than the trigger points, which is a clear indication that, as volatility grows, firms prefer to wait until uncertainty disappears, increasing the range of inaction.

4. Finally, when σ is zero, there is still a distance between W_i and W_d, which shows that the costs of adjustment prevent instantaneous price changes.

Figure 2.5: $W_d(W_D)$ and $W_i(W_I)$ when the elasticity of demand grows from 4 to 30.



2.5.2 Costs of Adjustment

As could be expected, increases in *both* components of the costs of adjustment widen the range of price inaction in Figures 2.3 and 2.4 (similar results can be found in Dixit [1989a,b], Bertola and Caballero [1990] and Delgado [1991]). These graphs present the particular case where the linear component for price increases, b_i, grows, b_d being held constant. It is important to observe that, since there is not a reliable measure of the costs of price adjustment, apart from the estimate of 4% given by Slade (1991)[21], the exercise tested whether small costs would produce enough price rigidity. More precisely, for the figure pointed out by Slade (1991), it was found that W would have to change 8% before the nominal price adjustment occurred. Therefore, it can be concluded that, even if these costs are insignificant, if they exist, they may be responsible for the price stickiness.

Furthermore, this experiment again detected an asymmetry, since an increase in b_i affected W_i more than W_d, which is the type of phenomenon reported by Bentolila and Bertola (1990)[22]. This finding makes sense because, given the dynamic setting of the experiment, when a price increase becomes *more expensive*, the exporter discounts all the possible costs derived from successive price decreases.

Finally, Figure 2.4 shows that an increase in a_i shifts the (W_i, W_d) boundaries outwards (broken line in Figure 2.4), for b_i increasing from 0 to 0.05, such that this increases the difference between the frequency of exchange rate shocks and that of nominal price responses.

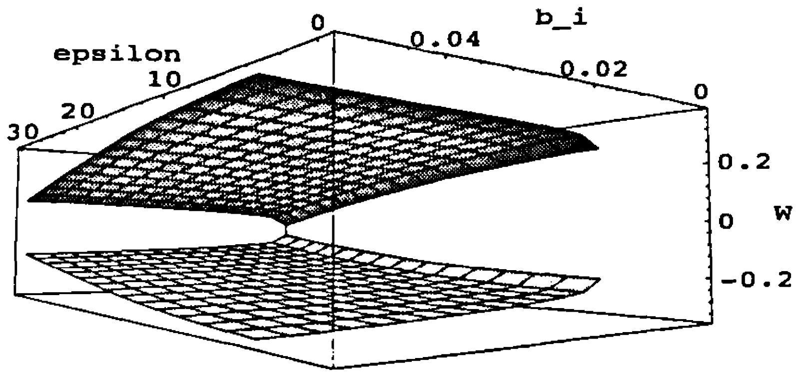
2.5.3 Markup Elasticity

Following Knetter (1989,1993), the way in which the range of price inaction varied as the elasticity of demand changed is studied. The former exercises were performed for an initial value of

[21] See footnote No. 17.

[22] These authors argue that when firing costs decrease, this would not necessarily affect the hiring decisions of firms.

Figure 2.6: W_d and W_i for simultaneous changes in the linear component of the cost of price increase and elasticity of demand.



$\varepsilon = 30$, which implied a markup over marginal costs of 3.4%. Therefore, by letting ε become 4, which implied that firms' markup rose to 33%, allowed us to see whether or not different market structures, subsumed in the value of this elasticity, affected the range of price inaction followed by exporters.

Figures 2.5 and 2.6 provide enough evidence that the elasticity of demand may play a role in deterring price adjustments, as important as those of the exchange rate volatility or the costs of price adjustments. Figure 2.6 shows the joint effect of different ranges of costs of adjustment and elasticity of demand, setting the price *inaction* zone near to 30% of the value of the exchange rate.

Recapitulating, these results points out that, apart from the existence of costs of price adjustment, market structure (and ultimately whose elasticity with respect to exchange rate changes) also appeared to be a major factor in explaining infrequent price adjustments. This finding is very important because, when the existence of costs of price adjustment cannot be proved and measured empirically, or their existence is simply criticised (as already shown), it allows us to explain price rigidity simply based on demand and market characteristics.

Nonetheless, what this section clearly shows is that *waiting* has a value to the exporter, and that, under the number of circumstances described above, enough fluctuation of the exchange rates must have been accumulated to implement a new price sheet.

2.6 Further Developments and Conclusions

Both specifications in Sections 2.3 or 2.4.2 developed a simplified analysis for only one foreign market. However, a corollary to these attempts would consist in studying the interactions between price setting in different markets, such as the example of the newsstand prices of magazines requires. As will be shown in Chapter 4, *multimarket* publishers increase their degree of price synchronization across markets during the 1980s, which spurred the interest for investigating the causes that recommend simultaneous price adjustment, and prevent staggered strategies. To this concern, Sheshinski and Weiss (1992) have studied the similar problem of a *multiproduct* producer, such that it would be possible to distinguish between two forms of adjustment costs that lead to different price timing:

1. **Menu costs**, which are independent of the number of markets in the price list: once the price sheet has to be renewed, it costs the same to change one or ten prices. This extreme form of increasing returns to scale leads to **synchronization**;

2. **Decision costs**, which imply constant returns to scale, since each price has an independent cost of adjustment. In this case, **staggering** is introduced.

Following the same structure as in preceding sections, consider only two different markets, that is, $j = 1, 2$. Assume that the starting implicit price levels are W_{1t} and W_{2t}, at $t = 0$, with different *trend* and *volatility*. Now, denote by $t = T$, the time of subsequent nominal price adjustment, such that the value of the firm can be divided into immediate and continuation profits, once any price change takes place. The value function defined recursively would look like

$$\begin{aligned} V(W_1, W_2) = \quad & \max_T E_0 \Big\{ \int_0^T \exp^{-\delta t} \textstyle\sum_{j=1}^2 f(W_{jt}) dt \\ & + \exp^{-\delta T} \max \Big[\max_{P_1, P_2} V(W_{R1}, W_{R2}) - \textstyle\sum_{j=1}^2 [I_j(dP_{jT} > 0) A_i^j - I_j(dP_{jT} < 0) A_d^j], \\ & \max_{P_1} V(W_{R1}, W_2) - [I_1(dP_1 > 0) A_i^1 - I_1(dP_1 < 0) A_d^1], \\ & \max_{P_2} V(W_1, W_{R2}) - [I_2(dP_2 > 0) A_i^2 - I_2(dP_2 < 0) A_d^2] \Big] \Big\} \end{aligned} \tag{2.44}$$

where

- $A_i^j (A_d^j)$ denote the associated cost of price increases (decreases) in each market j, as shown in equation (2.24), and;

- W_{R1} and W_{R2} are the *reset implicit prices* for market 1 and 2, respectively, such that if $A_i^j (A_d^j)$ has a linear component, they would yield two pairs as (W_{I1}, W_{D1}) and (W_{I2}, W_{D2}).

This primary characterization of the problem shows that multimarket pricing with non-independent costs of adjustment across markets increases the set of possible interactions, and raises questions as

- how large should the linear component of adjustment cost be to preclude price synchronization between markets with *cointegrated* exchange rates? Or inversely,

- if costs of adjustment only account for menu costs, are they sufficient to synchronize price adjustments across non-cointegrated markets?

As will be shown also in Chapter 4, the issue of synchronization has a major importance in identifying empirically *ex-ante* and *ex-post Pricing-to-market* across destinations,[23] or in other

[23] See Giovannini (1988).

words, differences in exchange rate pass-through due to different timing and stochastic structure of exchange rate changes.

The major aim of this chapter was to disentangle a number of factors that contribute to the exchange rate pass-through outcome: While changes in the exchange rate trend dominate in the long-run, short-term deviations from the certain and frictionless paradigm, characterized in (2.1), could be due to the volatility of these changes, and the existence of costs of price adjustment. Thus, these factors would be responsible for the price sluggishness observed empirically, as is the case with newsstand prices of magazines. Nonetheless, when prices are finally adjusted, the *ideal* price path, given in (2.2), contributes to the determination of the pass-through, given the expectations on the motion of exchange rates.

Chapter 3

Interview Study on Newsstand Prices of Magazines

"April price rise. Avoid the April cover price increase. Subscribe now..."
Typical advertisement of *The Economist* subscription offer.

3.1 Introduction

The existence of price sluggishness not only carries important consequences on the theoretical grounds of the exchange rate pass-through, but also to its estimation possibilities. LeCacheaux and Reichlin (1989), Kirman and Schueller (1990) or Herguera (1994) early reported in their study of automobiles prices that the different variability of nominal prices and exchange rates implied that standard regression techniques may fail to capture the true relationship between these two variables. Since this finding also applies to newsstand prices, an appropiate design of the empirical strategy to be followed in this study is needed. Thus, the core of this strategy consists on two different but complementary approaches:

1. Statistic/econometric inference, and;
2. Eliciting directly economic agents' on their own actions and opinions of how events actually occur.

Although the first alternative is dominant in economics, the second strategy has recently received some attention. Kanhneman *et al.* (1986) have discussed some common standards of fairness for price setting. They found some hostile reactions by consumers to price increases that are not justified by increased costs and therefore, viewed as unfair. Blinder (1993) and Hall *et al.* (1996) have proposed instead to elicit firms' opinions on the causes of price rigidity, and have detected that on the supply side there existed additional rules-of-thumb and standard conventions among firms when setting prices. Both articles conveyed the idea that if some considerations of fairness do restrict the actions of profit-seeking firms, economic models might be improved by a more detailed analysis of these constraints.

Provided this sort of interview studies tests whether or not the hypotheses used by economists are useful in explaining firms' real performances, this chapter proposes to apply them

1. to understanding why apparent deviations from a complete exchange rate pass-through could be explained by 'fair' or 'common/standard' behaviour as *instrumental* to the long-run equilibrium, and;

2. to gain some *insider's information* of the current pricing activity of firms.

This chapter presents the results derived from this *less used empirical approach*, and the steps followed to its consecution. The chapter is organized as follows: Section 3.2 discusses briefly whether asking individuals is a convenient way of investigation in economics, and describes how the interview study was carried out. The Appendix contains the questionnaire form: Section 3.3 summarizes the results for the questionnaires submitted to a number of publishers, and derives some implications for the exchange rate pass-through and the frequency of export price adjustment; the chapter finishes with some concluding remarks.

3.2 The Research Design

Newsstand prices are certainly appropriate for studying exchange rate pass-through and price stickiness at a multimarket firm level, since printed prices in different currencies constitute genuine consumer-level data. The first step in the analysis of these prices was to formally request to the publishers the series of weekly posted prices.[1] Despite this should not have implied any type of confidential information, as prices are posted on the front pages and known to everybody, only two, *Newsweek International* and *Le Point*, answered the request. While *Newsweek*'s reply was rather an invitation to collect the prices by looking at the front pages of the weekly issues, *Le Point*, apart from sending nominal price series in a number of markets since 1985, enclosed a revealing letter about its pricing routines, which is instructive to quote here:

> *(...) Nous ne sommes pas en mesure de pouvir vous transmettre tous nos prix depuis 1970 et nous ne pensons pas que beaucop d'éditeurs puissent le faire. Si pour certains pays nos prix de vente sont marqués sur la couverture de notre magazine, c'est que ceux-ci peuvent être maintenus régulièrement en raison de la stabilité monétaire du pays. Pour certaines zones comme l'Amerique du Sud (Argentine,Brésil) ou Israël par exemple le rythme de l'inflation atteignant parfois le 1% quotidien interdit toute mention de prix.*
>
> *Les variations de changes font également que nos distributeurs éloignés (nous exportons dans 83 pays) changent les prix de vente sans réellement nous consulter. Par conséquent, nous ne pouvons pas tenir un registre régulier des prix practiqués dans chaque pays. Nous pouvons toutefois vous apporter des renseignements sur la plupart depuis l'année 1985 où l'informatique nous a permis de mieux collecter l'information,*

[1] Series were firstly requested from Businessweek, Newssweek, Time, Fortune, Le Figaro, Le Nouvel Observateur, Le Point, L'Express, L'Expansion, Il Mondo and The Economist.

> *mais notre distributeur central à a Paris ne possède pas d'archives fiables avant cette période. Nous tenons à votre disposition pour consultation sur place notre collection de parutions depuis 1972 mais encore une fois tous les prix de vente par pays ne seront pas imprimés sur les courvertures car cela n'a jamais constitué une obligation (sauf pour certains pays). En Polynésie et Nouvelle Calédonie par exemple jusqu'en 1986 le prix de notre magazine variait chaque semaine en fonction de son poids et du prix du frêt avion, il n'existe donce aucune trace réelle.* (...) Paris, le 23 janvier 1992. Michel Lefèvre. Directeur des Ventes. Le Point.

Not only this manager foresaw correctly that not many publishers were going to provide the price series, but also raised some fundamental issues when considering export pricing:

- First, for highly inflationary countries, any mention of the price was precluded. Following Tommasi (1993), it seems that in high inflation economies, technologies that save on 'menu costs' are adopted. This reasoning may well be extended to the case of highly volatile exchange rates. These economies are characterized by the absence of catalogs, price advertising and the like, so consumers do not hold much information about prices. Therefore, folk theories that rely on *adjustment* or *information costs* are not unequivocally satisfactory explanations of the relationship between prices, inflation and exchange rates. As a matter of fact, not all prices where a single magazine or newspaper is sold were posted by the producer. For example, in the case of *Le Point*, the front page only displays prices in 24 currencies while the letter above indicated that the magazine is currently sold in 83 countries. Therefore, it may expected that non-posted prices to be adjusted more often to the exchange rate changes than printed ones.

- Closely related is the fact that in some markets retailers have more power to decide prices than in others. This implies that the risk sharing between buyers and sellers varies across countries: in some destinations, publishers fix retail prices in foreign currencies while in other cases they only set an export price in their own currency, and let retailers to decide on the consumer price. Obviously, each practice affects the exchange rate pass-through in a different way, since pass-through on consumer prices affect sales directly, while pass-through on export prices works on the exporters' markups.

Once data on newsstand prices of a number of magazines (see Section 4.2) for more details on these magazines) were finally obtained by *manual methods* and preliminary analyzed, then the interest in trying to contact again the publishers focused on investigating firms' opinions on a series of hypotheses on price determination. Thus, after examining the price series, a questionnaire on this information was constructed. Note that this preliminary statistical examination contributed greatly to the design of the questions, the understanding of firms' answers and the recognition of misleading, poorly thoughful or false responses. Four aspects were taken into consideration when proceeding with the experiment:

1. Questions were posed in plain language, so firms were expected to understand easily and give useful answers;

2. It could be possible that the sample of firms elicited was not representative of the underlying population, and thus no possible inferences could be made. This is, however, a familiar problem to any user of data: that is, when the firms analyzed are not sufficiently representative, their answers become anecdotal, and no useful information can be inferred about the population statistics. However, this is not enough to reject out of hand the questionnaires' responses;

3. Special interest was posed on getting in contact with the *right person* who could answer these questions, prior to the submission of the questionnaires. Once the responsible people were contacted, they were kind enough to collaborate and most of them, at least beforehand, did not reject the possibility of receiving the form;

4. Particular care was required for not being invasive of firms' privacy, promising complete confidentiality of the respondents' identity.

The questionnaire is divided in three sections. The first part investigates the nominal price rigidity, and the lag between changes in the economic environment and firms' price revisions. The second unit is designed to inquire about exporters' opinions on current theories of price adjustment, that is, about the reasons why exchange rate pass-through is not *complete* and why prices remain unchanged for long periods of time. Finally, the last part is basically devoted to the investigation of the effect of exchange rate fluctuations on price stickiness, and the pattern of synchronization among markets.

Two waves of 25 and 20 questionnaires were sent in February and April 1994, respectively, to 45 European and US magazines and newspapers[2] which usually print a list of their prices in markets where they are sold. A number of 29 questionnaires were returned completed. Hence, the response rate was nearly 65 percent.

3.3 Eliciting Firms' Opinions on Pricing

3.3.1 PART 1: Price Stickiness and Lags for Reactions

The interest of this set of questions centered not only on the frequency of price adjustments, but also frequency of simply considering the possibility of changing the price, since the pure contemplation of a revision of a price, even if the price is not actually adjusted, is a resource and time-consuming activity for the firm. For reasons of space, the question could not be formulated independently for each market in which the magazine was sold, and hence it was asked in a general form. Table 3.1 shows the distribution of 'declared' price stickiness. Price rigidity is above one year for half of the cases, and yearly stickiness accounts for near 40 percent of the cases studied. It is interesting to observe the low proportion of more than one change per year. Note, however, since firms were asked how often prices change 'in a typical year', it can be suspected that if the interview had been held in a period characterized by higher inflationary levels or larger exchange rate volatility, the results would have varied.

[2] Exceptionally, there was one Hong Kong magazine sold worldwide.

Table 3.1: Frequency of Price Adjustment

Frequency of price adjustment	**% of magazines**
Less than once per two years	0.0
Once per two years	6.8
Less than once per year	51.7
Once per year	37.9
Between 2 and 5 time per year	3.4
Between 6 and 12 times per year	0.0
More than 12 times per year	0.0
Frequency of considering the possibility of adjusting prices	
Less than once per two years	0.0
Once per two years	0.0
Less than once per year	6.8
Once per year	58.9
Between 2 and 5 times per year	34.1
Between 6 and 12 times per year	0.0
More than 12 times per year	0.0

Responses to the second question in Table 3.1 were believed as more important, because they provided an approximate basis to any price revision: Almost 60 percent of the firms interviewed declared that prices were *revised* normally on an annual basis. which itself implies a pre-condition for price rigidity and consequently, for a lagged response to changes in the economic environment.

Table 3.2: Combination of Frequency and Size of Price Adjustment

Price: change/frequency	Percent of magazines
Frequent and small changes	34.4
Unfrequent adjustments and large changes	27.5
None of these strategies	37.9

Given these two preliminary results, it was also inquired about the time that normally elapsed between a change in costs, aggregate price level, demand or the exchange rate *perceived by the firm*, and an effective price adjustment. Studies of export pricing (as Froot and Klemperer [1989], Kim [1990], Delgado [1991], Feinberg and Kaplan [1992] or Kasa [1992]) have stressed the fact that some empirical studies fail to capture the precise degree of exchange rate pass-through into prices when they neglect the possibility of lags in price adjustments. Contrary to other typical economic experiences, where a one-time change in an exogenous variable at any point in time will affect the expected value of prices in every period thereafter but gradually fade over time, here the short-run effect on prices which occurs in the same period when any state variable changes may be small or null, and a certain time is needed to observe its effect on prices. Therefore, when studying price adjustment in general, and in particular export price adjustment, it is possible to distinguish between a *long-term relationship* between prices and exogenous determinants of the price equation, and a *short-term relationship* which describes the speed of the long-term adjustment.

The performance of these questions was rather poor and heterogeneous among firms. Around a third of the respondents did not give any answer at all. Others only indicated quantitatively the lag between *increases* in costs and inflation, and a *decrease* in the exchange rate (defined as the number of producer's currency units per one unit of foreign), but they did not give any answer to opposite movements in these variables. Eight firms admitted not having a preset pattern. Finally, some respondents filled some of the blank spaces of question 2 in Part 1 of the questionnaire (see Appendix). Nevertheless, when an answer was obtained, the lags clustered between 5 and 9 months. These results contrasted strongly with those of Blinder (1993) who found that for 200 US firms, the mean lags clustered in the 3-4 month range, even though these distributions were quite spread out.

Since firms' pricing policy was characterize in Chapter 2 by the **frequency** and the **size** of the price change, it was also investigated how these two magnitudes are usually combined, as referred in Section 2.4. Results in Table 3.2 do not confirm any of these arguments: indeed it seems that neither of these two strategies is unanimously applied by firms.

3.3.2 PART 2: Evaluation of Pricing Theories

Table 3.3: Summary of evaluation of some non-measurable hypotheses.

Theory	% Affirmative	% Sometimes	% Negative
Implicit contracts	17.2	24.1	58.6
Explicit contracts	23.7	34.1	42.0
Costs of price adjustment	44.8	24.1	31.0
Pricing points	24.1	58.6	17.2
Sunk Costs	17.2	12.0	70.8
	% ↑ Markup	Markup constant	% ↓ Markup
↑ Price	41.3	34.4	24.1
↓ Price	27.5	14.1	58.2

The second section of the questionnaire inquired into a number of pricing theories themselves. The choice of these theories was largely based on Blinder's (1993) study, but was enlarged with some hypotheses related with the exchange rate pass-through theme. This experiment was taken as a guide because of its merits of having inquired first about *economists' opinions* on the testable implications of their own theories. As a result, Blinder reached some useful comments and feedback to be included in his questionnaire, but what is more important, he obtained the approval of theorists about the way in which the investigation was carried out.

For some hypotheses which could involve an unobserved or unmeasurable variable, or those for which there existed the suspicion that they were unknown or hardly familiar to the firm, it was first asked to the respondent if he/she recognized the existence of such an explanation.

Table 3.4: Typical questions and scaled responses.

Do you recognize the existence of ......?	
Answer	Scale
Affirmative	3
Sometimes	2
Negative	1
Do not know/cannot answer	N
How important is ...... in explaining the frequency (size) of price adjustment?	
Answer	Scale
Very important	4
Moderately important	3
Of minor importance	2
Totally unimportant	1
Do not know/cannot answer	N

Table 3.3 shows the level of agreement on their existence or recognition of this type of theories.

The basic structure of the questions is shown in Table 3.4. Each of these theories was succinctly summarized in plain language before the questions were formulated to avoid tediousness and misunderstandings. Table 3.4 also presents how the answers were scaled. Using this tabulation, it was possible to compute the mean score and the standard deviation for each theory. A score of 3.0 as interpreted as excellent, and one of 1.5, remarkably poor. Therefore, it was expected most theories to score between 1.5 and 3.0. Additionally, the *acceptance rate*, that is, ratio of *very important* and *moderately important* scores over the total was computed. Explanations, ordered from best to worst, are shown in Table 3.5. The main findings are presented below.

Table 3.5: Summary of evaluation of theories.

Rank	Theory	Mean Score	% of "3's" and "4's"
1	Cost-based Pricing (freq)	3.31 (0.60)	93.1
	Cost-based Pricing (size)	3.10 (0.77)	75.8
2	Strategic Pricing (freq)	3.13 (0.69)	82.7
	Strategic Pricing (size)	3.00 (0.70)	75.8
3	Pricing Points (freq)	2.48 (0.87)	58.6
4	Costs of Price Adjustment (freq)	2.31 (1.13)	48.2
5	Demand Elasticity (size)	2.13 (1.18)	41.3
6	Judging Quality by Price (size)	2.05 (0.82)	38.8
7	Implicit Contracts (freq)	1.79 (1.11)	24.1
8	Delivery Service (freq)	1.72 (1.03)	20.6
9	Sunk Costs (freq)	1.51 (1.06)	13.7
10	Explicit Nominal Contracts (freq)	1.44 (0.68)	10.3
	Explicit Nominal Contracts (size)	1.34 (0.55)	3.4

• Cost-based Pricing. Exporters were asked if shifts in the costs of production were reflected in price, or rather whether variations in the markups absorbed this change. Some authors such as Dornbusch (1987), Knetter (1989), Marston (1989), Hens *et al.* (1991), have stressed the fact that when measuring exchange rate pass-through into prices it is important to know if substantial changes in costs may bias estimates of the pass-through. What these studies suggest is simply the fact that costs are more passed-through into prices than exchange rates, so any estimation of the pass-through elasticity needs to discount costs.

This theory obtained, for explaining both the frequency and the size of the price adjustment, a mean score above 3.0, and in more than 75 percent of the cases this explanation was ranked as moderately important or very important. The conclusion was then straightforward: Increases in marginal costs seem to be reflected in prices, so it is necessary to separate price movements due to these two different forces. This finding would support Knetter (1989, 1993) econometric decomposition of pass-through tests. Section 3.3.3 discusses which type of cost mostly influences the price adjustment decision.

• Strategic Price Coordination and Market Share. A second reason why prices vary is competitors' price changes. Models of exchange rate pass-through have studied extensively this possibility when strategic effects among competitors influence decisively the firms' decision process, Hens *et al.* (1991), Kirman and Phlips (1992), Herguera (1993), Martin and Phlips (1993) and Baniak and Phlips (1994). If exporters are very sensitive to their competitor's price change in each market, once other firms move, they will follow quickly. Or, conversely, if the exchange rate trend causes a particular price movement, but competitors do not move, the pass-through may be null or delayed, and markups will vary.

The mean score for this explanation was also above 3.0, and the acceptance rate accounted for more than three-quarters of the respondents. Therefore, cost-based pricing and strategic price coordination appeared to be two pre-eminent reasons in explaining both the size and the frequency of the price adjustment.

• Pricing Points. Following Blinder (1993), I also investigated whether certain prices were psychological barriers which firms were reluctant to cross. Only 17.2 percent of the firms denied the existence of these pricing points (see Table 3.3), and most of them accepted that sometimes they occur. For a product such as magazines or newspapers, where repeated sales are very close in time and consumers certainly know the price, this theory makes some sense. Hence, if pricing points sometimes exist, they will cause some degree of price rigidity. This explanation scored 2.48, and, within the subsample of the firms who accepted the existence of these pricing points, almost 60 percent of the respondents thought that these points were important in explaining price stickiness.

• Costs of Price Adjustment. As shown in Chapter 2, this factor has received a great attention from theorists in recent years (Barro [1972], Sheshinski and Weiss [1977,1983,1992], Benabou [1992]) but the empirical counterpart of the models is rather scarce (Sheshinski *et al.* [1981], Cecchetti [1986], Slade [1991], Dahlby [1992]). The relationship between costs of adjustment and export prices has been pointed out primarily by Kasa (1992). This part of the questionnaire first explained briefly the nature of these costs (menu and transaction costs), and inquired the firms if they recognize their existence and if they were important in determining the behaviour of prices.

Results from the experiment conferred a certain importance to this theory. Around 45 percent of the firms accepted that these costs existed but a third rejected this hypothesis. Surprisingly, there were some respondents that admitted to recognising these costs *sometimes* (see Table 3.3). However, of those firms who experienced some costs of adjustment, only half of them considered this to be at least a moderately important factor. The theory reached a score of 2.31 which connoted a certain relevance to the costs of price adjustment.

• Demand Elasticity, Markups and Prices. Changes in demand elasticities and markups, when prices are pushed to change due to exchange rate fluctuations, have received some attention from Krugman (1987), Froot and Klemperer (1989) and Knetter (1989,1993a). These studies stress that the response of export prices to exchange rate changes ultimately depended on the convexity of the demand schedule which sellers perceive themselves as facing. If marginal cost is constant, both perfect and imperfect competition with constant elasticity imply that exchange rate pass-through into prices would be complete, and for the case of imperfect competition, that the price charged to each market would be a fixed markup over marginal cost.

However, if it is assumed that marginal cost is constant but demand elasticities change with changes in the destination currency price[3], this would surely vary price reactions to exchange rate changes, as shown in Section 2.2. Therefore, if demand elasticities alter with changes in the local currency price, then price discrimination among different demand schedules may appear, and consequently *Pricing-to-Market* takes place.

When these issues were formulated in the questionnaires, some of attention to putting them into plain language so as to avoid any misunderstanding. Of course, terms such as convexity or elasticity of demand were omitted from the questions. I asked questions for both upward and downward movements in prices in order to ascertain how firms perceive demand, and how this perception influenced price adjustment. A preliminary evaluation of both questions is presented in Table 3.3. It was found that price increases leave the markup unchanged in more than a third of the cases, while around 40 percent of the firms answered that it usually grows. Markup reductions account for a quarter of the responses. Price reductions strongly indicated that markups decreased. Therefore, it could inferred from these statistics that demand elasticity was not normally perceived as constant, and some degree of convexity was sometimes expected.

Finally, cases of increasing and constant markups when prices rise, and for decreasing and constant markups when prices fall, were evaluated. For both alternatives the score was above 2.0, and thus still of major importance.

• Judging Quality by Price. Sunk Costs. These two explanations are jointly presented because they affect, respectively, the downward and the upward rigidity of prices. Judging Quality by Price constitutes a psychological factor when deciding to adjust a price or not: if a price cut

[3]Some empirical studies of pass-through by Knetter (1989,1993a), Balaguer (1994), Ghosh and Wolf (1994) and Herguera (1994) have found evidence that the constant demand elasticity hypothesis may be ruled out. For example, Knetter underlines the fact that *local-currency price stabilization* is only possible if exporters perceive demand schedules to be more convex than those implied by a constant elasticity.

could be interpreted as a reduction in the product's quality, firms might be reluctant to push their prices down. Despite the fact that this may sound naive, this is not so when discussing export pricing. As explained in Section 1.3, when the exporter's currency depreciates, a *normal* reaction, *ceteris paribus*, implies a reduction in price, which does not always occur.[4] As a matter of fact, this theory, as formulated by Blinder (1993), emphasizes the downward rigidity of prices detected in many studies, for example, in Rotemberg (1982b). In fact, Kahneman *et al.* (1986), when studying standards of fairness for pricing, detected that rather than decreasing printed prices, firms preferred temporary discounts.

For the case of a permanent depreciation of the exporter's currency, Krugman (1987), Knetter (1989,1993a) and Martin and Phlips (1993) have found that firms were reluctant to decrease prices for certain goods where firms enjoyed a large monopolistic power, or where products' characteristics were not easily substitutable. Then, as these authors point out, profit margins grow without a risk of being cut by possible competitors. We could therefore also speak about *local-currency price stabilization*, as coined by Knetter (1993a), for upward trends of markups when prices tend to be unchanged in the buyers market.

With respect to the interview responses, it was interesting to observe that in Blinder's exercise, respondents gave to this theory the worst aggregate score, 1.45, while in this exercise, Judging Quality by Price performed better. Recall that Blinder (1993) carried out his experiment on domestic pricing practices for 200 US firms. In this case, exchange rates would only affect domestic prices indirectly through changes in competitors' import prices when the US dollar appreciated. Now, an average score above 2.0, but with the largest variance, could still be considered at least, relevant in explaining, downward rigidity of prices when the long-run relationship between prices and exchange rate fluctuations would predict a negative adjustment of prices.

In contrast, the existence of sunk costs linked with the *beachhead/hysteretic* or *bottleneck* effects, may preclude price increases when the export currency appreciates if higher prices could reduce firm's market shares and sales, and induce an exit from the market. This explanation has been studied extensively by Baldwin (1988b) and Baldwin and Krugman (1989), and in its dynamic versions by Dixit (1989a) and Delgado (1991). The importance of this theory was less clear, owing to the fact that an important number of respondents did not confer much importance to sunk costs when starting their activities in foreign markets.

• Implicit Contracts. This explanation denotes the 'invisible handshake' theory that firms have implicit understandings with their customers which prescribe price increases when markets are tight. As described by Kahneman *et al.* (1986), consumers may be hostile to price increases that are viewed as being unfair. Almost 60 percent of the firms rejected the idea of the existence of these contracts or understandings. Furthermore, within the group of positive respondents, less than a quarter felt this to be a factor of major importance.

• Delivery Service. The idea which this theory conveys is that price is but one of several elements that matter to buyers. Therefore, rather than adjust prices following changes in inflation,

[4] A statistical analysis of newsstand prices of nine magazines for periods of more than 10 years confirm this observation.

costs, sales or that exchange rates, firms prefer to shorten (lengthen) delivery lags or provide more (less) delivery services. For the case of magazines and newspapers, it seems that delivery and transportation services are rather contracted with distributors than supplied by producers themselves, or they are not easily changeable. Instead, Koeln and Rush (1990) noted that some magazines reduced the number of non-advertising pages during the periods when they did not adjust nominal prices. Common knowledge also suggests that sometimes price reductions may be substituted by some sort of special offers or gifts to readers.

Nonetheless, this theory performed relatively worse when compared with Blinder's (1993) estimates in which it yielded the highest score, hence this explanation also had a minor importance.

• Explicit Nominal Contracts. Explicit contracts fixing nominal prices do not add any new economic reasons for a particular behaviour of prices: instead they formalize in a contractual document some of the factors discussed above such as cost increases, strategic responses, exchange rate surprises, adjustment costs.... The existence of explicit written contracts between producers and retailers has been discussed largely in the literature as one of the major determinants of both the size and the frequency of price adjustments. First, some articles have investigated the *'contract period theory'* which says that there is a set time period with fixed, or otherwise, predetermined, nominal prices. They study mainly how contracts are determined, and linked successively. For instance, on one hand, Ehrenberg *et al.* (1984), Cecchetti (1985,1987), Dye (1985) and Dazinger (1987) reported no relationship between contract duration and inflation, since longer contracts have better indexation provisions. On the other hand, Carlton (1986) considered that a durable relationship between buyers and sellers could influence price decisions in the sense that if they have not had long associations, they would be more likely to use fixed price contracts, because they do not trust or know each other. The 'cost' of changing the price in such a contract is the risk of creating mutual distrust. Prices will change in these contracts only for substantial price movements. Buyers and seller who have had long associations are not as worried about mutual distrust, hence price changes are more frequent. Finally, as shown by Magee and Rao (1980a) and Bilson (1983) in Section 1.5.6, explicit contracts may include clauses that indicate the invoicing currency of the transaction, which ultimately determines which trader bears more risk in the transaction.

Results in Table 3.3 show that more than 40 percent of the respondents neglected the existence of explicit contracts concerning prices. Amongst those who admitted their existence always or sometimes, the theory scored the worst (under 1.5) which suggests that price adjustment mechanisms are not explicitly contained in contracts. Recalling the argument expressed in the letter quoted above, this may be explained by the fact that in most of the markets, prices are not printed by exporters, and retailers enjoy a certain autonomy in deciding when and by how much to change prices.

3.3.3 State Variables and Price Adjustment

The rest of the questionnaire can be divided into two parts. Respondents were asked to rank some state variables depending on how much they influenced pricing decisions. The typical candidates were inflation in foreign markets, sales, exchange rates changes, (defined as the number of currency units of the producer's country per unit of foreign currency) and cost shifts. Questions and scores were formulated in the same fashion as before: *How important....* Results are summarized in Table 3.6. The questionnaire requested a valuation from 1 to 5 for each of the pertinent variables. It was found that the exchange rates, magazine's domestic price and foreign inflation were the three variables most valued by firms when deciding export prices, whilst, domestic inputs and transportation and mailing costs were placed at the bottom.

Table 3.6: Valuation of some state variables for pricing decisions in foreign markets.

Rank	State Variables	Mean score	% of "4" and "5"
1	Exchange rates	3.86 (1.24)	68.9
2	Magazine's domestic price	3.55 (1.08)	58.6
3	Foreign inflation	3.55 (1.08)	44.8
4	Home inflation	2.93 (1.33)	31.0
5	Foreign competitor's prices	2.79 (1.14)	37.9
6	Foreign inputs	2.77 (1.02)	38.6
7	Foreign sales	2.51 (1.32)	31.0
8	Transp. and mailing costs	2.24 (0.78)	6.8
9	Domestic inputs	2.17 (1.25)	13.7

In the light of Table 3.5, it is possible to infer that those costs that affect mainly the cost-based strategy were the foreign ones. Nonetheless, the newspaper's domestic price also obtained a high score, which may indicate that this price may be a baseline in determining foreign prices. Transportation costs and domestic input were the least voted for. It is also interesting to note that fluctuations in foreign sales attained a medium score which suggests that swings in demand are absorbed by markups, as the pass-through literature has pointed out.

Table 3.7: Evaluation of the effect of inflation and exchange rates on the size and frequency of adjustment.

Rank	Variable	Mean Score	% of "3's" and "4's"
1	↑ Inflation,↑ Price change	3.44 (0.50)	100.0
2	↓ Exch.rate,↑ Price change	3.17 (0.92)	86.2
3	↑ Exch.rate volatility,↓ Price rigidity	3.03 (0.73)	75.8
4	↑ Inflation,↓ Price rigidity	2.86 (0.99)	65.5
5	↑ Exch.rate volatility,↑ Price change	2.42 (1.03)	58.6
6	↑ Exch.rate,↓ Price change	2.17 (1.52)	39.7

Two hypotheses about the distinction between trend and volatility changes in the exchange rate, inflation in foreign markets, and size and frequency of price change were investigated.

Giovannini (1988), Fisher (1989a), Froot and Klemperer (1989), Mann (1987) and Herguera (1994) have distinguished between exchange rate *trend* pass-through and exchange rate *volatility* pass-through. These studies found that an increase in the volatility of the exchange rate led to an increase in the price, and in general, a decrease in the total quantity traded in the industry.

More interestingly, three hypotheses already mentioned in this dissertation were asked in questionnaires:

- The (R_i, R_I) hypothesis formulated by Sheshinski and Weiss (1977), which established that increases in inflation implied larger price increases, the adjustment dates being constant, or shorter periods for identical price changes, or some solution in between (see Figure 4.3);
- The interaction of changes in exchange rate trend and volatility in determining the degree of pass-through, and;
- The existence of exchange rate pass-through asymmetries between appreciations and depreciations.

Table 3.7 reveals that the exchange rate volatility influenced the price rigidity more than the size of price change, while the opposite applied for inflation rates. Therefore, risk averse firms prefer to shorten the time between price revisions rather than setting a larger price in response to the increase in exchange rate uncertainty. Firms responses, however, again suggested that prices were more prone to increases in the event of an exporter's currency appreciation than to decreases following a depreciation, which indicates that the experience of import prices in the 1980s in the US reported by Mann (1986,1987), Baldwin (1988b), Hooper and Mann (1989), Knetter (1989,1993a) and Froot and Klemperer (1989) was not only due to the exporters' belief on the *temporary* swing of the US dollar, but rather because exporters were not fond of decreasing prices in the US market, given the downward rigidity of many product prices.

Finally, models of exchange rate pass-through have usually raised the issue of multimarket price discrimination, the *Pricing-to-Market* strategy (Krugman [1987]): If price adjustments across markets are perfectly synchronized, then it is possible to find *ex-ante Pricing-to-Market* and voluntary price discrimination. If price adjustment are staggered, we could speak about *temporary Pricing-to-Market*, until a new price change occurs. Note that despite this explanation has been addressed by a number of authors, it has not been sufficiently analyzed at an empirical level.

Table 3.8: Multimarket pricing strategies

Strategy	%Affirmative	%Sometimes	%Negative
Markets treated as Independent	82.7	17.2	0.0
Multimarket Price Synchronization	10.3	65.5	24.1

Table 3.8 summarizes the results for the price setting synchronization. It was found that markets were mostly considered independently, and that there was not widespread agreement about

the time pattern of price adjustments in several markets. which further complicates exchange rate pass-through comparisons in the short-run.

3.4 Concluding Remarks

This chapter constitutes an attempt to measure some pricing hypotheses. formulated according to theories in use. Based on Blinder's (1993) experiment on 200 US firms' responses on pricing behaviour. I studied export price adjustment combining theories on price stickiness and explanations of the sensibility of export prices to exchange rate fluctuations.

The results from the interviews suggest that

1. Prices were revised on an annual basis. which constituted a constraint for lagged price adjustment in the event of changes in the economic environment. and in particular to exchange rates;
2. Costs of production and competitors' decisions were very important in determining foreign prices;
3. Among the current explanations of exchange rate pass-through. it was shown that the perceived elasticity of demand and the costs of adjustment very much determined the elasticity between prices and exchange rate changes. It seems that price elasticity of demand was not perceived as constant by exporters. which affects price revisions;
4. Exporters recognized that some prices were psychological barriers that they were aware of crossing;
5. Respondants declared that the importance of sunk costs and beachhead or bottleneck effects was rather modest in determining price adjustments. Firms also rejected the idea of pre-established behaviour of prices by tight contracts;
6. Investigation of the state variables that must enter into the pricing equation. showed that exchange rates, magazines' domestic prices, foreign inflation and competitors' prices were the main factors to be taken into account. More importantly. increases in exchange rate volatility. instead of increasing prices as some theorists[5] have suggested. tend mainly to decrease the duration of prices;
7. In contrast. there was overwhelming evidence of asymmetric price rigidity to positive and negative shifts in the exchange rate: export prices were proved to be more downwardly rigid when exporter's currency depreciates than upwardly rigid when exporter's currency appreciates, which indicates that firms let their markups increase. and exchange rates are not passed-through.

As a conclusion, it might be said that some of the models of exchange rate pass-through in use should reflect not only the incompleteness of the reaction of prices to exchange rate fluctuations,

[5]See Ethier (1972), Baron (1976), Clark (1983), Giovannini (1988) and Donnenfeld and Zilcha (1991).

but also the speed of this adjustment. It was interesting, however, to discover how multimarket exporters confirm that markets can be treated as independent, opening the possibility of price discrimination across countries, while a price adjustment synchronization was not the rule. Therefore, costs of adjustment relevant to this case should be interpreted as *decision costs*[6] (acquiring information on production, demand and costs related to the organization, with these costs being dependent on the number of prices adjusted), rather than *menu costs*, linked with advertising and updating pricing lists which, on the contrary, are independent of the number of prices changed.

Nonetheless, the most interesting aspect of this study would be to contrast its results with those of the quantitative analysis of the next chapter because, if the findings obtained by directly inquiring of firms about their opinions are coincident with what they do in real life, it could said that this chapter contributes to the support of this type of methodology, as Blinder (1993) claimed, apart from reinforcing the conclusions exclusively related with the theme studied.

[6] See Cecchetti (1986), Sheshinski and Weiss (1993).

Chapter 4

A Panel Study of Newsstand Prices of Magazines

"One has only to imagine what would happen to business calculations and plans if the number of ounces in a pound, or of inches in a foot, were... variable, and then to remember that, whereas these measures enter only into contracts concerning goods sold by weight or length, the monetary unit enters into every single economic contract of any kind whatever, to get an idea of the extent of the damage to economic efficiency for which a monetary system that is unreliable, or imperfectly understood, may be responsible." Barbara Wooton, quoted in George N. Halm, *Monetary Theory*, Philadelphia, 1942.

4.1 Introduction

The plethora of theoretical work on industrial economics in the 1980s, based on advances in game theory, renewed in some degree the primary interest of researchers for empirical studies of markets and industries. This fact has been pointed out recently by Bresnahan and Schmalensee (1987), Bresnaham (1989) and Kirman and Phlips (1993), who recognized that empirical work in industrial economics has largely benefited from the latest theoretical advances, new and better data sets, and the use of the most recent econometric techniques. Indeed, earlier empirical studies not only suffered from unsound theoretical foundations, but also from the scarcity of data at micro level.

This thesis shares the same interests of these studies, and analyzes data on newsstand prices of magazines. Similar type of data have only been studied by Cecchetti (1986) and Ghosh and Wolf (1994).[1] This particular choice was rather motivated by three different but strongly interrelated issues already presented in Chapter 2:

1. The transmission of exchange rate changes into newsstand export prices at a multimarket

[1] Different aspects of pricing in the publishing industry have been studied by Merriless (1983) - price competition among Australian newspapers; Joyce (1990) and Delorme *et al.* (1994) - price discrimination and quality in journals; Cutcheon (1994) - advertising rates.

level (Dornbusch [1987], Baldwin [1988b], Baldwin and Krugman [1989], Knetter [1989, 1993a], Hens et al. [1991]);

2. The sluggish price response when there exist costs of price adjustment (Sheshinski and Weiss [1977, 1983], Cecchetti [1986], Dixit [1989a,b], Dahlby [1992]), and;

3. The multimarket synchronization of these price adjustments (Sheshinski and Weiss [1992])

Cover prices analyzed in this chapter are not the only revenue source for newspapers. As a matter of fact, newspapers have two additional revenues, which surely play an important role in explaning newsstand prices:

1. *Subscription rates.* Publishers basically sell their newspapers as spot sales on newsstands, and as subscriptions. Subscriptions might provide information about the long-term demand (see Carlton [1979]), and can reduce both the cost of operating in an uncertain environment, characterized by the transaction costs associated with finding buyers in the *newsstand* or *spot market* and, the variability of the cash-flows. In fact, in the *newsstand market*, publishers feel that they cannot sell all they want at the current printed prices and consequently, given that some prior commitment of production is needed, they can over/underproducing (see Carlton [1978]). Provided that prices do not vary continuosly to meet demand, uncertainty in demand is absorbed by changes in rationing frequency.

2. *Advertising rates*[2], which may also influence newsstand prices in a number of ways.

Nonetheless, the collection of this sort of data was troublesome. *Ulrich's International Periodicals Directory*, which contains detailed information on periodicals around the world, including subscription and advertising rates, did not provide this information for all the magazines and markets. Hence the possibility of jointly studying newsstand prices with subscription and advertising rates was neglected, as was desirable.

This chapter starts describing the data, the markets and the magazines studied. The remainder of the chapter is then divided in two large sections, corresponding with an analysis of the newsstand prices in a **closed** and **open economy** scenarios:

• Section 4.3 begins relating some basic features of pricing such as frequency and size of nominal price changes. Following Sheshinski and Weiss (1977, 1983), substituting W by R as state variable, where R denotes the real or deflated nominal price, a closed economy version of the model in Section 2.4.2 is tested. Therefore, the stochastic structure of inflation is sufficient to describe a pricing strategy made of lumpy and unfrequent changes. The estimation of this model also implies the use of Discrete Dependent Variables Model, which is also explained.

• Section 4.4 focuses on exchange rate pass-through into export prices, and test some specifications based on Section 2.2 (demand-side). Since tests on pass-through proved to be hard to carry out because of price stickiness, the (W_i, W_d) model of Section 2.4.2 was tested using again a Discrete Dependent Variables Estimation. Evidence of the existence of incomplete exchange rate pass-through into export prices, and asymmetries between appreciations and depreciations is found. Furthermore, the nature of the *Pricing-to-Market* is studied.

[2] See Cutcheon (1994).

The final section summarizes the main findings of this analysis and suggests some directions for future research.

4.2 The Data

To study pricing, and in particular the pricing of exports, requires data not readily available. Ideally one would like observations of the changes in the transaction price of a consistent and homogeneous product[3] over a period of time long enough for there to have been substantial variation in economic conditions. In addition, the product price must not be the outcome of a continuous auction market mechanism because these prices change costlessly between each transaction.

Data on the newsstand or cover prices of magazines satisfy these requirements. The prices exhibit the properties of discrete and infrequent adjustment, suggesting that they are not the result of an auction mechanism. Series on newsstand prices of magazines are the prices effectively charged to consumers. Furthermore, magazines are non-storable goods, so consumption could not be postponed.[4].

The data used in this thesis is based on newsstand prices of magazines. Series were collected on a weekly basis, but since there was not a substantial number of price changes within the month, monthly data is employed. For each magazine n, a basic $T \times J$ matrix of prices $\Pi^n = [P_{jt}^n(j)]$ was constructed, with $n = 1...N, j = 1...J, t = 1...T$, where n represents a particular magazine, j is the jth market where the magazine is sold, t is time, and (j) indicates that the price is expressed in market j's currency. The size of $T \times J$ varies across magazines: for each periodical, there was a particular number of markets, and a different length of series. However, for successive exercises, some homogenization in time and markets was performed. There is no blank or empty cell in these matrices, which facilitates greatly the calculations. The magazines and the periods studied are:

Businessweek.	January 1981-May 1992.	13 markets.
Fortune.	February 1983-March 1992.	11 markets.
Newsweek.	December 1977-June 1992.	11 markets.
Le Figaro.	October 1978-December 1988.	14 markets.
Le Nouvel Observateur.	October 1977-May 1992.	11 markets.
Le Point.	March 1976-May 1992.	13 markets.
L'Express.	March 1978-December 1988.	9 markets.
Il Mondo.	February 1980-May 1992.	10 markets.
The Economist.	March 1978-May 1992.	12 markets.

This choice is explained exclusively by the availability of the data. Not many magazines since late 1970s were sold both at home and abroad, and displayed the nominal prices in several markets in their front pages. Among these magazines, there were a number which did not report prices for enough markets, or for which the series were interrupted arbitrarily during

[3]Kirman and Schueller (1990) analyze prices of 17 models of automobiles for five European countries and, as far as all major features were concerned, the models were the same in each country. Nevertheless, there exist minor differences, although these should not have a significant effect on differences in price.

[4]Only libraries may consider the possibility of delayed consumption and storage!

some time. Hence, these were excluded from the study. Finally, although nowadays some of the magazines listed above report prices in more markets than those considered in this study, the length of the series is, unfortunately, too short.[5] Furthermore, in some markets, prices were available for all the magazines above: for instance, prices in Italy, Spain and Switzerland were obtained for all the magazines; prices in Germany were obtained in eight and prices in Belgium, France, Netherlands, United Kingdom and the US in seven magazines.

Therefore, these characteristics allowed not only to test the multimarket pricing features of a particular magazine, but also the multifirm competition in a market.

(For more details on the series of newsstand prices, see the Appendix.)

4.3 Price Rigidity and the Closed Economy Price Triggering

This section investigates the degree of price rigidity to contribute to the understanding of the price stickiness itself, and the apparent incompleteness of exchange rate pass-through, as will be shown later.

4.3.1 A Review of Empirical Studies on Nominal Price Rigidities

Since well before the publication of Keynes' *General Theory*[6], industrial economists have been aware that the responsiveness of prices to changes in the economic environment differs sharply across industries. Notwithstanding this early intuition of these incipient works, there have been few empirical studies that have well documented these differences in a systematic way. Quite a long time passed until a new and formidable attempt was performed by Stigler and Kindahl (1970), who collected prices from buyers for a large number of products mainly in the US. This data was later analyzed in a seminal paper by Carlton (1986), in which he set the basis for studying any structural relationship between sellers' and buyers' characteristics, and the price rigidity. He found a significant degree of price stickiness and a negative correlation between rigidity and the length of association between transactors. However, not all prices were rigid or remained unchanged for substantial periods of time.[7] This diversity in the pattern of price adjustment relative to the economic environment reinforced the interest in the analysis of nominal prices. More recently, Kashyap (1994)'s study of retail catalog prices of 12 goods over the past 35 years has reached basically the same conclusions obtained by Carlton's work for a time-series panel.

Apart from documenting price rigidity, other studies have tested some theories on price adjustment. Some empirical studies on '*contract period theory*'[8] such as Ehrenberg *et al.* (1984) and Cecchetti (1987) reported no relationship between contract duration and inflation,

[5] For example, the front cover of *The Economist* nowadays displays prices in 36 currencies, but this is relatively recent.

[6] For example, see Mills (1927) or Means (1935), who suggested that the degree of 'complexity' of a product was related with the degree of price rigidity.

[7] "The fixed costs of changing price at least for some buyers may be small. There are plenty of instances where small price changes occur", Carlton [1986], p. 638.

[8] See Chapter 2.

since longer contracts have better index provisions. Alternatively, based on the existence of *cost of nominal price adjustment models*, other articles have studied whether it is possible to determine a price inaction for a sufficiently long period. For example, Sheshinski *et al.* (1981) studied monthly prices for 15 years of two goods (instant coffee and noodles) produced by two local monopolists in Israel, a market characterized by high levels of inflation. They found that the starting real price in each price spell and the ending real price tend to increase, which did not support Sheshinski and Weiss' (1977), as shown below. One of their main findings was that the frequency of price changes increased greatly. Another famous attempt in this field is Cecchetti's (1986) study of newsstand prices of magazines. Using a similar technique to Sheshinski and Weiss (1977) - Discrete Dependent Variables estimation - he analyzed annual data on the cover prices of 38 magazines in the US over the period from 1953 to 1979. He showed that prices exhibited substantial price stickiness, allowing their real prices to be eroded by as much as one-quarter before implementing a price change. In this case, the costs of nominal price changes decrease either with increases in the frequency of adjustment, or with decreases in the size of a real price change, suggesting that price setters opted for more frequent price adjustments when inflation is higher, and that adjustment costs fall as changes become more frequent. A similar exercise was performed by Ghosh and Wolf (1994), for monthly prices of *The Economist* in 12 markets between 1973 and 1990, which pointed out the importance of menu costs in explaining the speed of the exchange rate pass-through. Dahlby (1992) included, in addition to costs, some information on demand. She used data on car insurance rates for 69 firms in Canada from 1974 to 1982, and found that a model which ignores future inflation performs as well as to one that does consider it.[9] Nevertheless, their estimates did not support firmly the Sheshinski and Weiss (1977) benchmark structure. Finally, other studies such as Domberger (1987)[10], Van Hoomissen (1988)[11], Lach and Tsiddon (1992)[12] and Tommasi (1993),[13] have stressed the importance of expected inflation in explaining price dispersion across products. More importantly, even in high inflation environments, price settings are not trivially short and price changes do not synchronize across firms.

To summarize, studies on price rigidity have analyzed how different inflationary regimes characterize the individual behavior of nominal prices, and the distribution of the frequency and the size of price adjustment. Although the conclusions depend greatly on the characteristics of the data used (basically on the number of dimensions these data contain, the level of microeconomic disaggregation, time basis, etc...) these studies stress two basic features:

1. Nominal prices show a persistent degree of stickiness, even in a changing economic environment and, perhaps more importantly,
2. The tension between empirical tractability and microeconomic reality is, sometimes, difficult to resolve. Hence, any effort in this direction is becoming increasingly valuable to this subject.

[9] Note, however, that inflation rates in Canada are relatively low.

[10] He studies quarterly price data of 80 disaggregated commodity groups in the United Kingdom from 1974 to 1984.

[11] She analyzes monthly price data for 13 uniquely defined goods sold in Israel between 1971 and 1984.

[12] Price adjustments of 26 food products during two inflationary episodes in Israel, 1978-79, 1981-82 and the first nine months of 1984.

[13] He studies weekly prices of 15 products in 5 supermarkets in Buenos Aires, from February to December 1990.

Table 4.1: Price Rigidity by Magazine

Magazine	# Markets	$\widehat{D^n}$ (months)		s.d. of $\widehat{D^n}$ (months)		$\widetilde{D^n}$ (months)	
		not cens	cens	not cens	cens	not cens	cens
Businessweek	13	18.6	22.8	18.8	24.2	24.2	29.0
Fortune	11	22.9	23.0	20.0	18.6	30.4	30.2
Newsweek	11	16.7	16.6	12.1	13.8	17.3	17.4
Le Figaro Mag.	15	12.5	14.2	10.6	13.4	14.8	16.7
Le Nouvel Obs.	11	12.1	14.7	10.6	15.6	14.2	16.7
Le Point	13	16.1	17.3	13.1	13.5	18.9	19.5
L'Express	9	16.2	15.2	13.6	13.4	17.4	16.1
Il Mondo	10	14.9	14.7	12.3	12.1	15.8	16.3
The Economist	12	13.3	12.7	10.1	10.1	15.0	14.2

4.3.2 Rigidity of the Newsstand Prices

Aggregate Price Rigidity

The term *spell* denotes the period between two sucessive price adjustments where a price stays in a specific level. The spell length or *duration* can be respresented by a random variable D_s. Therefore, observations of the *duration* will typically consist of a cross section of *durations*, $d^n_{1j}, d^n_{2j}, \ldots, d^n_{sj}, \ldots$, where d^n_{sj} is a realization of D_s of the sth *spell* for a particular magazine n in market j. The process observed may have begun at different points in calendar time. Thus, the *duration* may be *censored* if the measurement is made while the process is ongoing. Observations of durations of spells can suffer from two types of censoring: a duration is said to be *left-censored (right-censored)* if the price before (after) the first (last) sample observation is the same, so the duration of the corresponding spell could be higher. In this exercise, no account for *left-censoring* is taken, since most of the series started at a price adjustment, and hence, for each price series, a maximum of one right-censored spell could be obtained.

Table 4.1 and and Figure 4.8 present two gross measurements of this duration at aggregate level. Define the *aggregate average duration of a price for magazine n*,[14] as

$$\widehat{D^n} = \frac{1}{S^n} \sum d^n_{sj} \tag{4.1}$$

where S^n is the total number of price spells registered for magazine n, across all markets studied. This statistic was computed for *left-censored* and *non-censored* data. However, note that this $\widehat{D^n}$ does not weight the fraction of magazines sold at rigid prices which may lead to underestimation of the price rigidity. Therefore, to correct this possible bias, define the *aggregate average duration by market for magazine n*,[15] as

$$\widetilde{D^n} = \frac{1}{J} \sum_j \widehat{D^n_j}, \tag{4.2}$$

[14] See Cecchetti (1986).
[15] See Cecchetti (1986).

where J is the number of markets in which magazine n is sold, and $\widehat{D^n_j}$ is $\widehat{D^n}$ calculated independently for each market where n is sold. Since no measure of the quantity purchased in each market was available, all markets were equally weighted.[16] Table 4.1 also reports the standard deviation of the price rigidity measure, $\widehat{D^n}$.

Estimates indicate that price rigidity is concentrated at around 15 months (except for *Businessweek* and *Newsweek*, where it is larger) which coincides with the results of the interview study of Chapter 3. The measure $\widetilde{D^n}$ reinforces the price stickiness argument detected by $\widehat{D^n}$. Price spells tend to be larger for American magazines. Observe also that larger average rigidities are associated with a wider dispersion (across time and/or markets) of price rigidity, and the standard deviation grows with average duration.

Figure 4.8 plots histograms of d^n_{sj}. They show that the magazines with the highest price spell variance also experienced a relatively higher degree of price rigidity. However, there is no reason why larger price rigidity has to come associated with larger dispersion of spells' durations.

Nonparametric Analysis of Rigidity

Considering that the price is implicitly a process that has been under way for some time, it would be possible to characterize the distribution of the variable D_s by imposing fewer restrictions. First of all, note that normality turns out not to be particularly attractive for this setting, because duration is positive by construction. Thus, suppose that the random variable D_s has a continuous probability function, $f(d_s)$, where d_s is a realization of D_s. The cumulative probability is

$$F(d_s) = \int_0^{d_s} f(u)du = Prob(D_s \leq d_s). \tag{4.3}$$

Define now the *survival function* as the probability that the spell is of length *at least* d_s. This is

$$S(d_s) = 1 - F(d_s) = Prob(D_s \geq d_s). \tag{4.4}$$

Given the probability that a spell has lasted d_s, what is the probability that the spell will end in the next short interval of time, say Δ? A useful function for characterizing this aspect of the distribution of D_s is the *hazard* or *transition rate*, which can be written as

$$r(d_s) = \lim_{\Delta \to 0} \frac{Prob(d_s \leq D_s \leq d_s + \Delta | D_s \geq d_s)}{\Delta} = \lim_{\Delta \to 0} \frac{F(d_s + \Delta) - F(d_s)}{\Delta} = \frac{f(d_s)}{S(d_s)}. \tag{4.5}$$

[16] A naive example helps us to understand the difference between $\widehat{D^n}$ and $\widetilde{D^n}$. Assume that magazine price series are reported for two markets, each lasting for a one-year period, and that *both markets involve the same quantity of monthly sales*. Suppose that in market A, the price changes every month, while market B's price remains constant for the whole year. Therefore, there have been 13 spells of rigidity: 12 lasted 1 month and one lasted 12 months. In this example, $\widehat{D^n}$ would be equal to $[12 + (12 \times 1)]/13 = 1.8$ months: That is, conditional on a price change having just occurred, the average time to the next price change is 1.8 months, with 92 percent of the spells lasting one month and 8 percent lasting twelve months. However, notice that half of the goods purchased involved a price rigidity of one year. Hence, by using $\widetilde{D^n}$, this bias can be reduced to yield a quite different result, $(1 + 12)/2 = 6.5$, instead of 1.8.

Roughly, this hazard rate is the rate at which spells are completed after durations of d_s, given that they last until d_s. As such, the hazard function gives an answer to the original question.

As stated, this technique is based on the calculation of the survival and hazard rate *at every point in time where at least one spell has ocurred* (**Product Limit** or **Kaplan-Meier** estimation). However, given that the time intervals of price rigidity were grouped as in Table 3.1 for the interview study, and that realiable estimates are conditional to the number of spells of a particular duration, some smoothness of the results can be gained by grouping durations according to some *arbitrarily* defined intervals (**Life Table** estimation).

Therefore, splitting the time axis as follows,

$$0 \leq \tau_1 < \tau_2 < \tau_3 < \ldots < \tau_q,$$

and taking the convention that $\tau_{q+1} = \infty$, q time intervals can be obtained, I_l, each including the left limit, but not the right one

$$I_l = \{d_s \mid \tau_l \leq d_s < \tau_{l+1}\} \quad l = 1, \ldots, q.$$

Some definitions are needed to understand how this estimation runs:

- Let N_l denote the number of spells whose observed duration is at least τ_l. Given that a number of these spells could be censored, the number of spells that are *at risk*, borrowing this terminology from biostatistics, can be expressed as

$$U_l = N_l - \omega Z_l,$$

- where Z_l is the number of censored price spells whose duration is at least τ_l; as referred above, ω, $(0 \leq \omega \leq 1)$ represents the ratio of censored episodes that should be contained in the risk set, that is, the unchanged prices that are at risk of being adjusted during the lth interval:

- finally let E_l denote the number of observed spells completed at τ_l.

Thus, the conditional probabilities for having an event in the lth interval, e_l, become

$$e_l = \frac{E_l}{U_l}$$

and that for surviving the interval, p_l, becomes

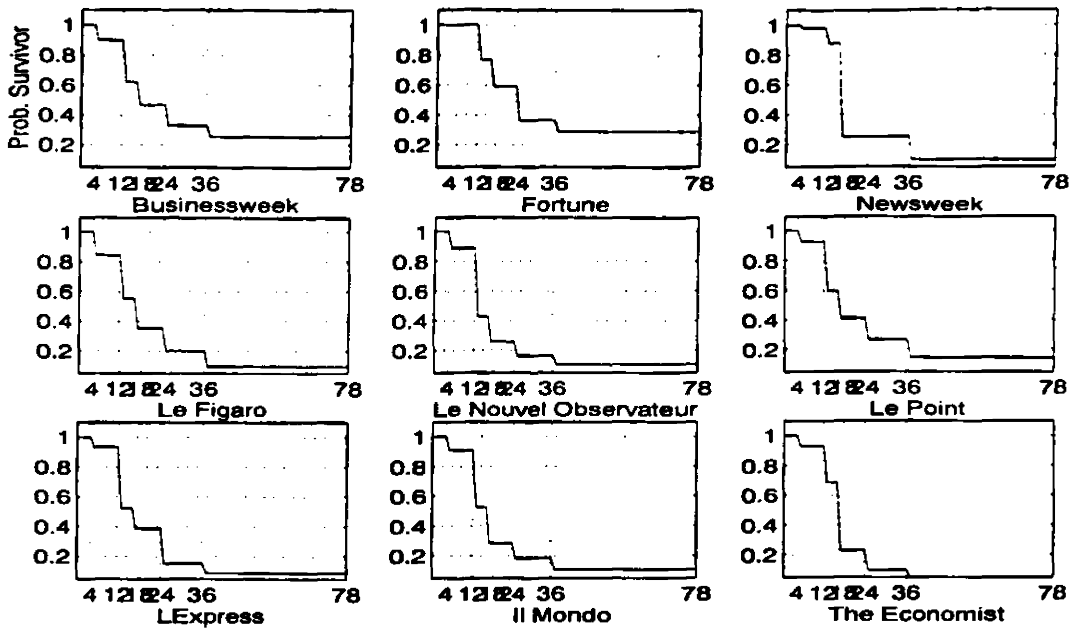
$$p_l = 1 - e_l.$$

Given these expressions, an empirical estimate of the *survivor function* can be obtained:[17]

$$S(\tau_l) = p_l S(\tau_{l_1}).$$

[17] Note that the survivor function is calculated at the beginning of each interval, which is a common convention.

Figure 4.1: Estimated Survival Functions. (x-axis, months)



Once estimates of the survivor function are computed, the density function is evaluated approximately at the midpoints of the intervals with the first derivative.

$$f_l = \frac{S(\tau_l) - S(\tau_{l+1})}{\tau_{l+1} - \tau_l} \quad l = 1, \ldots, q-1.$$

Estimates of the transition rate, r_l, are also calculated at the midpoints of the intervals, as follows:

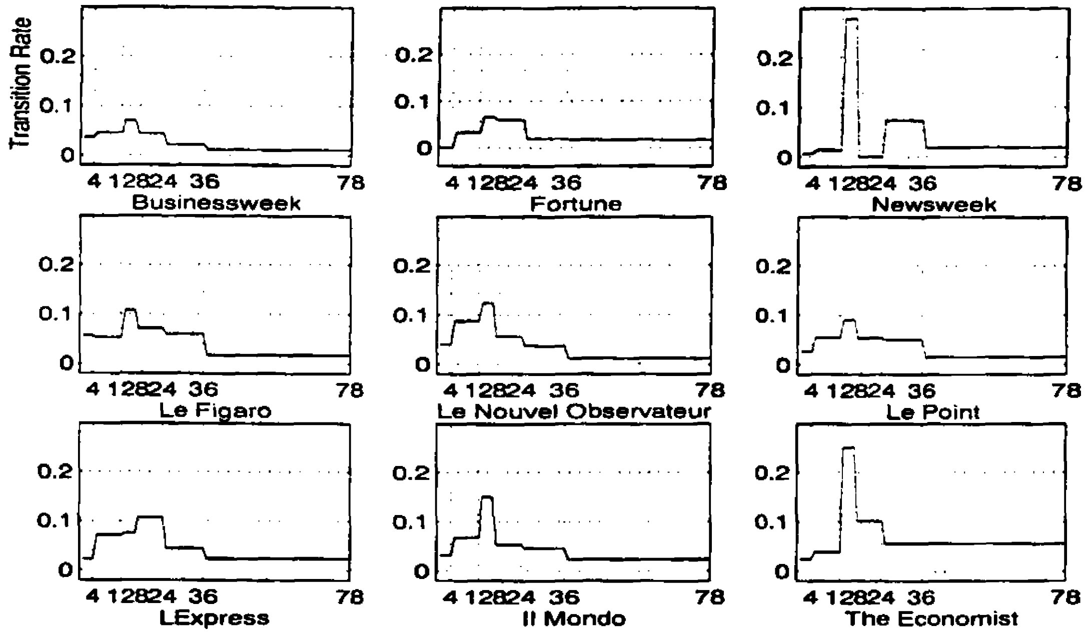
$$r_l = \frac{f_l}{\overline{G}_l}, \quad \overline{G}_l = \frac{G_l + G_{l+1}}{2}.$$

For estimation purposes, since a large number of observations were necessary to get a good approximation of the distribution of D_s, the analysis was carried out at a magazine level, aggregated for all destinations. Concerning the number of censored spells of duration d_s should enter into the survival function, represented by ω, it was assumed that half should be contained but, clearly, this is a somewhat random assumption.[18]

Therefore, according to the criteria of Table 3.1, some distinct survival times were chosen: $\{4, 12, 18, 24, 36, 78\}$. Estimated survival functions for each magazine in Figure 4.1 show a sharp decrease in the probability of a price remaining unchanged for more than 1 year, for four magazines in particular: *Newsweek*, *Le Nouvel Observateur*, *Il Mondo* and *The Economist*. Inversely, estimates of *Fortune* show a probability for the survival of a price change for more than two years as near 0.36, and for more than three as 0.28. This feature is confirmed in Figure 4.2, where these four magazines above displayed a peak in their transition rate for [12,16) months,

[18] Cf. the discussion given by Namboodiri and Suchindran (1987), p.58ff.

Figure 4.2: Estimated Transition Rates. (x-axis, months)



the riskiest interval for a price change to take place. The abrupt change that this function exhibits for *Newsweek* and *The Economist* between [12,16) and [16,24) is very noticeable, which indicates that price adjustments are quite clustered in the interval [12,16), i.e. annual changes. If this marked concentration of the distribution of price spells around the one year together with the questionnaires' responses (once per year) are firm indications of a fixed calendar schedule of price revision, some of the premises of the economic rationale designed in Chapter 2 based on cost of adjustment, and in the path of inflation and exchange rates would be seriously undermined! Indeed, newspapers such as *The Economist* used to announce in their subscription advertisements a cross-increase cover price each year in April: "April price rise. Avoid the April cover price increase. Subscribe now..."[19] Therefore, when natural decision periods arise, it is necessary to analyze whether or not a cross-market/cross-time convergence is compatible with the pricing schemes earlier described in this thesis.[20]

The next two subsections offer a disaggregated analysis of these results across markets and time.

[19] By examining the data, it can be proved that since 1987 price adjustments have taken place with this announced periodicity around the year. This choice could possibly have some relationship with the beginning of the UK fiscal year. Nonetheless, this only explains why April is chosen in particular, and not the fixed calendar prospectus itself.

[20] As a matter of fact, the case of *The Economist* deserves special attention because first, these price increase announcements appear recently and second, these yearly price adjustment became more important in the late 1980s.

Cross-market Price Rigidity

Let us compare here the stochastic structure of price rigidity for each magazine across markets. One way of testing the homogeneity of the frequency structure of price adjustments for each magazine consists of calculating a coefficient of variation for price rigidity:[21]

$$CVR^n = \sqrt{\frac{\Sigma^2}{E(\sigma^2_{jn})}} \ ,$$

where σ^2_{jn} is the variance of the price durations in market j, for each magazine n, $E(\sigma^2_{jn})$ is its mean, and Σ^2 is the variance of these variances σ^2_{jn} in each market. For this coefficient, if there is an idiosyncratic trend in the rigidity of prices for a given market, an absolute mean variance would not be comparable, since the bases from which the deviations are measured would differ materially in value. For this reason, by expressing the deviations as percentages of the respective averages, as in CVR^n, this problem is solved. Although a trend factor may slightly affect the value of the measure of variability for a given magazine, it does not lessen the comparability of measures between different magazines.

Table 4.2: Heterogeneity of Cross-market Price Rigidity.

Magazine	$E(\sigma^2)$	Σ^2	CVR^n
Businessweek	8.31e+02	9.19e+05	33.2
Fortune	2.38e+02	4.29e+04	13.4
Newsweek	2.35e+02	4.22e+04	13.3
Le Figaro Mag.	2.32e+02	1.07e+05	21.5
Le Nouvel Obs.	3.13e+02	5.19e+04	12.8
Le Point	1.97e+02	2.59e+04	11.4
L'Express	2.22e+02	3.37e+04	12.3
Il Mondo	1.81e+02	2.78e+04	12.4
The Economist	1.40e+02	4.60e+04	18.0

To obtain robust conclusions, some homogenization of the identity of the markets included in CVR^n was needed. Therefore, when calculating this measure only nine destinations were taken and neglected those less representative markets of the sample. The results in Table 4.2 are certainly interesting. They indicate firstly, that the market price series within any magazine presents a low degree of heterogeneity, (only for *Businessweek* and *Le Figaro* is the coefficient of variation above 20 percent), and secondly, that CVR^n is close in value among magazines, which may suggest a common rigidity trend for the whole industry.

Time-series Price Rigidity

For each magazine n, the annual frequency in each market is calculated by dividing the number of monthly changes in a year by 12 and then, an average is computed for all the markets in which

[21] See Carlton (1986).

the magazine n is sold. Figure 4.7 plots this frequency, which shows peaks and cross-section trends: on aggregate, price stickiness varies across time.[22] Some salient facts can be observed:

1. Magazines published by *American companies* exhibited a larger frequency of price adjustment between 1982 and 1986. As is shown later, this result is very interesting in interpreting the behavior of import and export prices in the US during the appreciation of the Dollar in the first half of the 1980s.

2. For the rest of the magazines there were found to be two peaks, one around 1980-1981 and the second in 1985-86. Furthermore, the frequency of price adjustment mainly decreased since 1986-87 with respect to the levels of preceding years.

To summarize, magazines' price rigidity was, on average, above 12 months, and survivor functions indicated that the probability of a price remaining unchanged for one year was about 0.80, so prompt price reactions in the event of economic fluctuations seem to be precluded. Despite the fact that price stickiness showed some variability across markets and time, important divergences between price rigidities across markets for a particular magazine could not be found: on the contrary, some common patterns among magazines, both across markets and time were detected.

4.3.3 Size of Price Changes in a (R_i, R_I) scheme

Once the level of price rigidity is known, it is also necessary to report the size of the price jumps and to explore the link between these two measures. Since this analysis is a time-series cross-market one, comparisons between magazines and destinations require some sort of normalization: for example, **implicit prices**, $W_{jt}(j)$ as in Chapter 2, or **real prices**, $R_{jt}(j) = P_{jt}(j)/\mathbf{P}_{jt}$, where $\mathbf{P}_{jt}$ represents the general price level in j.

For the moment, let us concentrate on this last normalization and, following Sheshinski and Weiss (1977,1983), analyze newsstand price changes as if they were simply domestic prices. Some definitions are needed:

- When $P_{jt}(j)$ is adjusted at, say, t_τ, a new interval or price spell starts. If $t_{\tau+1}$ represents the time of the next nominal price adjustment, let τ denote the interval $[t_\tau, t_{\tau+1}]$ during which the nominal price remains unchanged.

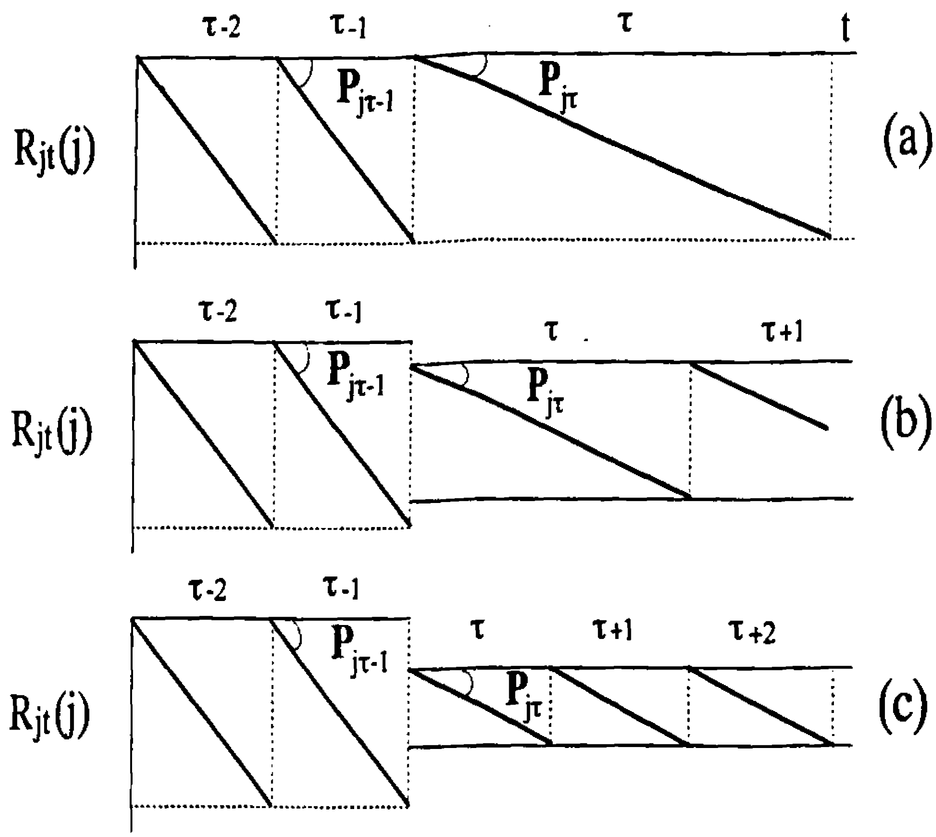
- Define $R_{I\tau}$ as the level of R when the interval τ starts, and $R_{i\tau}$ when it finishes. Hence, call the (R_i, R_I) scheme, a pricing policy characterized by nominal price adjustments such that the real prices remain within these bounds.

- Sheshinski and Weiss (1977, 1983) predicted that at $t_{\tau+1}$, if stationary conditions about the rate of inflation held, the nominal price *could* be adjusted such that the resulting R would be set to $R_{I\tau+1} = R_{I\tau}$; but if not, $R_{I\tau+1} \neq R_{I\tau}$.

Therefore, it is possible to distinguish between two different measures of the real price change:

[22] Note also that magazines produced in the same country reported prices in basically the same importing countries, so this eased the comparisons.

Figure 4.3: Expected paths of $R_{jt}(j)$ in the event of a decrease in the rate of inflation $\mathbf{P}_{jt}$.



1. **Real Price Erosion or Cumulative Inflation within the Spell** defined as

$$(R_I/R_i)_\tau, \quad \tau = 1, 2, \ldots \text{ and}$$

2. **Real Price Adjustment** given by

$$R_{I\tau+1}/R_{i\tau}, \quad \tau = 1, 2, \ldots$$

where $R_{I\tau+1}$ could be coincident with $R_{I\tau}$.

Consequently, after these two definitions and following Sheshinski and Weiss (1977),we can derive some conjectures about the relationship between frequency and size of nominal price adjustment, summarized in two propositions

Proposition 3 *Higher expected rates of inflation, $\mathbf{P}_{jt}$, increase the upper limit, R_I, and decrease the lower limit, R_i, so the band of fluctuation for real prices widens,*

$$\partial R_I/\partial \mathbf{P}_{jt} > 0$$

Table 4.3: Proportion of Real Price Adjustments: $(R_I/R_i)_\tau$ and $R_{I\tau+1}/R_{i\tau}$.

Magazine	*less 2%*	*less 5%*	5 – 10%	10 – 15%	15 – 20%	20 – 25%	+25%
Real Price Erosion. $(R_I/R_i)_\tau$							
Businessweek	14.8	40.5	24.3	13.5	8.1	1.3	1.2
Fortune	11.3	43.3	24.5	16.9	7.5	1.8	5.6
Newsweek	15.6	40.8	27.8	15.6	5.2	3.4	6.9
Le Figaro Mag.	22.0	40.3	27.5	20.1	3.6	5.5	2.7
Le Nouvel Obs.	18.0	44.2	22.1	11.4	9.0	7.3	5.7
Le Point	13.8	33.3	27.7	15.2	12.5	4.8	6.2
L'Express	27.2	46.7	24.6	10.3	5.1	7.7	5.1
Il Mondo	15.0	52.6	22.5	7.5	11.8	0.0	5.3
The Economist	23.7	58.1	19.3	11.2	6.2	3.1	1.8
Real Price Adjustment. $(R_{I\tau+1}/R_{i\tau})$							
Businessweek	0.0	11.4	21.3	24.5	13.1	9.8	19.6
Fortune	0.0	14.2	35.7	7.1	16.6	2.3	23.0
Newsweek	1.0	5.1	56.7	18.5	14.4	5.1	0.0
Le Figaro Mag.	5.5	10.0	27.5	33.0	15.5	7.3	6.4
Le Nouvel Obs.	4.2	23.1	43.1	23.1	9.4	0.0	1.0
Le Point	1.5	13.6	33.3	31.0	11.3	6.8	3.7
L'Express	1.4	10.2	25.0	41.1	17.6	1.4	4.4
Il Mondo	0.0	12.0	36.1	25.3	13.2	12.0	1.2
The Economist	2.7	29.0	39.1	20.2	8.1	2.0	1.3

and

$$\partial R_i / \partial \mathbf{P}_{jt} < 0,$$

and inversely for a lower inflation.

Proposition 4 *Let c_τ denote the size of the interval τ between two adjustment times t_τ and $t_{\tau+1}$. Assume that the value of the firm, V, depends on real prices $R_{jt}(j)$. Then, if $V'(R_{jt}(j)) \cdot R_{jt}(j)$ is a non-increasing function in $R_{jt}(j)$ - the monotonicity condition - it results that*

$$dc_\tau / d\mathbf{P}_{jt} < 0.$$

Figure 4.3 shows graphically these propositions for a decrease in inflation at time, say t_τ, so $\mathbf{P}_{jt_{\tau-1}} > \mathbf{P}_{jt_\tau}$. Observe that the solution ranges from the constancy of (R_i, R_I) while c_τ varies (case a), to the the opposite, where the time between price adjustment remains fixed and the boundaries vary (case c).

Distribution of Price Changes

Given the main aspects of the (R_i, R_I) hypothesis, the real price series[23] (solid line in Figures 4.16, 4.18, 4.20, 4.22, 4.26, 4.28, 4.30 and 4.32) showed that the band of inaction (R_i, R_I) varies across spells or, in the best case, between different sub-samples.[24] Observation of $(R_I/R_i)_\tau$ and $R_{I\tau+1}/R_{i\tau}$ in Table 4.3 and in Figures 4.9 and 4.10 respectively, indicates that:

[23]The series have been normalized by taking as a base the starting observation for each market.

[24]Nevertheless, observe that the values of some real prices at the beginning and at the end of the period are nearly equal: for instance, prices of *Businessweek* and *Newsweek* in Austria, Germany, Netherlands, Sweden, Switzerland, UK and US.

Table 4.4: Heterogeneity of Cumulative Inflation within the Spell, $(R_I/R_i)_\tau$, across markets.

Magazine	$E(\sigma^2)$	Σ^2	CVC^n
Businessweek	1.35e+02	3.46e+04	15.9
Fortune	1.11e+02	2.63e+04	15.3
Newsweek	6.37e+01	1.98e+03	5.5
Le Figaro Mag.	1.17e+02	2.31e+04	14.0
Le Nouvel Obs.	1.43e+02	2.80e+04	14.0
Le Point	8.91e+01	6.31e+03	8.4
L'Express	7.17e+01	4.36e+03	7.7
Il Mondo	5.48e+01	1.73e+03	5.6
The Economist	4.39e+01	9.67e+02	4.6

1. Real price erosion within the spell of less than 5% occurs for more than 40% of the cases, and variations over 25% account for only around 5% of the spells. The data reveals substantial variability and does not immediately suggest obvious trigger points.

2. There is a significant number of $(R_I/R_i)_\tau$ that could be considered of small size, i.e., less than 2%. These cases sum up more than 15% of the total and, for some magazines, such as *The Economist*, *L'Express* or *Le Figaro*, they constitute a quarter of all spells. Hence, this evidence may suggest that *if the costs of being at the wrong price are only proportional to the real price erosion*, as assumed by this first approximation, these costs seem to be quite large for a number of cases: that is, since these figures are aggregated by magazine, prior to observing changes in $W_{jt}(j)$ within the spell, it would be appealing to discuss whether or not they correspond to markets more sensitive to price changes, or to a specific period.

3. Computing the coefficient of variation of cumulative inflation within the spell, CVC^n,[25] in Table 4.3.3 captures the existence a common stochastic structure for $(R_I/R_i)_\tau$ among markets. These estimates show that we could not reject this conjecture mainly for *Newsweek*, *Il Mondo* and *The Economist*. However, it is perhaps more interesting to notice that this measure was rather similar for those magazines which displayed a larger heterogeneity. Again, this may suggest a certain pattern for the whole industry.

4. Estimates of $R_{I\tau+1}/R_{i\tau}$ in Table 4.3 and Figure 4.10 of less than 2% are rather scarce, and negative price adjustments in Figure 4.10 were not explained by negative inflation. On the contrary, these figures were larger relative to those of $(R_I/R_i)_\tau$ which indicates that price adjustments were offset more by the real erosion within the spells.

Over/Undershooting Cumulative Inflation

Figures 4.34-4.51 show the percent variation of $(R_I/R_i)_\tau$ within each spell, and the degree of undershooting (overshooting) calculated as

$$R_{I\tau+1}/R_{i\tau} - (R_I/R_i)_\tau < (>) 0,$$

[25] It is similarly calculated as CVR^n in Section 4.3.2.

respectively, and represented by negative (positive) vertical line, when a price change occurred. Vertical dotted lines denote adjustments times, so if no bar appears, the nominal price change exactly offsets the real erosion within the spell. These pictures indicate that:

1. There exists some heterogeneity in real price erosion by market. Despite the transitions from larger to smaller cumulative inflation within the spell being rather smooth, it is difficult to sustain the hypothesis that the nominal price series is a sequence of steady states. It seems that the price rule measured in terms of the parameters (R_i, R_I) has been changing gradually over time.

2. In real terms, overshooting is predominant, which suggests either that expectations are aimed at an increase in the rate of inflation or simply that this bias is motivated because no account is taken of exporters' currency appreciations. Notice that it is also interesting the case of Spain, where high inflation led to a persistent undershooting.

3. The lower the frequency of price adjustment, the less is the degree of under/overshooting performed by the firm when a price is adjusted, thus for these cases, $(R_I/R_i)_\tau$ is more accurately triggered.

Reduced-form correlations

The rest of this section investigates the existence of some reduced form of relationship between $\mathbf{P}_{jt}, (R_I/R_i)_\tau, R_{I\tau+1}/R_{i\tau}$ and ϵ_τ for a given country or magazine. The analysis by market is summarized in Table 4.5 which presents some statistics for these variables across time for six selected countries aggregated by magazines. Additionally, this table includes the average number of price adjustments, the current value of inflation and an average of the countries' exchange rate. Several conclusions emerge from this data:

- Over the entire period considered, there has been an increase in the average length of a completed spell, [1] in Table 4.5, and a certain decrease in the number of price adjustments [2] except for the US;

- When an upward trend was detected for the average size of the fixed price change [3] in four countries (Belgium, Germany, Spain and Italy; this measure remained relatively stable in Switzerland and increased in the U.S.), the average of cumulative inflation since last change [4] experienced its lowest values between 1985 and 1988;

- While this performance seems to be positively correlated with current inflation [5] in Belgium, Germany and Switzerland, increases in [4] for Italy, Spain and U.S were accompanied by a stabilization or slight decrease in the inflation rates. This fact could ultimately be explained by fixed time adjustments around the year having recently predominated, and despite the moderation of inflation rates in Italy and Spain, their levels were still higher than in the rest of the countries considered. Nonetheless, it is remarkable that the slowdown of the growth rate of price levels that has occurred in this decade yielded a sizeable increase in price stickiness across markets;

Table 4.5: Magazine Price Changes by Country, 1981-1991.†

Year	[1]	[2]	[3]	[4]	[5]	[6]	[1]	[2]	[3]	[4]	[5]	[6]
			Belgium						**Germany**			
1981	7.1	0.6	16.8	9.8	8.8	-7.0	6.9	0.4	13.7	15.7	5.0	1.1
1982	6.9	1.2	17.6	12.7	8.5	-8.6	11.1	0.4	11.0	5.5	3.3	3.1
1983	5.4	1.2	8.7	6.8	9.0	-5.8	11.8	0.6	10.4	6.0	2.3	-0.8
1984	7.3	0.8	9.7	11.2	7.1	-3.6	9.7	0.8	11.8	5.3	1.8	-4.8
1985	5.0	1.2	9.5	7.4	4.0	8.4	6.6	0.8	8.1	5.0	0.8	13.2
1986	7.4	0.8	9.8	1.7	2.3	13.1	6.5	0.8	4.5	0.5	-0.3	15.6
1987	7.9	0.4	7.3	5.1	2.2	4.1	12.5	0.0	3.1	5.1	0.7	4.8
1988	13.2	0.2	7.5	8.6	3.3	-2.9	25.4	0.0	3.1	8.6	1.8	-3.8
1989	21.7	0.2	7.5	11.9	4.2	4.6	25.1	0.4	4.7	4.4	2.2	4.2
1990	17.6	0.6	9.4	10.0	4.4	4.8	26.0	0.0	5.8	10.0	2.4	3.8
1991	18.2	0.2	12.1	11.6	1.8	-2.6	17.3	0.6	6.5	8.2	2.0	-2.6
			Italy						**Spain**			
1981	3.8	1.2	17.8	8.5	13.0	-10.7	6.2	1.0	19.3	23.8	18.5	-4.5
1982	5.4	1.4	4.8	14.3	12.7	-3.6	6.9	1.0	19.7	24.0	15.4	-13.1
1983	4.9	0.8	13.5	9.9	9.6	-5.8	4.9	1.0	19.2	10.4	20.5	-10.2
1984	4.9	1.0	13.2	9.9	7.6	-6.9	7.1	1.0	19.8	27.5	18.1	-1.2
1985	4.0	1.6	11.5	6.1	6.1	2.8	5.0	1.6	14.5	14.5	10.8	-0.1
1986	6.3	0.8	8.0	3.9	4.7	12.9	4.3	1.2	8.3	8.5	8.1	4.5
1987	6.5	0.8	6.8	5.4	5.1	0.0	6.1	0.6	3.8	8.1	7.0	6.9
1988	8.4	0.6	3.2	4.9	4.6	-3.7	12.2	0.3	4.3	9.9	9.4	1.8
1989	16.7	0.6	2.8	7.0	5.1	4.0	12.1	0.5	4.2	23.7	9.0	3.3
1990	29.2	0.6	2.7	18.1	5.3	2.0	14.6	0.3	4.4	25.9	7.6	5.0
1991	19.6	0.6	3.1	8.3	4.3	-2.8	11.4	0.5	2.5	17.2	5.5	-2.5
			Switzerland						**U.S.**			
1981	4.9	0.5	9.9	8.1	5.0	13.3	13.9	0.2	9.0	7.5	6.8	22.7
1982	11.4	0.3	9.6	8.2	3.9	0.8	27.4	0.2	8.9	46.7	3.3	15.6
1983	13.7	0.3	5.2	9.0	1.9	4.0	21.2	0.0	9.2	9.0	3.1	13.9
1984	14.0	0.6	6.4	6.6	2.7	-6.5	36.4	0.0	9.2	6.6	3.1	16.7
1985	7.5	0.8	6.2	4.7	1.6	11.3	26.1	0.7	9.1	21.9	2.3	-21.1
1986	10.7	0.5	7.8	2.1	0.5	14.3	12.1	0.7	9.2	8.2	1.8	-15.3
1987	18.2	0.0	8.6	8.1	1.5	5.5	7.3	0.7	10.6	4.1	3.4	-10.4
1988	25.4	0.1	8.2	2.9	1.8	-6.7	11.5	0.2	9.8	4.5	3.8	6.7
1989	32.3	0.1	7.9	2.5	3.6	0.0	17.2	0.2	12.6	3.8	3.8	-2.1
1990	39.4	0.1	7.2	5.0	4.8	7.0	23.1	0.2	12.0	19.9	4.4	-12.0
1991	22.5	0.6	8.0	14.2	2.1	-6.3	13.5	0.5	10.3	13.6	1.2	7.1

† I did not use all the magazines when analyzing these statistics for a number of markets: Spain and Switzerland, 6 magazines; Belgium, Germany, Italy and US, 5 magazines. The usage of more magazines would have implied to decrease the number of years since some series finished at 1988. [1]= Average length of price spells, $\bar{t}_\tau$; [2]= Average number of price changes, $\bar{I}_t$; [3]= Average fixed price change, $R_{I\tau+1}/R_{i\tau}$; [4]= Average of the cumulative inflation since last price change, $(R_I/R_i)_\tau$; [5]= Current Inflation, $\mathbf{P}_{jt}$; [6]= Average exchange rate variation, S_{jt}. All changes are measured as percentages.

- Finally, observe that exchange rate depreciations (appreciations) [6], in the first half of the sample of the Belgian Franc, Italian Lira and Spanish Peseta (Deutschmark, Swiss Franc and Dollar) led to a lagged response decreasing (increasing) the length of price spells.

Table 4.6: Estimates of the Correlation between Inflation, Cumulative Inflation within the Spell, Real Price Adjustment and Frequency of Adjustment.

	Correlation Coefficients				
Magazine	$[\mathbf{P}_{jt}, (R_I/R_i)_\tau]$	$[\mathbf{P}_{jt}, \epsilon_\tau]$	$[(R_I/R_i)_\tau, \epsilon_\tau]$	$[(R_{I\tau+1}/R_{i\tau}), \epsilon_\tau]$	$[\mathbf{P}_{jt}, (R_{I\tau+1}/R_{i\tau})]$
Businessweek	0.40	-0.30	0.60	-0.19	-0.01
Fortune	0.42	-0.15	0.32	-0.33	0.05
Newsweek	0.37	-0.23	0.50	-0.21	0.22
Le Figaro Mag.	0.23	-0.32	0.50	0.02	0.34
Le Nouvel Obs.	0.36	-0.16	0.62	-0.05	0.31
Le Point	0.28	-0.21	0.54	-0.01	0.36
L'Express	0.40	-0.11	0.52	0.03	0.41
Il Mondo	0.51	-0.15	0.54	0.13	0.45
The Economist	0.36	-0.14	0.57	0.04	0.38

The results for an analysis **by magazine** are shown in Tables 4.6 and 4.7 and in Figures 4.11 to 4.15, the most salient of which facts are:

1. There exists a positive correlation between current and cumulative inflation if ϵ_τ, as shown in Figure 4.3, does not decrease.

2. Inflation and spell lengths are negatively correlated at an aggregate level. At disaggregate level estimates were not significant, and largely heterogenous across markets. Coefficients were significant for Austria, Belgium and Germany. Furthermore, for Italy and Spain, negative estimates were rather low, thus for higher inflation levels, firms seems to react more by increasing prices than by decreasing price rigidity. *Newsweek* and *The Economist* exhibit, in Figure 4.13, a decrease in the value of the coefficients due to the 12-months adjustment schedule.

3. Price rigidity, ϵ_τ, and $(R_I/R_i)_\tau$ are positively correlated but as these variables increase, the variance rises, so inference may be difficult at larger values.

4. Finally, the estimates of the correlation between $R_{I\tau+1}/R_{i\tau}$ and inflation were positive and significant for all cases except for *Businessweek* and *Fortune*, which suggests that inflation is incorporated when price adjustment occurs.

Summarizing, a first approximation to the (R_i, R_I) scheme is sufficient to show that the constancy of the barriers which determine price inaction does not hold across time. Both accumulated inflation within the spell and real price adjustments ranged mainly between 2% – 25%, and 5% – 25%, respectively. Some degree of homogeneity between markets for a single magazine was detected, which together with the homogeneity of price rigidity, raises the issue of synchronization of pricing decisions. The data also pointed out different regimes for the state variables and, consequently, the importance of studying the transition among these regimes. Tests on the relationship between current and cumulative inflation, real price adjustment and price

Table 4.7: Correlation Coefficients between $\mathbf{P}_{jt}$, ϵ_τ and $(R_I/R_i)_\tau$ by market.

	AS	BF	DK	FF	DM	FL	LI	SK	SF	UK	US	CA	PT	MA	SE	IV	TU
Correlation between $\mathbf{P}_{jt}$ and ϵ_τ.																	
BUS	-1.00	-.91	.15	-.94	-.35	-.30	-.34	-.07	-.99	.48	-.39		-.29				
FOR	-.29	-.08	.26	.03	-.76	-.72	.00		.87	.16			-.27				
NEW	-.75	-.12	.21	-.30	-.70	-.25	-.48	.50	-.46	.44			-.08				
LEF	-.25	-.82	-.68			.08	-.09		-.48	-.08		.91	-.69	.18	-.01	-.38	-.35
LNO		-.43		-.07			-.30		.15		.73	-.09	.22	-.58	-.36	-.35	.13
LEP		-.36		.04	.01		-.14		-.13		.41	.54	.10	-.11	-.54	-.01	.06
LEX	-.40			-.16	.11	.28	-.02		.92	.15	-.05		-.15				
TEC	.13	-.01	.60	.39	-.29	.38	-.31	-.25	-.41	-.24	-.44		-.29				
ILM				-.55	-.45	-.31	-.34		-.67	.28	.53	.70	-.18				
Correlation between $\mathbf{P}_{jt}$ and $(R_I/R_i)_\tau$.																	
BUS	1.00	-.33	.43	-.85	.51	.30	-.03	.10	-.99	.75	-.21	.14	-.60				
FOR	.17	.53	.60	.67	.52	.95	.45		-.50	.94			-.53				
NEW	-.42	.19	.25	.36	-.34	-.20	-.20	.67	.76	-.26			-.18				
LEF	-.24	-.29			.66	.94	.66		.04	.65		.99	-.54	.52	.56	.86	-.18
LNO		.35		.55			-.09		.29		.73	.27	.31	-.38	.78	.62	.16
LEP		.53		.47	.42		.08		.05		.75	.52	-.05	.18	.37	.62	.05
LEX	.24			.36	.63	.74	.30		.98	.07	.26		-.01				
TEC	.45	.25	.60	.75	.10	.68	.08	.06	.47	.50	-.15		-.33				
ILM				.48	.45	.51	.67		-.46	.62	.69	.78	-.04				

rigidity seemed inadequate in providing a concise idea of the way in which these magnitudes combine, thus the next section develops a more formal econometric analysis of the determination of price adjustments within this (R_i, R_I) context, allowing for more variables affecting the firms' decisions.

4.3.4 A Discrete Dependent Variables Estimation of Price Adjustments in a (s,S)-type Scheme

A Description of the Application of Discrete Dependent Variables Model to the Price Adjustment Problem

As shown in Section 4.3.1, attempts to parametrize of the price adjustment rule have usually been performed using Discrete Response models; see for example, Sheshinski *et al.* (1981), Cecchetti (1986), Dahlby (1992) and Ghosh and Wolf (1994). This method typically consists of approximating the firm's pricing behavior by a discrete dependent variable that indicates whether or not a price change has occurred, depending on a set of covariates (for a description of these models, see Chamberlain [1980, 1984], Amemiya [1981], Maddala [1983] or McFadden [1984]). Applied to the general (s,S) pricing rule where both a price increase and decrease may occur, recall the latent or dummy variable I_{jt} in Chapter 2, but defined as follows for estimation purposes:

$$I_{jt} = \begin{cases} 1 & \text{if } P_{jt} > P_{jt-1} \\ 0 & \text{if } P_{jt} = P_{jt-1} \\ -1 & \text{if } P_{jt} < P_{jt-1}, \end{cases} \tag{4.6}$$

such that the objective of this technique would be to determine the probability that I_{jt} take one of these three values:

$$\begin{aligned} Pr(I_{jt} = 1) &= Pr(\Delta P^{*}_{jt} \geq Z^{i}_{j}) \\ Pr(I_{jt} = 0) &= Pr(0 < \Delta P^{*}_{jt} < Z^{i}_{j} \text{ and } \nabla P^{*}_{jt} > Z^{d}_{j}) \\ Pr(I_{jt} = -1) &= Pr(\nabla P^{*}_{jt} \leq Z^{d}_{j}), \end{aligned} \tag{4.7}$$

where

- P^{*}_{jt} denotes the unconstrained or frictionless price the firm would choose if adjustment costs did not exist, and;
- $Z^{i}_{j} > 0 (Z^{d}_{j} < 0)$ is the maximum positive (negative) deviation between P^{*}_{jt} and P_{jt}, before P_{jt} is increased (decreased).

Thus, in the (R_i, R_I) scheme of last section, the unconstrained price would be given by

$$P^{*}_{jt} = P_{jt} \cdot \mathbf{P}_{jt};$$

and in the (W_i, W_d) model of Section 2.4, by

$$P^{*}_{jt} = P_{jt}/\mathbf{S}_{jt}.$$

In general, we may assume that

$$P^{*}_{jt} = h(\mathbf{X}_{jt}), \tag{4.8}$$

where h is a function of the matrix $\mathbf{X}_{jt}$ that includes whatever covariates influencing the motion of the unconstrained optimal price.[26]

[26] For example, Cecchetti (1986) characterizes this optimal price, following Rotemberg's (1982a,b) demand and cost functions for a monopolist, as:

$$f_t(P_t, \mathbf{P}_t, \mathbf{Q}_t) = [P_t/\mathbf{P}_t]^{a}\mathbf{Q}^{b}_{t}. \tag{4.9}$$

For expositional purposes, a one-sided model is only considered which is sufficient to demonstrate the logic of this technique. Therefore, let Z_j denote Z_j^i in short. Estimating the probabilities in (4.7) requires a definition of the distance D_{jt} as

$$D_{jt} = \Delta P_{jt}^{*} - (Z_{jt} - P_{j\tau-1}) = \theta_{jt} + \beta \mathbf{X}_{jt} + u_{jt}, \tag{4.12}$$

where $P_{j\tau-1}$ is the level at which the nominal price was set when it was last time changed; Z_{jt} is the current maximum deviation, such that

$$\theta_{jt} = Z_{jt} - P_{j\tau-1}$$

represents the information about the price adjustment rule at time t. The two most popular specifications for u_{jt} are: the *Standard Normal Distribution* function, which leads to what is called Probit model, and the *Logistic Distribution* which yields the Logit model.[27] Therefore, the estimated model can be stated as

$$Pr(I_{jt} = 1) = \Phi(\bar{D}_{jt}). \tag{4.13}$$

where $\bar{D}_{jt} = D_{jt} - u_{jt}$, and Φ is any of the distributions mentioned above, commonly expressed as a cumulative distribution to guarantee that its values range from 0 to 1, required for an interpretation as probabilities. Then, estimates of the coefficient vectors β can be obtained by maximizing the unconditional likelihood function

$$L = \prod_{t \in I_t = 1} \Phi(\cdot) \prod_{t \in I_t = 0} (1 - \Phi(\cdot)) \tag{4.14}$$

However, this basic procedure of the Discrete Dependent Variables Models when implemented to a price adjustment problem, has to be amended by a pair of important caveats. The first one refers to the type of data to which this technique can be applied, and the other to the possibility that magazines change their price rule over time:

1. <u>*Data Restrictions*</u>: The method described above was created for analyzing panels characterized by a large number of independent individuals' discrete responses, at a single or, if available, multiple points in time, called *waves* in the literature's terminology (see Hsiao

and

$$c_t(f(\cdot)) = e^{\delta t} f_t(\cdot)^{\alpha} w_t, \tag{4.10}$$

where $\mathbf{P}_t$ is the aggregate price level, $\mathbf{Q}_t$ is the total industry sales, $e^{\delta t}$ represents technological change, w_t are input prices, and α, a and b are constants. Assuming that w_t and $\mathbf{P}_t$ change at the same constant rate, and substituting (4.9) into (4.10), it gives the profit function. Taking the derivative with respect to price, setting this first-order condition equal to zero and solving for P_t, yields P_t^*. Thus, adding a stochastic error term u_t to represent the components of P_t^* not directly included in (4.9) and (4.10), ΔP_t^* can be written as

$$\Delta P_t^* = \beta_1 T_t + \beta_2 (g_t \cdot T_t) + \beta_3 \dot{\mathbf{Q}}_t + u_t \tag{4.11}$$

where T_t, $(g_t \cdot T_t)$ and $\dot{\mathbf{Q}}_t$ are the time, the cumulative inflation, and the cumulative change in industry sales respectively *since the last price change*. Here, it is clear that the (R_t, R_T) characterization of P_{jt}^* in (4.8) is nested in (4.11).

[27] *Normal* and *Logistic* distributions are very similar but differ in their variances.

[1983]). Hence, expressed in terms of the current price adjustment problem, this characterization would require a panel composed by a large number of magazines' pricing decisions in a particular market. For example, Cecchetti (1986), who studied yearly price responses of 38 magazines sold in the US from 1953 to 1979, or Dalhby (1992) who recorded price adjustments from 69 insurance firms by quarters between 1974 and 1982, used this sort of data.

The problem arises when the data originates in a different manner. Look, for example, at Sheshinski *et al.* (1981), studying monthly prices of two single goods (instant coffee and noodles), for 15 years, produced by a pair of local monopolists in Israel, and Ghosh and Wolf's (1994) investigation of price changes of *The Economist* in different countries for 17 years.

- In the first exercise, strictly speaking, there were only two independent discrete responses at each point in time, which precluded *per se* an application of the technique described above. However, Sheshinski *et al.* (1981) circumvented the problem by considering **each single time record**, that is, each monthly price observation for each good, **as an individual asked about his response to a certain stimulus**, in the fashion explained above; and by assuming that some stationary conditions about inflation remained for the whole period, these time series observations became **price adjustments of a single wave**. Obviously, proceeding in this way, observations are clearly path-dependent and, in fact, the application of this technique to such data would cast some doubt on the resulting estimates.
- Furthermore, the second exercise not only pooled the cross-time observations as individuals' responses, but also data from different markets.

Nonetheless, despite their shortcomings, a Discrete Dependent Variables Estimation may still result a good approximation, especially as the series analyzed in this dissertation look much like those in these last examples: If we had proceeded exactly as this technique indicates, for analyzing pricing decisions in a single market, we would have had, in the best case, 9 magazines (individuals or respondents); alternatively, interpreting each market as an individual and analyzing the price rule for each magazine across markets, we would not have had more than 14. In both cases, the number of individuals would never have been large enough. Furthermore, considering the fact that the newsstand price series were monthly and that price rigidity was relatively large, we would have obtained many degenerated *waves*, that is, with no price change for all the individuals. This would have precluded running any estimation. Therefore, these facts constrain us both to adopting a similar interpretation of the Discrete Dependent Variables Models such as that of Sheshinski *et al.* (1981) or Ghosh and Wolf (1994), and also to introducing some changes to correct the bias when applying this technique to this data.

2. *Grouping Data and Changes in the Price Rule.* In the last exercises, it was assumed that the price adjustment rule represented by the term θ_{jt}, was constant. Nonetheless, Iwai (1981) and Sheshinski and Weiss (1983,1992) on one hand, and Dixit (1989a,b) on the other, have pointed out that θ_{jt} possibly varies over time, so it might be convenient to consider an econometric estimation that could take this fact into account: To see this,

note first that the model specified in (4.12) could be modified to include the information contained in the previous fixed price change. $\Delta P_{j\tau-1} = Z_{j\tau-1} - P_{j\tau-1}$. Thus.

$$\theta_{jt} + \Delta P_{j\tau-1} = Z_{j\tau-1} - Z_{jt}. \tag{4.15}$$

Then, defining $\theta^*_{jt} = \theta_{jt} + \Delta P_{j\tau-1}$, (4.12) can be re-written as

$$D_{jt} = \theta^*_{jt} - \Delta P_{j\tau-1} + \beta X_{jt} + u_{jt}. \tag{4.16}$$

where θ^*_{jt} is a measure of the distance from the current ceiling barrier to the one recorded for the previous change.

Allowing for the possibility that the price change rule varies. θ_{jt} and θ^*_{jt} become time-varying parameters and a particular form for the function Φ will be necessary to capture this effect. In fact, Cecchetti (1986) has addressed the statistical problems associated with this, by employing a rarely used but very powerful fixed effect model developed by Chamberlain (1980, 1984) to deal with discrete panel data sets where unobservable effects vary across time and groups. Thus, based on his application to the case of American magazines, this chapter also followed a similar analysis for the data on newsstand prices of magazines.[28]

Fixed Effect Model for Panel Data

Therefore, let us investigate how the possibility of allowing the price change rule to vary over time affects the Discrete Dependent Variables Model specified above: Suppose that in the case of a particular magazine and market, observations of certain adjacent years are known to be related (let us say, an identical inflationary or exchange rates environment), and that the price adjustment observed within these adjacent years responds to a concrete adjustment rule. This relationship is what Chamberlain calls **fixed effect**, and observations related are believed to belong to the same **group**. Therefore, assuming that Φ signifies a logistic function, equation (4.13) can be written as

$$Pr(I_{j\{kT\}} = 1) = \frac{exp(\theta_{jk} + \beta X_{j\{kT\}})}{1 + exp(\theta_{jk} + \beta X_{j\{kT\}})} \tag{4.17}$$

where it is important to understand what the subindices $\{kT\}$ properly mean:

- Given a magazine n, the subscript k denotes a series of adjacent observations during which the price change rule is assumed not to change, so k would be an interval of t, where each time record is considered as an individual. Therefore, if k can be called an *observational unit*.

- $T = T_1, T_2, ...T_w$ denotes the group to which these *individuals* belong. Put in other words, T denotes the number of *observational units*. T is also called a *wave*, in the terminology used above.

[28] I have found in some studies that researchers tend to apply this model as if stationarity conditions hold, and thus a typical test is to examine whether or not variations in current inflation change the frequency and the limits (R_s, R_I).

Hence, by proceeding in this way, the strong assumption of Sheshinski *et al.* (1981), and Ghosh and Wolf (1994) that all the cross-time observations are considered as individuals, applies only to the cross-time observations of each wave T.

Chamberlain (1980) proposed a means of estimating this logit model with unobserved heterogeneity in panel data sets with large observational units, k and small number of observational units, T. The unconditional likelihood function for the $\{kT\}$ observations would be

$$L = \prod_{k}\prod_{t}(\Phi_{j\{kT\}})^{I_{j\{kT\}}}(1-\Phi_{j\{kT\}})^{1-I_{j\{kT\}}}. \tag{4.18}$$

Chamberlain suggest instead to maximize the conditional likelihood function,

$$L^c = \prod_{k} Pr[I_{j\{k1\}} = i_{j\{k1\}}, I_{j\{k2\}} = i_{j\{k2\}}, ..., I_{j\{kT\}} = i_{j\{kT\}} | \sum_{T} i_{j\{kT\}}]. \tag{4.19}$$

The likelihood for each set of T observations is conditional on the number of $I_{j\{kT\}} = 1$ in the set. Chamberlain notes that when Φ is a logistic function, the sum of the dependent variables within a wave or group is a sufficient statistic for the fixed effect, or group-specific constant term θ_k^-. To see how this works, think of magazine n sold in market j and label a group of observations over which the constant term is believed to be the same by k, and its associated constant θ_{jk}^-. If, for example, we have a set of observations for magazine n in market j for 48 months, then θ_{jk}^- represents the constant for that portion of panel data. Some thought reveals that formulation of the conditional likelihood will entail throwing out some cells where all $I_{j\{kT\}}$ are the same, so their sum is either zero or the size of the cell. These cells are obviously degenerate; the likelihood of observing a particular outcome at a given time would then be completely determined given this sum.

Finally, it is interesting to notice that this conditional likelihood function is only a function of the slope parameters β, and not of the fixed effects themselves. The θ_{jk}^-, which are treated as nuisance parameters, are integrated out: they are never estimated.

We can therefore conclude that if the price adjustment rule were truly linear, then the Chamberlain technique would be unnecessary. The constant would not vary, at least over time, but allowing the constant to vary permits the specification of the determinants of the rule to be more complex than a simple fixed linear function. Thus, this technique is employed.

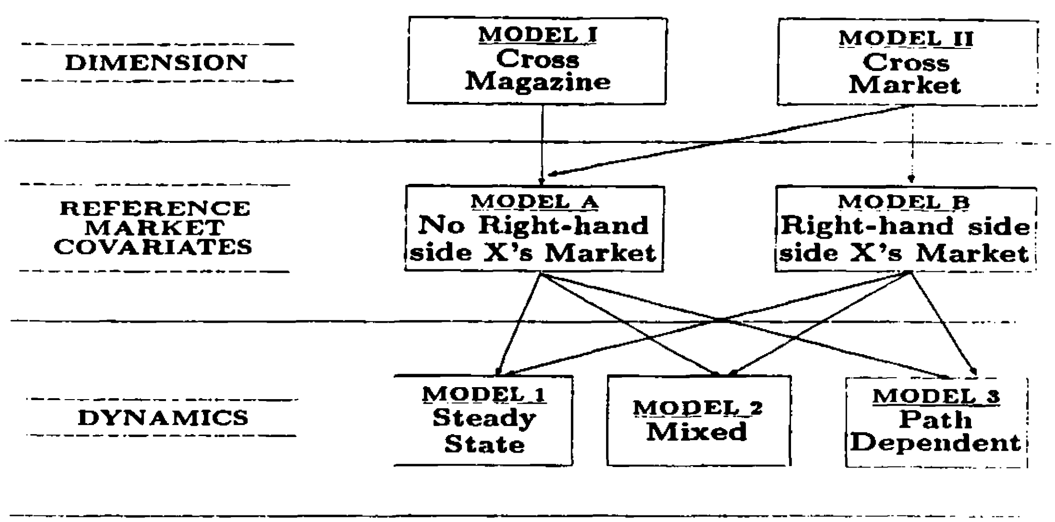
Estimation Design

The nature of the data set permits us to analyze pricing decisions at a threefold level. Figure 4.4 shows these stages:

i) Dimension. Discrete Dependent Variables specifications only dealt the case of a single firm which fixes prices in one market. When looking at the dimensions of the data available for this exercise, it is necessary to decide which pricing rule is studied:

1. Following the examples of Sheshinski *et al.* (1981), Cecchetti (1986) and Dahlby (1992), it seems appropriate to analyze the rule on a single market, that is, a **cross firm or magazine** study but;

Figure 4.4: Arrays of Data for Estimation.



2. The exceptional multimarket quality of the data also suggests a **cross market** analysis of the pricing routine for each magazine.

Whereas the first analysis resembles much of the existing work, the second one investigates the existence a **market fixed effect** not yet taken into consideration, for example, by Ghosh and Wolf (1994), when studying a multimarket setup.

ii) Reference Market's Covariates. The multimarket characteristics offered another way to arrange the data, which consisted of experimenting with regressors relative to the reference country. As pointed out in Chapter 3, this attempt was aimed to test if variables affecting price decisions in the exporter market could be taken as a baseline when deciding on price adjustments across markets and as a measure of common costs affecting all countries.

iii) Dynamics. A further implication of this type of model, as stressed by Iwai (1981) and Cecchetti (1986), is the conflict between *history dependence* and *contemporaneous changes* of the exogenous variables in determining the price setting decisions. Put in other words, whether or not these variables' levels or expectations explain price adjustment patterns better than their realized values since the last adjustment, as the assumption of Brownian Motion in Chapter 2 indicated. Note that if some dependency on expectations presumes that rule changes, or at least is reconsidered, for every observation, which does not seem very realistic[29]. Hence, it would be necessary to distinguish between the information available to the firm when changes its price, and when changes its rule.

[29] Questionnaire responses in Chapter 3 do not provide much help since they indicate that publishers considered the possibility of changing prices every year, which does not imply a variation in the rule, but simply a price change.

Two models or specifications are performed: *Model I* will consider price adjustments in a single market where a number of firms operate; *Model II* will experiment with the cross-market array to study the characteristics of the multimarket firm's setting.

Cross-Magazine Results. Model I

To study the pricing rule across magazines, we have to define **X** in (4.8) as $\mathbf{X}^j_{nt}$. This represents the covariates influencing the motion of the unconstrained optimal price in market j for each magazine n. Let $\mathbf{X}^j_{nt}$ include the following variables:

- $\tilde{T}^j_{nt}$: Time since the last price change of magazine n in market j.
- $\mathbf{P}^j_t$: Current monthly rate of inflation in market j.
- $SINC^j_{nt}$: Number of price changes which have occurred in other magazines sold in market j. This series were smoothed by taking a 3-month moving average, in order to capture realistically simultaneous price variations.
- $\tilde{\mathbf{P}}^j_{nt}$: Cumulative inflation since the last price change of magazine n in market j, which gives an idea of the deviation in real terms since the last adjustment.
- $\Delta P^j_{n\tau-1} = Z^j_{n\tau-1} - P^j_{n\tau-1}$: Previous fixed real price adjustment of magazine n in market j.

Before the results of this exercise are presented, it is covenient to keep in mind that:

- Price responses are only analyzed for a number of magazines in six selected markets: Belgium (5 magazines), Germany (5), Italy (5), Spain (6), Switzerland (6) and the US (5) between 1981 and 1992.[30] Given the monthly nature of the data, and the price stickiness already reported in this chapter, which could yield a large number of $I^j_{nt} = 0$ relative to the total, the constant term was allowed to change every four years, thus T_1, T_2 and T_3 denoted the three observational units analyzed.
- Since for this cross magazine study, the exporter's data was dispersed among different countries of origin, *Model B*'s analysis was dismissed. Hence, the exercise was focused on the three different specifications for *Model A* as in Figure 4.4:
  - *Model I.A.1* estimates the steady state version, where the probability of observing a price change should depend on the current rate of inflation, $\mathbf{P}^j_t$, and the number of changes which have occurred in other magazines, $SINC^j_{nt}$;
  - *Model I.A.3* tested a pure path-dependent version, which included, as determinants of the price change, the time, $\tilde{T}^j_{nt}$, and the cumulated inflation, $\tilde{\mathbf{P}}^j_{nt}$, since last price change, and the size of the previous real price adjustment, $\Delta P^j_{n\tau-1}$, and;
  - *Model I.A.2* combined steady state and path-dependent variables.

β-parameters. Type-A specifications. Table 4.9 presents the results for these exercises:

[30] This choice of countries was determined by the availability of the data for a period of time sufficiently long to observe enough price changes. It would have been possible to add more magazines at the cost of decreasing the sample length.

- The log-likelihood values for the three specifications seem to suggest that path-dependent models are substantially better in explaining price adjustments;
- For *Models I.A.1* and *I.A.2*, the effect of inflation $\mathbf{P}_t^j$ on the probability of observing a price adjustment is positive, except for Germany and the US;
- Estimates for $SINC_{nt}^j$ are always positive, which states that the number of price changes made in other magazines (possibly at an industry level) increases significantly the probability of observing a price change in magazine n. Furthermore, observe that t-statistics indicated unambiguously that these estimates were always significantly different from zero:
- In the mixed specification *I.A.2* and the pure path-dependent one *I.A.3*, coefficients for the time since the last price change, $\tilde{T}_{nt}^j$, are positive but mostly not significant. Hence, it is important to notice that calendar time *per se*, as was suggested in Section 4.3.2, does not seem to be a major determinant of price adjustments;
- The effects of inflation here appear mixed for some cases: While estimates of the effect of cumulative inflation since last price change in *Model I.A.3* predict an increase in the probability of adjusting a price, a joint consideration of $\mathbf{P}_t^j$ and $\tilde{\mathbf{P}}_{nt}^j$ in *Model I.A.2* increased matters because negative values of the parameters of $\tilde{\mathbf{P}}_{nt}^j$ - even though not significantly different from zero - are obtained together with positive estimates of $\mathbf{P}_t^j$ for the cases of Italy and Spain. This means that the probability is somewhat lower than where it would have been. Acknowledging that these two markets were characterized by higher inflation rates relative to the rest, I follow Cecchetti (1985) in stating that a pronounced increase in inflation could induce a decrease of the informativeness of the price system, and therefore, make more diffuse the correlation between frequency and inflation when explaining price adjustments. In fact, at aggregated level, Figure 4.13 did not offer a clear picture of the relationship of these two variables.

θ-parameters. I.A.3 specification. In order to study the price rule in particular, the estimates of the average value of the constant term for each j, $\bar{\theta}_{T_w}$, were also computed as

$$\bar{\theta}_{T_w} = (\Pi_{T_w}^j/(1 - \Pi_{T_w}^j)) - \bar{X}_{nT_w}^j\hat{\beta} \tag{4.20}$$

where $\Pi_{T_w}^j$ is the average probability over the four-year period covered by wave T_w. Estimates of $\bar{\theta}_{T_w}$ and $\bar{\theta}_{T_w}^-$ for *Model I.A.3* only, are reported in Table 4.10, together with the average fixed price change, $\%\Delta\bar{P}_{n\tau}^j$, the average number of price adjustments, $\bar{I}_T^j$, and the average inflation rate, $\bar{\mathbf{P}}_t^j$, during each of the waves T_w. By construction, increases in the value of $\bar{\theta}_{T_w}$ decrease the distance from the previous return point to the current barrier. A rise in $\bar{\theta}_{T_w}^-$ can be interpreted as a lowering of the current ceiling, relative to the previous one. Furthermore, recall that if price rigidity and costs of price adjustment remain constant, the distance from the return point to the barrier of the price change rule should grow with inflation, so estimates of $\%\Delta\bar{P}_{n\tau}^j$ should increase with inflation, and the $\bar{\theta}_{T_w}$ should decrease.

As a matter of fact, if the intercept θ_{T_w} displays sufficient variability, it can be said that the price rule has changed across waves. Under normal circumstances, these comparisons could be carried out by either a likelihood ratio or a Wald statistic, computed from the set of parameter estimates and their estimated covariance matrices but, as mentioned, Chamberlain's method only permitted computation of the non-comparable conditional likelihood, $logL^c$, which precluded classical tests. However, it is yet possible to use a Hausman (1979) test to examine two nested models. Under the null hypothesis of no misspecification (in this case, there are unobserved time-varying fixed effects parameters), there will exist a consistent, asymptotically normal and asymptotically efficient estimator; under the alternative hypothesis (in this case, there is no heterogeneity across waves), the estimator will be biased and unconsistent. Therefore Hausman (1979) proposes the following specification test:

$$h = \hat{q}\hat{M}(\hat{q})^{-1} \quad \hat{q} = \hat{\beta}_0 - \hat{\beta}_1 \tag{4.21}$$

distributed as a χ^2_m, where $\hat{\beta}_0$ is the efficient estimate under H_0, $\hat{\beta}_1$ is a consistent estimator under H_1, and M is the correspondent covariance matrix. Therefore, if no misspecification is present, the probability limit of $\hat{q}$ is zero. With misspecification, $plim\hat{q}$ will differ from zero and if the power of the test is high, $\hat{q}$ will be large in absolute value relative to its asymptotic standard error.

Table 4.10 presents some evidence about the value of θ-intercept:

- θ_{T_w} experienced an increase in most markets, except in Germany which exhibited a clear decrease in the value of both $\bar{\theta}_{T_w}$ and $\bar{\theta}^-_{T_w}$;

- Hausman tests were performed for model *I.A.3*. They clearly indicated that for Belgium, Italy and Spain, estimates obtained using the Fixed Effects technique were not significantly different from those using constant term specifications. This finding could suggest that the aggregate price rule remained unchanged in these countries during this period;

- Nonetheless, the downward trend in the value of $\%\Delta\bar{P}^j_{n\tau}$ for all countries, except for Switzerland and the US, comes associated with a deceleration of the inflation levels;

- Cases where the time-varying intercept was noticeable also deserved some attention. The increasing trend in the estimates of $\bar{\theta}_{T_w}$ and $\bar{\theta}^-_{T_w}$ for the US, which showed a lowering of the ceiling barrier, were contemporaneous not only with a fall in the inflation but also with an increase in the frequency of price adjustment, which goes further than case (c), described in Figure 4.3. Indeed, this fact reflects a situation in which uncertainty increases;[31]

- However, the US prices experience contrasted with the decreasing trend of the estimates of $\bar{\theta}_{T_w}$ and $\bar{\theta}^-_{T_w}$ for Germany: in this case, a decrease in inflation implied an increase of both inaction bands and rigidity, again a more extreme case than the one depicted in Figure 4.3 as (a). Therefore, if exchange rates are not yet taken into consideration, this performance could be explained not only by a low but also a stationary trend in inflation that reinforces the importance of costs of adjustment in precluding price changes.

[31] As is shown later, exchange rates are important in explaining the behaviour of these price adjustments, mostly when the Dollar value experienced large swings during the period studied.

Cross-Market Results. Model II

The second wave of regressions exploited the multimarket nature of the data and explored the possibility that the constant term could vary across markets, so a number of dummy variables for each market where the magazine was sold was included. For these cross-market models, both type-A and B models were tested as depicted in Figure 4.4, allowing the constant term to change every four years. Therefore, now $\mathbf{X}$ in (4.8) becomes $\mathbf{X}^n_{jt}$.

For type-A models, the following variables were considered:

- $\tilde{T}^n_{jt}$: Time since the last price change in market j where magazine n is sold.
- $\mathbf{P}^n_{jt}$: Current monthly rate of inflation in each market j where the magazine n is sold.
- $SINC^n_{jt}$ = Number of price changes which occurred in other markets where magazine n is sold. Again these series were smoothed by taking a 3-month moving average in order to capture realistically the simultaneous price variations.
- $\tilde{\mathbf{P}}^n_{jt}$: Cumulative inflation since the last price change in market j, which gives an idea of the deviation in real terms since the last adjustment.
- $\Delta P^n_{j\tau-1} = R'_{i\tau-1} - R'_{I\tau}$: Previous fixed real price adjustment in market j for magazine n.
- α^n_{jt}: Dummy variable included in the regression to capture the idiosyncratic effect of market j.

For type-B models, variables denoted by the subscript $j = 1$ referred to the reference or exporter's country.

β-parameters. Type-A specifications. Tables 4.11 to 4.15 present the results for this exercise. An initial examination of the results for the type-A models suggests that

- *Path-dependent* models added more valuable information about the adjustment rule;
- For the steady state formulation *II.A.1*, increases in current inflation also implied a larger probability of a price adjustment occurring, but the effects of inflation for *II.A.2* appeared mixed, with negative estimates of the cumulative inflation, $\tilde{\mathbf{P}}^n_{jt}$. The most salient result relative to inflation, however, constitutes the fact that for *II.A.3* specification, positive and mostly significant coefficients of $\tilde{\mathbf{P}}^n_{jt}$ poses some importance for the belief that price adjustments could occur following independent (R_i, R_I) in each market. This finding is not necessarily contradictory to price synchronization while stationary conditions hold in each destination, despite different levels of current and cumulative inflation being realized;
- Indeed, regressions yielding positive estimates of $SINC^n_{jt}$ - not to be confused with $SINC^j_{nt}$ - indicate a *cross-market* synchronization of price changes for each magazine. This may imply that the costs of price adjustment can be interpreted as menu costs rather than

decision costs, which could undermine the hypotheses about the nature of costs of price adjustment in Chapter 2;[32]

- Within the path-dependent models, estimated coefficients for $\tilde{T}_{jt}^{n}$ proved to be more significant than for the cross-magazine analysis, that is, *Models I*. Nonetheless, given the relative importance of $SINC_{jt}^{n}$, it seems that time-coincident price adjustment times across markets for a single magazine have more to do with the reasons addressed above than with calendar considerations *per se*. Therefore, firms not only synchronized their decisions internally, but also relative to competitors in a market.

Contrary to the cross-magazine cases, cumulative inflation since the last price adjustment and the previous fixed price change of the magazine were proved to be unambiguously positive and negative respectively, and significantly different from zero for most cases, and thus these variables largely determined price adjustments.

β-parameters. Type-B specifications. These models aimed basically at testing whether pricing strategies in the exporter's market approximated sufficiently his behaviour abroad. The $j = 1$ column relative to the market of origin was dropped from the matrix I_{jt}^{n}, but covariates in $\mathbf{X}_{jt}^{n}$ corresponding to this market were grouped and taken as if they affected to the $J - 1$ remaining markets in I_{jt}^{n}. Since no reference of the price in the domestic market was available for *Fortune*, *Newsweek* and *Le Figaro*, in these cases regressions included only the current inflation in the reference market. Results in Tables 4.11 to 4.15 show that:

- For the steady state *Model II.B.1*, current inflation in the reference market was positive and significant, except for *Businessweek*, *Fortune*, *L'Express* and *The Economist*;

- As before, it is interesting to analyze whether the current and cumulative inflation of price changes in the exporter's market had mixed effects on price decisions for the models combining steady-state and path-dependent variables. These phenomena were found for *Businessweek* and *Fortune*: Observe that the high price rigidities of *Fortune*, and to a lesser extent *Businessweek*, make price adjustments appear linked to the relatively lower US inflation levels. However, both cases differ in the sense that, while for *Businessweek*, the estimates of the parameter of $\mathbf{P}_{jt}$ and $\tilde{\mathbf{P}}_{jt}^{n}$ are positive and significant, despite their effects on the probability being offset by $\mathbf{P}_{1t}^{n}$ and $\tilde{\mathbf{P}}_{1t}^{n}$, price series of *Fortune* seem to be exclusively dominated by inflation in US;

- Estimates for $SINC_{1t}^{n}$ were all positive and significantly different from one. Since this variable had a similar performance to $SINC_{jt}^{n}$ in the *Type-A* models, the argument that increasing returns to scale where menu costs are present determines largely synchronized price adjustments is reinforced. It is remarkable that the fact that did $SINC_{1t}^{n}$ had a larger effect on the probability of a price adjustment than $SINC_{jt}^{n}$ for *Fortune*, *Le Figaro* and *Le Nouvel Observateur*.

[32] Menu costs, as referred in Chapter 2 are independent of the number of markets in the price list, that is, once the price sheet has to be renewed, it costs the same to change one or ten prices, so this extreme form of increasing returns to scale leads to synchronization.

θ-parameters. II.A.3 specification. Table 4.14 discusses the price-adjustment rule in terms of θ_{T_u} and $\bar{\theta}_{T_u}$ for the *Model II.A.3*. The last column of Table 4.14, $\bar{P}^n_{jt}$, shows the average current inflation across all markets where n is sold.

- Tests indicated that only for the cases of *Businessweek*, *Fortune*, *Le Nouvel Observateur* and *The Economist*, were estimates obtained using the Fixed Effects technique significantly different from those using constant term specifications. While estimates of $\bar{\theta}_{T_u}$ for *The Economist* and *Businessweek* decreased across time, *Fortune* and *Le Nouvel Observateur* increased the upper barrier across all markets.

- Further consideration of the statistics reported in Table 4.14 reveals a decrease in the average inflation level across markets and, as Figure 4.7 shows, a peak in the number of price adjustments corresponding with the middle of the 1980s. As occurred for the cross-magazine analysis, here mixed results were obtained on the relationship between these time-varying parameters and inflation and the fixed nominal price adjustment. Regressions for magazines where θ_{T_u} was not significantly different from a common θ_{T_u} for the whole period indicated that during period of higher inflation, changes in the price rule were rather insignificant, but the frequency of adjustment $\bar{I}_T$ and the fixed price changes $\Delta\bar{P}_\tau$ increased. Therefore, this finding clearly indicates that since those exporters **preferred to accommodate the time schedules rather than the boundaries**, costs of price adjustment could have fallen at this time. Nonetheless, given this common pattern in terms of inflation and frequency of price changes across magazines, but the various outcomes in terms of θ_{T_u}s, the consideration of exchange rates in the next section will contribute to the formulation of these conclusions.

α-parameters. II.A.3 specification. Finally, the data arrangement for type-*II* Models permitted estimation of a fixed market effect, captured by α^n_{jt}. Table 4.15 shows the estimates of the markets' fixed effects for *Model A.3*. Observe that the *t*-statistics indicate that these coefficients are unambiguously different from zero, and, what it is more important, tests for the restricting hypothesis of equal market effects is rejected, so despite the fact that the time-varying parameter hypothesis was appealing in half of the cases, market fixed effects appear for all the markets.

Concluding Remarks

This section provided a first approach to the price characteristics analyzed in this dissertation. Starting from a non-restrictive description of the rigidity and size of price adjustments, a number of Discrete Dependent Variables estimations aimed at testing whether the (R_i, R_I) pricing scheme proposed by Sheshinski and Weiss (1977) held were carried out.

1. The unconstrained optimal price was allowed to be governed by variables other than current inflation, and studied especially whether price adjustments relied more on path-dependent arguments than on current events. Work with both types of data array suggested that path-dependent models offered a more realistic view of what really happened;

2. The nature of the data also permitted investigating whether synchronization of price adjustment worked from two directions; cross-market and cross-firm;

3. Fixed Effect Chamberlain estimates were proved to be unnecessary for a number of cases. since price adjustment rules seem not to have changed during the period considered. but fixed market effects unambiguously existed.

Since any consideration of exchange rate changes was absent in this analysis. the rest of the chapter will take this factor into account. This preliminary analysis. apart from offering some standard evidence relative to existing work. will nevertheless prove useful in determining whether nominal export prices quoted in the foreign market's currency are sensitive or insensitive to changes in the local economic environment, independent of exchange rate fluctuations.

4.4 Price Characteristics II: Implicit Prices, Exchange Rate Pass-Through into Export Prices and Pricing-to-Market.

The consideration of exchange rates constitutes another way of relating price adjustments for the same product across markets. It also pushes further the scope of the analysis of the frequency and size of price adjustments because exchange rate variations not only allow to reconsider the price setting dynamics studied above, but also let us investigate how exchange rate fluctuations are finally *passed-through* into nominal prices. Therefore, this section will concentrate first on the study of *pass-through*, to end up with the analysis of the price adjustment rule as shown in Section 2.4. To begin with, Section 4.4.1 underlines again the idea that the characteristics of the series of each study define the scope of the analysis of the exchange rate pass-through. Section 4.4.2 investigates a demand-side specification of this relationship, and studies differences in the pass-through elasticities across markets and time. Since some of these tests will be proven to be insufficient, due to the existence of price adjustment lags. The last section analyzes the pass-through using the Discrete Dependent Variables specification to obtain a picture of the determinants of foreign price changes.

4.4.1 Series Characteristics and Exchange Rate Pass-Through

Empirical estimation of exchange rate pass-through into prices has been carried out using different econometric implementations, depending on the theoretical conjectures economists were testing.[33] When Section 1.6 surveyed several empirical studies on exchange rate pass-through, interests were not merely to list some particular results for a number of cases, but also to distinguish carefully the **source** of this evidence. As a matter of fact, it was precisely the type of data analyzed in each article that, in some degree, determined the limits of the study and the nature of the conclusions. Thus, despite studies have proliferated in recent years, almost no two of them have tested the same hypotheses on an identical data set, preventing competition between results from different studies.[34] Rather, research on this subject have contributed in the direction of accumulating evidence on the pass-through elasticity.

Series Characteristics

Let us enumerate a number of caveats to take account of when measuring and comparing exchange rate pass-through:

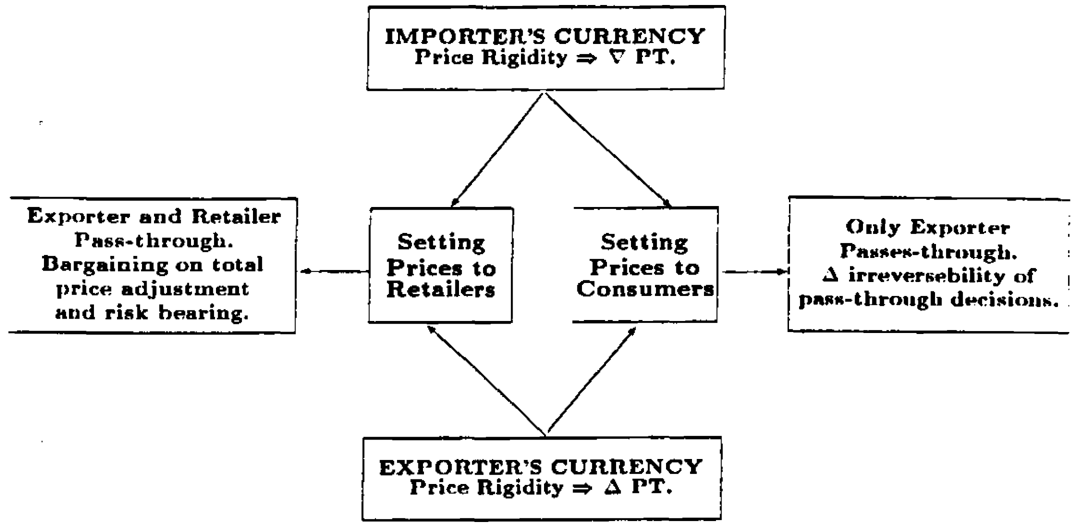
1. Tables 1.6 to 1.9 showed that the majority of empirical studies on pass-through has been performed for **price indexes or import/export unit values of industrial sectors**.[35] If all the exporters in a particular industry collude, then the aggregate behaviour is equivalent to what would result from a single monopolist; but if products are differentiated

[33] See Tables 1.6 to 1.9.

[34] This dissertation analyzes, among others, newsstand prices of *The Economist* as in Ghosh and Wolf (1994), so it will be possible to compare the results of this work with those of Ghosh and Wolf (1994).

[35] For instance, Knetter's (1989, 1993a, 1994) important contributions to the empirical estimation of pass-through does not analyze price indexes of a number of industrial sectors, but export unit-values exclusive of transportation and tariff wedges, based on customs declarations in the respective countries of export.

Figure 4.5: Price stages when measuring exchange rate pass-through to the exporter's selling price.



or no significant strategic interactions occur, then, aggregated series would show some differences from what is observed at firm level. Furthermore, aggregated data is always smoother than when an individual product is studied. Despite the fact that this may characterize an important number of transactions, work on **exchange rate pass-through at the retail price level**, as in this dissertation, is rather scarce.[36]

2. Studies also differ in the **dimension** in which the pass-through is investigated: some articles analyze how several exporters behave in a single market, while others allow comparisons of a single exporter's behaviour in different destinations.

3. The **exporter's invoicing strategy** (or the currency in which the prices are known by the researcher) and the stage at which prices are available, that is, **producer or retailer/consumer prices** affect seriously the results of measuring the pass-through. Figure 4.5 summarizes these features:

    - For example, assume that pass-through is always *calculated* on the exporter's selling price. Then, this price may be invoiced in either exporter's or the importer's currency units, and it can be either the intermediate price set for dealers in the foreign market or the final foreign consumer price. On one hand, when the exporter quotes prices in his own currency[37] ($p_{jt}(1)$ in the terminology employed in this dissertation), if prices are rigid when the exchange rate changes, these fluctuations would automatically affect the value paid in foreign currency units by retailers or final consumers, and

[36] See Feenstra (1986), LeCacheaux and Riechlin (1989), Kirman and Schueller (1990), Ghosh and Wolf (1994) and Herguera (1994).

[37] See Mann (1987), Marston (1989) and Knetter (1989,1993a).

exchange rates would be **exporter fully passed-through.** However, if some foreign dealers take part in the transaction, then it would be possible to define a **two-stage pass-through,** (that is, on wholesale and on consumer prices); therefore, exporter's actions, with respect to his selling price, may be reversed, neutralized or augmented by retailers' decisions on the final price.

- Alternatively, assume that exporters fix prices in the foreign currency.[38] **Exporter full pass-through** is observed here when export prices are fully sensitive to exchange rate changes; if they are not, exporter's markups will vary.

Therefore, these considerations may strongly affect the empirical measurement of pass-through elasticity.

4. Finally, as Knetter (1992,1993a) has pointed out that upward and downward trends in exchange rates within the samples studied may also affect the empirical specification of the models and imply, in some cases, non-linearities in the relationship between exchange rates and prices.[39]

These aspects are therefore sufficient to conclude that the **data characteristics impose some restrictions on what can finally be inferred from the current data and may determine the specific econometric implementation adopted by researchers.** It is precisely this last point which will receive some attention in the next section.

Earlier Econometric Implementation of the Pass-through for Importer's Currency Retail Prices

As mentioned, studies of exchange rate pass-through on retail prices are not common. Newsstand prices of magazines are fixed by the exporter,[40] denominated in foreign currency, and display a large degree of stickiness. Estimations based on data with similar characteristics have proven to present some technical difficulties. Here, I will refer to three examples: LeCacheaux and Reichlin (1989), Kirman and Schueller (1990) and Herguera (1994) on prices of automobiles. Starting from the earliest attempts Le Cacheaux and Reichlin (1989), and Kirman and Schueller (1990) applied a basic model of the form

$$A^n_{j1,t} = \alpha_j + \beta S_{jt} + u_t, \qquad (4.22)$$

where $A^n_{j1,t}$ is the ratio between the prices of car n in markets j and 1 (the reference market), respectively, that is, the exchange rate level implied by the two prices; S_{jt} is the current spot

[38] See LeCacheaux and Riechlin (1989), Herguera (1994).

[39] Indeed, these phenomena have sometimes been obscured by the large amount of work performed for the US market on the first and the second halves of the 1980s, in which it was possible to distinguish a net appreciation and depreciation, respectively, for a sufficiently long period. But if the whole decade is studied, it is observed that the US dollar experienced a cycle.

[40] Despite the fact that prices are posted in the destination currency, this is not sufficient to conclude by whom they were set. I asked a Spanish retailer of several international magazines about this practice, and he answered that, in this case, publishers determine prices but retailers *use to advice* (sic) about the optimal adjustment in each situation.

exchange rate defined, as the foreign currency price of the reference currency, and u_{jt} is an error term. Assuming constant elasticity of demand with respect to the local currency price in the importer's market[41], their formulation permits the testing of the null hypothesis of complete pass-through and perfect competition if

$$H_0: \alpha_j = 0; \quad \beta = 1 \qquad u_{jt} \sim N(0,1) \quad \forall j \neq 1.$$

Estimating this relationship with individual price data gave rise to serious statistical difficulties, which would not allow us to perform correct inferences of the true values of the parameters in (4.22). More importantly, they stressed a pair of crucial facts to be taken into account when estimating this relationship:

1. *Different Frequencies*: Given the rigidity of prices of automobiles, $A^n_{1j,t}$ was expected to be unchanged except when either of the two prices was adjusted, which contrasted with the high frequency of the exchange rate changes;

2. *Size of Exchange Rate Changes*: Some observations of the spot exchange rates for EMS currencies were characterized by small variations, and occasional large step changes when parity realignments occurred. Therefore, this could be the case where small fluctuations of the exchange rates were not sufficient to induce a price adjustment.

Le Cacheaux and Reichlin (1989) did not stop here, and tried to find any sort of misspecification in the model: rather than implementing any transformation of the series to make them smoother, they proposed to estimate the characteristics of the residuals in (4.22) to infer the nature of the misspecification:

$$u_{jt} = \gamma + \rho u_{jt-1} + \sum_l \lambda_l (u_{jt-l} - u_{jt-l-1}) + \epsilon_{jt}, \tag{4.23}$$

where u_{jt} are the residuals from equation (4.22) and $l = 1, 2, ...6$ represents the lags introduced in the estimation. Estimates of this last equation proved that u_{jt} residuals were well explained by their own values lagged one period with ρ, for most of the cases, never significantly different from one. No autocorrelation was found beyond the first lagged value, so it could not be rejected that ϵ_t was white noise.[42] All this implied that estimates of equation (4.22) could not be improved by the typical procedures of adding lagged values of the explanatory variable and, given the characteristics of the residuals, nothing could be inferred about the possible existence of a systematic relationship between prices and exchange rates. Nevertheless, since this autocorrelated structure of the residuals was entirely due to the discrete nature of the price adjustments, the estimation results in (4.22) could be improved by allowing the residuals to

[41] Recall that no matter what model of market structure is assumed, the result for price adjustment in response to exchange rate changes is ultimately dependent on the firms' perceptions of how demand elasticities change with respect to local destination price (see, for example, Stone [1979] for some estimates of the price elasticities of demand for exports and imports in the US, EEC and Japan; see also section 1.5.3). This point is discussed below.

[42] A further attempt consisted in adding some other variables and putting in some dummies for appreciations and depreciations. Unfortunately, any improvements were not noticeable. Note also that since automobile prices were non-stationary in most of cases, any regression of the form of (4.22) was of spurious usefulness and estimates could result in being strongly biased (see Granger and Newbold [1974]).

behave in such a way, as this autocorrelation measures the speed of the error correction from a long-run relationship between prices and exchange rates.[43]

Thus, the lesson of these attempts was that **exchange rate effects on export prices tend to be gradual** due to various adjustment costs, uncertainty, the producer-customer relationship, and so forth. Export prices, when measured at a retail level, do not seem to move quickly. Therefore, it is necessary to distinguish those changes in the relationship that arise from the long-run relationship between prices and exchange rates, and those exclusively related with dynamics of pass-through, that is, whether the pass-through has become more lengthened recently than before or not.

[43] See Kim (1990) and Hung *et al.* (1993) for a discussion of the usage of an Error Correction Mechanism of this type when price adjustment takes time.

4.4.2 Empirical Specification of Demand-side Models

In order to cover a wide range of pricing responses, Section 2.2 presented a multimarket firm's program whose first-order conditions implied that

$$P^{*}_{jt} = [\frac{\varepsilon_j}{\varepsilon_j - 1}]c_t\kappa_t S_j = (1+\eta_j)c_t\kappa_t S, \tag{4.24}$$

such that, to determine the exchange rate pass-through, differentiating the expression (4.24) in logarithms, yields

$$\frac{\partial ln P^{*}_{jt}}{\partial ln S_{jt}} = 1 + \frac{\partial ln\,[(1+\eta_j)c_t\kappa_t]}{\partial ln S_{jt}} = \frac{\partial ln\,[(\varepsilon_j/\varepsilon_j - 1)c_t\kappa_t]}{\partial ln S_{jt}}. \tag{4.25}$$

In terms of the regulated variable of our problem, W_{jt}, (4.25) turns

$$W^{*}_{jt} = [\frac{\varepsilon_j}{\varepsilon_j - 1}]c_t\kappa_t = (1+\eta_j)c_t\kappa_t, \tag{4.26}$$

and

$$\frac{\partial ln W^{*}_{jt}}{\partial ln S_{jt}} = \frac{\partial ln\,[(1+\eta_j)c_t\kappa_t]}{\partial ln S_{jt}} = \frac{\partial ln\,[(\varepsilon_j/\varepsilon_j - 1)c_t\kappa_t]}{\partial ln S_{jt}}, \tag{4.27}$$

where the demand function in country j at time t is given by $Q_{jt} = q_j(P_{jt}(j))$. Recall that $P_{jt}(j)$ is the price expressed in the destination market's currency, S_{jt} the exchange rate, defined as before, and $C_t = C(\sum_{j=1}^{n} Q_{jt})\kappa_t$ is the cost function with κ_t being a random variable that may shift the cost function (i.e. input prices, as shown), and $c_t = dC_t/dQ_{jt}$. Furthermore, the perceived elasticity of demand is denoted by ε_j, and η_j is defined as the markup, both in market j. Therefore, the price is a markup over marginal costs, with this markup determined by the elasticity of demand in the various destination markets. Hence, this formulation opens a wide field of hypothesis to be tested, and the possibility to infer the convexity of the demand schedule if marginal costs are known, as underlined in Section 2.2. To ease the exposition of these tests, an empirical specification of (4.26) is considered. Linearizing (4.26) by taking logarithms and following the empirical exercises by Knetter (1989) or Ghosh and Wolf (1994), consider a fixed-effects regression model of the form:

$$w_{jt}(1) = \theta_t + \alpha_j + \beta_j s_{jt} + v_{jt}.^{44} \tag{4.28}$$

where

- $w_{jt}(1)$ is the logarithm of the implicit price, defined in Chapter 2 as $p_{jt}(j)/s_{jt}$. This transformation was adopted because of reported rigidity of $P_{jt}(j)$, and its associated problems for estimation referred in Section 4.4.1. Additionally, this specification was the same used by Ghosh and Wolf's (1994) for the analysis of newsstand prices for *The Economist*, which enables comparisons. Of course, this manipulation does not change the conclusions obtained from regressing $p_{ij}(j)$ on the r.h.s of (4.28). Apart from this transformation, notice

[44] This double-fixed-effects implementation (market and time) has sometimes been criticized because the cost in terms of degrees of freedom is often not justified.

that observed retail prices $p_{jt}(j)$ are not independent of transportation costs, so the interpretation of the constants in (4.28) becomes less clear-cut than in other studies, for instance, Knetter (1989) which employs export prices in the exporter's currency.[45]

- θ_t is a time effect. A factor underlying this time effect is the marginal cost of the exporter, or any sort of change in markups over marginal costs that is common to all destinations. Since the marginal cost is assumed to be *common and spillover* on prices across all destinations, it seems reasonable to use a time dummy to control for these cost shifts. In fact, as Knetter (1989,1991,1993a,b) has stressed, for an empirical implementation, as the one formulated above, changes in the marginal cost of production affect all markets by the same proportion, independently of how exchange rate fluctuation, inputs or other factors have any effect on it. Furthermore, any effects of the exchange rate changes on costs through inputs or returns to scale would be accounted by this term.

  An alternative approximation of this cost is $p_{1t}(1)$, defined as the logarithm of price of the magazine in the exporter's market expressed in the exporter's own currency. Examples of this use are Mann (1986), Baldwin (1988b), Marston (1990) and Ghosh and Wolf (1994), who used $p_{1t}(1)$ as a proxy of marginal costs when estimating pass-through of *The Economist*. Apart from the criticisms this approximation has received,[46] θ_t and $p_{1t}(1)$ could be understood, in the present study, as two competing variables in characterizing a similar factor.[47] Therefore, $p_{1j}(j)$ was also experimented in (4.28);

- α_j is a market effect. This intercept term is allowed to vary due to unobservable factors that are assumed to be constant over time but may vary across markets. One can think of institutional features in each destination, regulatory barriers, tariffs, licensing or in the degree of competitiveness, which determine the markups over costs, such as market factors;

- s_{jt} is the logarithm of the exchange rate;

- v_{jt} is an autoregressive disturbance

$$v_{jt} = \rho v_{jt-1} + u_{jt}, \tag{4.29}$$

  where $u_{jt} \sim N(0,1)$, and ρ, given the rigidity in export prices, measures the speed of error correction from the long-run relationship between prices and exchange rate changes. This ρ indicates how sensitive traders become to correct quickly deviations from the long-run relationship referred above. These errors may also arise if the pass-through relationship is non-linear.

This formulation permits testing a perfectly competitive international market against a number of alternative hypothesis of imperfect competition as shown below.

[45] Since no reliable and homogeneously defined values of these costs could be found for each market, the transportation expenses were not included in the regressions.

[46] See Stigler and Kindalh (1970).

[47] Exporter's own market prices were not available for *Newsweek*, *Fortune* and *Le Figaro*, so rather than approximating these series by an index price of publishing products in each respective country, $p_{1j}(1)$ was dropped from the regressions.

H_0: Competitive International Market.

This hypothesis implies the *Law of One Price*: Price equals marginal cost and prices are equal across markets. Therefore, θ_t in (4.28) would represent the common price at each t, and no residual variation of prices could be correlated with exchange rate changes or idiosyncratic country effects. Therefore,

$$H_0 : \alpha_j = 0; \quad \beta_j = 0 \quad \text{and} \quad u_{jt} \sim N(0,1) \quad \forall j,$$

which denotes a complete pass-through of current exchange rates into the relative magazine prices.

H_1: Imperfectly Competitive International Market.

The rejection of the null hypothesis would involve some price discrimination between markets, and can be owed to a number of factors that affect the value of α_j and β_j.

1. **Constant elasticity of demand with positive and equal markups across destinations.**

$$H_1 : \alpha_j = \alpha_k \neq 0, \forall j \neq k, \quad \beta_j = 0, \forall j$$

   Constant elasticity of the perceived demand in each market means that the price in these destinations is a *fixed* markup over marginal cost. Therefore, exchange rate changes are fully passed through into import prices, $p_{jt}(j)$, and consequently, implicit prices $w_{jt}(1)$ will be irresponsive to exchange rate fluctuations. Hence, any variation of these prices would reflect changes in marginal cost common across all markets, measured by the time effect θ_t. Markups, measured by the market effect α_j, are allowed to be above the competitive level, but they are equal across markets, so price discrimination does not necessarily arise when imperfect competition.

2. **Constant elasticity of demand with different markups across destinations.**

$$H_1 : \alpha_j \neq \alpha_k, \forall j \neq k, \quad \beta_j = 0, \forall j$$

   This case shows that price discrimination across markets may be consistent with complete pass-through. The value of $\beta_j = 0$ still implies that the markup in a particular destination is unresponsive to fluctuations in the exchange rates. Pass-through is complete but the different α_j's reflect different optimal markups in each market. Again, any variation in the implicit prices $w_{jt}(1)$ will be associated with shifts in marginal cost.

   The specification in (4.28), however, has a critical implication when price elasticities of demand are assumed to be constant: there is no residual variation in export prices that could be correlated with destination-specific exchange rates. Furthermore, the effect of an additive cost change on price can only reveal the underlying movements in marginal costs exactly if demand has constant price elasticity in all the destination markets.

3. **Non-constant but common elasticity of demand across markets with positive and equal markups across destinations.**

$$H_1 : \alpha_j = \alpha_k \neq 0, \forall j \neq k, \quad \beta_j = \beta_k \neq 0, \forall j \neq k$$

When coefficients on exchange rates in equation (4.28) are different from zero, exchange rate pass-through is not complete and markups may vary at the event of exchange rate fluctuations. Note that since β coefficients can be equal across markets, induced changes in markups are common across markets, and price discrimination does not appear. Therefore, changes in implicit prices $w_{jt}(1)$ are not only owed to cost shifts but also will depend on exchange rate variations. Furthermore, given that all β coefficients are equal, a non-constant elasticity of demand and a non-complete exchange rate pass-through could be compatible with non-price discrimination.

4. **Non-constant and different elasticity of demand across markets with different markups across destinations.**

$$H_1 : \alpha_j \neq \alpha_k \neq 0, \forall j \neq k, \quad \beta_j \neq \beta_k \neq 0, \forall j \neq k$$

This case is interesting because refers to the particular *type* of price discrimination implied by the *Pricing-to-market* phenomena described in Section 1.5.3. Now, not only markups vary across destinations but also it is possible to measure the differences in markup elasticities to exchange rate changes across markets.

Two controversial issues arise when elasticities of demand are not constant:

- Time effects will not provide exact estimates of marginal cost.[48] However, as Knetter (1989) pointed out, even if this condition is violated, estimates are not necessarily biased, if there exists enough degree of heterogeneity in the convexity of the perceived demand schedules in any market or in the exchange rate fluctuations in each market. If this is the case, this measure of the marginal costs might only be a noisy one, and the empirical framework in (4.28) will isolate correlations between exchange rates and export prices that are due to fluctuations in the markup: and,
- Whether changes in elasticities over time, due to factors other than changes in the local currency price, are systematically related to exchange rates. Empirical evidence indicates that exchange rates are at best weakly correlated with other macroeconomic variables.[49] This supports the notion that demand side general equilibrium effects are small. If this is true, then the exchange rate coefficients reveal how elasticities change along the demand schedule. Therefore, since equation (4.28) disentangled export pricing in supply (θ_t) and demand (α_j and β_j) determinants, it is possible to provide an economic interpretation of the value of these parameters. Knetter (1989) give us the general rule to interpret the idea that pass-through is dependent on the elasticity of demand: *Net of the effect of any associated changes in marginal costs with exchange rates*, if demand, as perceived by the exporter, becomes less (more) convex - more (less) elastic - than the constant elasticity one as the foreign currency price rises when exporter's currency appreciates, then the optimal markup charged by the exporter will fall (rise).[50] Hence, estimated coefficients on exchange rates β_j

[48] See Bullow and Phleiderer's (1983) comment on Summer's (1981) investigation of the cigarette industry (quoted by Knetter [1989]) which illustrates this point.

[49] See Meese and Rogoff (1983).

[50] Notice that prices may change not only because of exchange rate swings, but also because of inflation (real prices), which may affect the perceived elasticity of demand as well.

may provide evidence on how elasticities change along the demand schedule faced by the exporter in different destination markets, and consequently, markups.

Therefore, at the light of Tables 1.1 and 1.2 in Chapter 1, values of $\beta_j \neq 0$ can be classified as follows:

1. If $\beta_j > 0$, the *sign* of the exchange rate pass-through is normal, and the *size* is **more-than-complete**;
2. When $-1 < \beta_j < 0$, the sign is **normal** and the size is **less-than-complete**:
3. If $\beta_j = -1$, the pass-through is **null**, and;
4. Finally, if $\beta_j < -1$, the sign of the pass-through is said to be **perverse**, since rather than, for example, increasing when the exporter's currency appreciates, the price, $p_{jt}(j)$ decreases.

Thus, it is possible to conclude that the equation (4.28) determines the exchange rate pass-through into prices in two ways:

1. By affecting marginal cost, through changes in quantities or input prices, and:
2. By affecting the elasticity of import demand or markups.

Given the time-series cross-section characteristics of the data and the variety of destination markets studied in this exercise, it seems convenient to consider some variations of equation (4.28) to assess the robustness of the results. These variations are based on two major criteria:

1. Import-Currency Price Stabilization Regressions: They consist of a series of specifications for the data which allow to compare those results obtained when using $p_{1t}(1)$, as Ghosh and Wolf (1994), and θ_t, as a measure of common marginal costs.
   - *Model 1.1*:
   $$w_{jt}(1) = \theta_t + \alpha_j + v_{jt}. \tag{4.30}$$
   - *Model 1.2*:
   $$w_{jt}(1) = \alpha_j + \gamma p_{1t}(1) + \beta_j s_{jt} + v_{jt}. \tag{4.31}$$
   - *Model 1.3*:
   $$w_{jt}(1) = \theta_t + \alpha_j + \beta_j s_{jt} + v_{jt}. \tag{4.32}$$
2. Adjusted Exchange Rate Pass-through Tests: The strong price rigidity of the series, and the positive inflation that erodes the value of nominal prices while unchanged, have serious consequences of the dynamic relationship between exchange rates and prices. Despite an estimation of the differences of the variables in (4.28) may lose some of the information contained in the level ones, this attempt may reveal why a demand-side specification when

prices are rigid, is unsufficient. Therefore, estimation results between the **level** and the **difference** versions of equation (4.28) are compared. This analysis consists of regressing changes in the (monthly) *adjusted* currency price in each destination, $\Delta r_{jt}(j) = w_{jt}(1)/\mathbf{p}_{jt}$, on variations in the corresponding *adjusted* price of the reference country (when they exist) $\Delta r_{1t}(1) = p_{1t}(1)/\mathbf{p}_{1t}$, and on changes of current and lagged values of the *adjusted* nominal exchange rates, defined as $s_{jt}^A = s_{jt}/\mathbf{p}_{jt}$, $\mathbf{p}_{jt}$ being the corresponding logarithm of inflation in market j, and $j = 1$ being the reference market, such that prices must be unaffected when

$$\Delta r_{jt}(j) = \psi_j \Delta r_{1t}(1) + \sum_{l=0}^{L} \lambda_{jl} \Delta s_{1j,t-l}^A + v_{jt}. \quad (4.33)$$

Hence, the pass-through elasticity at lag l is then given by $\lambda(l) = \sum_{l=0}^{L} \lambda_{jl}$. Notice that this equation indicates that the exporter's revenues are not only subject to exchange rate fluctuations but also to inflation in his respective country. Equivalently, multiplying (4.33) by $\mathbf{p}_{jt}$ yields

$$\Delta w_{jt}(1) = \frac{\mathbf{p}_{jt}}{\mathbf{p}_{1t}} \left(\psi_j \Delta p_{1t}(1) + \sum_{l=0}^{L} \lambda_{jl} \Delta s_{1j,t-l} \right) + v_{jt}, \quad (4.34)$$

which corresponds to the standard real exchange rate pass-through equation.

Finally, since exchange rates are not linear and in some cases non-stationary, it is of interest to analyze sub-samples to test whether pass-through elasticities for appreciations are not significantly different from those corresponding to depreciations, and if there may have been changes in the structural relationship between exchange rates and prices.

4.4.3 Import-Currency Price Stabilization Regressions and Pass-through

Deviations from the Law of One Price

As explained in Chapter 1, the classical paradigm of the *law of one price (LOP)* should be replaced by other explanations which incorporate non-competitive market structures. As a matter of fact, the impossibility of magazine arbitrage impedes any claim of the *LOP* when comparing price levels in different countries. Therefore, let $DLOP_{jk,t}$ denote the departure from the *LOP* between a pair of countries j and k, $j \neq k$, defined as

$$DLOP_{jk,t} = \frac{w_{jt}(1)}{w_{kt}(1)}, \quad \forall j \neq k.$$

For each magazine, $DLOP_{jk,t}$ was computed for all possible pairs of markets, then the respective mean and standard deviation of each of these series were calculated, as shown in Tables 4.16 to 4.20. Estimates above unity indicate that column j's market price is, on average, larger than row k's one, and viceversa.[51] Some observation of the results indicates that:

1. Prices in the producer's country are normally lower than in any other market. Exceptions to this rule are prices in Spain for *Businessweek*, in Morocco for *Le Nouvel Observateur* and *Le Point*, in Luxembourg for *Le Point*, and in the United Kingdom for *L'Express*.

2. Consistent with Knetter's (1994a) explanation of higher retail prices in Japan due to non-tariff barriers rather than distribution costs, the Yen prices of *Businessweek* and *Fortune* are unequivocally larger than in any other market. Furthermore, the United Kingdom proved to be, on average, the cheapest market.

3. Estimates of the mean of $DLOP_{jk,t}$ above 20% account for a large number of cases even for countries the geographical or economic vicinity of which would permit local arbitrage opportunities (see, for instance, the relative price of Germany and the Netherlands for *Businessweek* or *Il Mondo*, or of Belgium and the Netherlands for *Businessweek*, *Fortune* and *Le Figaro*). There are also cases where prices displayed a homogeneous performance, (see the relative price of Germany and Netherlands for *Fortune* and *The Economist*, of Belgium and Netherlands for *Newsweek* and *The Economist*, and Senegal, Ivory Coast and Tunisia for French magazines).

4. The volatility of $DLOP_{jk,t}$ was higher for those pairs whose currencies floated over much of the sample period, especially, with respect to Sterling, the Swiss Franc and the US and Canadian Dollars.

OLS Estimations, Autoregressive Disturbances and Discrete Price Adjustments.

Nine separate export magazine estimations were carried out for each of the models expressed in equations (4.30), (4.31), (4.32) described above, imposing cross-equation restrictions. The errors were assumed to be independently and identically distributed, and uncorrelated across

[51] For example, prices of *Newsweek* in Austria are larger, on average, than those in Belgium.

equations, since the presence of a full set of fixed effects in the specification precluded estimating an unrestricted covariance matrix. Since all the models contained a regression constant, a set of market effects and a time effect (except for *Model 1.2*), in practice only $(J_n - 1)$ market fixed effects could be estimated to avoid singularity, where J_n is the number of markets in which magazine n is sold. Consequently, the series were normalized around one market (Switzerland), so the fixed effects could be interpreted as differences from those implicit in the regression constant. Tables 4.21 to 4.29 report the results for these three specifications, and the conclusions derived affect both the functional form adopted and the significance of the variables included.

As referred in Section 4.4.1, and earlier detected by LeCacheaux and Reichlin (1989) and Kirman and Schueller (1990), persistent different frequencies of prices and spot exchange rates changes could imply that errors v_{jt} were characterized by an autoregressive structure, with ρ never significantly different from one. Results in Tables 4.21 to 4.29 confirm this finding for the case of newsstand prices: outside the null hypothesis of full pass-through $(\beta_j = 0)$, it is not possible to rule out correlation between the regression disturbances and the exchange rates, despite the fact that no autocorrelation was found beyond the first lagged value of the error term, and it could not be rejected that u_{jt} was white noise. In fact, implicit price and nominal exchange rates series in Figures 4.16-4.33 have almost an identical shape, especially for series of non-U.S. magazines, due to the strong price rigidity. As a result, following Kim (1990) and Hung *et al.* (1993), this observation would allow us to interpret this autoregressive structure of the residuals as an Error Correction Mechanism or speed of prices to adjust exchange rate fluctuations in the long-run.

Therefore, these results clearly indicate that commonly used OLS formulations may have a limited power in explaining export price adjustment as in cases like the one studied here. Nonetheless, it is interesting to comment in some detail the estimates obtained using these econometric specifications.

Long-run Pass-through and Import Price Stabilization.

Exchange rate coefficients β_j show a remarkable difference in performance between US- and Europe-based exporters.

1. Estimates for European magazines were mainly negative, significantly different from zero across destination markets, and for a large number of cases, not significantly different from -1, which violated the invariance of the implicit export prices to exchange rates implied by the constant elasticity assumption. This clearly suggested that European exporters seemed not to pass-through completely exchange rate fluctuations into prices, stabilizing prices in foreign currencies, an action denominated by Knetter as a *Local Currency Price Stabilization* strategy, henceforth *LCPS*. As a consequence, **the hypotheses of global competition, price equalization across markets and constant elasticity of demand could be ruled out in favour of price discrimination with non-constant elasticities of demand in most markets, where variable markups absorb the exchange rate fluctuations.**

2. This apparent unresponsiveness of prices contrasted noticeably with the degree of pass-through displayed by American magazines *Businessweek*, *Newsweek* and *Fortune*. Here, instead, point estimates of β_j were mostly significantly different from -1, and in a number of cases, not significantly different from zero, implying a higher sensitivity of retail prices to US dollar variations. Here, it seems that firms kept their margins relatively stable. These differences between US exporters and the rest are not surprising since a number of studies by Mann (1986), Knetter (1989,1993a), Ohno (1989), Marston (1990) and Hung *et al.* (1993) have also reported the same fact: that US firms tend to maintain markups more stably than any other exporters. One reason, in addition to those addressed above, might be that for US producers, export markets are small relative to the domestic market so there may be less concern for maintaining export market share by price discriminating. Alternatively, if the US market is considered larger and more competitive, this may promote a tendency for non-US exporters to stabilize their export prices.

Furthermore, it seems that, for a number of cases, price constancy,[52] when the US dollar depreciated, worked in the direction of passing-through exchange rate changes in real terms to the destination market. Note also that some few positive estimates of β_j indicated an *amplification* of the effects of exchange rate changes into prices (typically for the prices in Italian Lire for some french magazines). Several explanations can be given for this behaviour:

- One is the traditional belief that this currency is considered weaker relative to other European ones, so exporters adjust their prices faster than in any other market and by more than the exchange rate variations if expectations suggest doing so. As a matter of fact, a large pass-through was also reported for prices in Spanish Pesetas;
- Similarly, the highest average inflation levels recorded for these two markets may indicate that prices have been proven to be more exposed to adjustment, so this *more-than-complete* behaviour would be optimal if exporters perceive demand to be less elastic than the constant elasticity case as foreign currency prices rise.

Exporter's market Price and Time-varying Effects as a Marginal Cost Baseline.

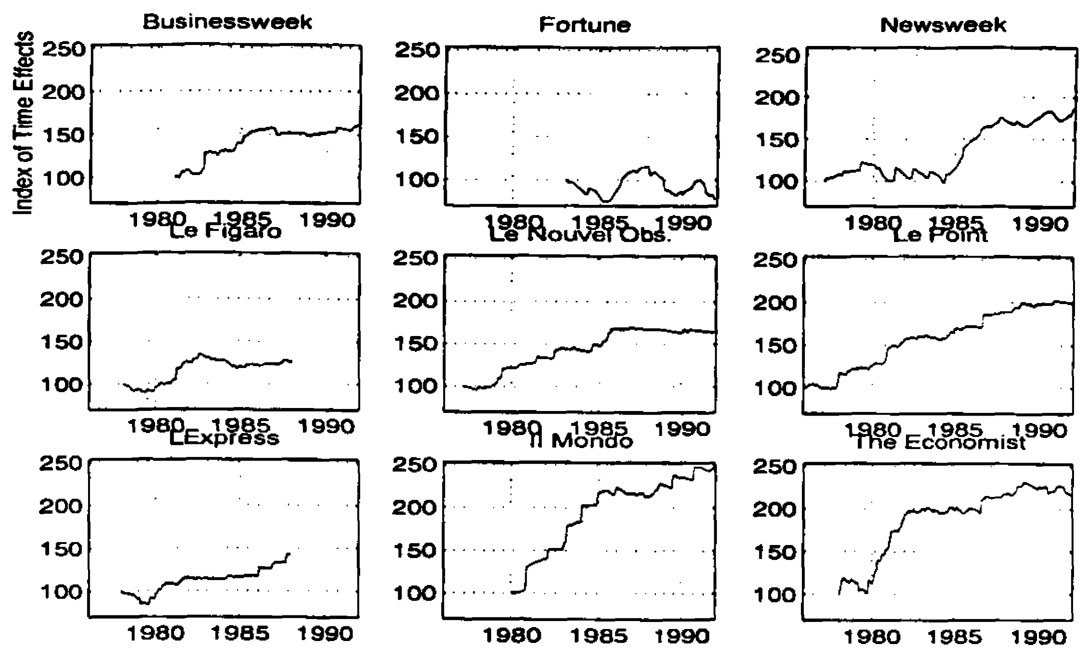
A comparison between *Model 1.2* and *1.3* indicates that the last one is a better specification of the prices. Furthermore, when using $p_{1t}(1)$ as a measure of costs, the hypothesis of a common γ across destinations was always rejected, providing more support to the formulation *1.3*. As mentioned, this fact may arise because exporter's market price and time effects probably reflected the same thing. Nonetheless, if the estimated time effects seem more suited to the regressions, this could cast some doubt on the importance of the variations of the markups in explaining the behaviour of $p_{jt}(j)$, as is shown below.

Figure 4.6 plots an index of the estimated time effects of *Model 1.3*[53], which indicates an upward trend of this estimated fixed effect over the sample for all the magazines, except for

[52] Recall, for example, that *Fortune* presented the highest mean rigidity.

[53] As mentioned, it is sometimes controversial to consider these effects as a measure of changes in marginal costs if the constant elasticity hypothesis does not hold.

Figure 4.6: Estimated time effects, θ_t.



Fortune. However, the most interesting feature is the break which occurred in the slope of this trend in the late 1980s (except for *L'Express*), because this performance coincides with the stabilization experienced in the frequency of price adjustments commented on in Section 4.3. (I will later evaluate whether foreign competitor's prices or domestic costs are more important in explaining price adjustments.)

The Source of Price Discrimination.

Since estimates of the average of $DLOP_{jk,t}$ suggested the existence of different price allocations across markets, two hypotheses about the origin of *Price Discrimination* were tested:

1. Null hypothesis of common market fixed effects, $\alpha_j = \alpha, \ \ \forall j$. F-tests for *Model 1.1* indicated that this hypothesis could not be rejected, except for *Le Point* and *Il Mondo*, where market-specific exchange rate variables and exporter's own market price were not considered. However, this hypothesis was mainly rejected for *Models 1.2* and *1.3*, which reveals that markups across markets seem to be different, possibly varied across time, and could be due to geographical segmentation, different market sizes and degrees of competitiveness where firms operate.[54]

2. Null hypothesis of common β_js across markets. For the cases of *Businessweek*, *Fortune*, *Le Nouvel Observateur* and *Le Point*, F-tests indicated that the null of $\beta_j = \beta, \ \ \forall j$, could

[54] See the recent study of Martins *et al.* (1996) on markup ratios in manufacturing industries.

not be rejected. For the rest of the exporters, the F-tests revealed differences in the β_js across markets, but in some cases the magnitude of the F-statistic fell close to the critical value (see, for example, *The Economist*). A common β_j parameter across markets for four out of nine magazines provided some evidence that *Price discrimination* was not based on differences in pass-through or markup elasticities to exchange rate fluctuations. Therefore, it could not be found strong evidence of *Pricing-to-market* behaviour across destinations, as defined above in the fourth alternative hypothesis to competitive world market above. Rather, it seems that the characteristics of the exchange rate fluctuations - that is, appreciations or depreciations, floating and pegged rates - have not had much impact on the evolution of price differences across markets for any magazine, since price reactions, despite being incomplete, do not differ significantly across markets. Thus, the causes of different price levels across markets are more based on different α's, which reveals also differences in allocation possibilities across markets. Therefore, the interest of this empirical estimation is to separate these different factors that affect the degree of pass-through, which may have strong and useful implications to predict export policies. In fact, as Knetter (1993a, p.484) has correctly pointed out, when analyzing US import prices,

> "Large, perhaps unsustainable, swings in the dollar may have piqued interest in PTM but are not responsible for its existence."

Additional tests were performed among competing models in order to know the best specification. Both time and marked fixed effects appeared to be sensitive in these analyses.

Recapitulating, apart from the empirical evidence detailed earlier, which showed an incomplete reaction of price changes and the existence of *PTM*, this analysis stressed not only that the exchange rate pass-through is sensitive to sluggish price adjustments, but also that the effects of exchange rate changes could persist for some time and also that the nature of the stochastic process governing the exchange rates influences decisively when firms extract signals concerning the behaviour of these rates. Therefore, the next section proposes a series of tests in order to cope with these problems.

4.4.4 Adjusted Exchange Rate Pass-through Tests

As proceeded earlier, before presenting estimates for the model in differences of equation (4.33), the value of the change in the nominal and adjusted exchange rates between two nominal price adjustments,[55] that is, within the spell, τ, and how much these adjustments offset the variation in the exchange rate and in the implicit price w_{jt} are reported.

Figures 4.52 to 4.69 and 4.70 to 4.87 depict price adjustment times by the dotted vertical lines and inverted cumulative nominal $(1/\tilde{s}_{j\tau})$ and adjusted $(1/\tilde{s}^{A}_{j\tau})$ exchange rates; positive (negative) shaded areas indicate depreciation (appreciation) of the producer's currency within the spell; vertical bars in the plots indicate the percent level of nominal and adjusted *gross pass-through*, since only the variation in prices and exchange rates is taken into account. For a depreciation (appreciation), the corresponding pass-through is said to be *normal and complete* when the bar length equals zero; *incomplete* when it is positive (negative) but smaller in absolute value than

[55] Notice that in the best case, it was possible to obtain 20 adjustments in a period of 15 years.

the size of the exchange rate variation; *more-than-complete* when it is negative (positive); and *perverse* when it becomes positive (negative) and larger in absolute value than the size of the depreciation (appreciation). Some facts arise from these plots:

- Nominal appreciations seem to be more closely passed-through (particularly for transactions where the US and Canada are involved as importer or exporter) and, in a large number of cases, by more than the exchange rate variation.

- The less the exchange rate trend changes, the nearer the pass-through is to being complete.

- The time that elapses between adjustments when the nominal exchange rate depreciates is larger than when it appreciates.

- Adjusted exchange rates within the spell are allowed to deviate more during depreciations, which reinforces the hypotheses of downward price rigidity and imperfectly competitive markets.

- When comparing changes in nominal and adjusted exchange rates within the spell it is often observed that nominal depreciations become *de facto* appreciations, which could explain some perverse nominal exchange rate pass-through when prices increase in the event of a nominal depreciation.

This preliminary picture indicates that there exist no obvious exchange rate trigger points and also, that estimates of the pass-through may differ largely between nominal and real levels and between upward and downward exchange rate movements. Here it seems that during appreciations of the exporter's currency, markups vary less, and pass-through increases, and conversely for depreciations. Therefore, the rigidity of price adjustment, more acute for downward price movements, together with the assumption that exporter's concern is his returns in domestic currency, suggests to evaluate this *adjusted* exchange rate pass-through as in equation (4.33).

Consequently, when attempting to estimate the specification (4.33), the sample could additionally be decomposed into subsamples, corresponding to common and persistent movements in exchange rate *trends*, that is, where no reversion of these tendencies occurred.[56] Hence, to cope with the trend of the adjusted exchange rates, a quarter backward and quarter forward moving average of the series was calculated. With respect to the time splitting of the series, the criteria used for American magazines were entirely determined by the swing in the dollar value experienced in the 1980s. For French and Italian publishers, the EMS exchange-rate realignment calendar (see Table 4.8) was used, which indicated that the period 1982-1987 was characterized by a large number of adjustments, followed by a relatively larger stability until the crash of 1992, reflecting the development of the EMS.[57] At least for currencies belonging to the EMS, volatility is relatively lower than for other pairs of rates, and realignments, as detailed in Table 4.8, constitute a signal of the exchange rate changes. For *The Economist*, since the Sterling floated for most of the period - it joined to the EMS in 1990 - the time axis was splitted around 1981 and 1984.[58]

[56] The volatility component of the exchange rates is studied below.

[57] Since series displayed different lengths, the subsamples studied are not completely coincident among

Table 4.8: Exchange-Rate Realigments within the EMS (percent).

	Dm	HFl	Ff	BFr	LIt	DKr	IRl
09-24.1979	2.0	-	-	-	-	-2.9	-
11-30.1979	-	-	-	-	-	-4.8	-
03-23.1981	-	-	-	-	-6.0	-	-
10-05.1981	5.5	5.5	-3.0	-	-3.0	-	-
02-22.1982	-	-	-	-8.5	-	-3.0	-
06-14.1982	-4.25	4.25	-5.75	-	-2.75	-	-
03-21.1983	5.5	3.5	-2.5	1.5	-2.5	2.5	-3.5
07-22.1985	2.0	2.0	2.0	2.0	-6.0	2.0	2.0
04-07.1986	3.0	3.0	-3.0	1.0	-	1.0	-
08-04.1986	-	-	-	-	-	-	-8.0
01-12.1987	3.0	3.0	-	2.0	-	-	-
01-05.1990	-	-	-	-	-3.7	-	-

The numbers are percentage changes of a given currency's bilateral central rate against those currencies whose bilateral parities were not realigned. A positive number denotes a depreciation. On March 21, 1983, and on July 22, 1983, all parities were realigned. The Spanish Peseta entered the EMS on June 22, 1989 and the Sterling in October 1990. Dm = Deutschemark; HFl = Dutch Guilder; Ff = French Franc; BFr = Belgian/Luxembourg Franc; LIt = Italian Lira; DKr = Danish Kroner; IRl = Irish Punt. *Source*: Commission of the European Communities

Table 4.30 reports the $\lambda(12)$ coefficients of the specification (4.33). The twelve-month lag allowed for a sufficiently sluggish adjustment, but unfortunately, estimated parameters exhibited a large standard deviation.

- Few whole sample estimates were close zero, and these mainly corresponded to Italy (*Businessweek*, -0.32; *Newsweek*, -0.21; *Le Figaro*, -0.35; *Le Point*, -0.29; *L'Express*, -0.25) and Spain (*Fortune*, -0.37; *Newsweek*, -0.41; *Le Figaro*, -0.29; *Le Point*, -0.31; *L'Express*, -0.13). On the contrary, most estimates of $\lambda(12)$ revealed that for the adjusted exchange rate changes are not fully passed-through into prices.

- However, studied for subsamples, it was found that this relationship varied across time. American producers interestingly passed-through both the dollar appreciation (1981-1984), increasing nominal prices as expected, and dollar depreciation (1985-1988), decreasing nominal prices (*Fortune*) or leaving them unchanged for whole period, which certainly implies a pass-through in *purchasing power* terms for foreign buyers. Pass-through asymmetry arose in both directions

magazines.

[58] Exchange rate movements during the period studied (1978-1992) could be summarized as follows: US and Canadian Dollars experienced a strong cycle during the 1980s, and increased their values well above 70% relative to most of the currencies until 1984; since the end of 1970s the Sterling has also experienced a cycle with two different peaks, one in 1981, when it increased its value around 30% with respect to the Austrian Shilling, Deutschmark, Dutch Guilder and Swiss Franc, and another in 1984, with respect to the rest of the currencies. After, it depreciated strongly with respect to the first group of currencies (60%), and somewhat less (20%) relative to the rest, until the beginning of the 1990s; also since the end of 1970s the French Franc has depreciated on average over 50% with respect the Swiss Franc, Austrian Shilling, Deutschmark and Dutch Guilder, and appreciated relative to the Italian Lira (25%) and the Spanish Peseta (35%); the value of the Italian Lira decreased with respect to the Swiss Franc, Dutch Guilder and Deutschmark, about 50% since the beginning of the 1980s.

(*Businessweek* and *Newsweek* passed-through more Dollar appreciations than depreciations, and the opposite applied for *Fortune*). Furthermore, cases of *more-than-complete* pass-through for *Newsweek* reported in Table 4.23 for Denmark, France, Italy, Sweden and Spain turned out to be *less-than-complete* possibly owed to the use of adjusted variables (U.S. inflation level was lower) or the smoothing of the 12-month lag used in the estimation. For European magazines, estimates for subsamples starting after 1988 suggested a decrease in the level of exchange rate pass-through.

- Almost a quarter of estimates greater than -1 which indicated a *perverse* pass-through, that is, an increase (decrease) in the adjusted exchange rate was followed by a price increase (decrease) in real terms, instead of oppositing movements. It seems that these sort of reactions are common, and that they arose both for the whole sample and for shorter periods. French magazines presented the highest proportion of these results, but the conclusions were puzzling across markets. For example, estimates for *Le Figaro* and *L'Express* stubbornly point out that German real prices increased, or at least did not change, when the French Franc depreciated against the Deutschmark, both currencies belonging to the EMS. This behaviour should also have been expected for markets tied up with the German economy in terms of inflation and exchange rates, such as the Netherlands, Switzerland, Austria and, to a lesser extent, Belgium. However, only Dutch Guilders performed similarly. Notice also that those markets whose currencies belonged to the EMS are *more perverse* in terms of pass-through than those not attached to the system, despite the EMS reduced the volatility of the exchange rate signal and increased the predictability of the exchange rate movements. So, does the relative stability of the EMS induce producers to be less sensitive to exchange rate variations?

Furthermore, it was paid special attention to the estimates where US import/export prices were involved. When looking at the *PPP* and nominal exchange rates series in Figures 4.16-4.33, it can also be observed that these variables display a similar pattern in the long run, except for cases where the U.S. Dollar is involved: To this concern, it is interesting to notice that the Dollar cycle in the 1980s hardly existed at a *PPP* level. Hence, Froot and Klemperer (1989)[59], analyzing import prices in the US, found that, in the first half of the 1980s, the dollar appreciation was believed to be *temporary* rather than *permanent* by foreign exporters, so import prices in the US did not adjust quickly to the increasing value of the Dollar and foreign exporters' profit margins grew:

- The results partly confirmed this finding because exchange rate changes do not seem to have been fully reflected in terms of the Dollar prices of European magazines;

- Thus, the hypothesis that the large swing in the American currency was perceived by foreign exporters as temporary could not be rejected;

- However, this belief seems not to have been *shared* by American exporters: The first half of the 1980s is the period of fastest price adjustments, at least for *Businessweek* and *Newsweek*: it seems that apart from any consideration of the exchange rate expectations, some asymmetry of the pass-through relative to the sign of the exchange rate fluctuations exists. Therefore, even if exchange rates shifts were perceived as temporary, American

[59] See Chapter 1.

> exporters (and not only US firms) tended to pass-through appreciations independently of the consistency of the exchange rate signal. Thus, it can be claimed that explanations of the exchange rate pass-through based on temporary/permanent characteristics of the data are conditioned not only by the sign of the exchange rate trends, but also what market circumstances allow markups to vary up and downwards.

To end up this section, it was studied whether fluctuations in the markup affected the correlation between export prices and exchange rates. If the real implicit prices in each case are adjusted to offset real exchange rate movements in each period, then these prices should reflect the firm's optimal markup. Excluding the (rather unlikely) possibility that the difference in the optimal markup across markets is non-stationary, if follows that the equivalent currency price ratio should be a stationary stochastic process. Then, for this series to have a true component it must have at least one unit root. Table 4.31 presents the twelve lag augmented Dickey-Fuller statistics for the residual of the unrestricted regression $w_{jt}(1)$ on $p_{1t}(1)$ and for the first difference specification, for those magazines where $p_{1t}(1)$ was available. Table 4.31 reveals clearly that a rejection of the unit root was only possible in five cases, which indicates that markups were not stationary. This certainly reveals that the magazine industry operates with markups large enough to absorb exchange rate fluctuations and maintain a *LCPS* strategy in destination markets.

4.4.5 Concluding Remarks

The evidence presented in this section poses some important questions relative to the determination of export prices of firms operating in multiple international markets, the relationship between exchange rates and prices, and the techniques applied to analyze these problems.

1. Findings ranging from more-than-complete to perverse pass-through had important implications for the ability of exchange rates (whether under fixed or floating rates) to equilibrate trade imbalances;

2. Not all evidence of different markups indicated the existence of *Pricing-to-Market*, since exchange rate pass-through coefficients across markets did not differ significantly. Therefore, strategic price setting and non-complete pass-through became two related topics;

3. The analysis of these series presented a combination of effects that implied a reconsideration of pass-through studies;

4. It was stressed why the choice of invoicing currency of export prices matters when measuring this relationship (see Figure 4.5). Analyzing prices quoted in foreign currency causes observationally indistinguishable sluggish responses of prices to exchange rate movements and *ex-ante* price discrimination: Price rigidity, as explained by Giovannini (1988), can mean that incomplete pass-through just reflects only postponed, rather than deliberately forestalled, adjustment. The results obtained confirm both sources of price discrimination but not significant differences among markets for almost half of the cases, based on different pass-through elasticities.

It is for this set of reasons why standard tests based on *Pricing-to-Market* models and the like may be spurious and a new formulation is needed which takes into account the existence of costs of price adjustment and distinguish whether incomplete pass-through arise from sluggish price adjustments in the presence of some costs, or are rather reflected a deliberate intention to mitigate nominal exchange rate movements. Therefore, the remainder of this chapter will investigate the possibilities that a Discrete Dependent Variables specification offers for the study of the exchange rate pass-through, and ultimately to the understanding of export pricing decisions.

4.4.6 A Discrete Dependent Variables Estimation of Export Price Adjustment in a (R_i, R_d) Scheme

The current analysis should be interpreted as an extension of the Discrete Dependent Variables estimations performed in Section 4.3.4, for the case where exporters are concerned about their revenues expressed in their own currency, that is, in terms of W_{jt}. Therefore, this section tests the conclusions achieved for the (W_i, W_d) scheme in Section 2.4.

As shown in Section 4.3.4, if the usual random walk specification is adopted for inflation or exchange rate changes, exporters would face a trivial signal extraction problem, namely that he would simply infer that all changes in the exchange rates are permanent.[60] However, it was proved that some sort of *history dependence* determined the firms' decisions. Therefore, following the Brownian Motion decomposition of exchange rates in Chapter 2 of the (W_i, W_d) scheme, for estimation purposes i can be written

$$\Delta s_{jt} = \mu_s + \sigma_s, \tag{4.35}$$

where μ_s and σ_s approximate the behaviour of the exchange rate trend (mean) and volatility (standard deviation), respectively: the less volatile exchange rates are, the larger will be the effect of a trend change in exchange rates on export prices in the destination country.

Therefore, following Section 4.3.4, the same analyses as depicted in Figure 4.4 were performed and a number of new variables to be included in the respective matrix of covariates **X** were added. The type of notation used and the sequence of exercises is also identical to facilitate comparison between the (R_i, R_I) and the (W_i, W_d) models.

Cross Magazine Results. Model I

Additional variables in the matrix $\mathbf{X}^j_{nt}$ to those defined earlier are required for this round of estimations:

- $\mu^j_{s,nt}$ = Exchange rate trend, expressed as the number of magazine n's domestic market currency units per unit of market j's currency and proxied by a moving average of the nominal exchange rate, including one quarter ahead an one quarter behind.
- $\sigma^j_{s,nt}$ = Exchange rate volatility, also proxied by a quarter-ahead and a quarter-behind moving average of the month-to-month percentage changes in the nominal exchange rates.[61]
- $\tilde{\mu}^j_{s,nt}$ = nominal exchange rate variation since the last price change in market j.

Using these definitions, price responses in the same six selected markets for a number of magazines,[62] between 1981 and 1992, were analyzed, using Chamberlain's fixed effect technique.

[60] Section 4.3.4 addressed similar criticisms about the use of current levels of inflation that presumed the price rule changed every year where no explicit model of timing rule revisions existed.

[61] I also tried a 6-month behind moving average and a 6-month ahead moving average for both trend and yields, but this did little to affect the results.

[62] Belgium (5 magazines), Germany (5), Italy (5), Spain (6), Switzerland (6) and the US (5).

β-parameters. Type-A specifications. Table 4.32 reports the results for these models, that can be summarized as follows:

- Comparisons among different dynamic specifications point out the presence of history dependence when determining price adjustments, so (*Models I.A.2* and *I.A.3*) seem to perform better than the pure steady example in *I.A.1* which confirmed the findings for the Discrete Dependent Variables estimation of model (R_i, R_I);

- Price synchronization across magazines sold in one market, and both current inflation and cumulative inflation since last adjustment and expected inflation seem to play the main role in determining a decision to change a price. This happened despite (as detected again for the cases of Italy and Spain in *Model I.A.2*) the effects of inflation appeared sometimes mixed: A counter-intuitive result with respect to the cumulative inflation since last price change was obtained for prices in Spain since estimates of $\tilde{P}^j_{nt}$ were negative and significantly different from those for *Models I.A.2* and *I.A.3*, that is, an increase in the inflation since last change decreases the probability of a upward price revision;

- Estimates of $\mu^j_{s,nt}$ were, however, mostly insignificant, except for regression *I.A.2* in Spain;

- Cumulative exchange rate fluctuation since last price change, $\tilde{\mu}^j_{s,nt}$, only displayed some importance for Belgium, Italy and Spain, with estimates positive and significantly different from zero;

- It is remarkable that for the rest of the markets studied (Germany, Switzerland and US) cumulative exchange rates parameters, even though not significant, were mostly negative. This may happen because countries for which *exchange rates matter when predicting price adjustment*, were characterized by larger inflation and, at least for Italy and Spain, a net depreciatory average exchange-rate trend (see Table 4.33). Since Section 4.4.4 reported the existence of some asymmetric pass-through behaviour, the present results simply stress that conclusion;

- Estimates of exchange rate volatility, $\sigma^j_{s,nt}$, appear to be significant only in explaining price changes in the US where rate-fluctuations more permissible.

θ-parameters. II.A.3 specification. Estimates of the average value of the constant term $\bar{\theta}_{T_w}$ are reported in Table 4.33 which, added to those statistics presented in Table 4.10, give a new column of cross-exporter average of the exchange rate variation within the wave, $\bar{S}^j_{nT}$.

- Note that while estimating (R_i, R_I) these parameters captured the evolution of the pricing rule expressed in terms of R^j_{nt}; here this pricing scheme refers also to the motion of W^j_{nt};

- Hausman tests indicate the existence of a time-varying fixed parameter, both $\bar{\theta}_{T_w}$ and $\bar{\theta}^-_{T_w}$, for Belgium, Germany, Switzerland and the US[63] giving support to the use of the Fixed Effect Chamberlain technique, but odd conclusions about the relationship between exchange rates and time-varying fixed effects: An upward tendency of the values of these parameters

[63] Recall that for the closed economy, analysis differences were only significant for the last three markets.

was confirmed for all countries except Germany. The aggregate appreciation experienced by the Deutschemark stresses the surprising conclusions reached when exchange rates were not explicitly taken into account (Section 4.3.4): relative low inflation rates and a strong currency increase price rigidity at the cost of larger gaps between the nominal and the *unconstrained* or *frictionless* prices;

- Nonetheless, inferences have to be made carefully since this last case contrasts notably with that of Switzerland, which exhibits similar macroeconomic indicators but a different trend in the $\bar{a}_{T_u}$ parameters: Prices in Swiss francs seem to perform closer to the standard dynamics shown in Chapter 2, that is, a lower bands of fluctuation for the deviation of nominal prices from *short-term optimal* ones, and an increase in the frequency of price adjustment;
- When comparing estimates of $\bar{\theta}_{T_u}$s for Belgium with those of Spain and Italy, inflation prospects, rather than exchange rate movements, seem to determine the deviations between nominal and *unconstrained* prices;
- The depreciation of the Dollar after 1984 made exporters to the US decrease the permissible gap between both prices.

Cross-Market Results. Model II

The cross-market regressions exploited the multimarket nature of the data and explored the existence of idiosyncratic market effects by including a number of dummy variables for each market in which the magazine was sold. Recall now that this panel array allowed us to test both type-A and B. It was also assumed that the constant term changed every four years. Some additional definitions of the variables included in $\mathbf{X}^n_{jt}$ for type-A models were required:

- $\mu^n_{s,jt}$ = Exchange rate trend, expressed as the number of magazine n's domestic market currency units per unit of market j's currency, and proxied by a quarter-behind and a quarter-ahead moving average of the nominal exchange rate.
- $\sigma^n_{s,jt}$ = Exchange rate volatility also proxied by a quarter-behind and a quarter-ahead moving average of month-to-month percentage changes in the nominal exchange rates.[64]
- $\widetilde{\mu}^n_{s,jt}$ = nominal exchange rate variation since the last price change in market j.
- $D\widetilde{LOP}^n_{(1j)t}$ = Cumulative deviation from the *law of one price* since the last price change between magazine n's domestic price (denoted by the subindex 1) and market j. If the adjustment costs are expected to matter for predicting price changes, this cumulative deviation must be used rather, than level or differences in the LOP.

β-parameters. Type-A and -B specifications. Results for these models are shown in Tables 4.34 to 4.38:

[64] I also tried a 6-month behind moving average and a 6-month ahead moving average for both trend and yields, but this did little to affect the results.

- Path-dependent specifications were again preferred;
- Similarly to what happened for the cross-magazine estimation of (W_i, W_d), for steady state models, current inflation seemed to be more significant than current exchange rates, and its volatility[65] in predicting price adjustments;
- Positive and significant estimates of $SINC^n_{jt}$ stress mostly the existence of menu costs rather than decision costs when a multimarket producer fixes prices. The number of inflation mixed effects only appear in the cases of *Businessweek, Le Figaro* and *L'Express* in *Models II.A.2* and for *Businessweek* and *L'Express* in *Models II.B.2*;
- Cumulative time since last price change, $\tilde{T}^n_{jt}$, maintains its relatively modest contribution to the understanding of pricing decisions;
- Estimates of the $\tilde{\mu}^n_{jt}$ pointed in the direction of the history dependence of the exchange rates changes influencing price decisions;
- Estimates of the cumulative deviation from the *LOP* were small in value but negative and significantly different from zero for *Businessweek, Le Nouvel Observateur, L'Express, Il Mondo* and *The Economist*[66] which suggests that when exchange rate changes drive implicit prices apart, nominal prices are adjusted;
- Using the reference market variables as regressors, as made for type-B estimations of (R_I, R_i), the most remarkable finding was the existence of a significantly positive relationship between ***cumulative inflation in the exporter's country since the last price adjustment***, $\tilde{\mathbf{P}}^n_{1t}$, and price changes.

θ-parameters. II.A.3 specification. Table 4.39 presents estimates for $\bar{\theta}_{T_w}$ and $\bar{\theta}^-_{T_w}$ for *Model II.A.3*:

- As happened when testing for changes in the price change of the (R_i, R_I) scheme, some evidence of variation in the price rule was found (now expressed in terms of W^n_{jt}) for the same magazines plus *Le Figaro*;
- Note that, in the light of the statistics reported in Table 4.14, different trends in the estimates of $\bar{\theta}_{T_w}$ and $\bar{\theta}^-_{T_w}$ did not allow us to make straightforward conclusions: For example, it was shown that the decrease in inflation and the frequency of price adjustment since the mid-1980s observed for most magazines (see Table 4.14) should yield an increase in the estimated values of $\bar{\theta}_{T_w}$ and $\bar{\theta}^-_{T_w}$, implying a reduction of the distance between upper and lower limits, where R_{jt} fluctuated and no nominal price adjustments occurred. This evidence was difficult to explain for a downward trend of the time-varying parameter for *Fortune* and *Le Nouvel Observateur*. Now, the (W_i, W_d) scheme reveals that the well-behaved cases of *Businessweek* and *The Economist* were also characterized by an aggregated exchange-rate cycle, while the decreasing $\bar{a}_{T_w}$'s parameters for *Fortune* and

[65] Only $\sigma''_{I,jt}$, for American magazines, was relevant in reflecting obviously the larger variability of the US dollar relative to the rest of the currencies

[66] Point estimates were slightly higher than those obtained by Ghosh and Wolf (1994)

Le Nouvel Observateur were associated with net average depreciations of the exporter's currency, without any consideration of inflationary levels. As shown, depreciations were passed-through to a lesser extent than appreciations, thus it could be maintained that the boundaries for W_{jt}^{n} increased for this data. Nonetheless, it is an open question why estimations of $\bar{a}_{T_w}$, for magazines with similar conditions, rejected the time-variation hypothesis of these parameters.

α-parameters. II.A.3 specification. Table 4.40 shows that the market-fixed effects were appropriate for this characterization, pointing out the source of *Pricing-to-market*, as explained in Section 4.4.3.

4.4.7 Concluding Remarks

The lesson of this section is twofold:

1. **Methodological:** Using standard price-discrimination and pass-through tests for the analysis of export prices at a consumer level may yields spurious results, so a Discrete Dependent Variables analysis, despite the present restrictions, seems to be more adequate for the purposes of this dissertation;

2. **Economic:**

   - It was proved that a genuine case of multimarket firms, which set export prices in the destination currency and at a consumer level, permit us to distinguish international price discrimination caused by deliberate *Pricing-to-Market* from those generated by price-sluggishness and costs of adjustment;
   - Multimarket companies do not continuously change prices in their foreign markets when facing fluctuating exchange rates, and, apparently, that once companies have changed their prices in one direction, a return of the exchange rates to its original state does not reverse the effect; and,
   - Cross-market and cross-firm price synchronization arose as a decisive factor in the analysis of pass-through, because it allowed us to test it at discrete points in time, when two or more prices are adjusted, and isolated the part of the pass-through differences due to different price elasticity from the one created by market idiosyncratic components.

Conclusion

Starting from the paradigm of the *Law of One Price* that relates exchange rate changes with goods prices across frontiers, this dissertation intended to underline those factors that prevent this relationship from holding. After an exhaustive theoretical research, it was clear that no explanation could be discarded *a priori*, and that both demand and supply-side theories deserved to be empirically tested.

The regularities found on newsstand price data raise not only economic issues but also methodological ones. On the economic side, the stubborn rigidity shown in 105 monthly price series on an average of 10 markets and 15 years indicated that incomplete exchange rate pass-through could not be deliberate, and that some costs of adjustment were needed to distinguish between *ex-ante* and *ex-post* price discrimination. Adjustments took time, and there seems to exist a range of inaction that depends on the market characteristics, the stochastic structure of exchange rates and the existence of costs of adjustment. In fact, when taking into account these aspects, a wide range of price responses to exchange rate fluctuations were found. For example, while American producers tend to be more sensitive to dollar variations, European magazines displayed the highest degree of incompleteness in the pass-through elasticities. Furthermore, not all evidence of different markups indicated the existence of *Pricing-to-Market*, since exchange rate pass-through coefficients across markets did not differ significantly. Therefore, strategic price setting and non-complete pass-through became two related topics.

Since these findings ranged from more-than-complete to perverse pass-through, important implications for the ability of exchange rates (whether under fixed or floating rates) to equilibrate trade imbalances arose. Now, any assertion on the effects of a exchange rate variation in macroeconomic terms should seriously take into account the idiosyncratic behaviour of their industries at these events: share of firms or industries with sufficient monopolistic power to avoid price jumps when exchange rates change, existence of costs of adjustment or binding contracts, and invoicing practices.

On the methodological side, the thesis put special emphasis on three aspects:

1. Underlining the constraints and shortcomings that each particular dataset imposes on the set of research possibilities, as shown by the comprehensive review of the empirical work on this subject;
2. Comparing different econometric techniques for standard demand-side models (OLS) and supply-side models (Binary Response Estimations), and understanding why some spurious result may arise, and;
3. Trying an alternative way of analyzing industrial behaviour by asking firms directly about their own actions.

As a result, rather than offering a unique answer to the exchange rate pass-through issue at a firm level, it highlighted the number of economic interactions a researcher should take into consideration when facing future research, and how to asses their importance.

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Figures

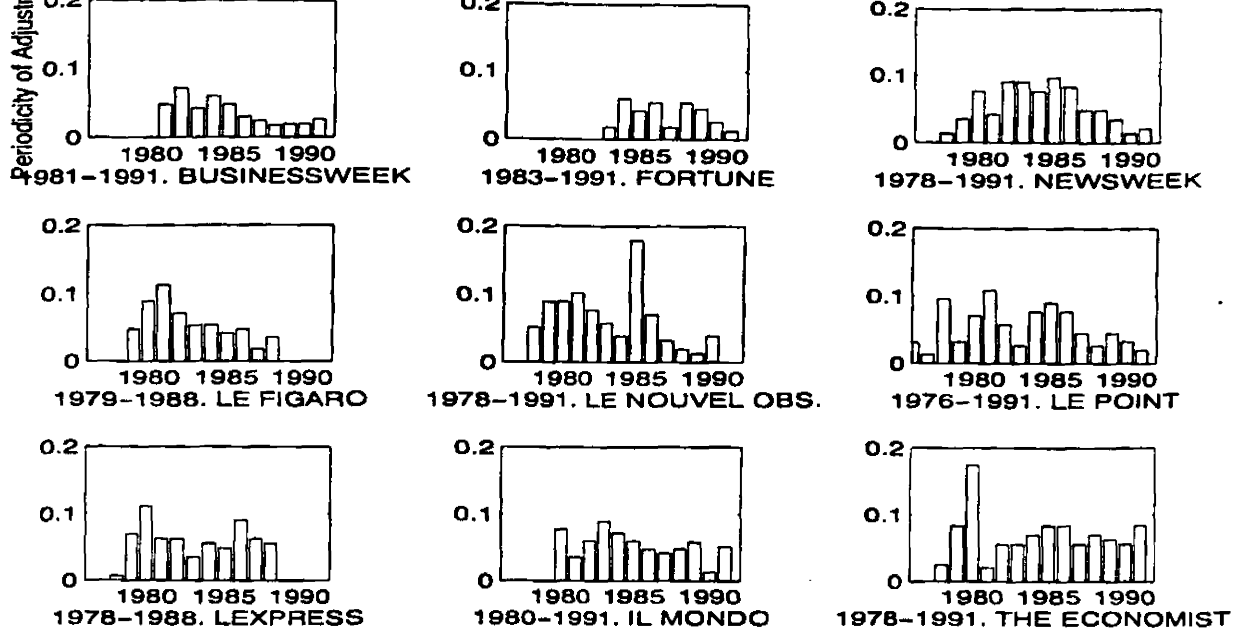


Figure 4.7: Frequency of Price Adjustment.

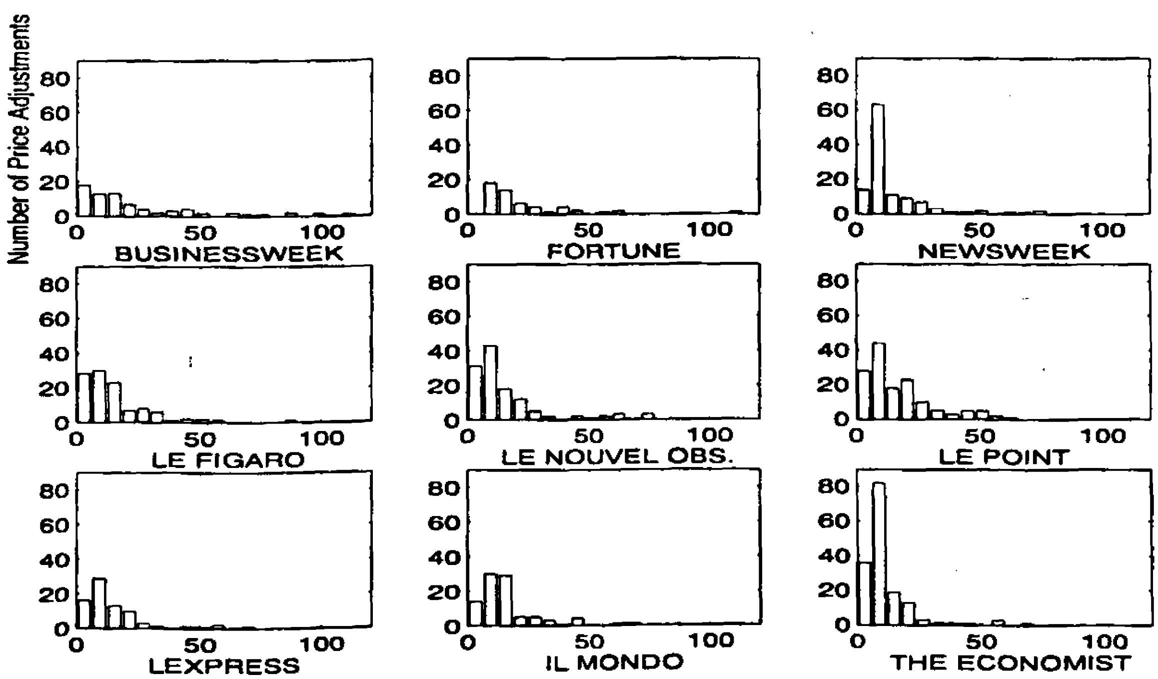


Figure 4.8: Histograms of Duration of Price Spells.

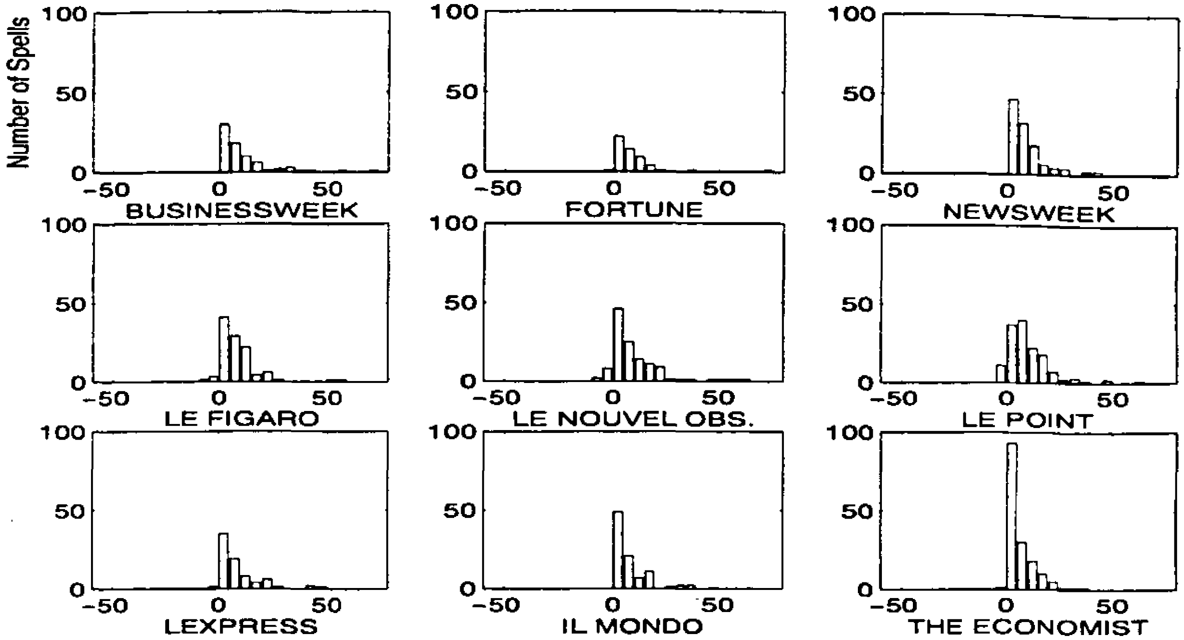


Figure 4.9: Histograms of $(R_I/R_i)_\tau$.

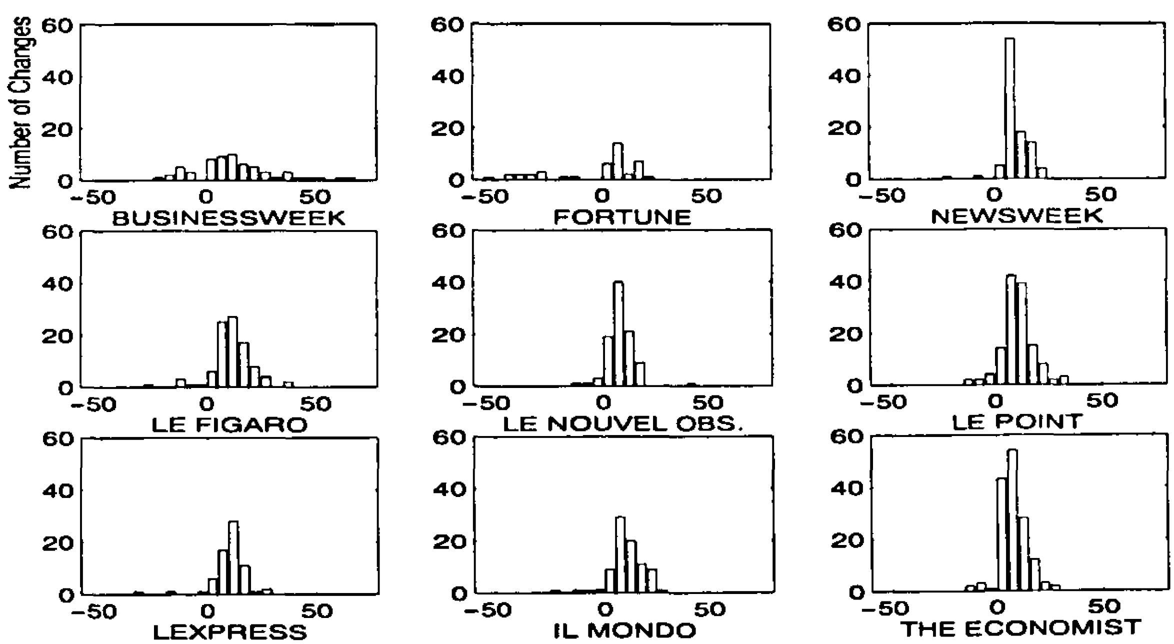


Figure 4.10: Histograms of $(R_{I\tau+1}/R_{I\tau})$.

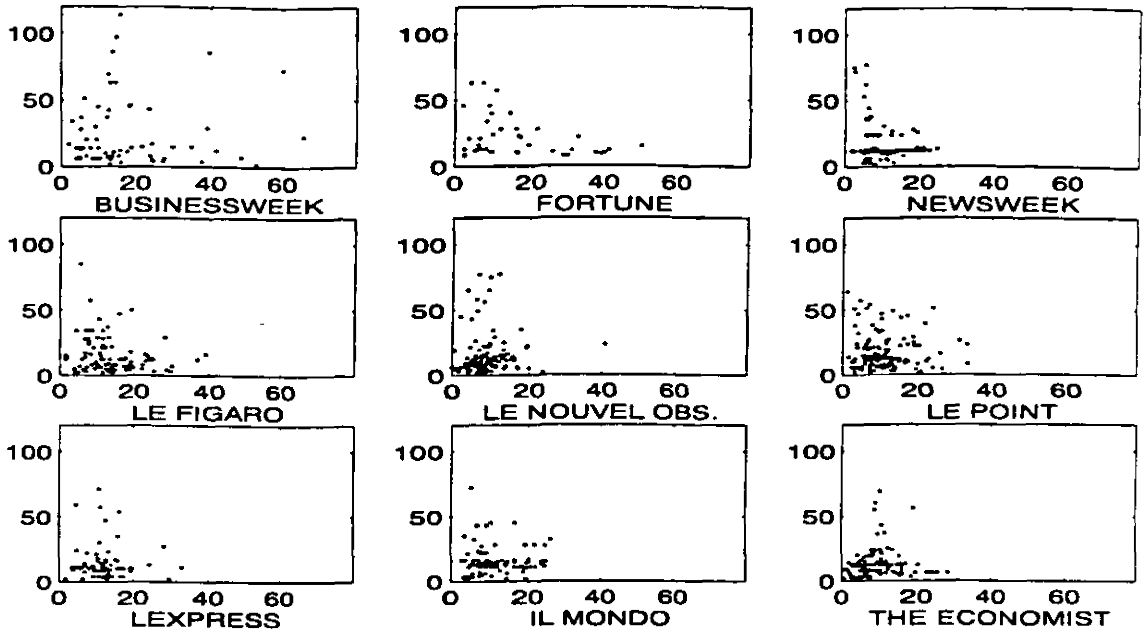


Figure 4.11: Cross-plot of $R_{I\tau+1}/R_{I\tau}$ and ϵ_τ

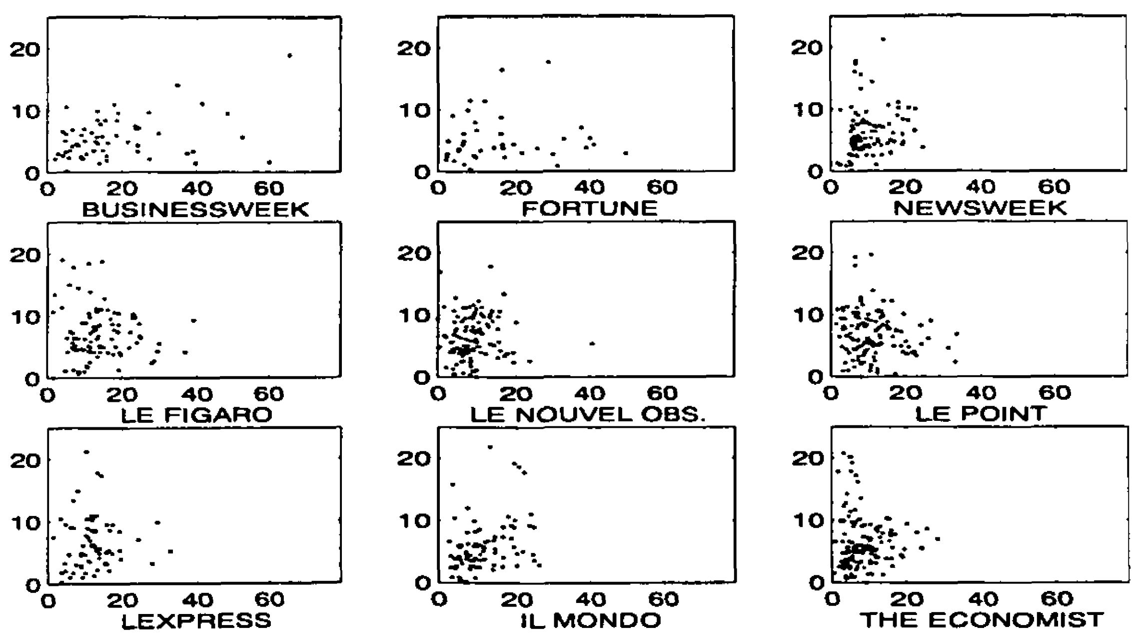


Figure 4.12: Cross-plot of $R_{I\tau+1}/R_{I\tau}$ and $\mathbf{P}_t$

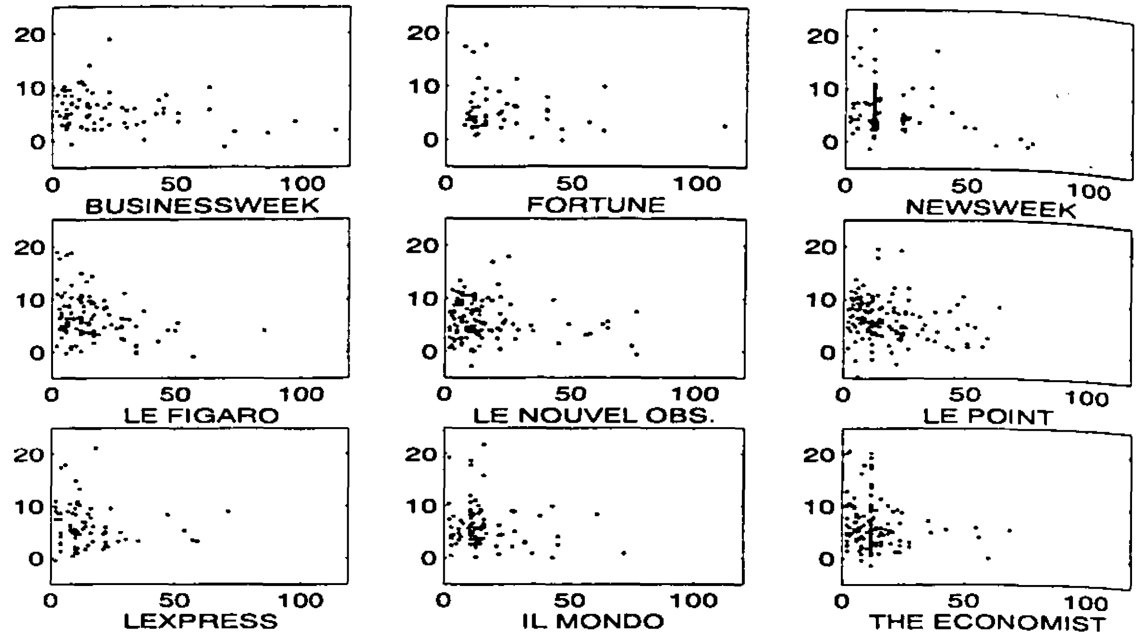


Figure 4.13: Cross-plot of $\mathbf{P}_t$ and ϵ_τ

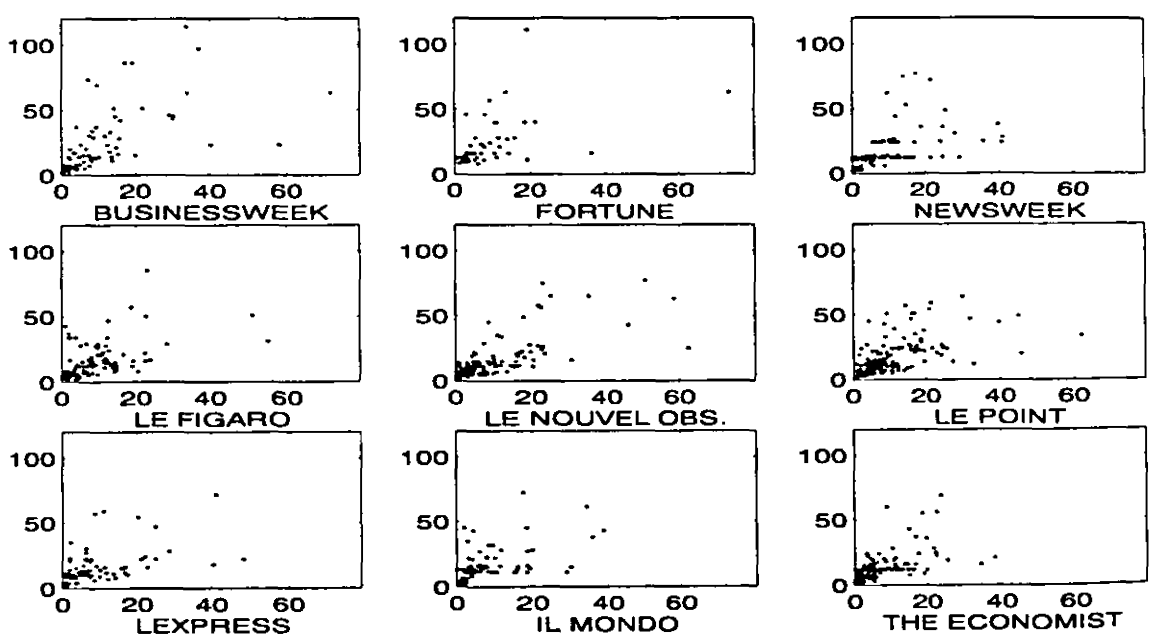


Figure 4.14: Cross-plot of $(R_I/R_i)_\tau$ and ϵ_τ

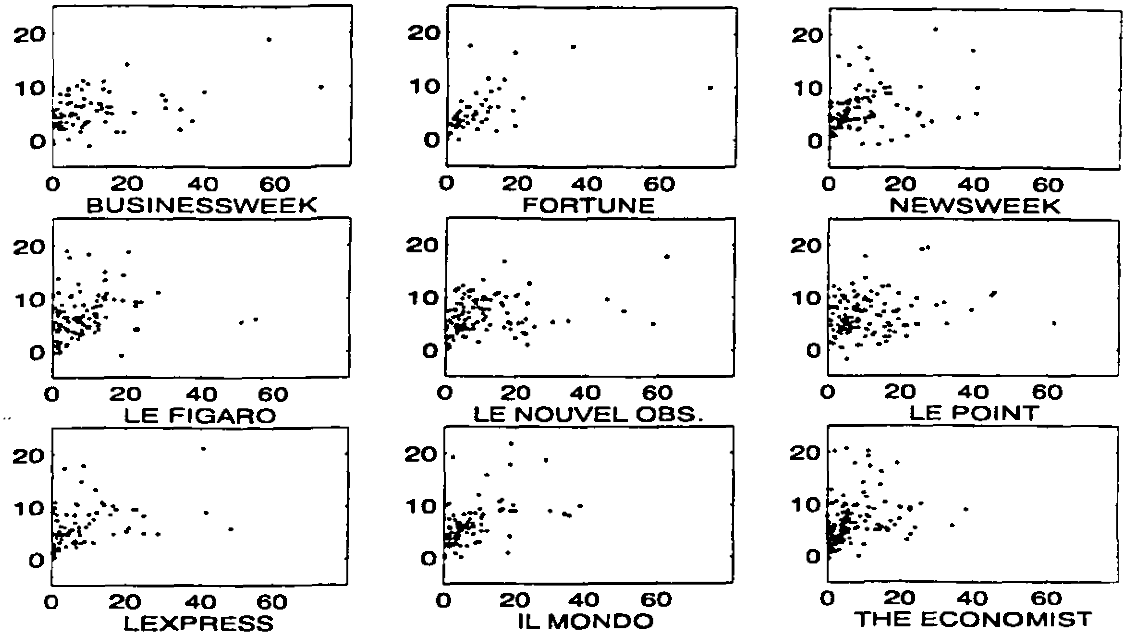


Figure 4.15: Cross-plot of $(R_I/R_i)_\tau$ and $\mathbf{P}_t$.

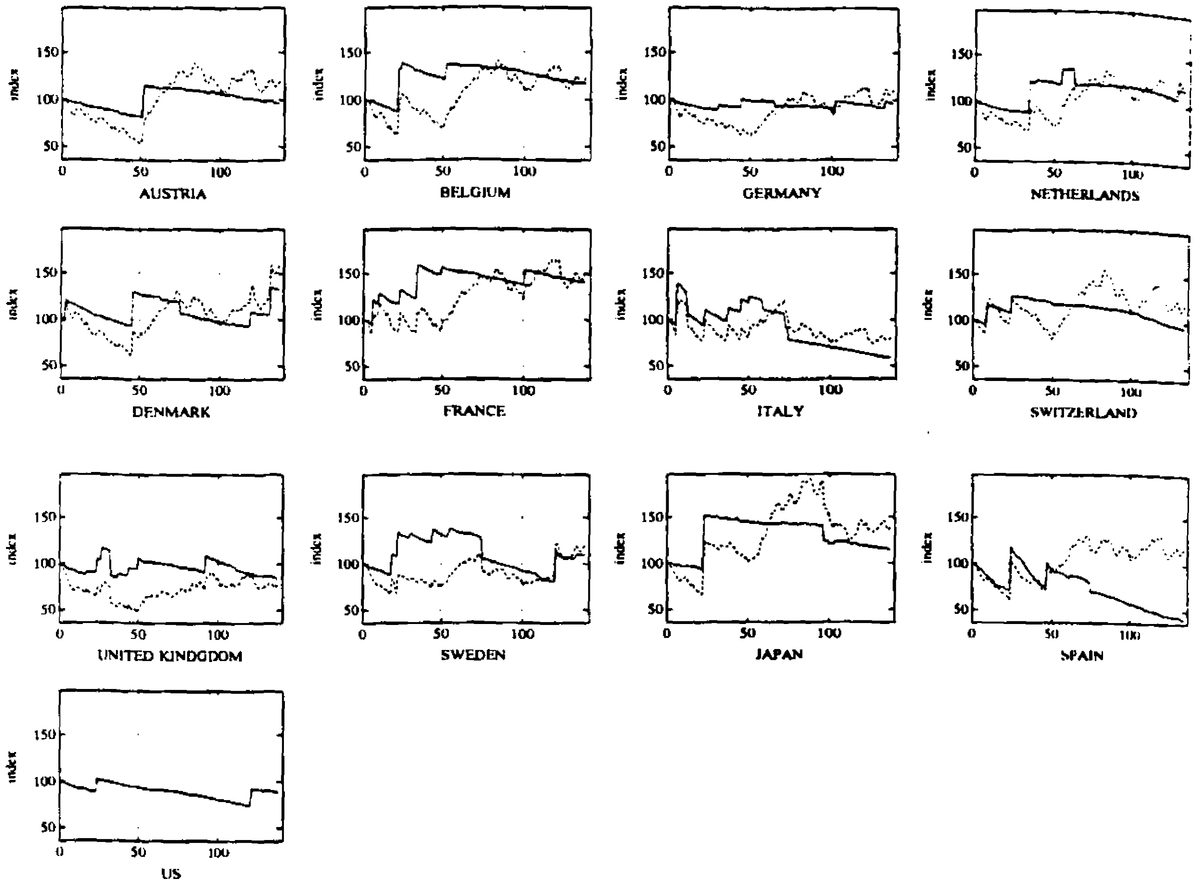


Figure 4.16: Businessweek. Real Price, R_{jt} (solid line) and Implicit Prices, W_{jt}, Indexes. January 1981-May 1992.

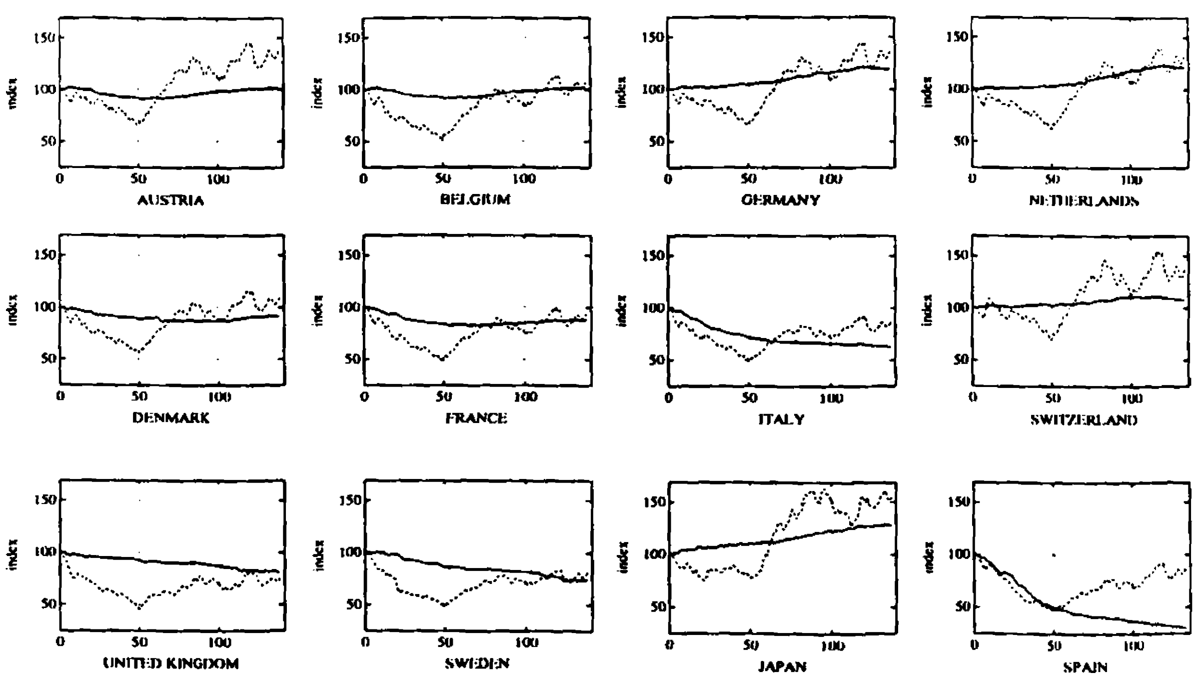
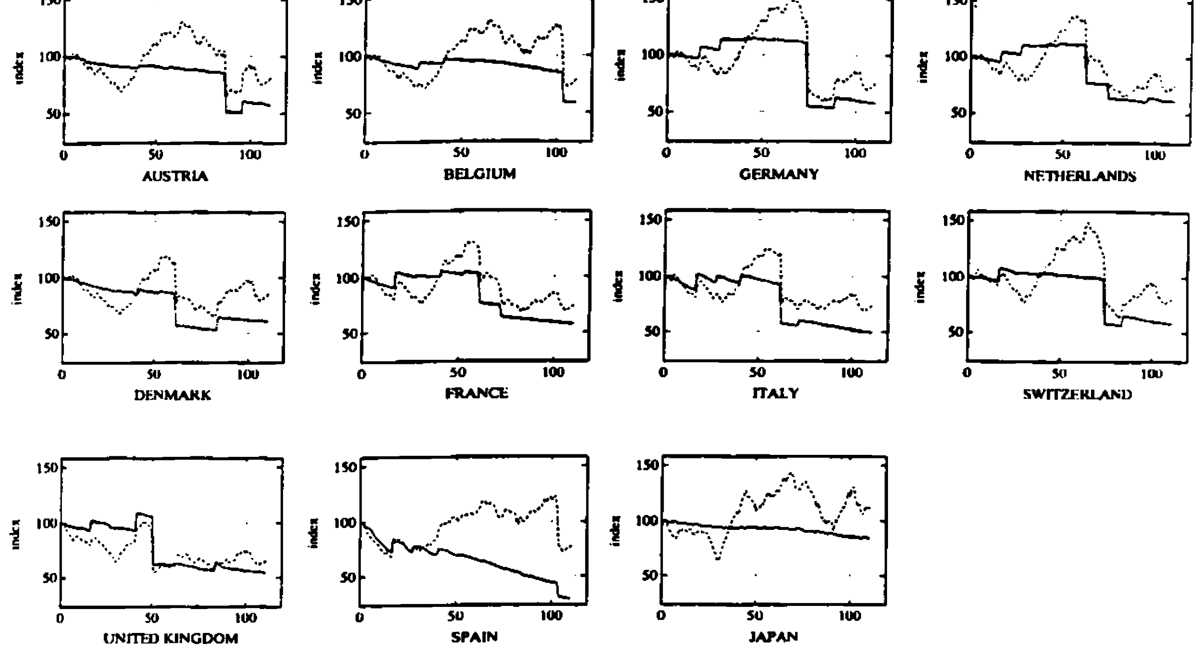


Figure 4.17: Businessweek. PPP Exchange Rate, $\frac{P_{1t}}{P_{jt}}$ (solid line) and Nominal Exchange Rate, $1/S_{jt}$, Indexes. January 1981-May 1992.



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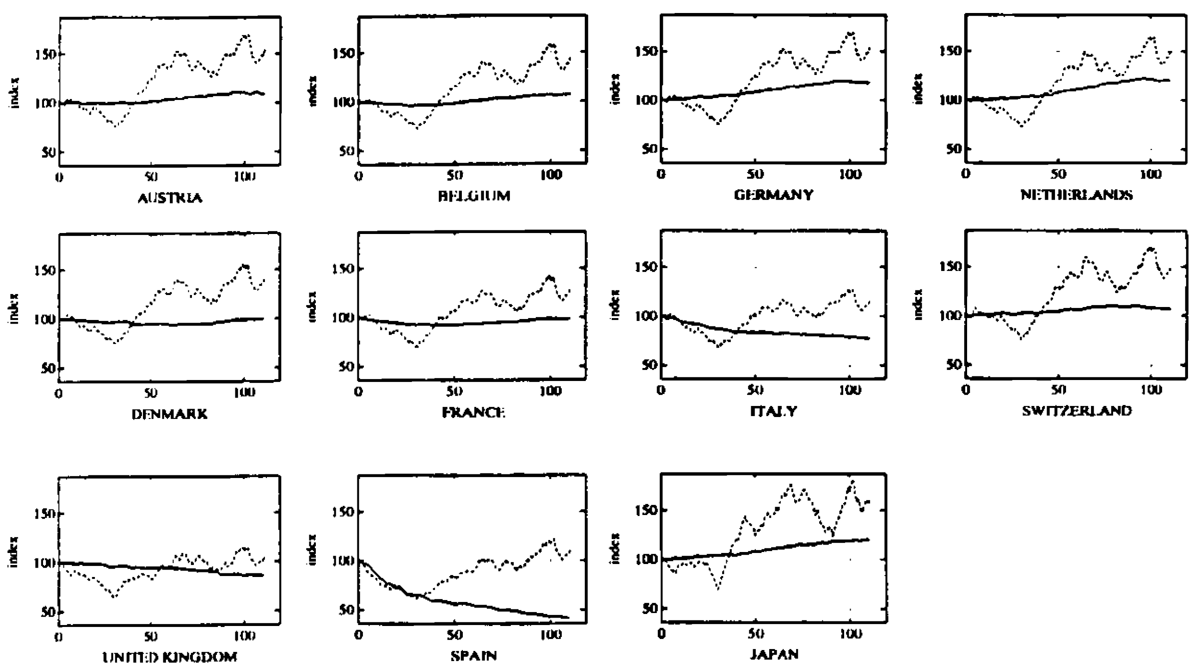


Figure 4.19: Fortune. PPP Exchange Rate, $\frac{P_{1t}}{P_{jt}}$ (solid line) and Nominal Exchange Rate, $1/S_{jt}$, Indexes. February 1983-March 1992.

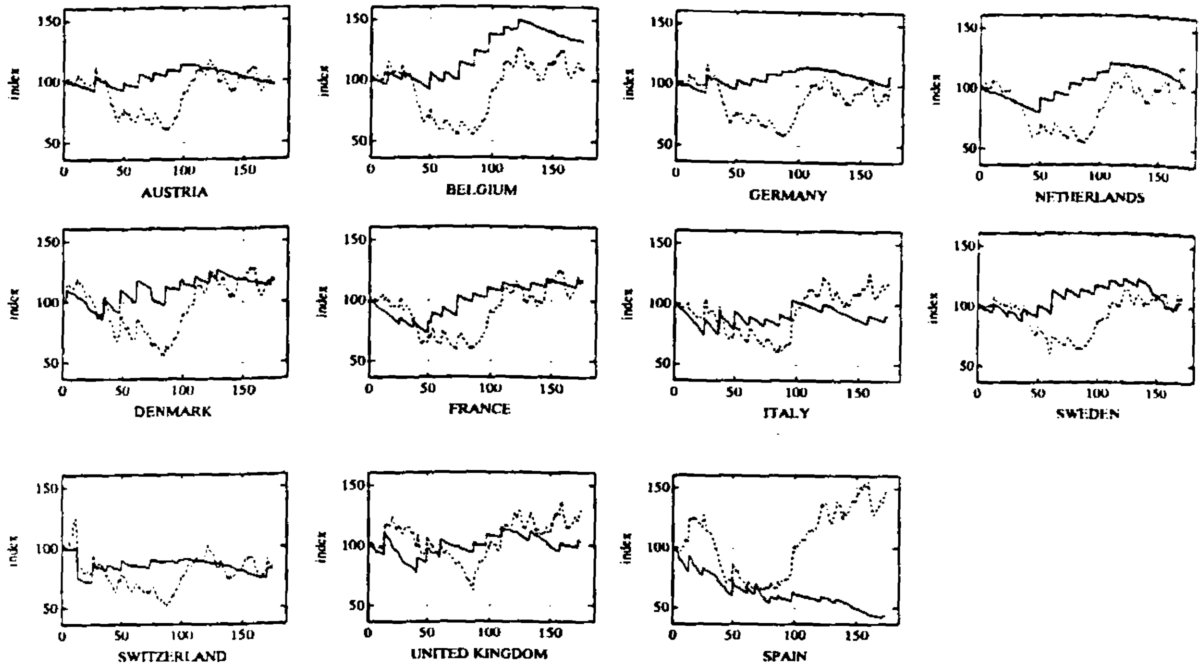


Figure 4.20: Newsweek. Real Price, R_{jt} (solid line) and Implicit Price, W_{jt}, Indexes. December 1977-June 1992.

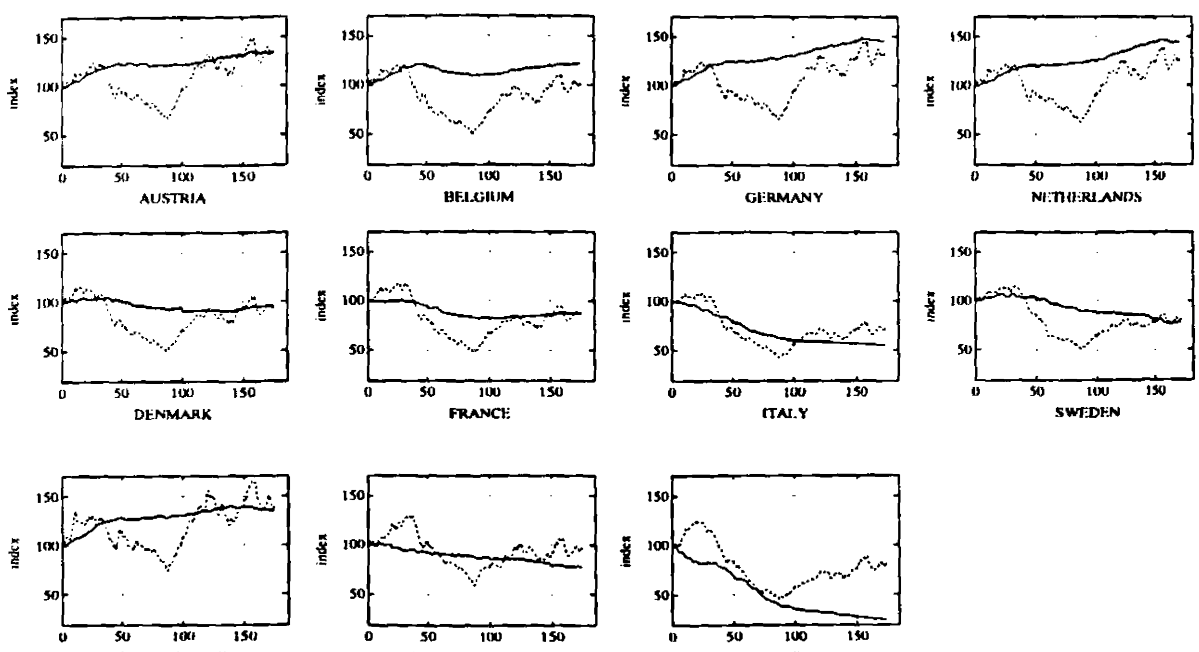


Figure 4.21: Newsweek. PPP Exchange Rate, $\frac{P_{1t}}{P_{jt}}$ (solid line) and Nominal Exchange Rate, $1/S_{jt}$, Indexes. December 1977-June 1992.

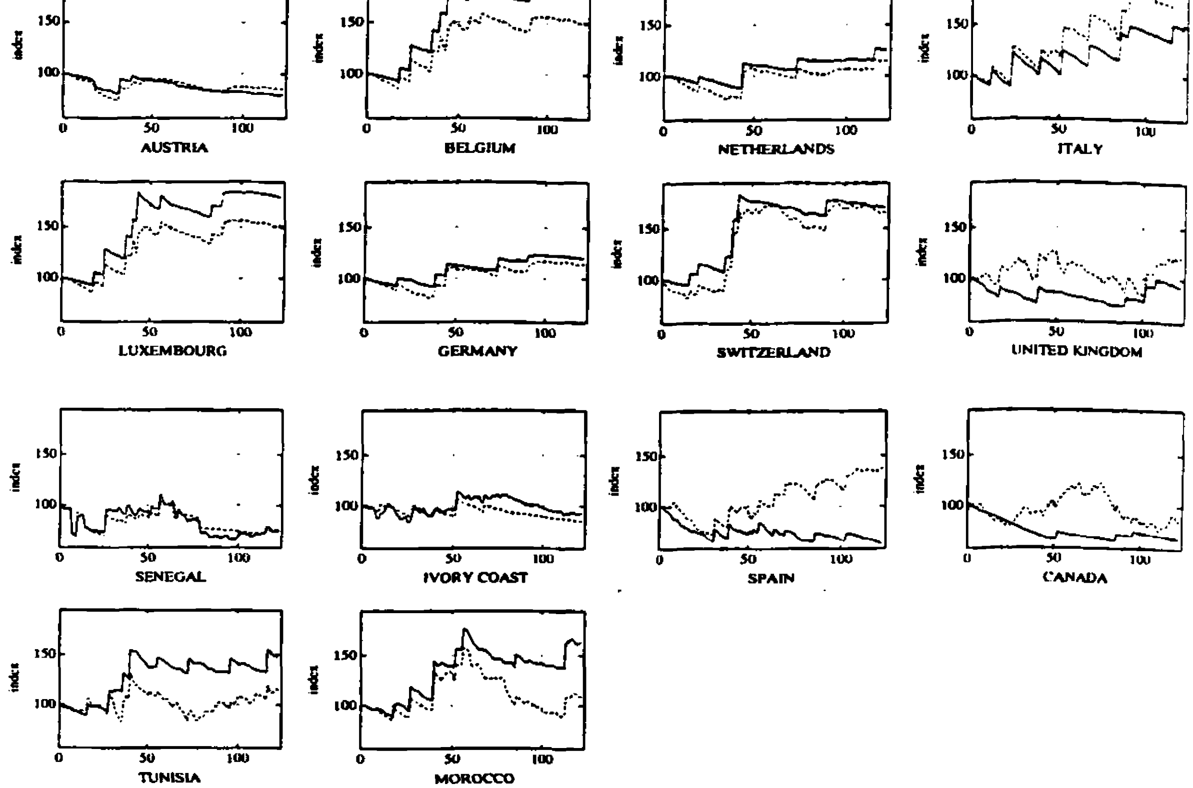


Figure 4.22: Le Figaro. Real Price, R_{jt} (solid line) and Implicit Price, W_{jt}, Indexes. October 1978 - December 1988.

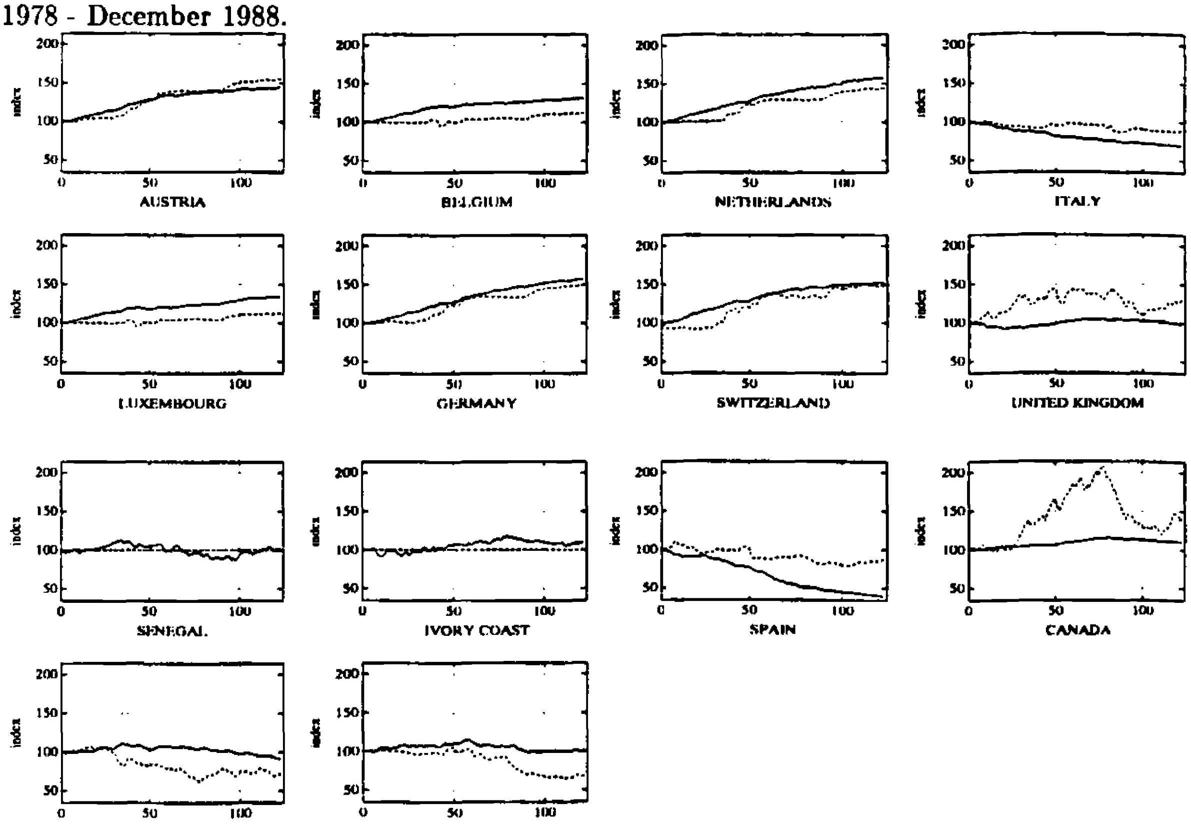


Figure 4.23: Le Figaro. PPP Exchange Rate, $\frac{P_{1t}}{P_{jt}}$ (solid line) and Nominal Exchange Rate, $1/S_{jt}$, Indexes. October 1978 - December 1988.

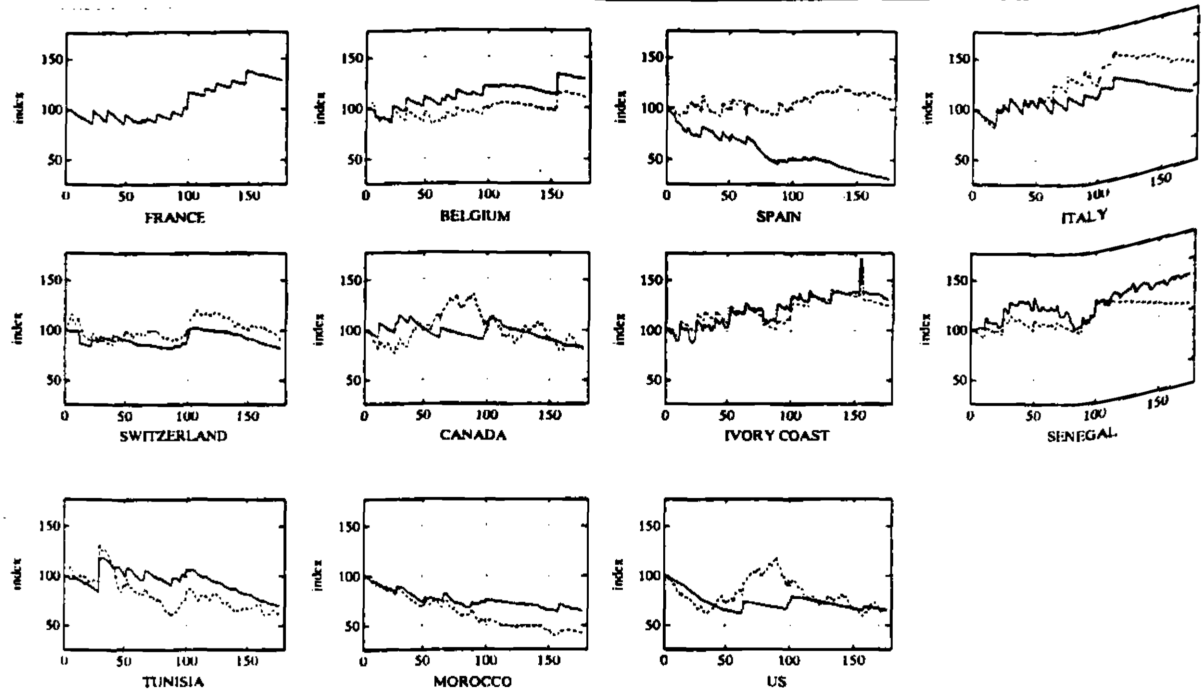


Figure 4.24: Le Nouvel Observateur. Real Price, R_{jt} (solid line) and Implicit Price, W_{jt}, Indexes. October 1977-May 1992.

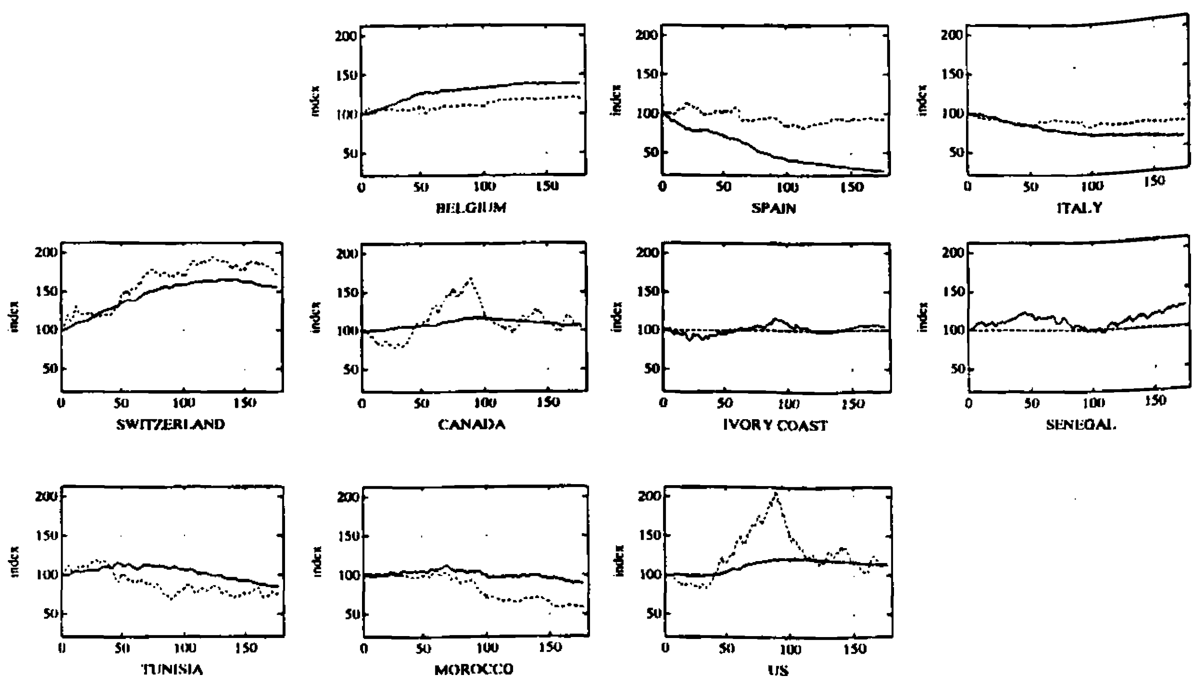


Figure 4.25: Le Nouvel Observateur. PPP Exchange Rate, $\frac{P_{1t}}{P_{jt}}$ and Nominal Exchange Rate, $1/S_{jt}$, Indexes. October 1977-May 1992.

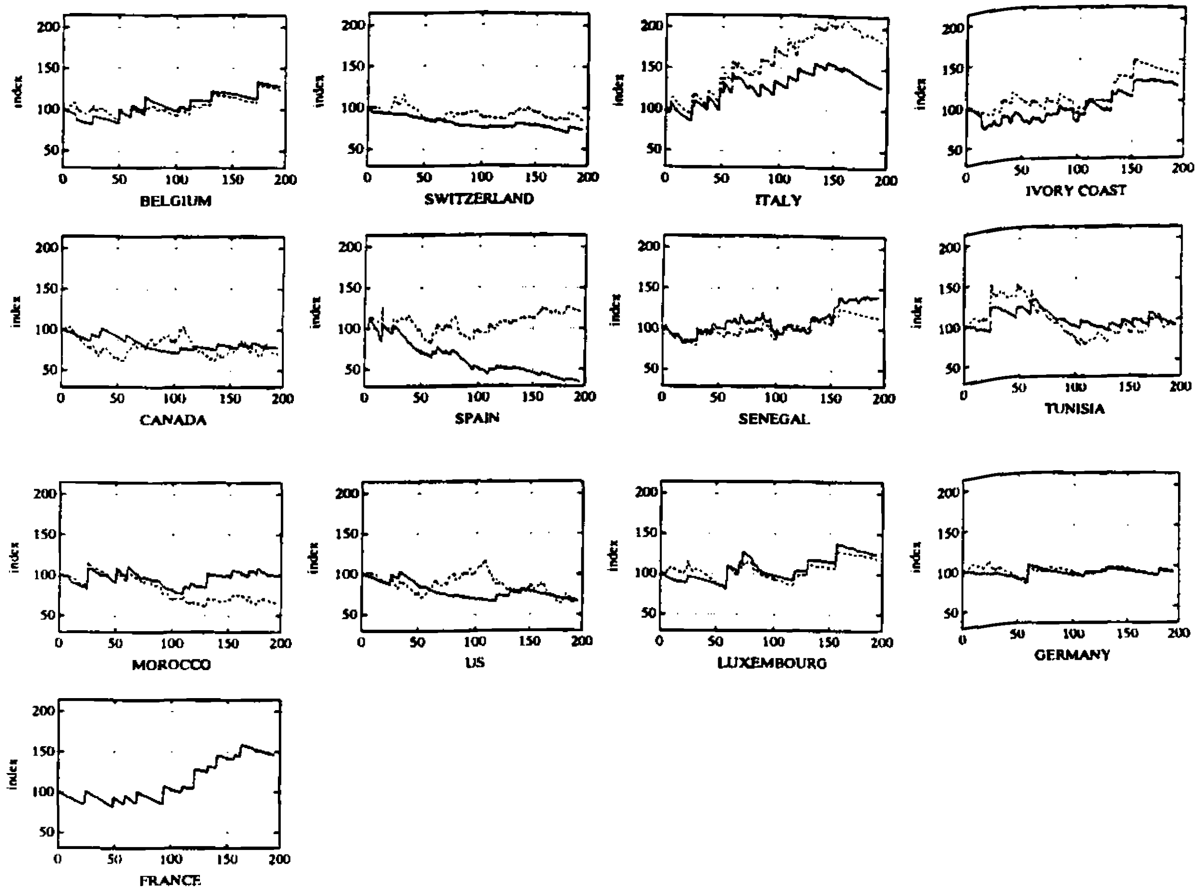
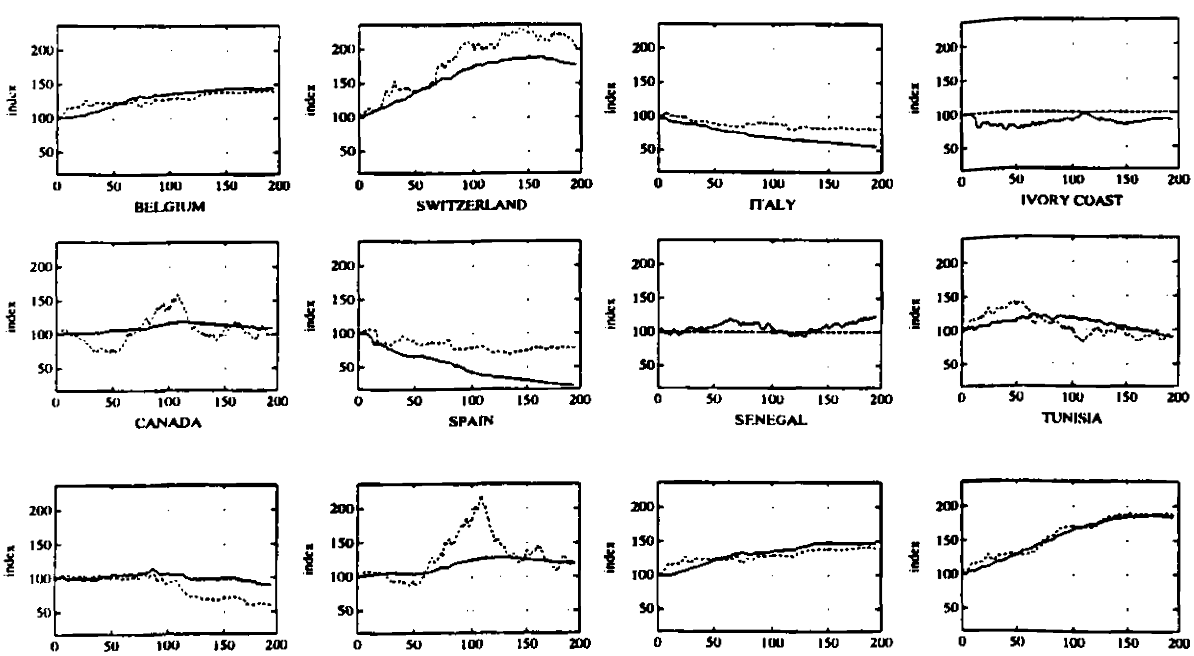


Figure 4.26: Le Point. Real Price, R_{jt} (solid line) and Implicit Price, W_{jt}, Indexes. March 1976 - May 1992.



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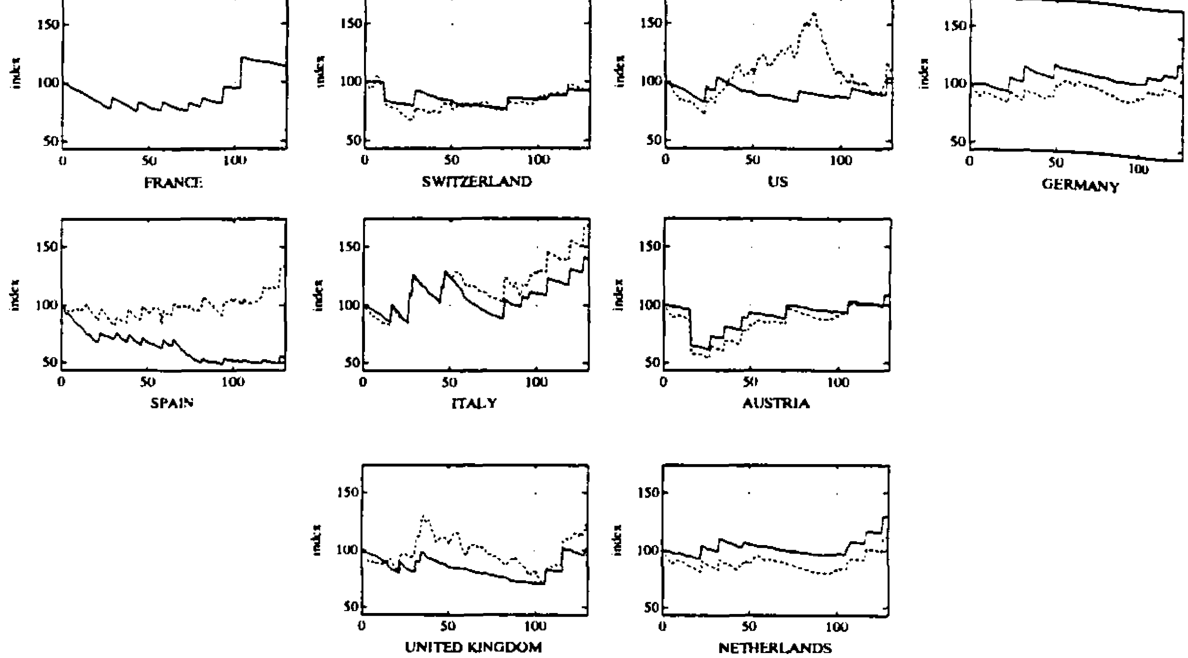

Figure 4.28: L'Express. Real Price, R_{jt} (solid line) and Implicit Price, W_{jt}, Indexes. March 1978-December 1988.

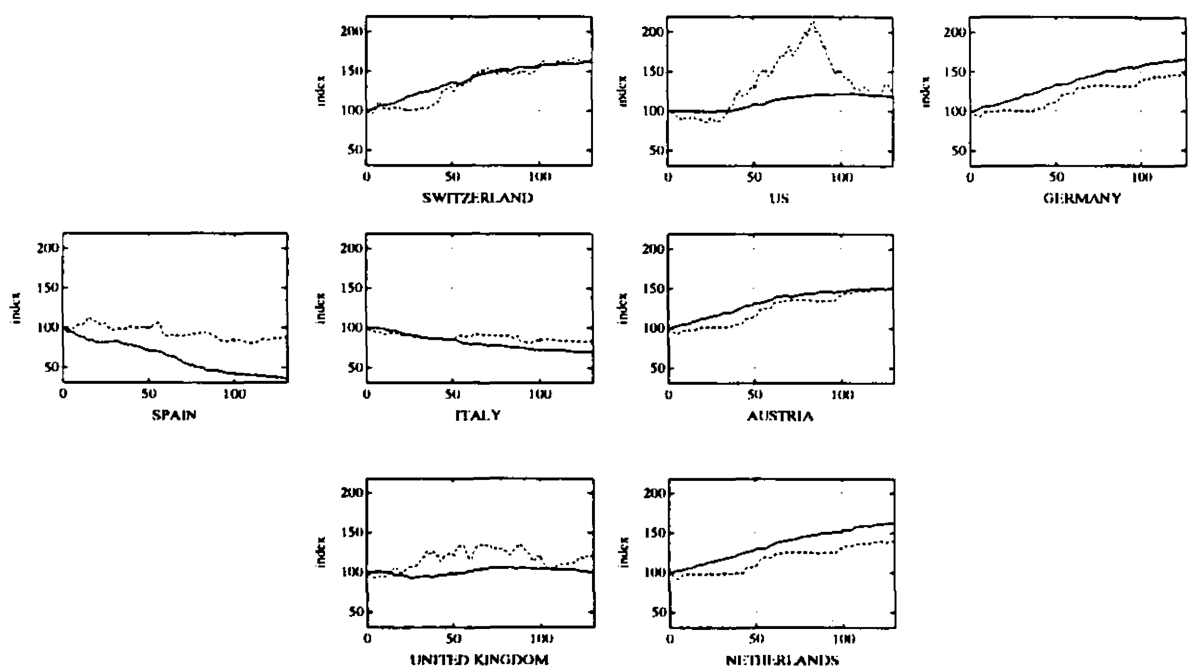

Figure 4.29: L'Express. PPP Exchange Rate, $\frac{P_{1t}}{P_{jt}}$ and Nominal Exchange Rate, $1/S_{jt}$, Indexes. March 1978-December 1988.

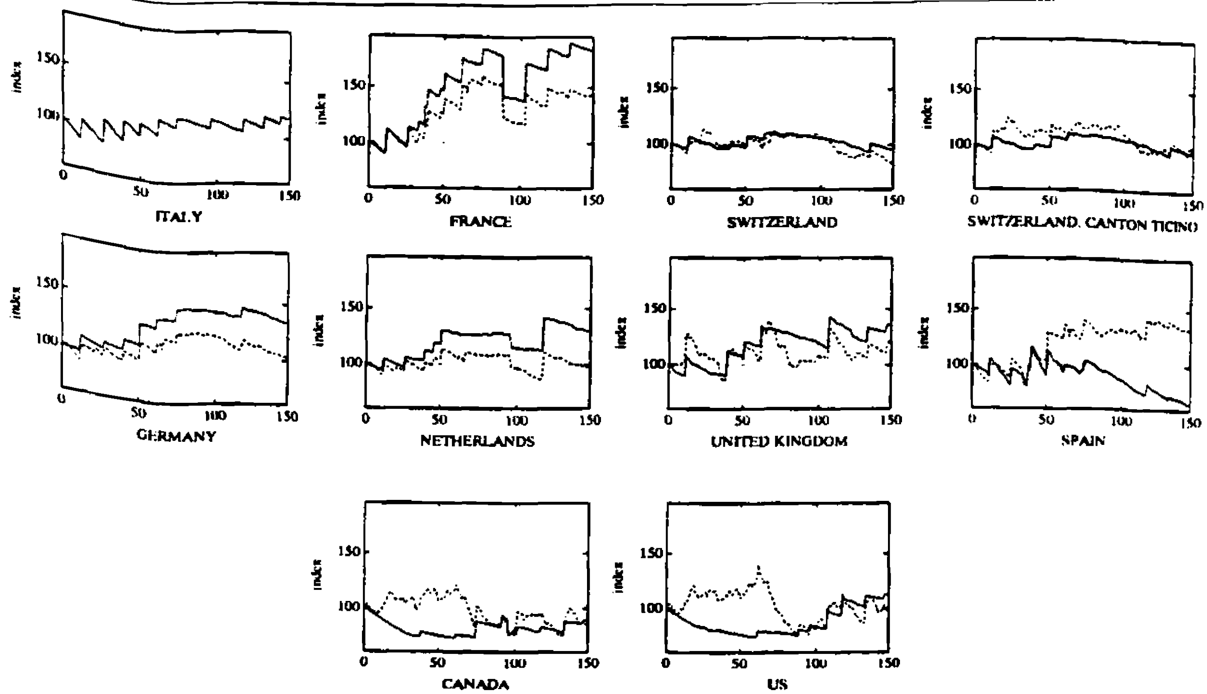

Figure 4.30: Il Mondo. Real Price, R_{jt} (solid line) and Implicit Price, W_{jt}, Indexes. February 1980 - June 1992.

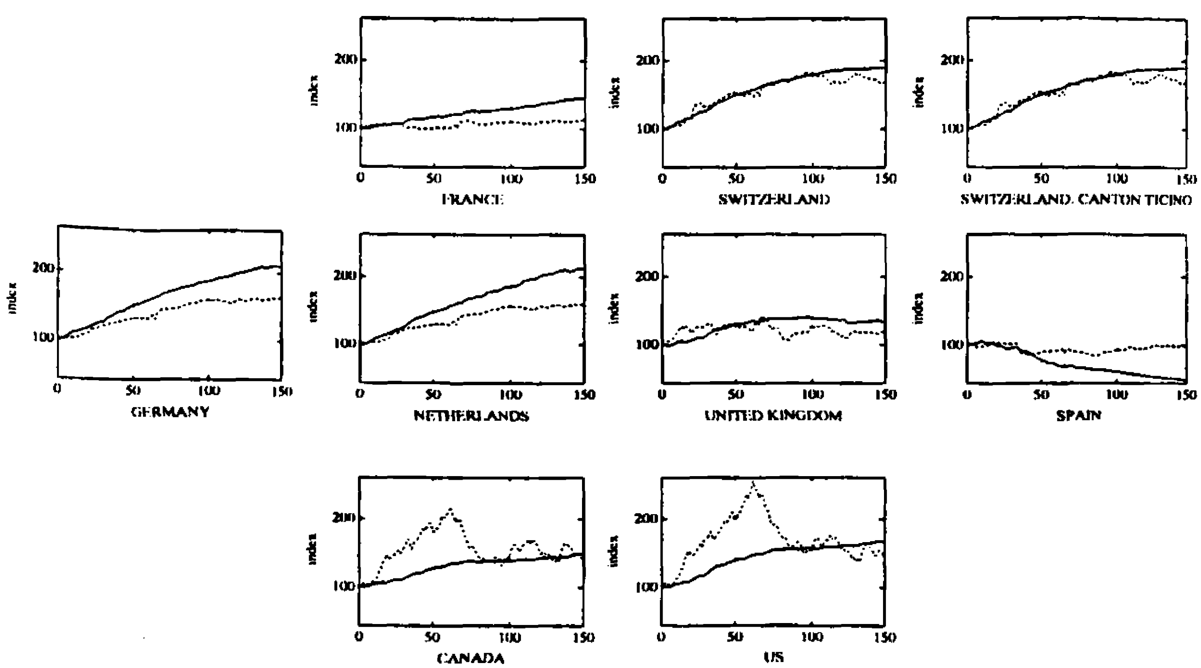

Figure 4.31: Il Mondo. PPP Exchange Rate, $\frac{P_{1t}}{P_{jt}}$ and Nominal Exchange Rate, $1/S_{jt}$, Indexes. February 1980 - June 1992.

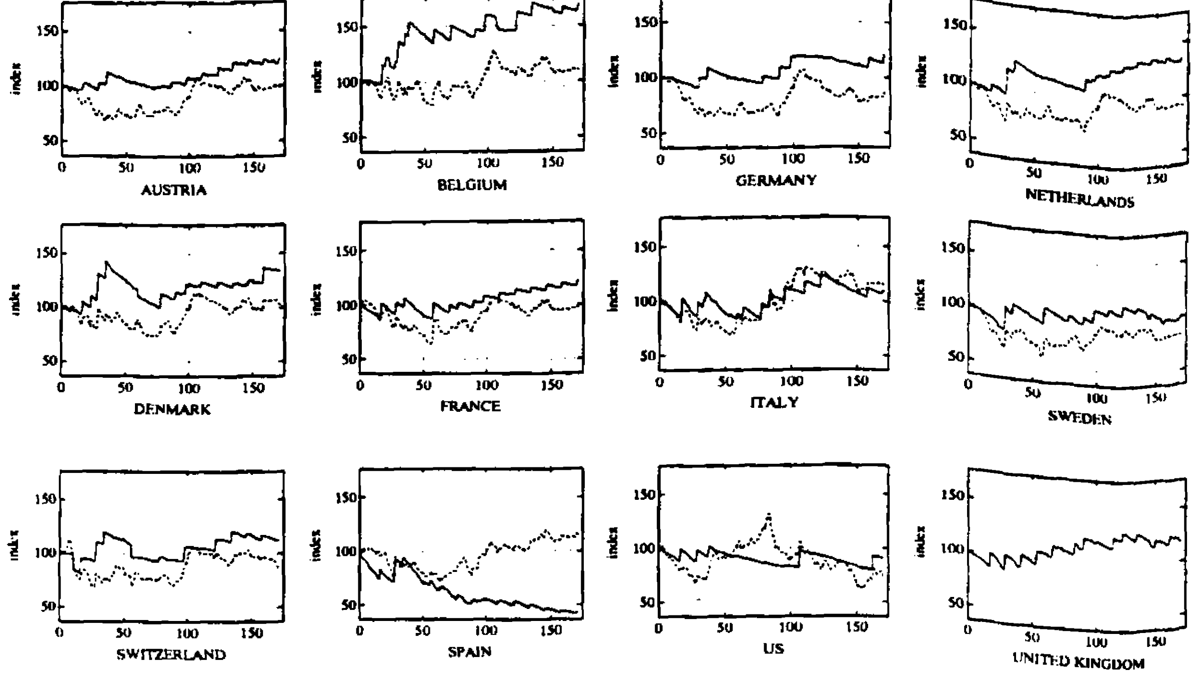

Figure 4.32: The Economist. Real Price, R_{jt} (solid line) and Implicit Price, W_{jt}, Indexes. March 1978 - May 1992.

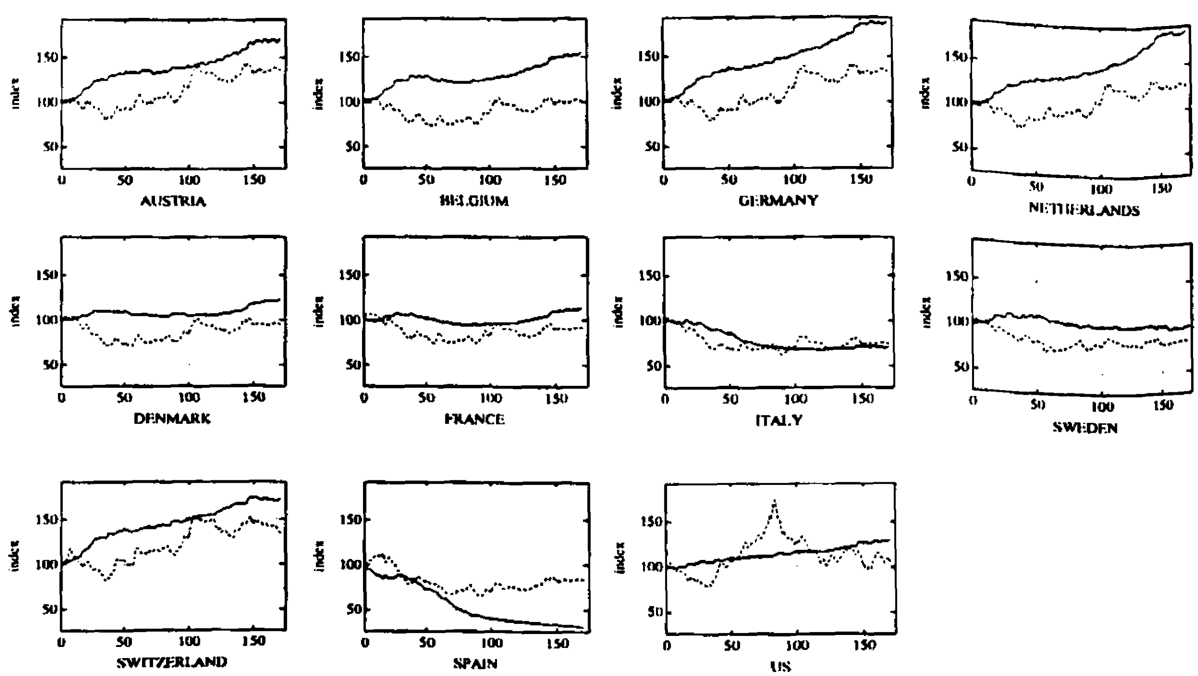

Figure 4.33: The Economist. PPP Exchange Rate, $\frac{P_{1t}}{P_{jt}}$ and Nominal Exchange Rate, $1/S_{jt}$, Indexes. March 1978-May 1992.

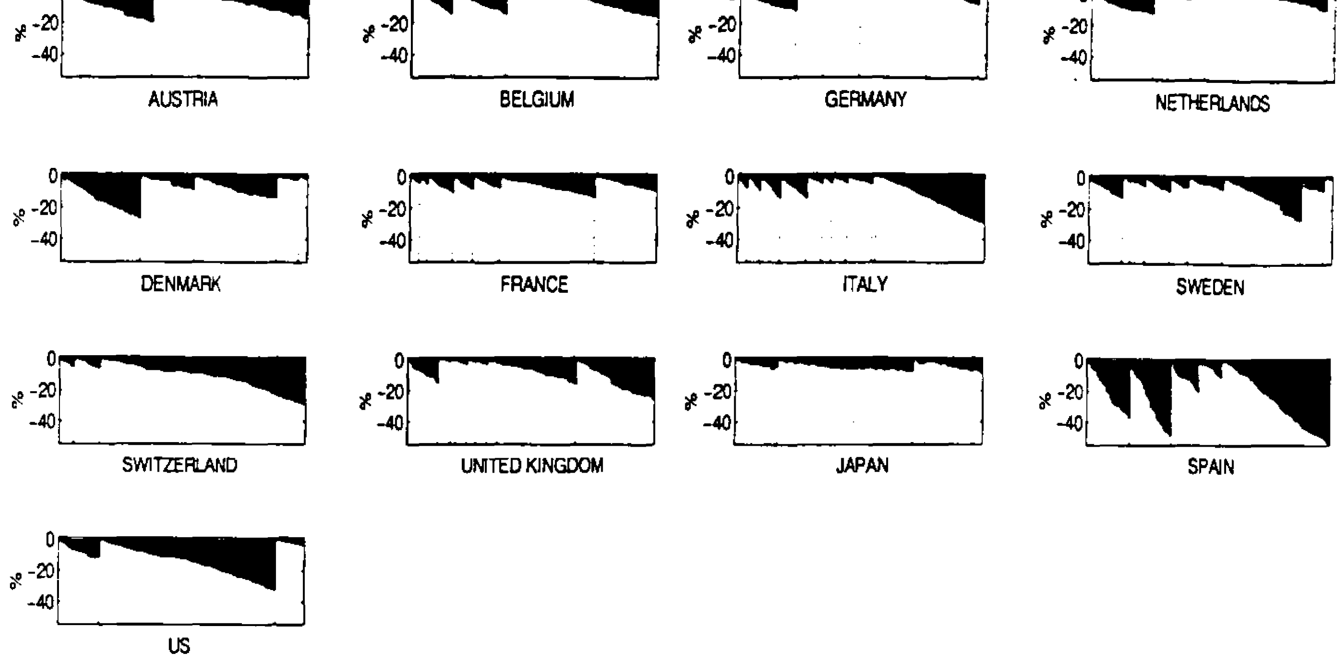

Figure 4.34: Businessweek. $(R_I/R_i)_\tau$.

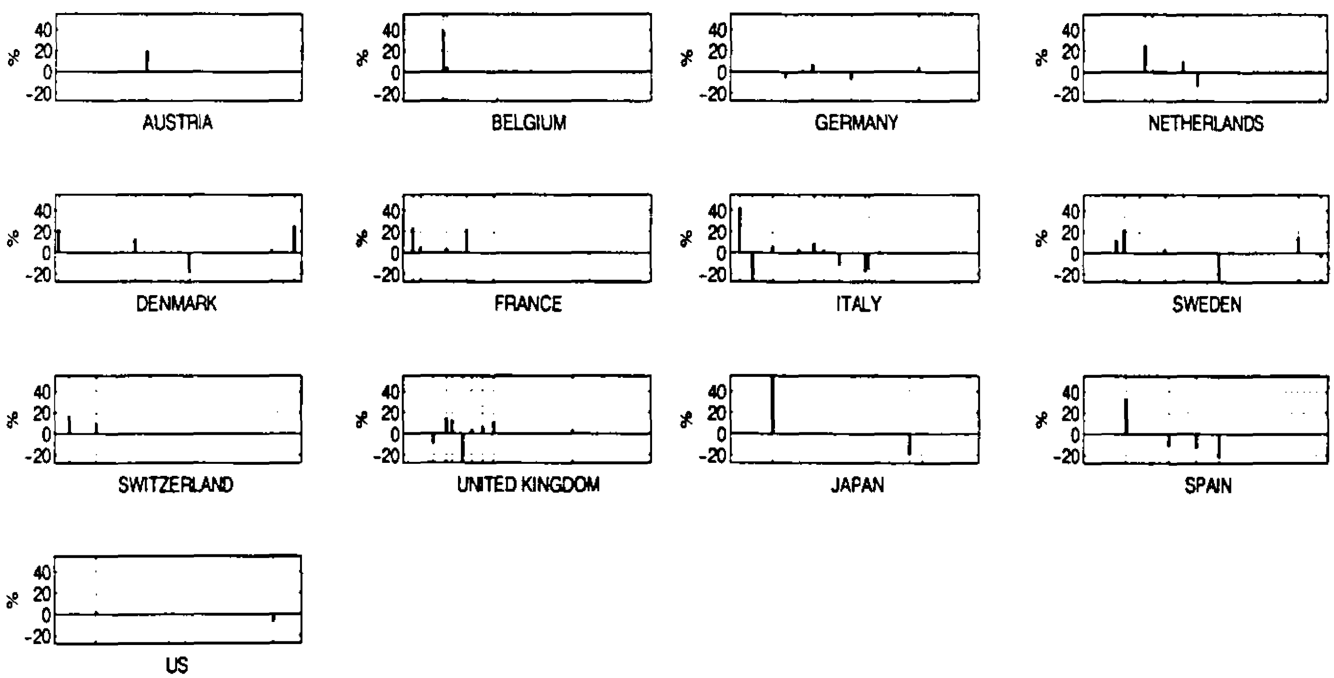

Figure 4.35: Businessweek. $(R_{I\tau+1}/R_{i\tau}) - (R_I/R_i)\tau$.

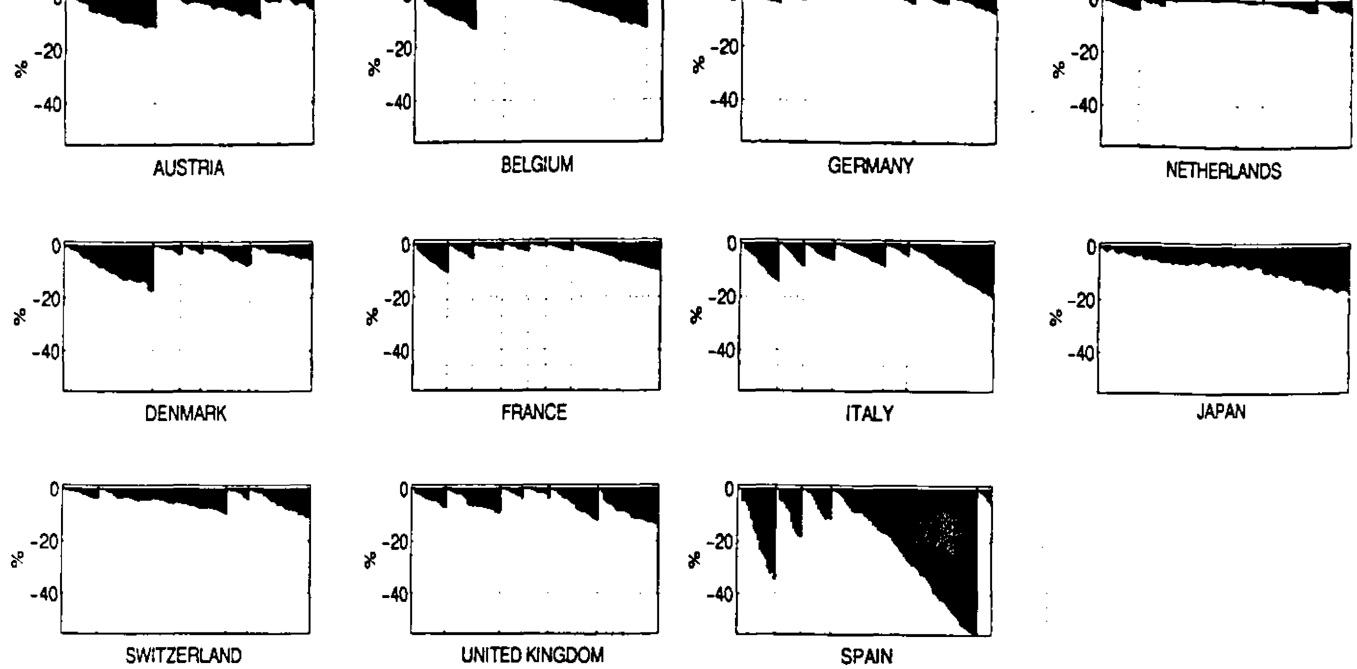

Figure 4.36: Fortune. $(R_I/R_i)_\tau$.

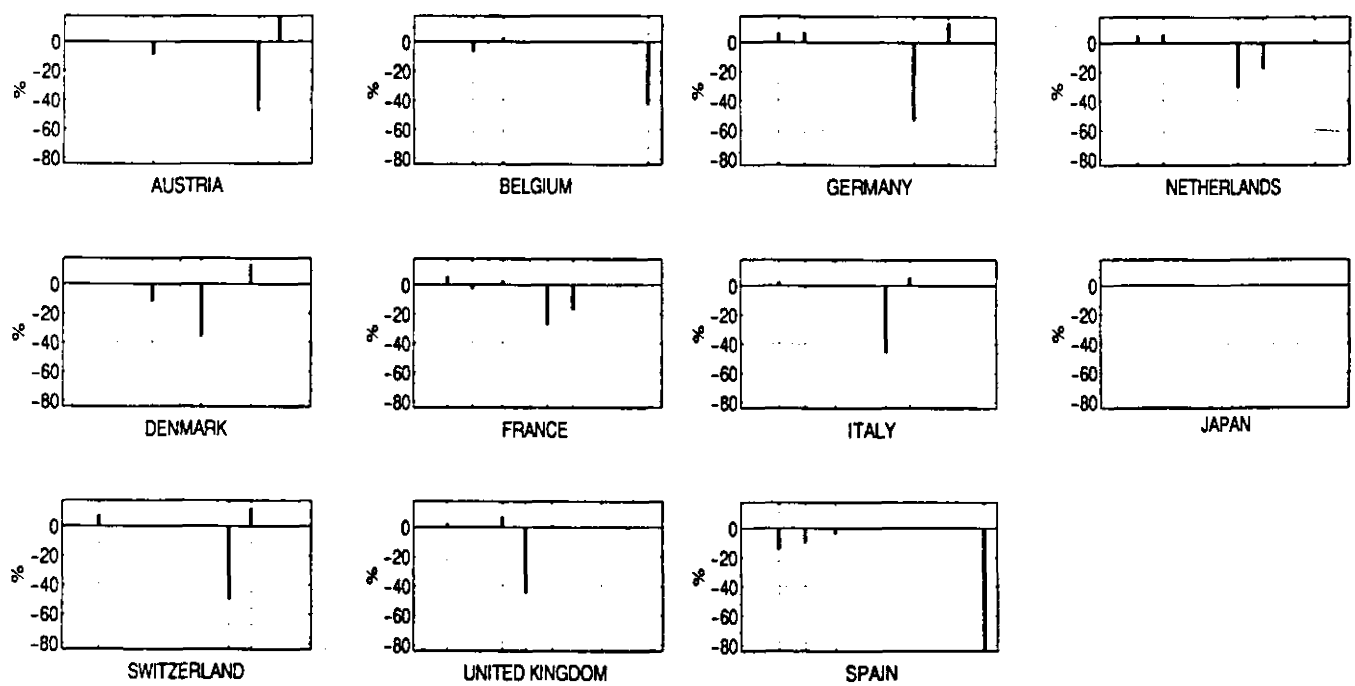

Figure 4.37: Fortune. $(R_{I\tau+1}/R_{i\tau}) - (R_I/R_i)\tau$.

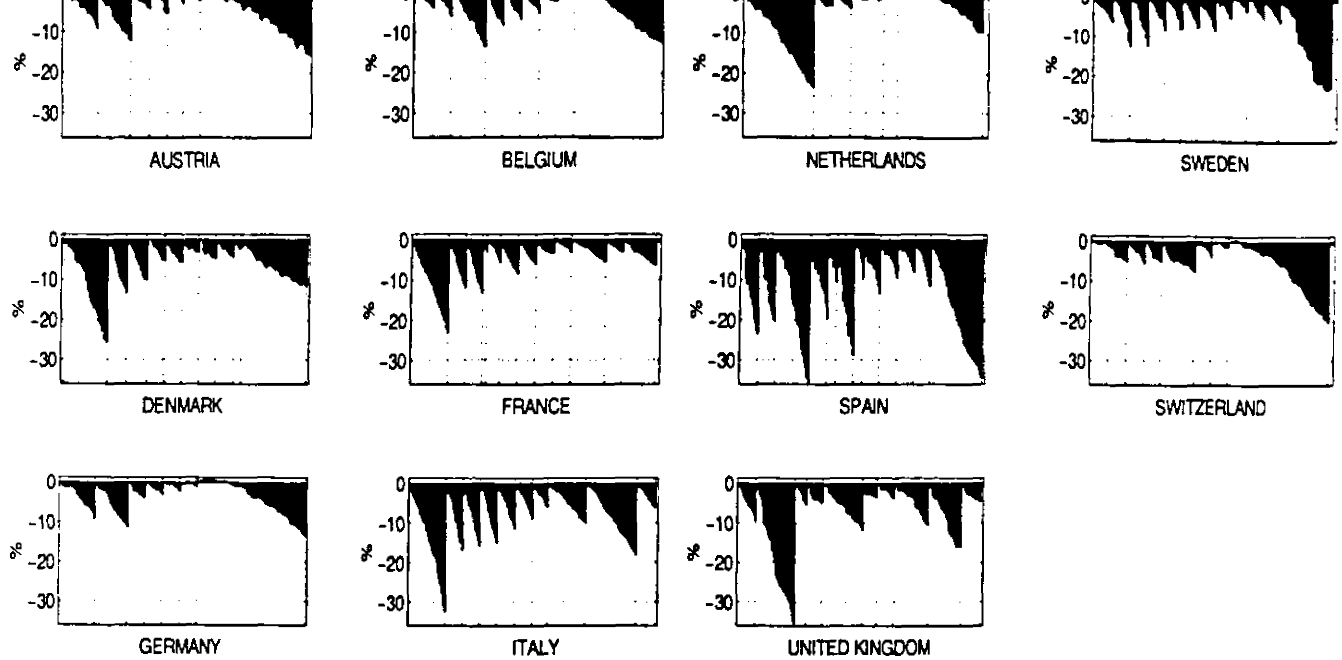

Figure 4.38: Newsweek. $(R_I/R_i)_\tau$.

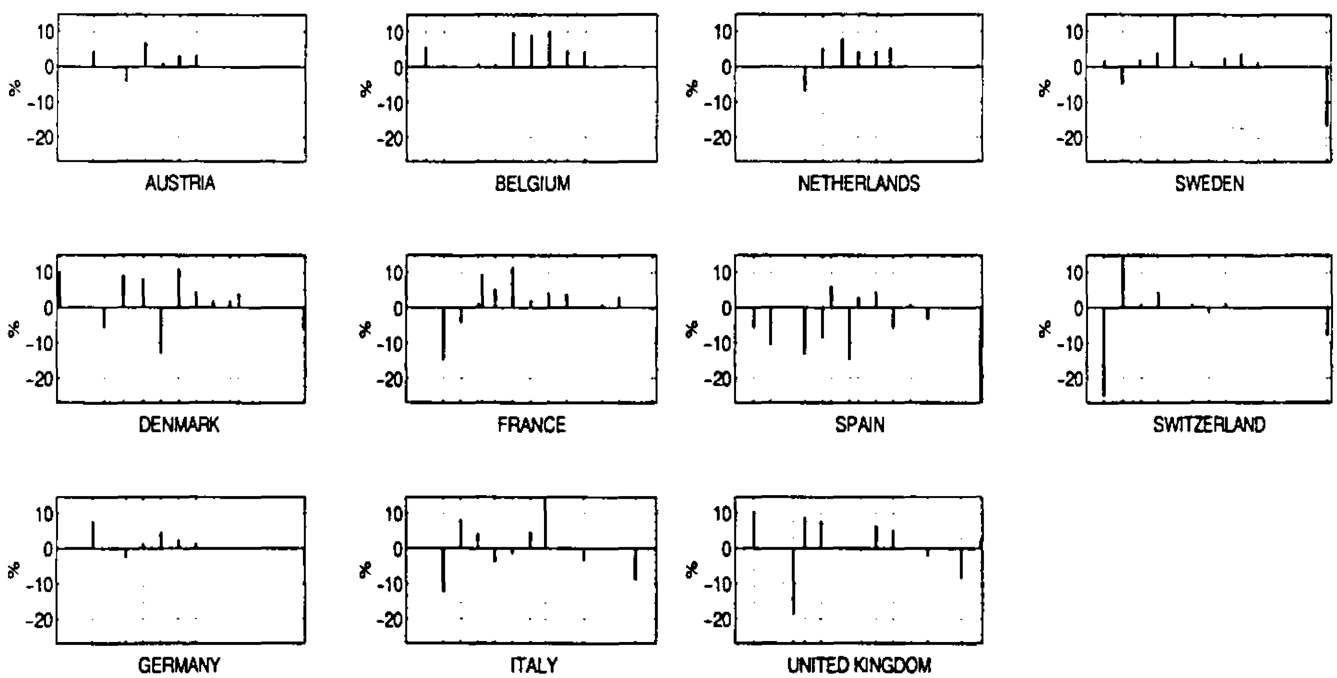

Figure 4.39: Newsweek. $(R_{I\tau+1}/R_{i\tau}) - (R_I/R_i)\tau$.

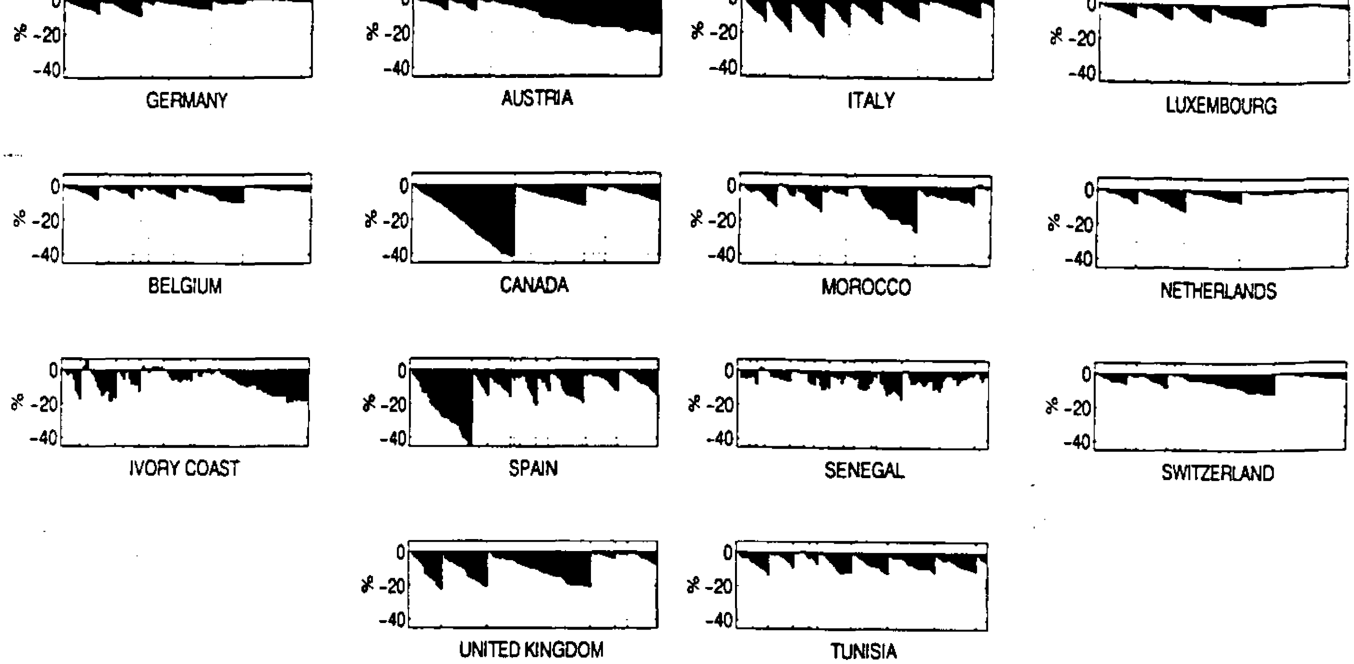

Figure 4.40: Le Figaro. $(R_I/R_i)_\tau$.

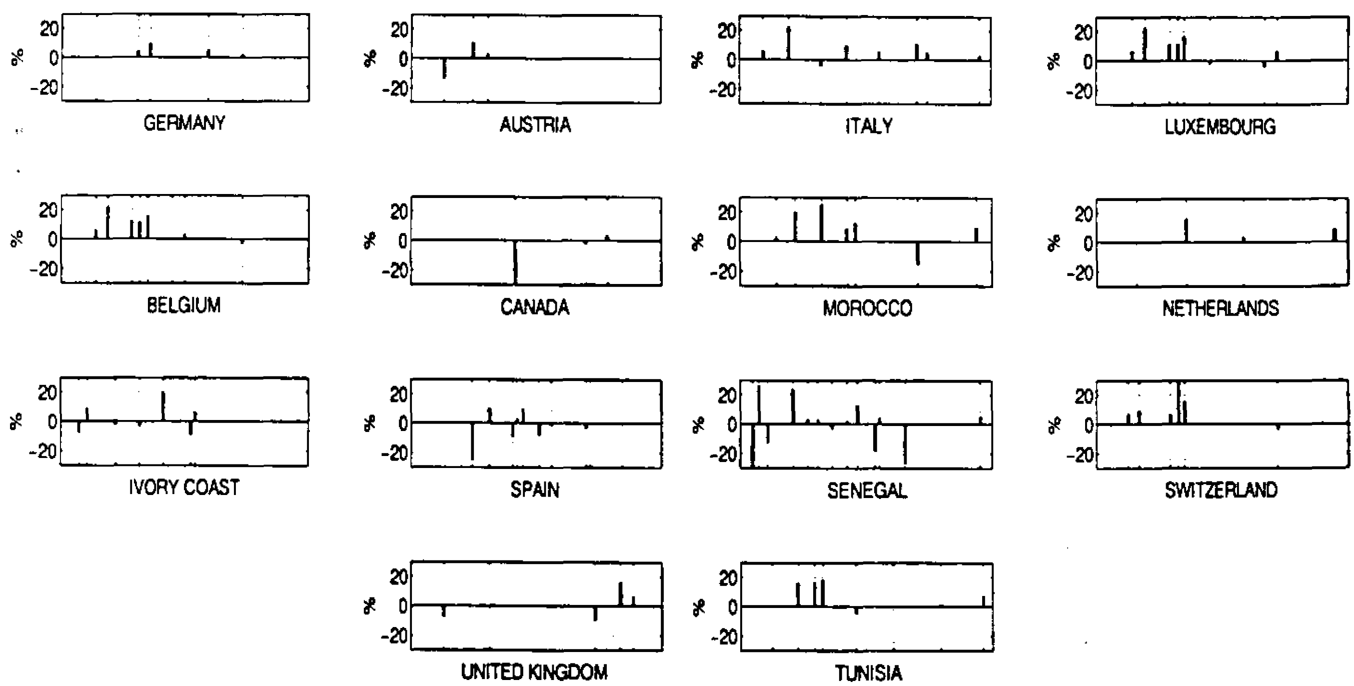

Figure 4.41: Le Figaro. $(R_{I\tau+1}/R_{i\tau}) - (R_I/R_i)\tau$.

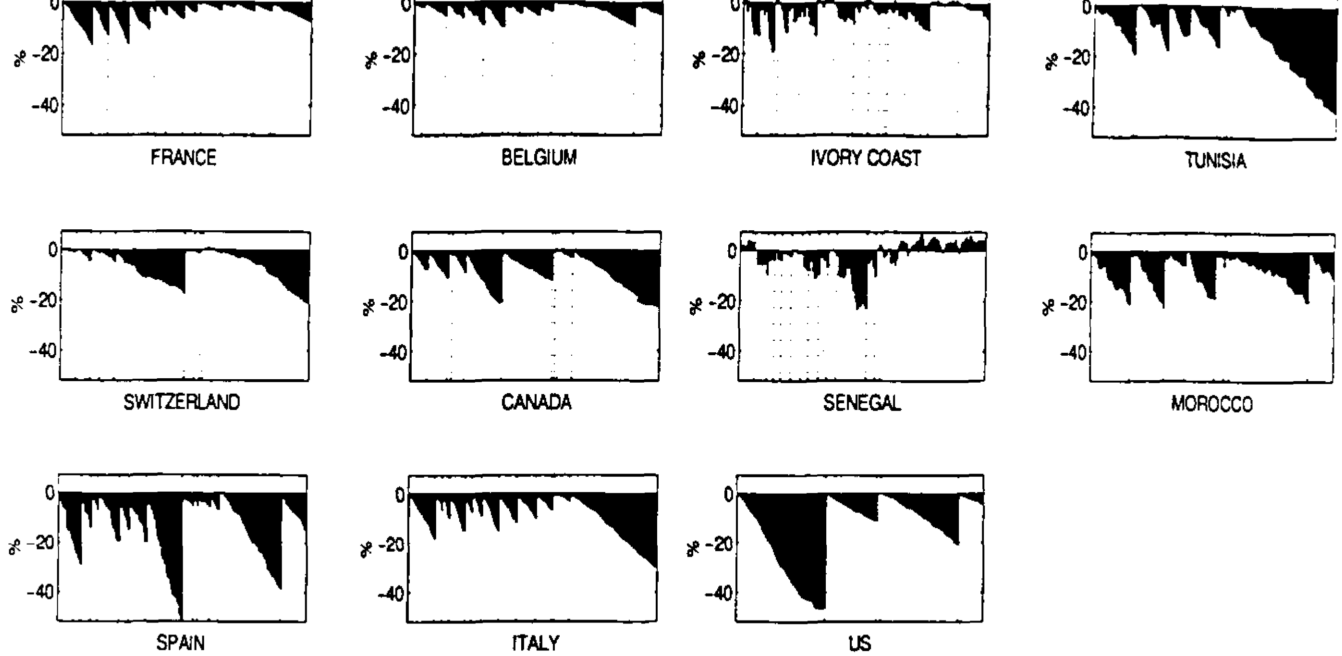

Figure 4.42: Le Nouvel Observateur. $(R_I/R_i)_\tau$.

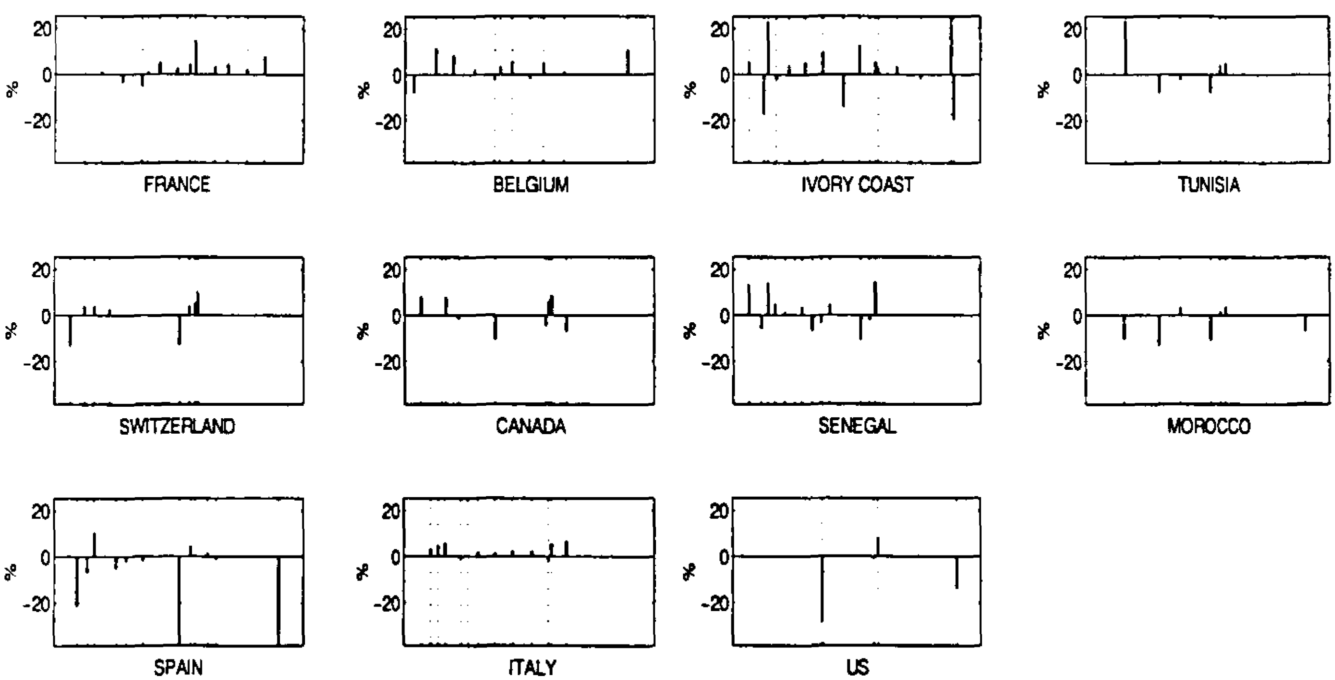

Figure 4.43: Le Nouvel Observateur. $(R_{I\tau+1}/R_{i\tau}) - (R_I/R_i)\tau$.

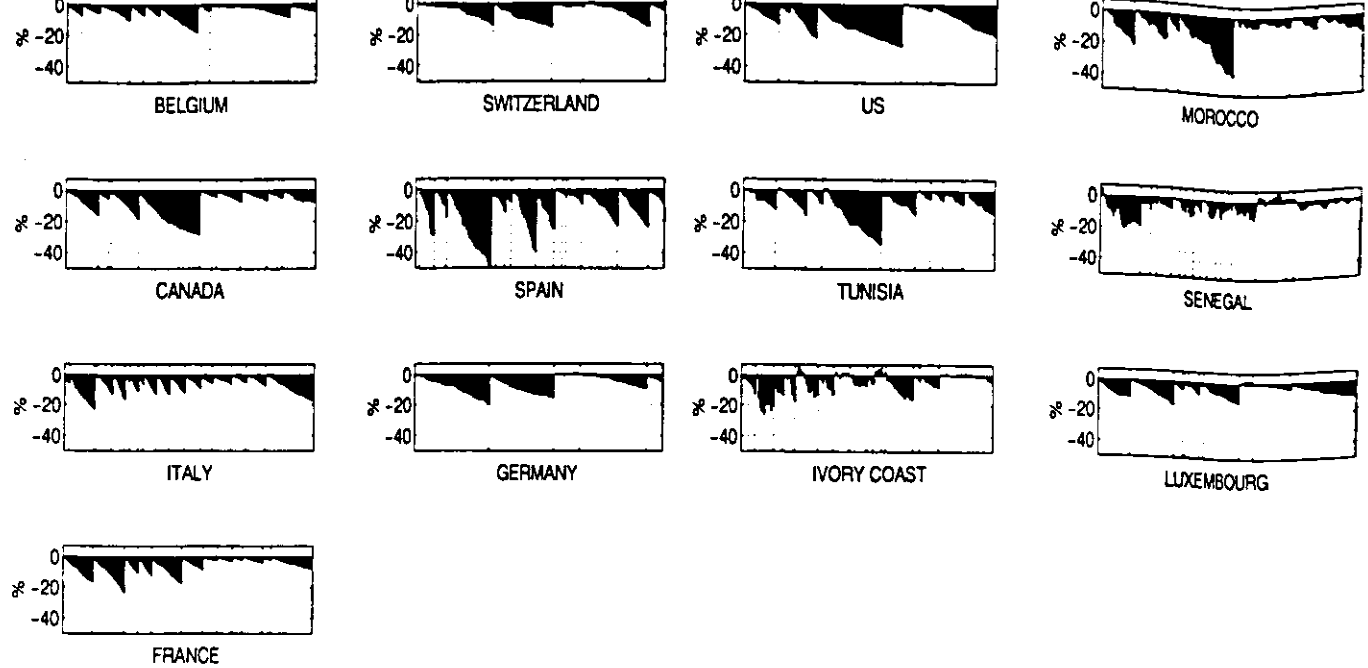

Figure 4.44: Le Point. $(R_I/R_i)_\tau$.

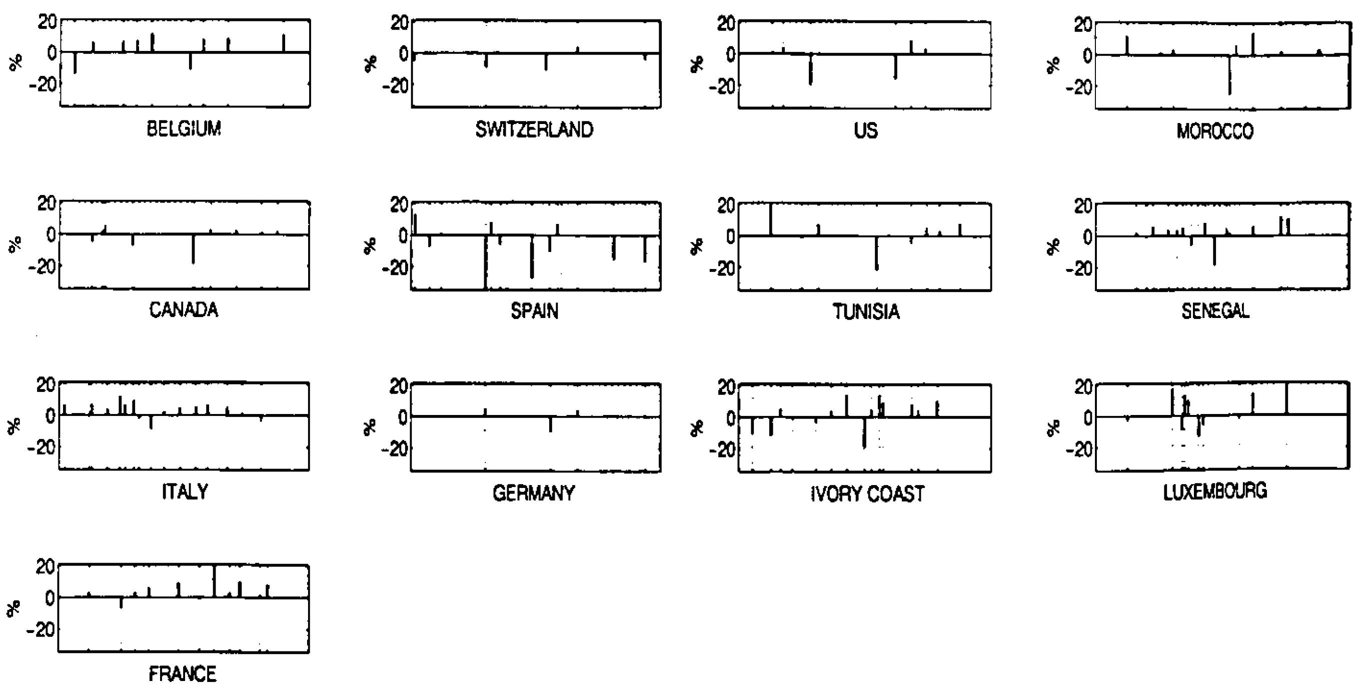

Figure 4.45: Le Point. $(R_{I\tau+1}/R_{i\tau}) - (R_I/R_i)\tau$.

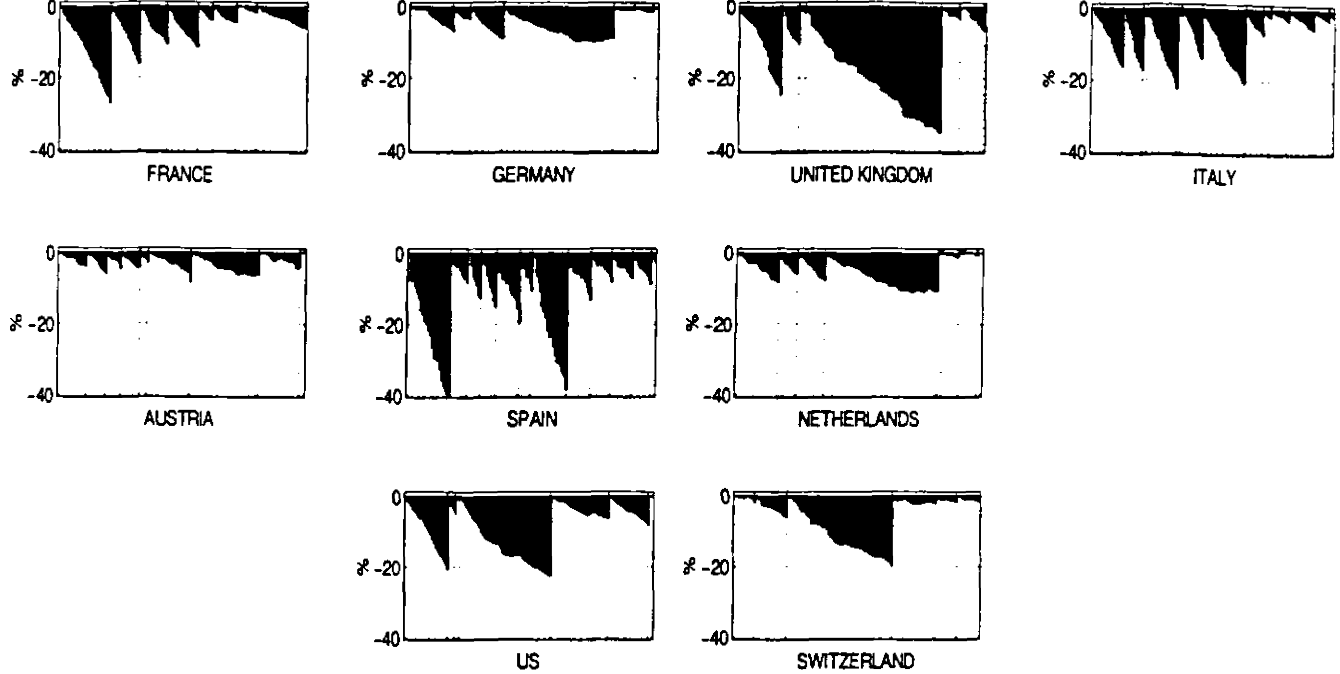

Figure 4.46: L'Express. $(R_I/R_i)_\tau$.

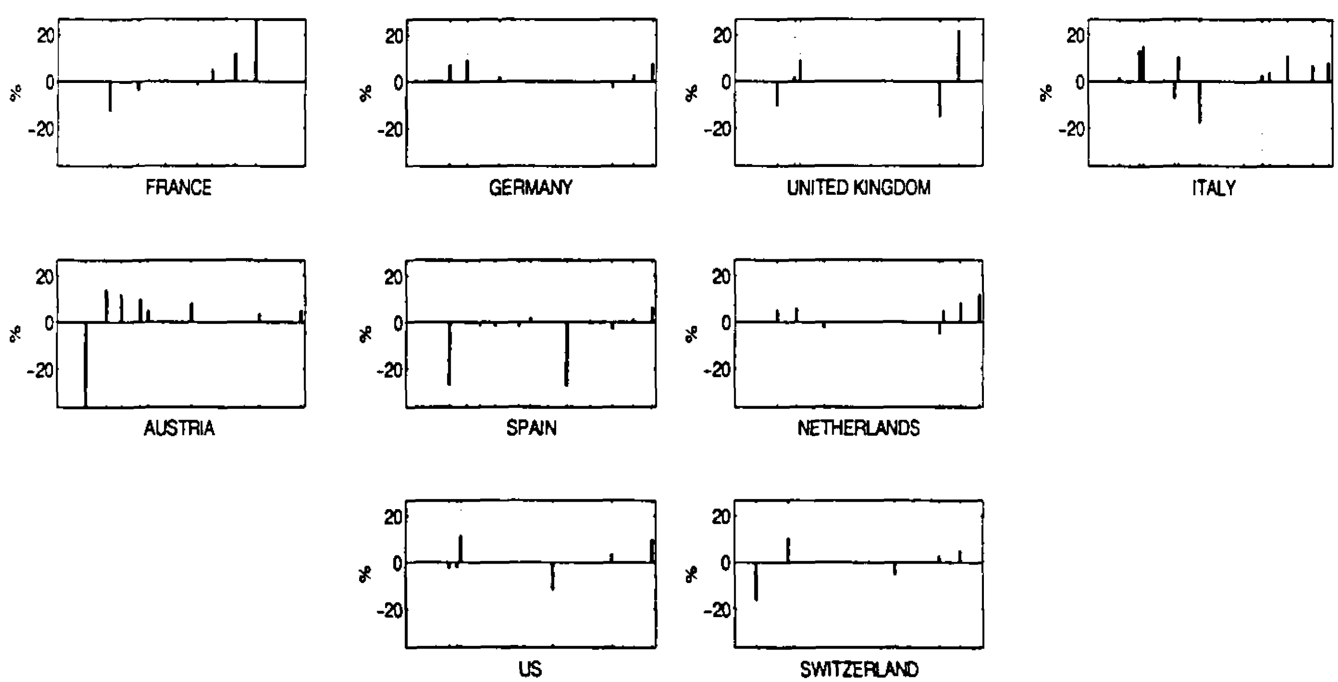

Figure 4.47: L'Express. $(R_{I\tau+1}/R_{i\tau}) - (R_I/R_i)\tau$.

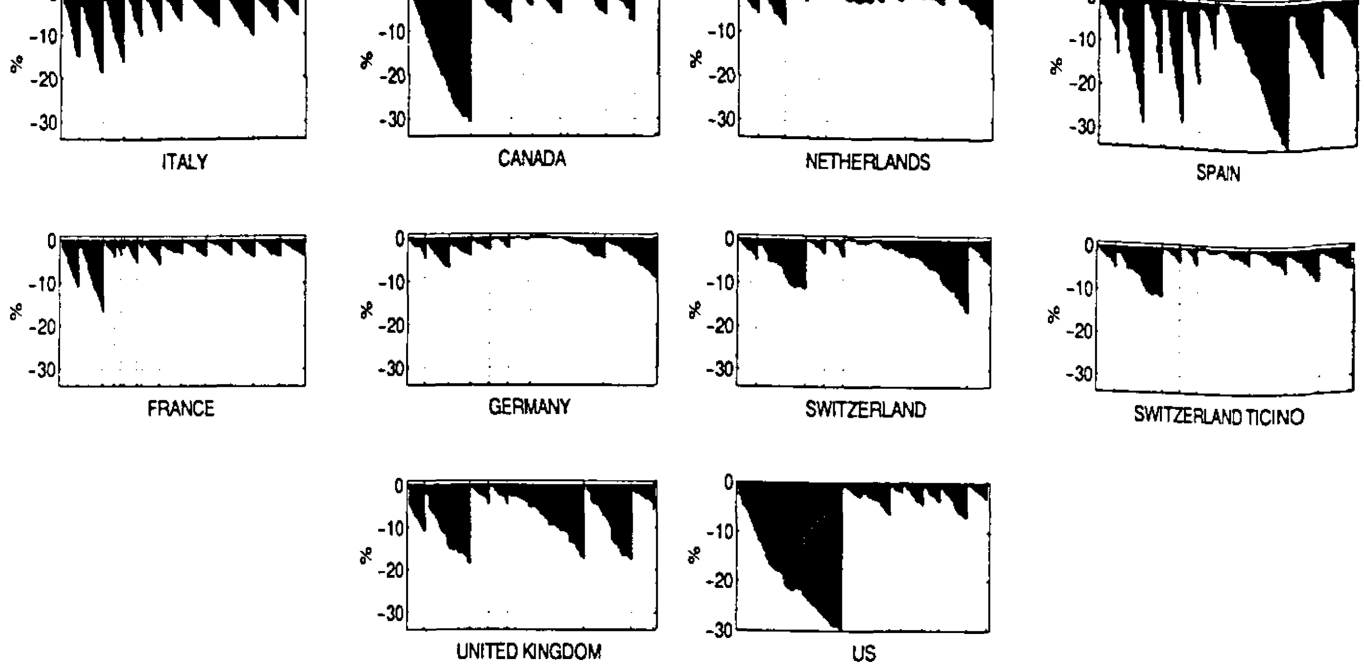

Figure 4.48: Il Mondo. $(R_I/R_i)_\tau$.

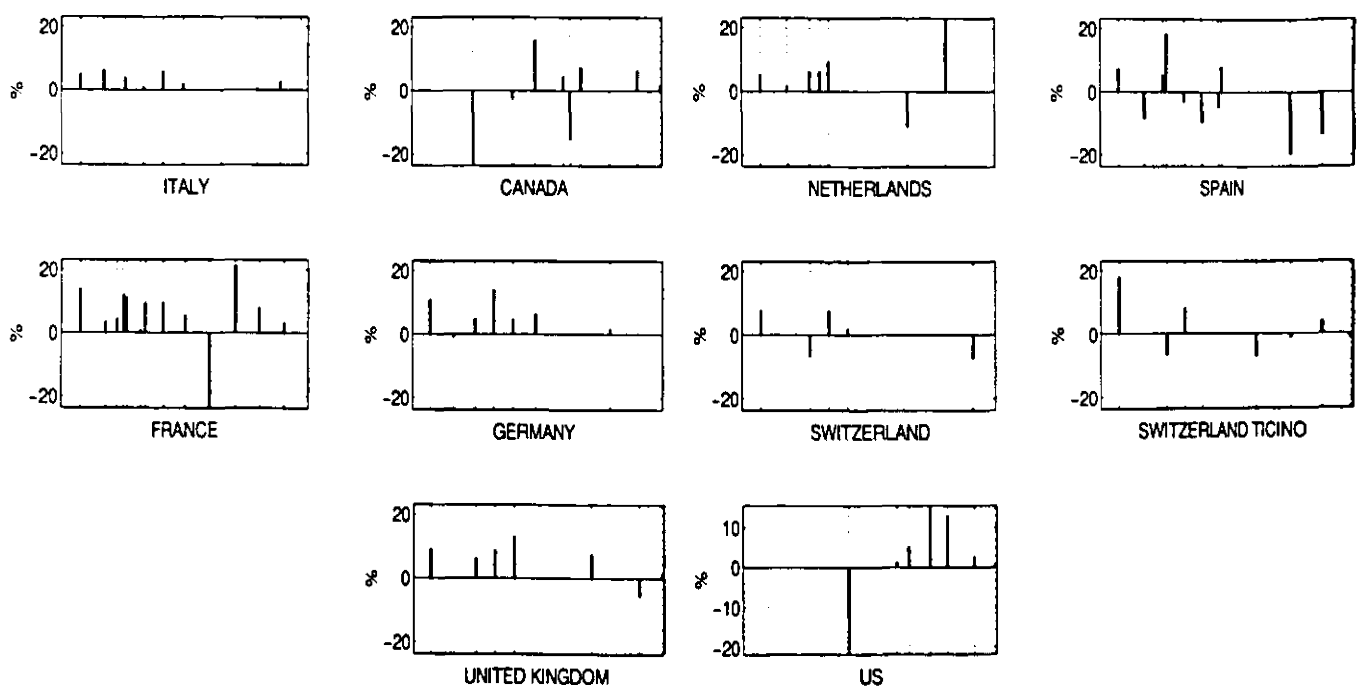

Figure 4.49: Il Mondo. $(R_{I\tau+1}/R_{i\tau}) - (R_I/R_i)\tau$.

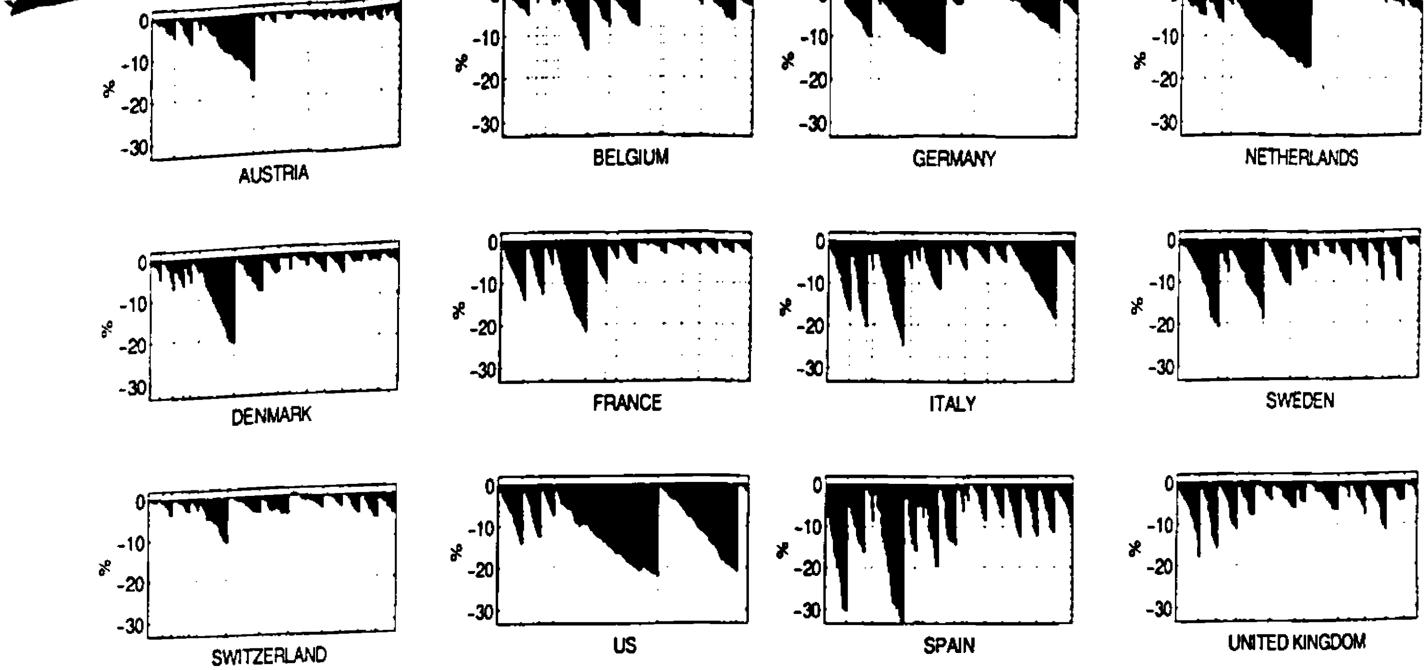

Figure 4.50: The Economist. $(R_I/R_i)_\tau$.

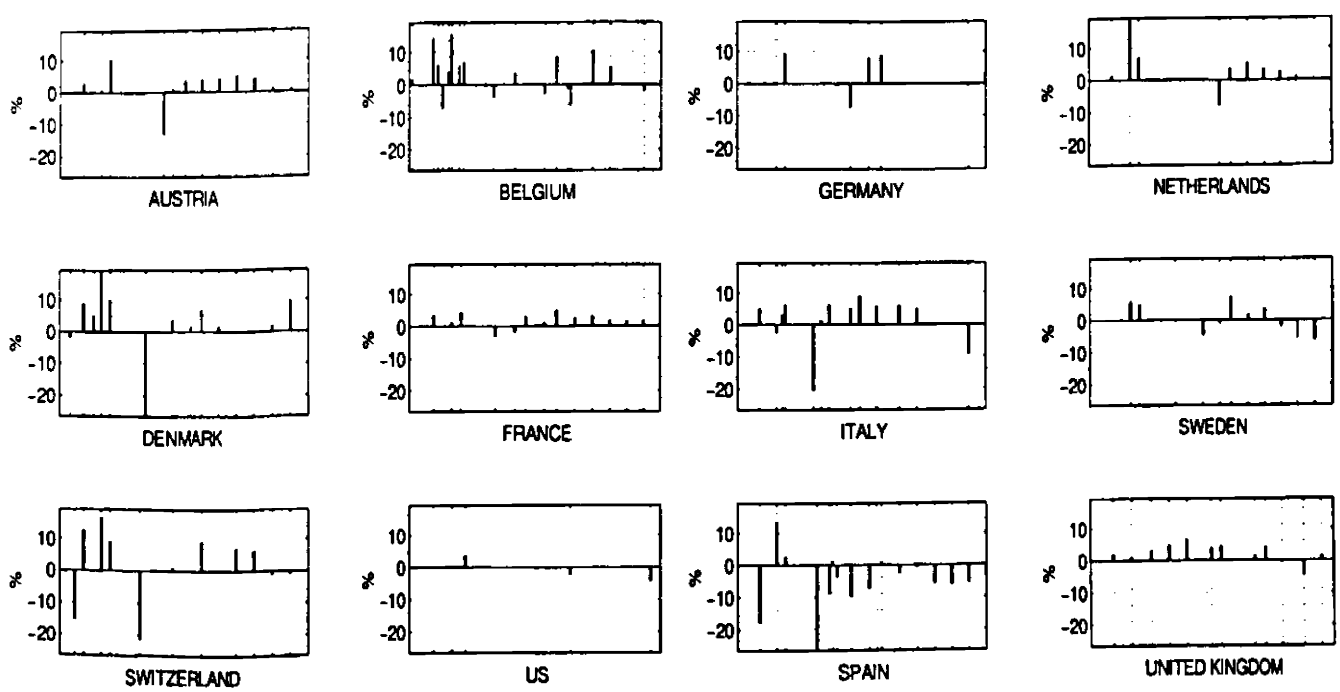

Figure 4.51: The Economist. $(R_{I\tau+1}/R_{i\tau}) - (R_I/R_i)\tau$.

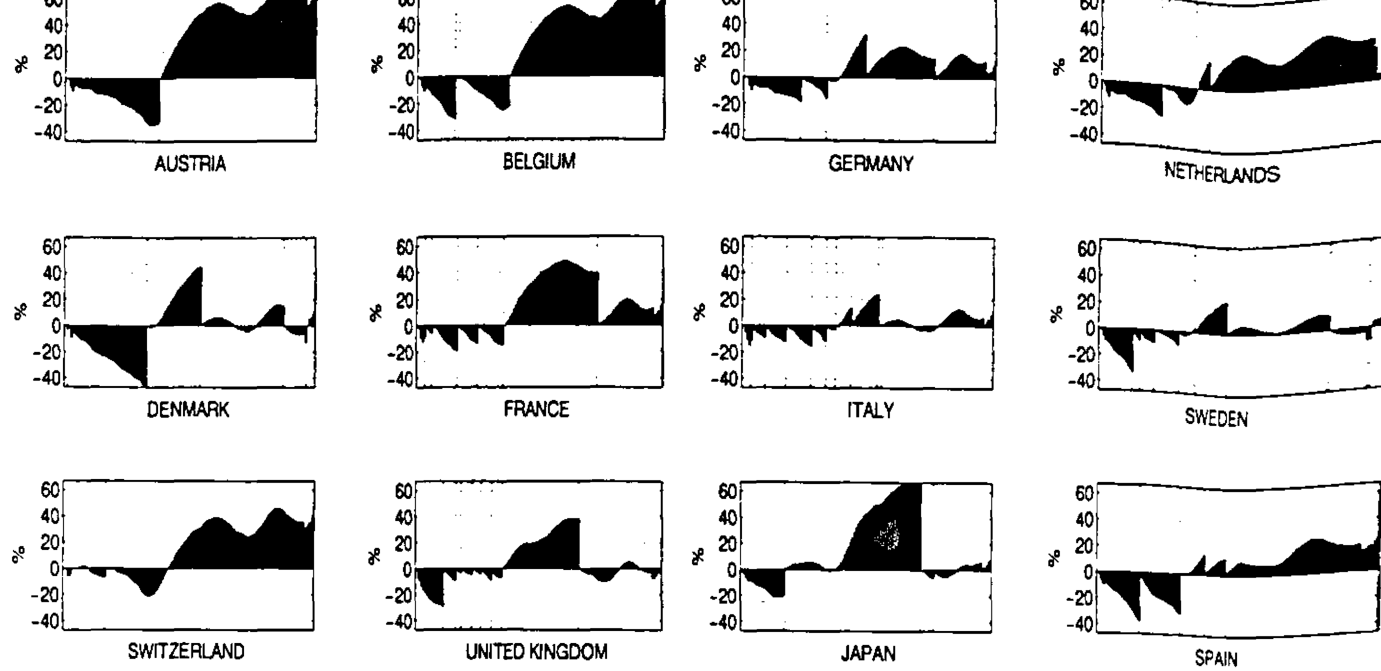

Figure 4.52: Businessweek. $1/\tilde{s}_{j\tau}$. Jan81-May92.

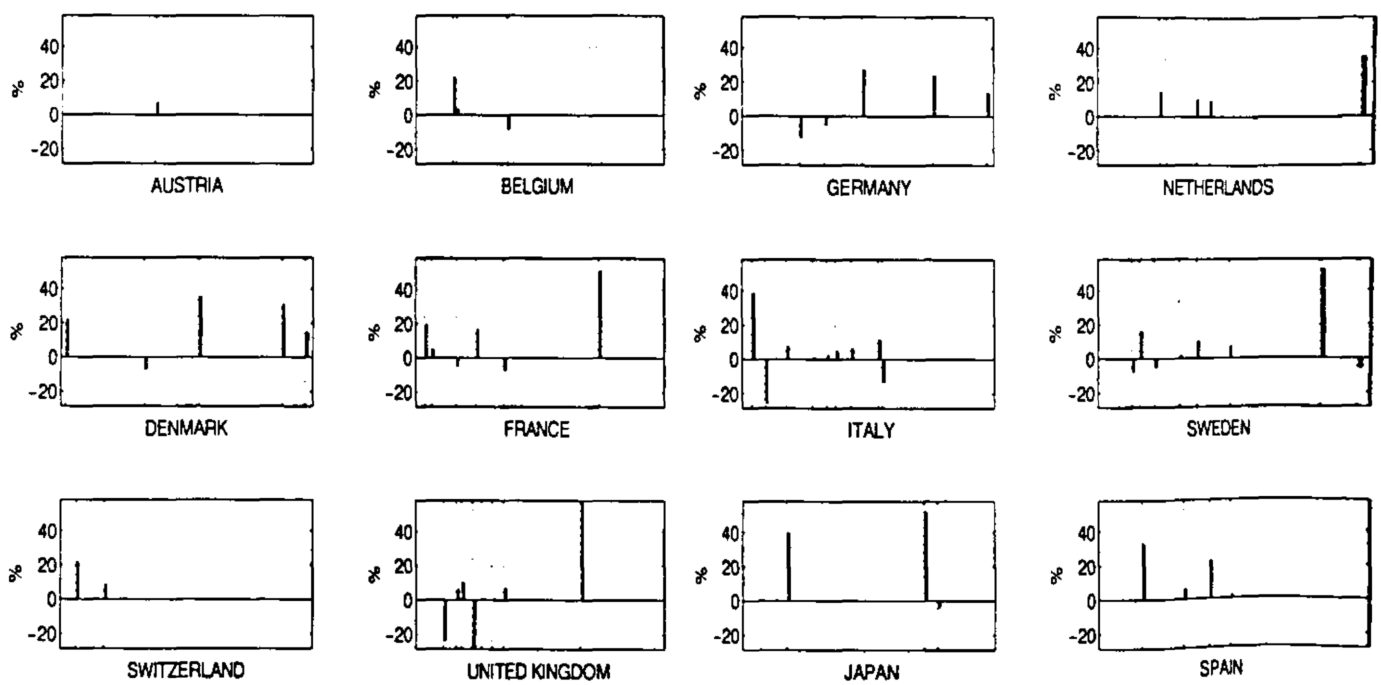

Figure 4.53: Businessweek. $PT^{1/\tilde{s}_{j\tau}}$. Jan81-May92.

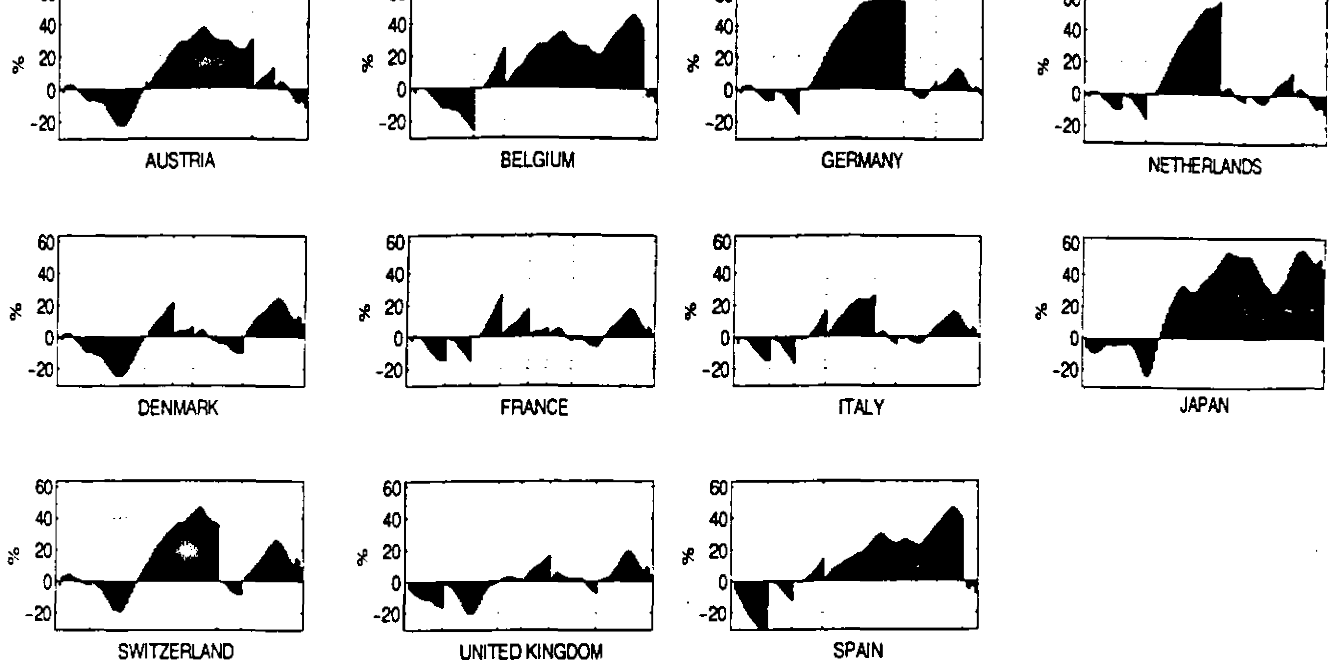

Figure 4.54: Fortune. $1/\tilde{s}_{j\tau}$. Feb83-Mar92.

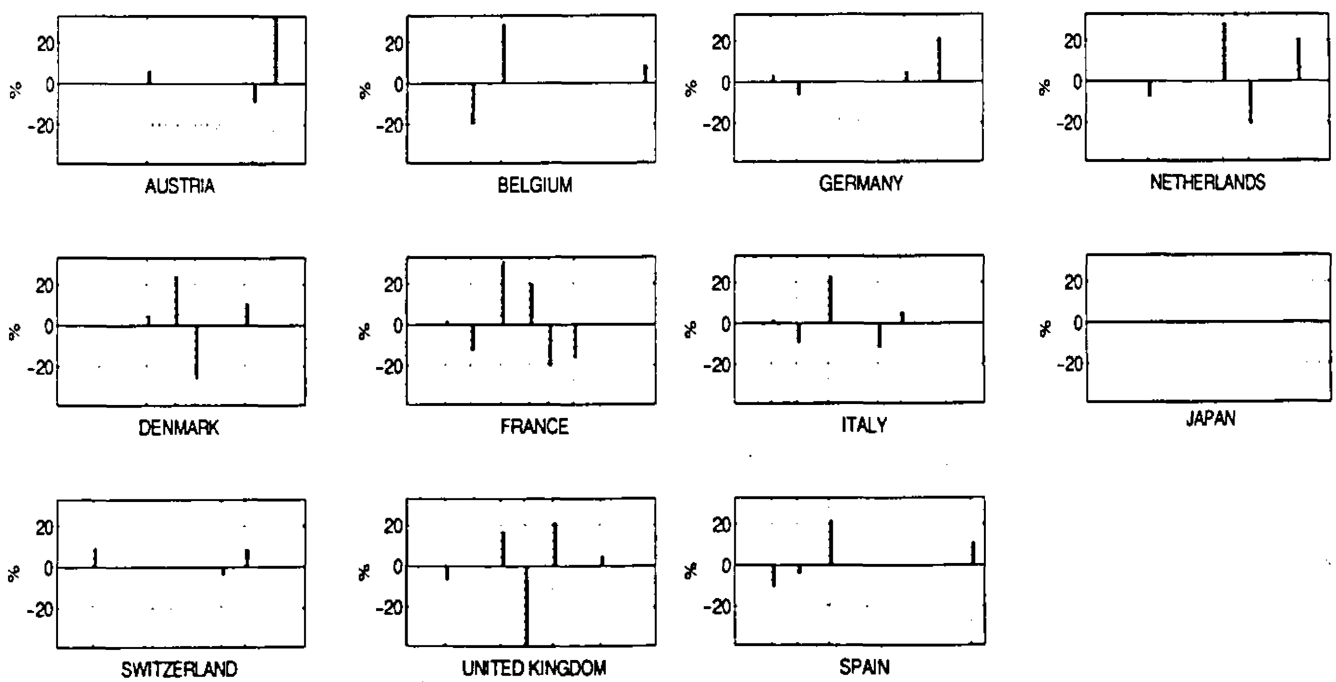

Figure 4.55: Fortune. $PT^{1/\tilde{s}_{j\tau}}$. Feb83-Mar92.

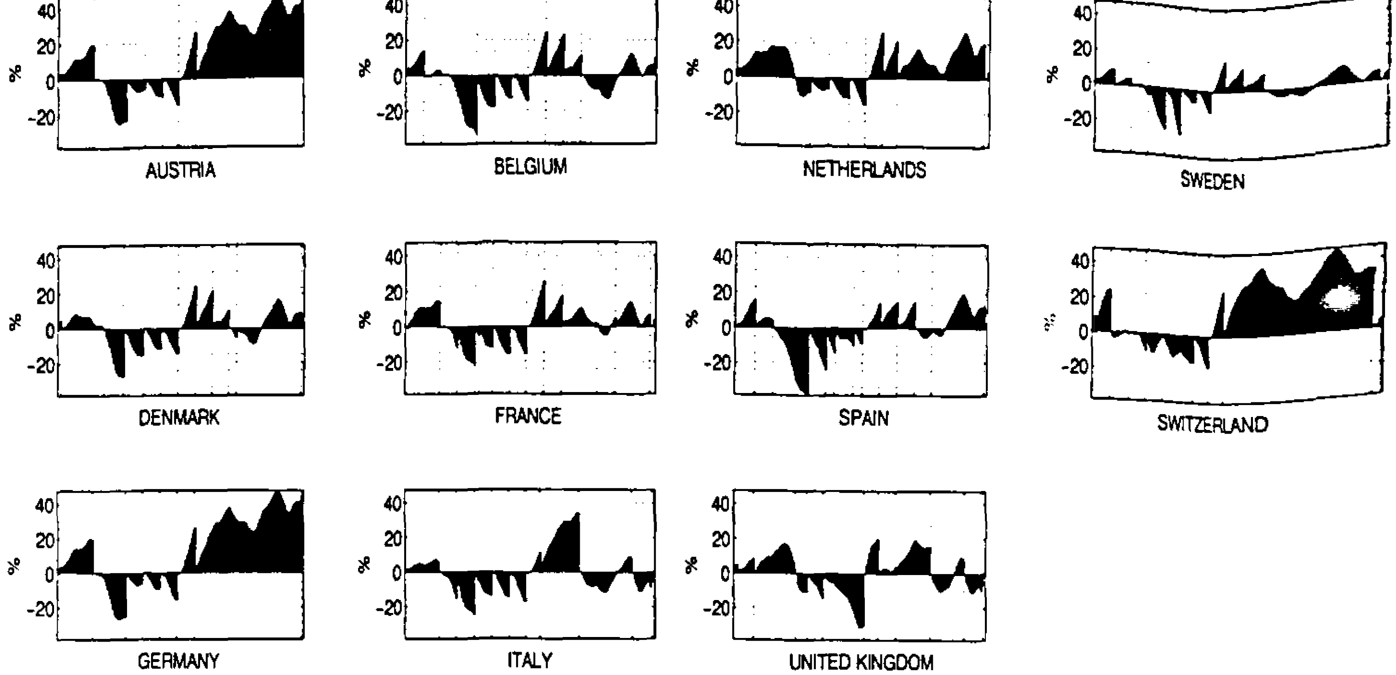

Figure 4.56: Newsweek. $1/\tilde{s}_{j\tau}$. Dec77-Jun92.

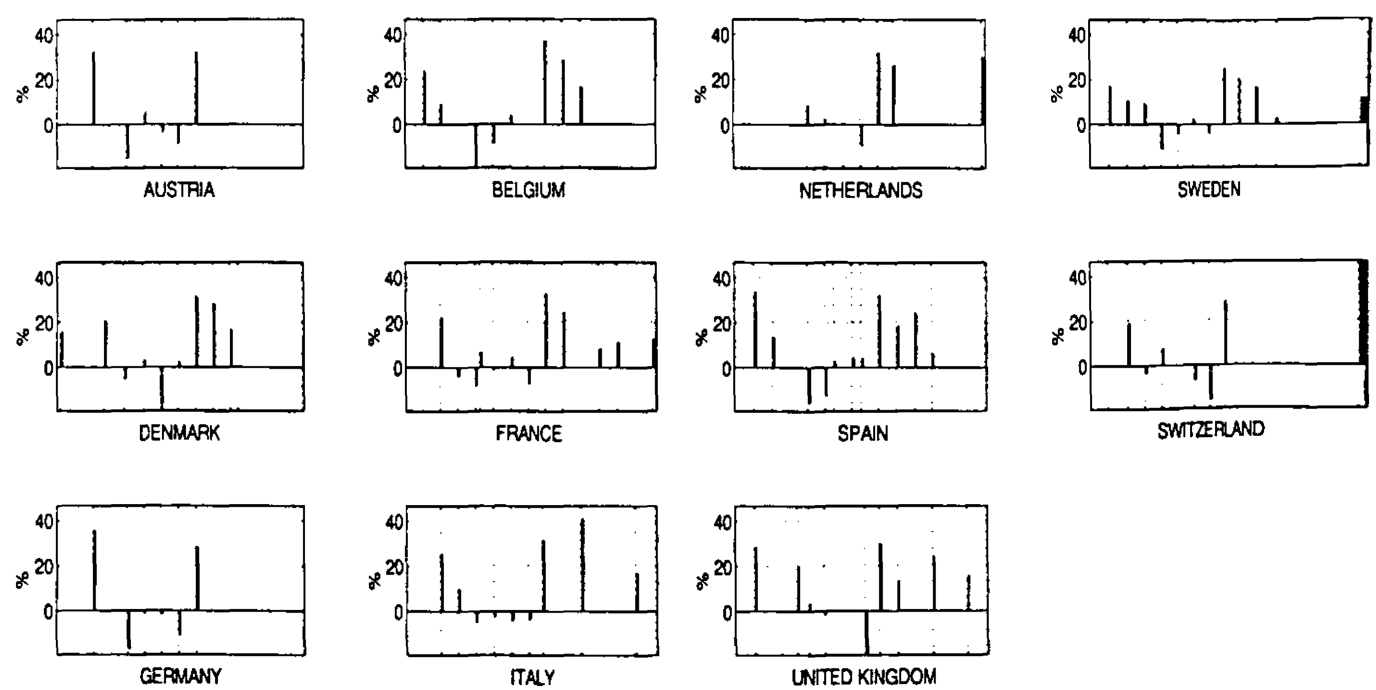

Figure 4.57: Newsweek. $PT^{1/\tilde{s}_{j\tau}}$. Dec77-Jun92.

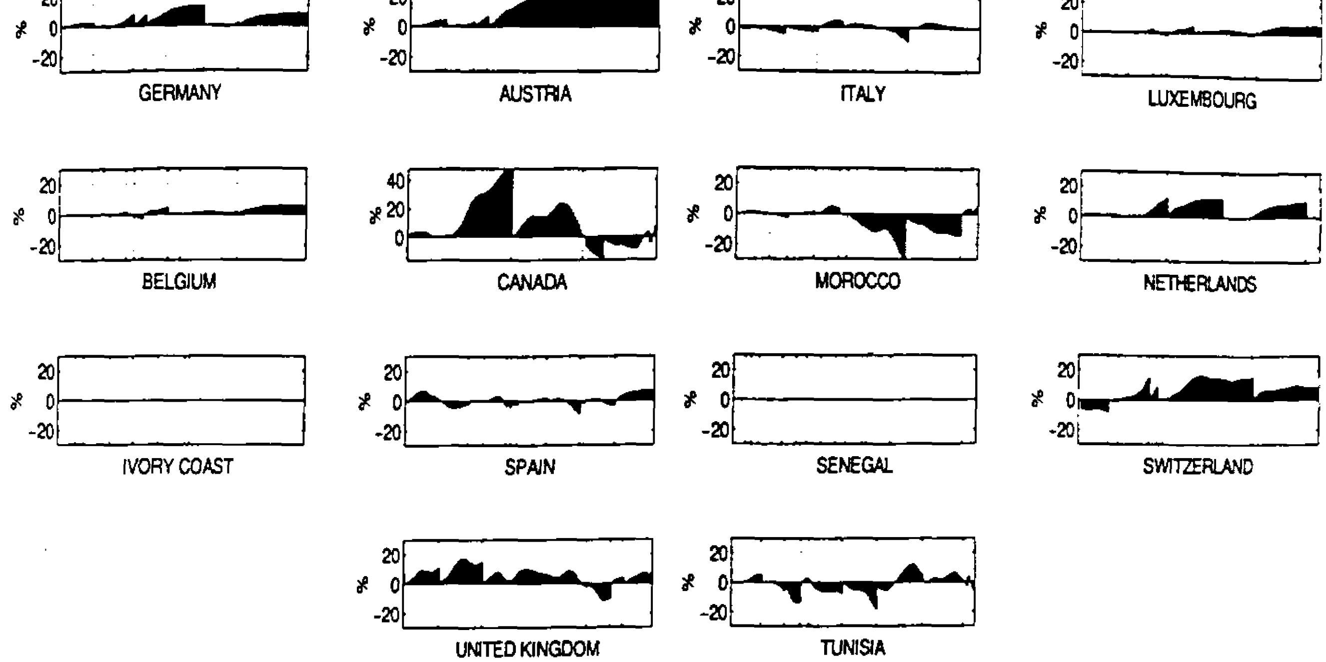

Figure 4.58: Le Figaro. $1/\tilde{s}_{j\tau}$. Oct78-Dec88.

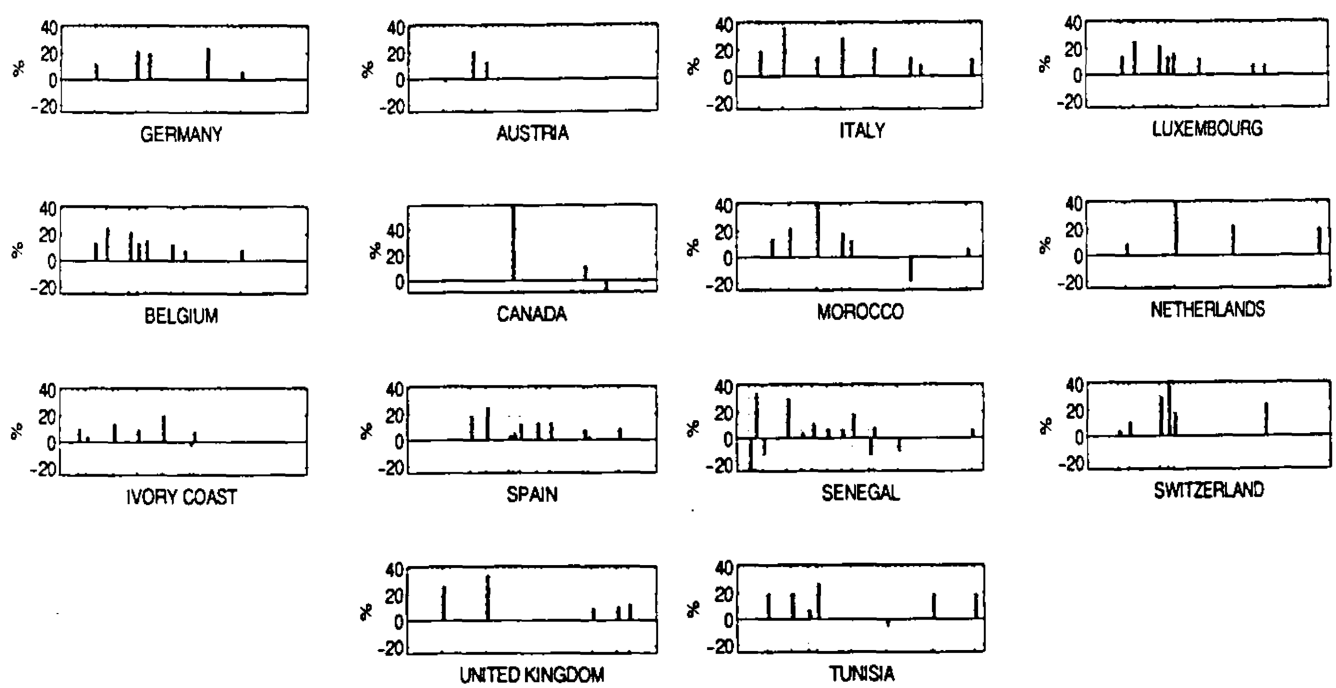

Figure 4.59: Le Figaro. $PT^{1/\tilde{s}_{j\tau}}$. Oct78-Dec88.

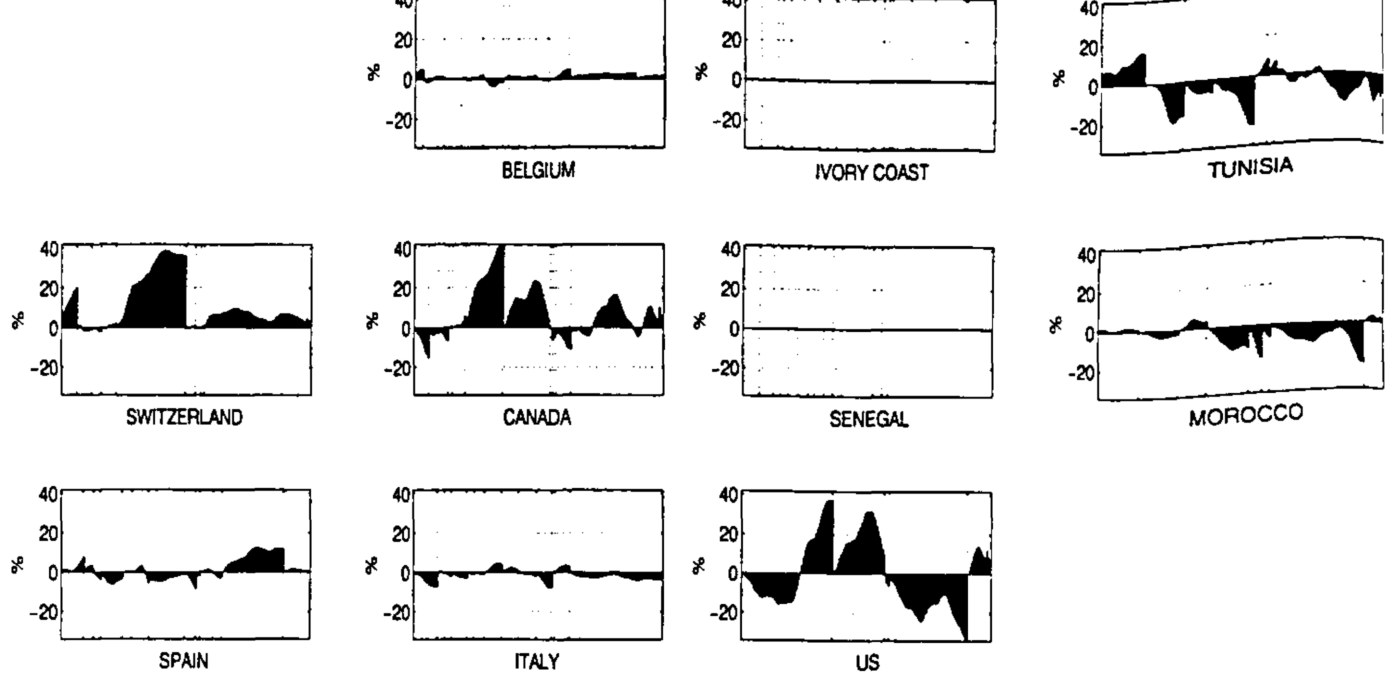

Figure 4.60: Le Nouvel Observateur. $1/\tilde{s}_{j\tau}$. Oct77-May92.

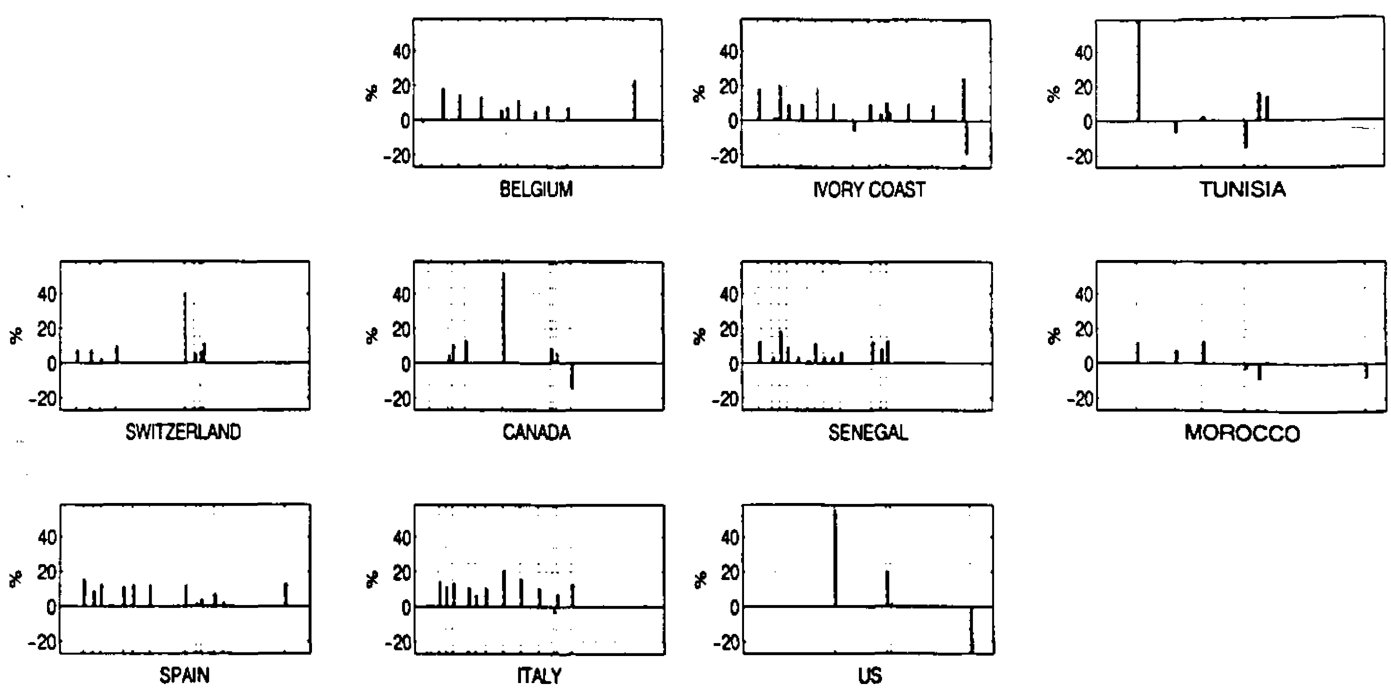

Figure 4.61: Le Nouvel Observateur. $PT^{1/\tilde{s}_{j\tau}}$. Oct77-May92.

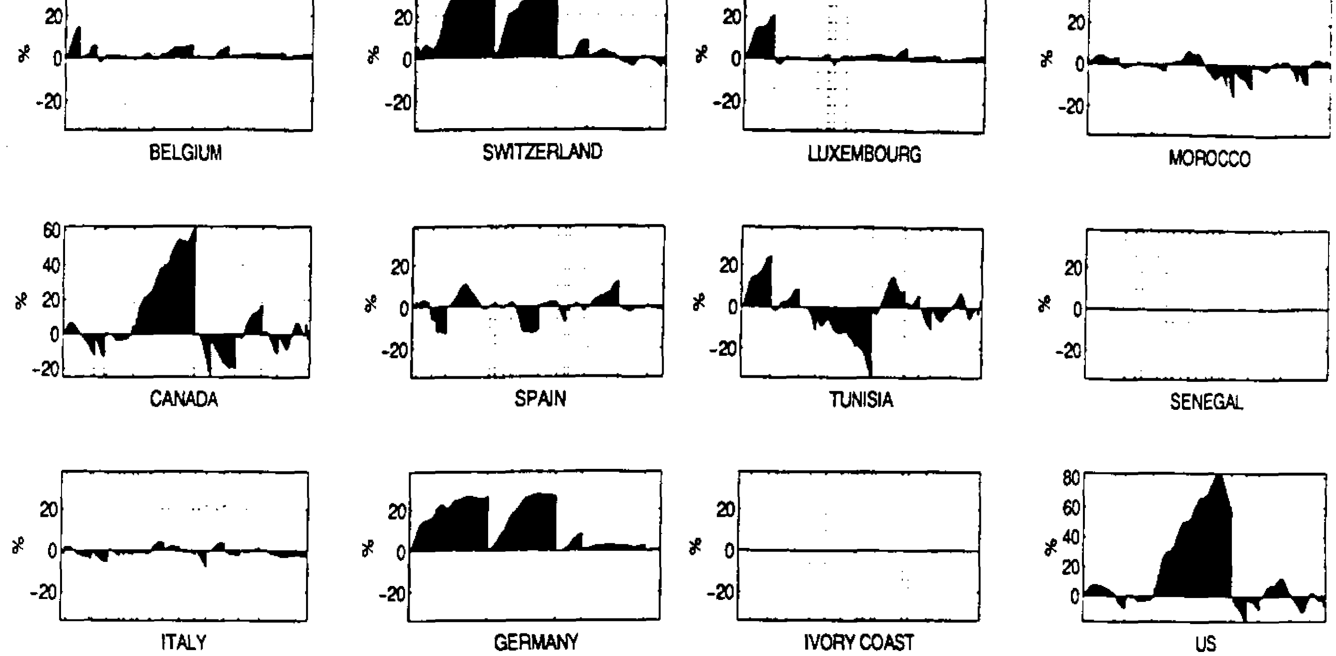

Figure 4.62: Le Point. $1/\tilde{s}_{j\tau}$. Mar76-May92.

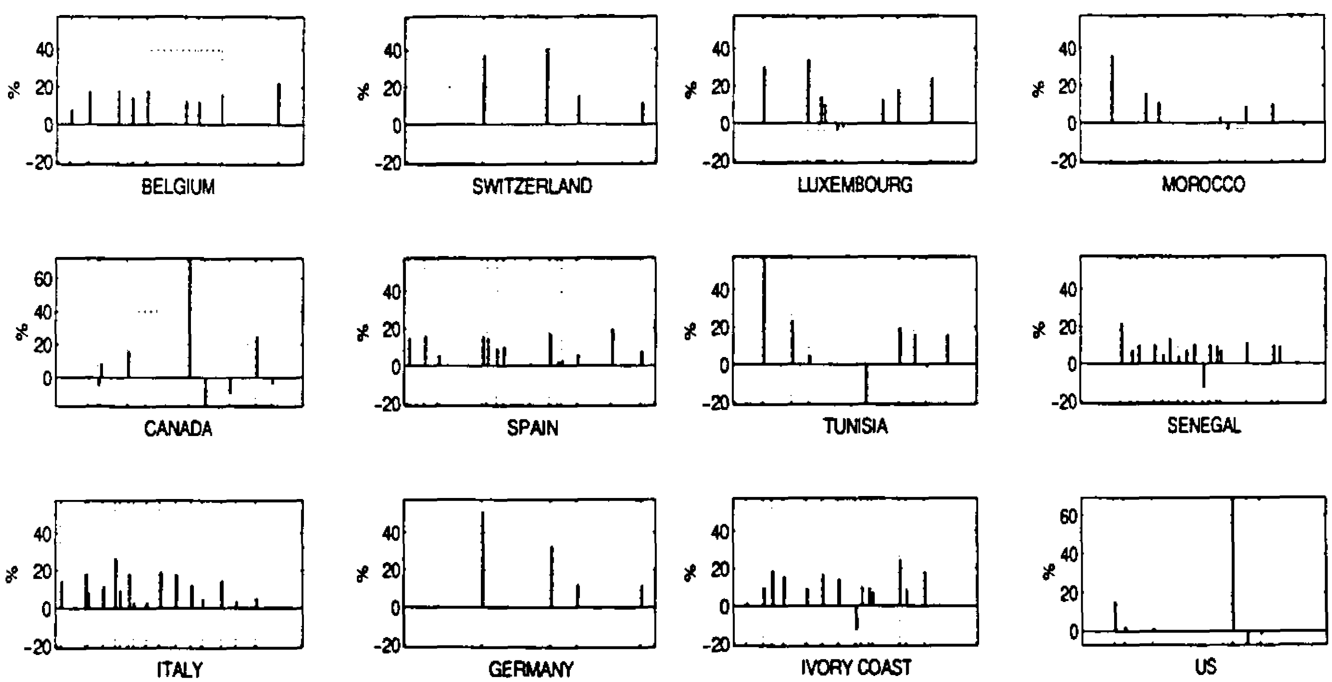

Figure 4.63: Le Point. $PT^{1/\tilde{s}_{j\tau}}$. Mar76-May92.

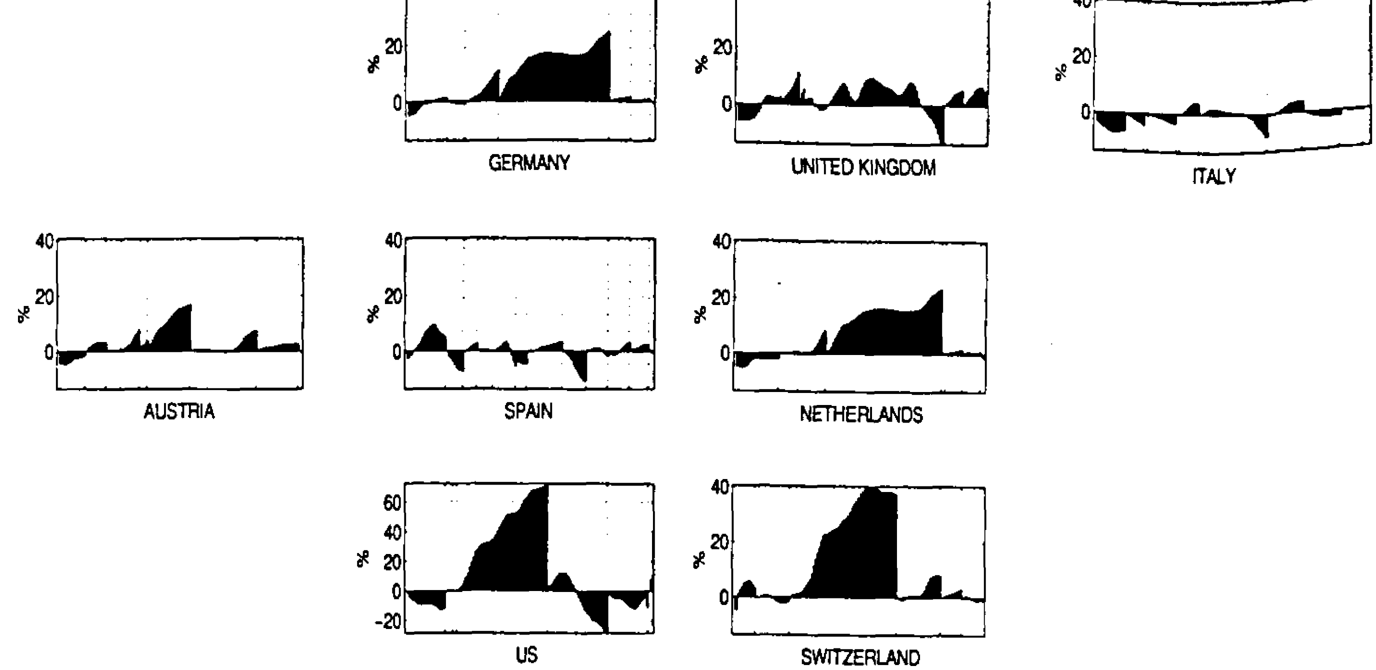

Figure 4.64: L'Express. $1/\bar{s}_{j\tau}$. Mar78-Dec88.

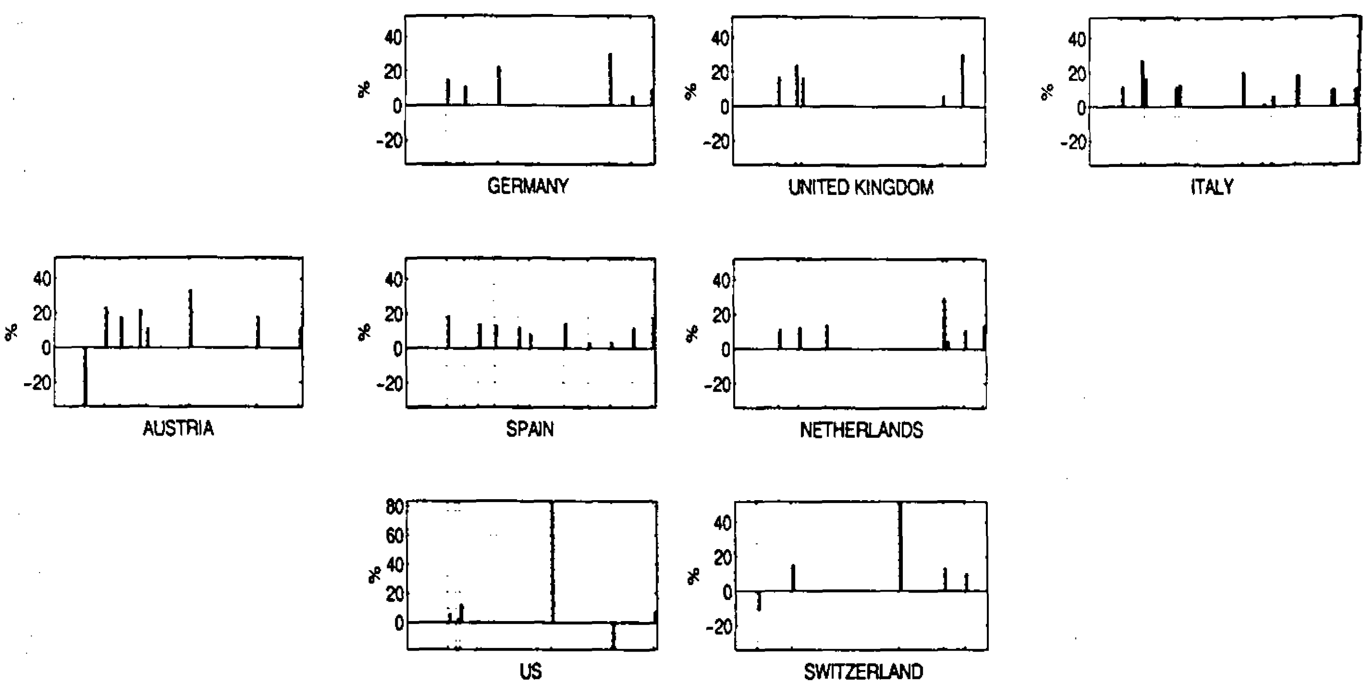

Figure 4.65: L'Express. $PT^{1/\bar{s}_{j\tau}}$. Mar78-Dec88.

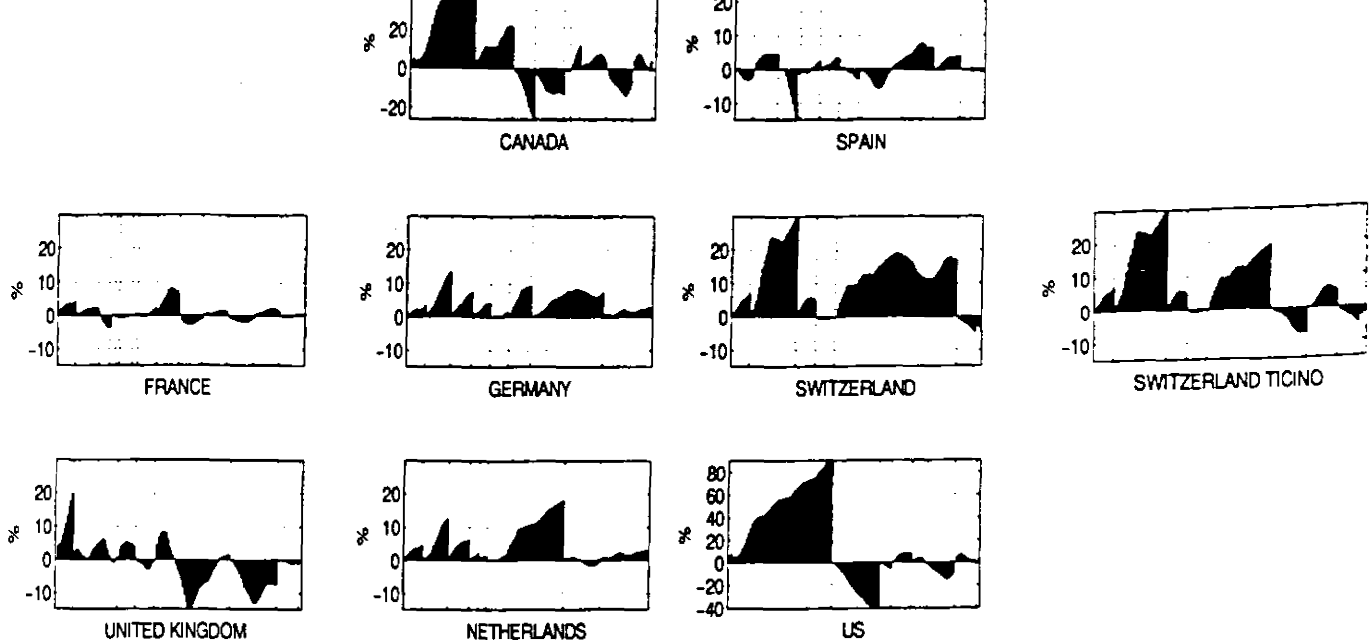

Figure 4.66: Il Mondo. $1/\bar{s}_{j\tau}$. Feb8-June92.

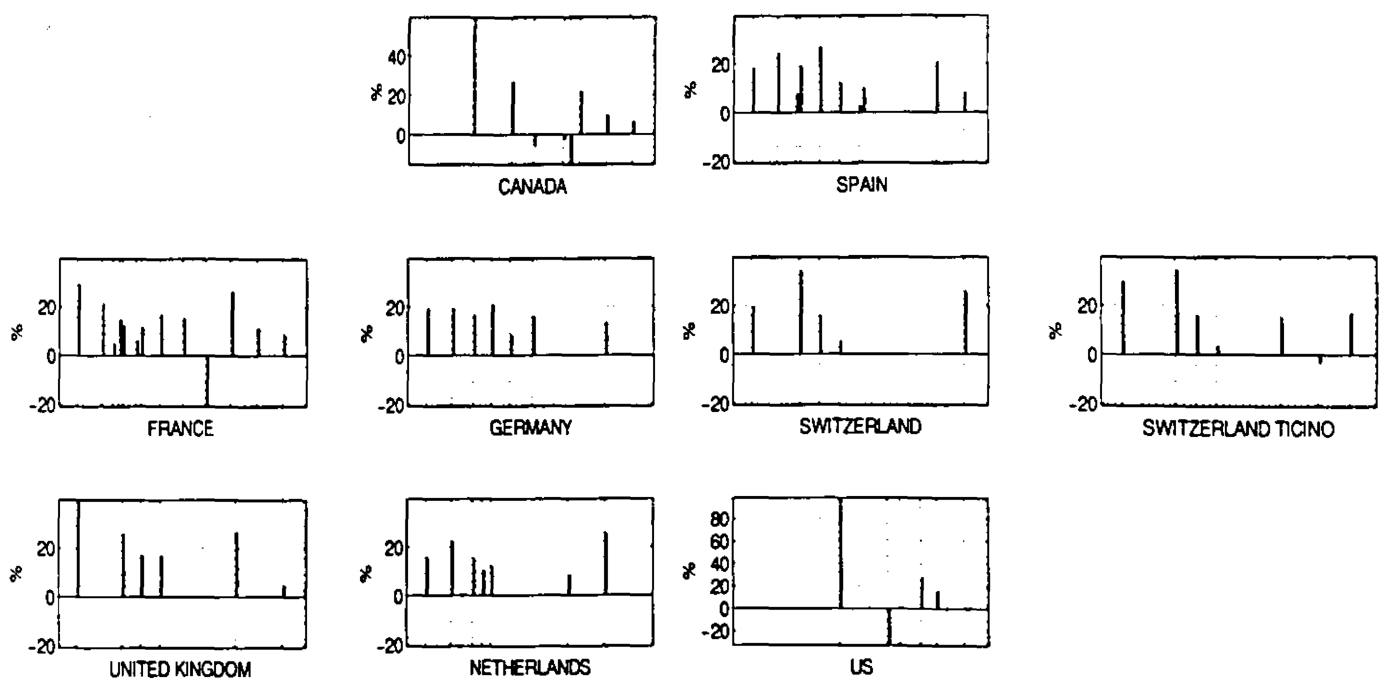

Figure 4.67: Il Mondo. $PT^{1/\bar{s}_{j\tau}}$. Feb80-Jun92.

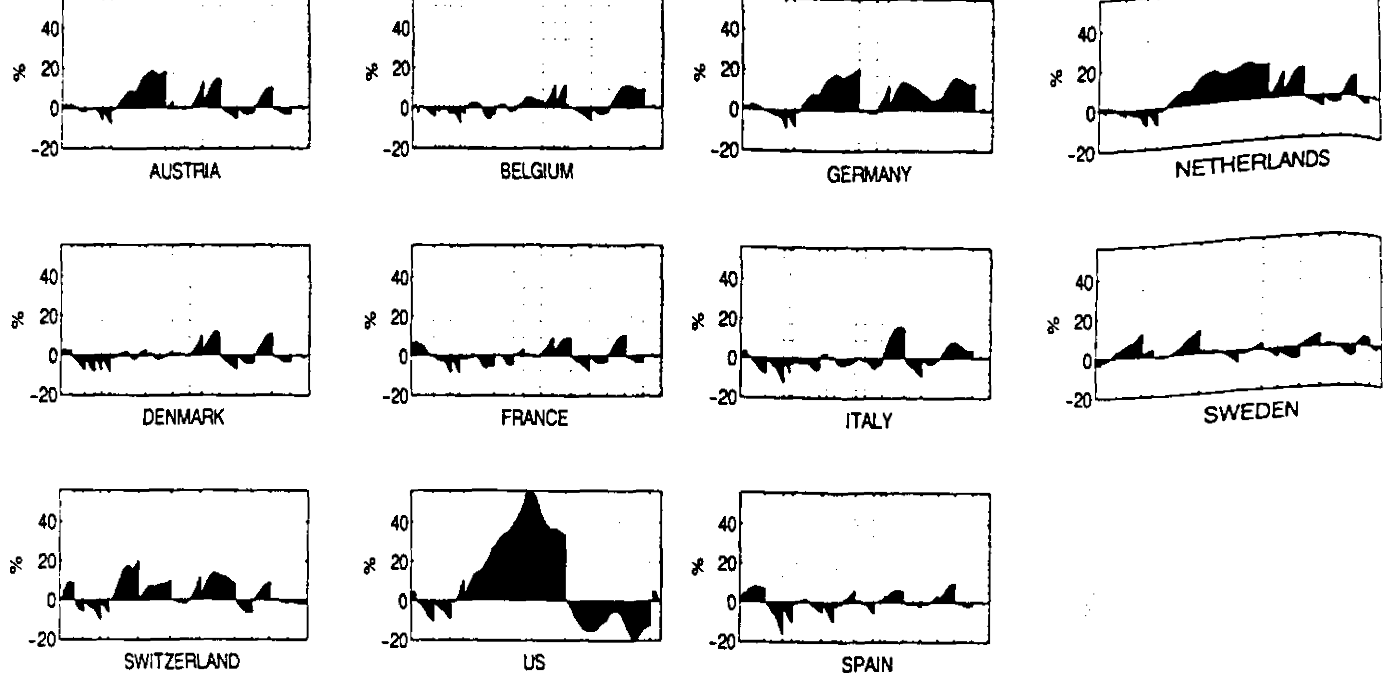

Figure 4.68: The Economist. $1/\tilde{s}_{j\tau}$. Mar78-May92.

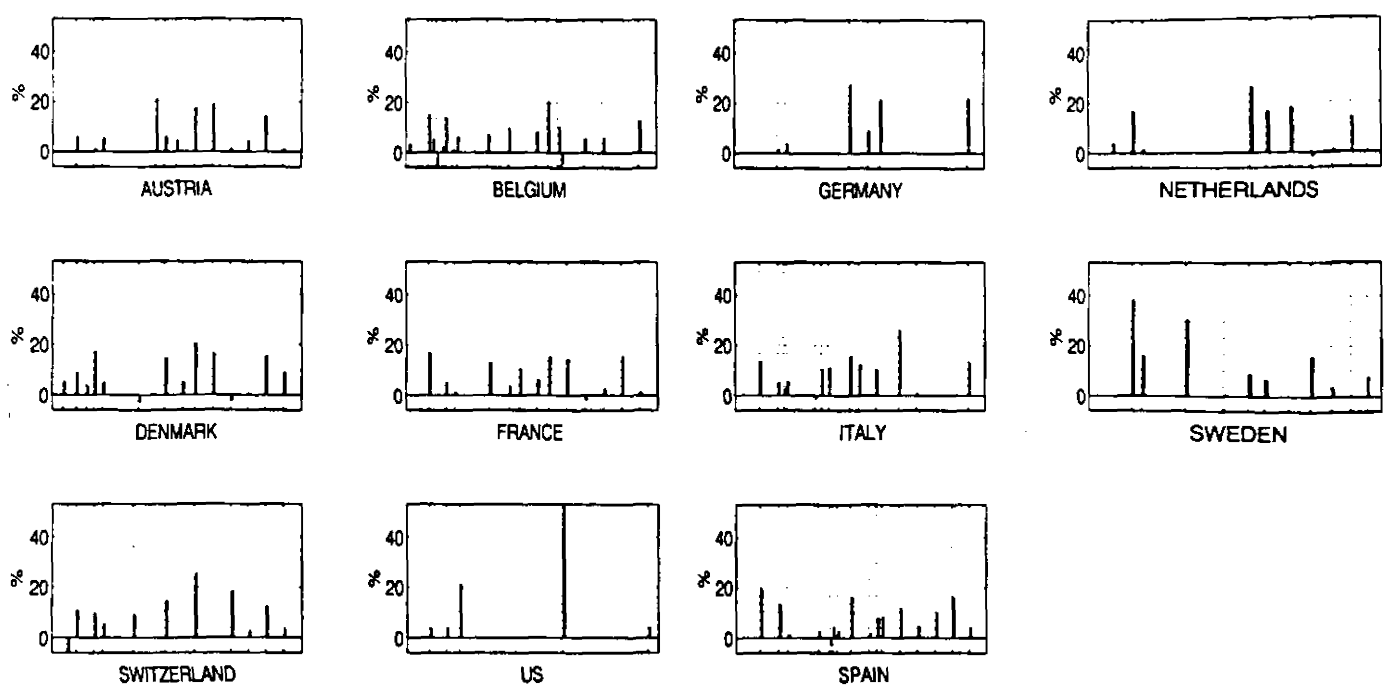

Figure 4.69: The Economist. $PT^{1/\tilde{s}_{j\tau}}$. Mar78-May92.

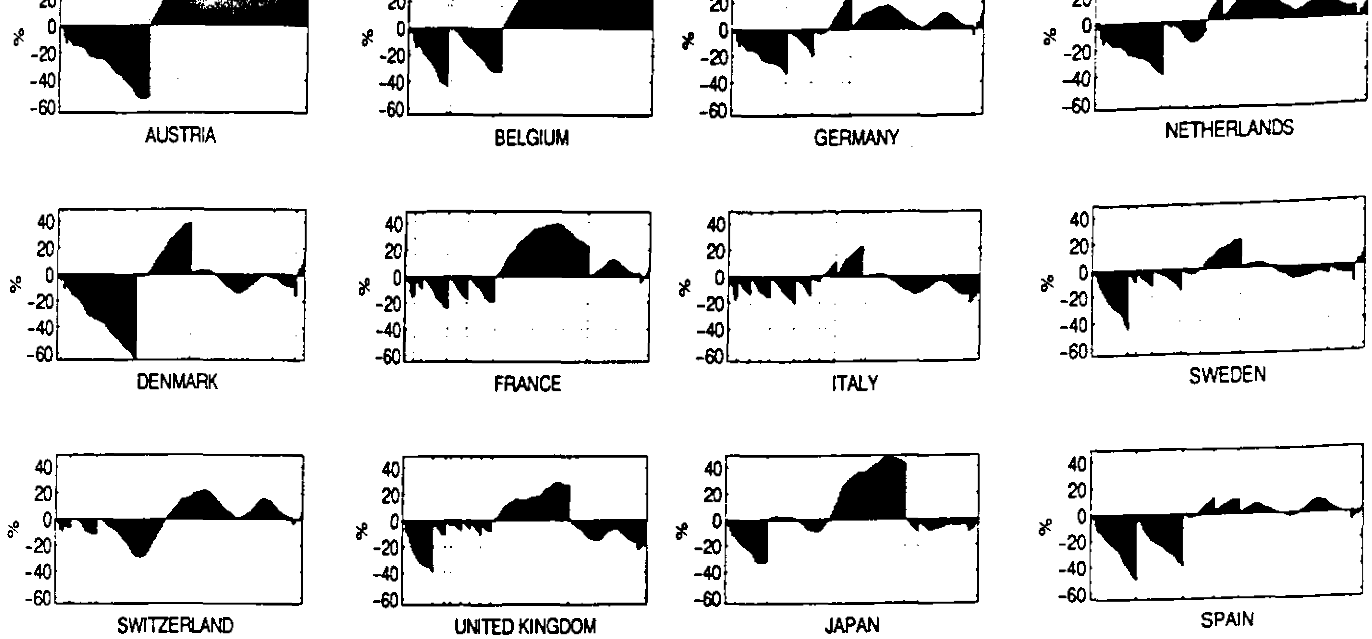

Figure 4.70: Businessweek. $1/\tilde{s}^{A}_{j\tau}$. Jan81-May92.

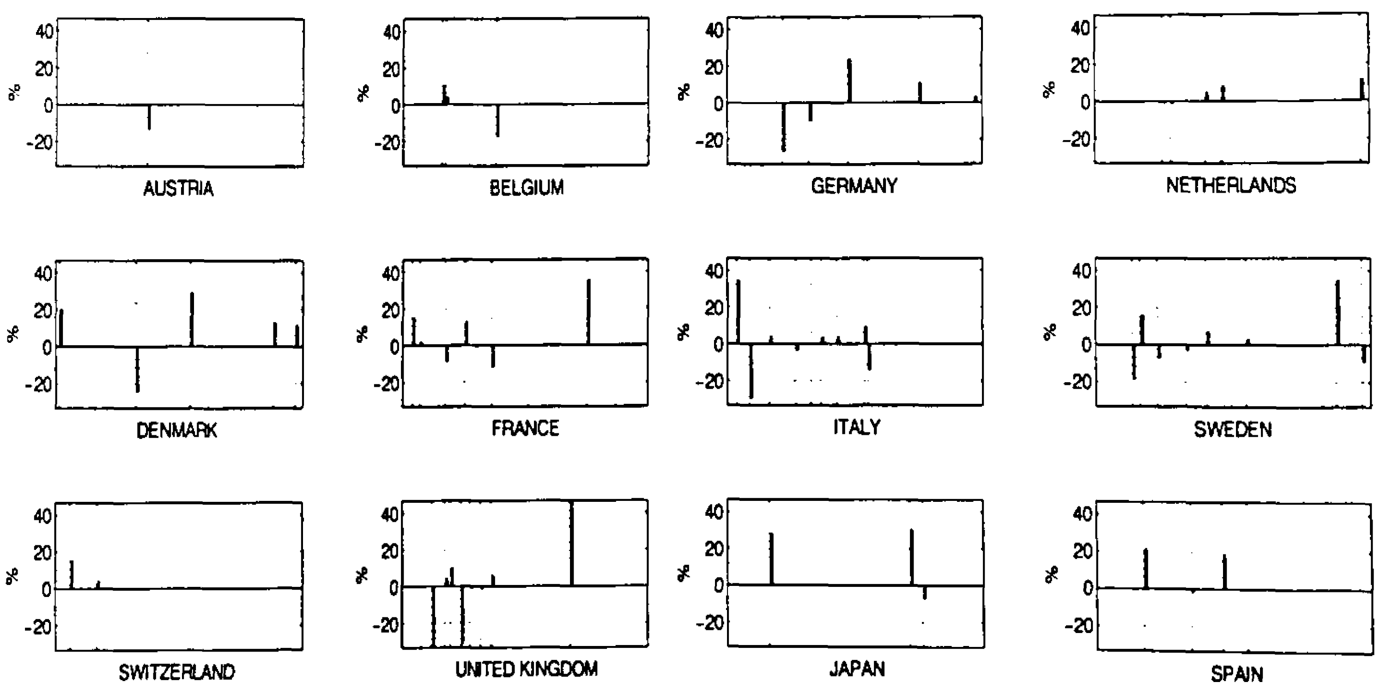

Figure 4.71: Businessweek. $PT^{1/\tilde{s}^{A}_{j\tau}}$. Jan81-May92.

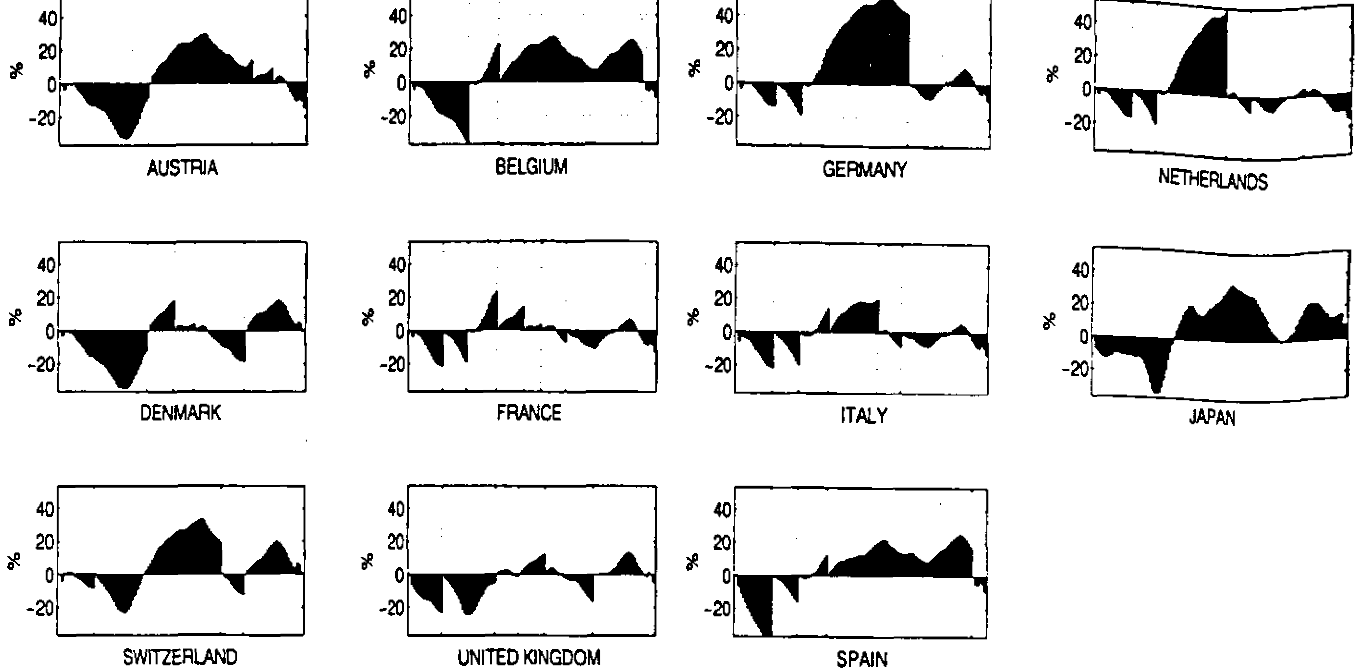

Figure 4.72: Fortune. $1/\tilde{s}^A_{j\tau}$. Feb83-Mar92.

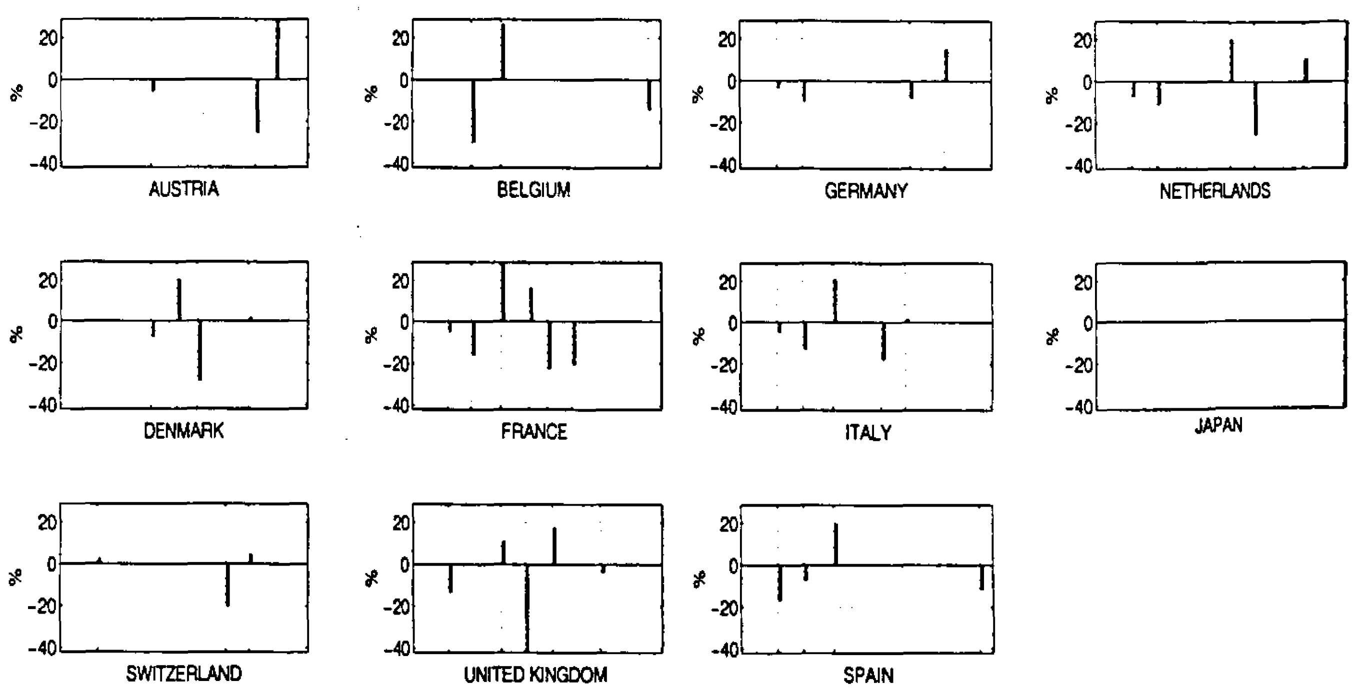

Figure 4.73: Fortune. $PT^{1/\tilde{s}^A_{j\tau}}$. Feb83-Mar92.

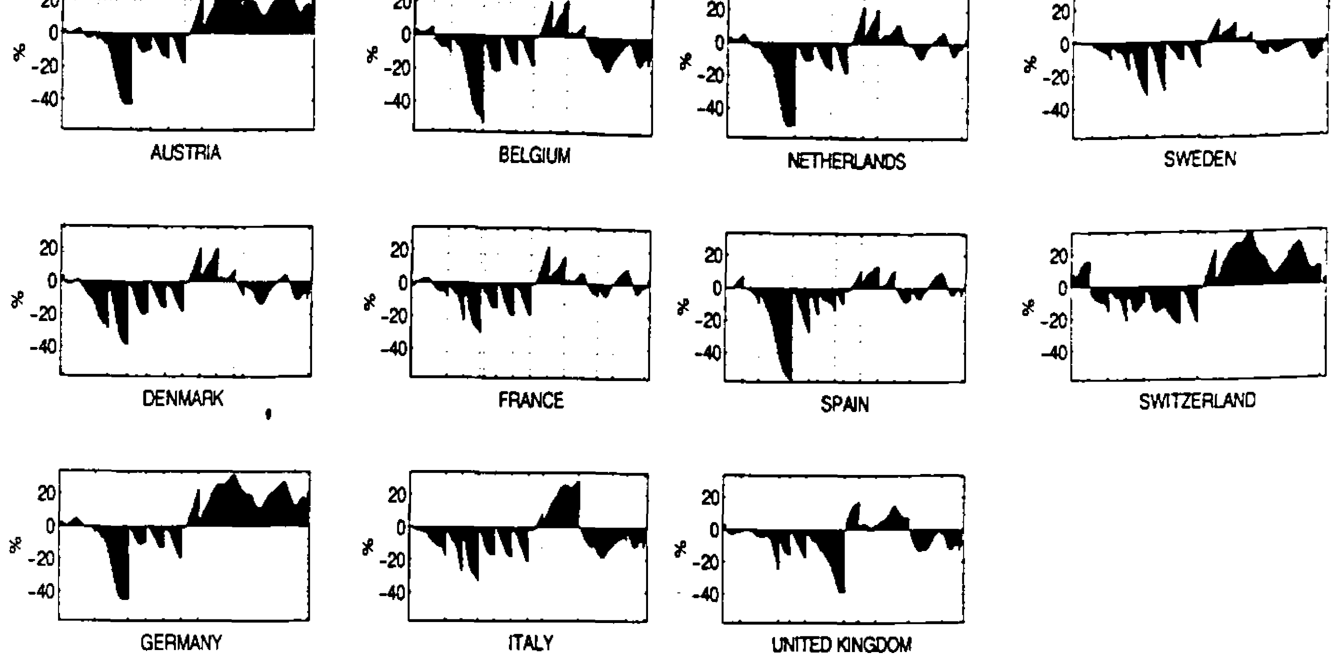

Figure 4.74: Newsweek. $1/\tilde{s}^A_{j\tau}$. Dec77-Jun92.

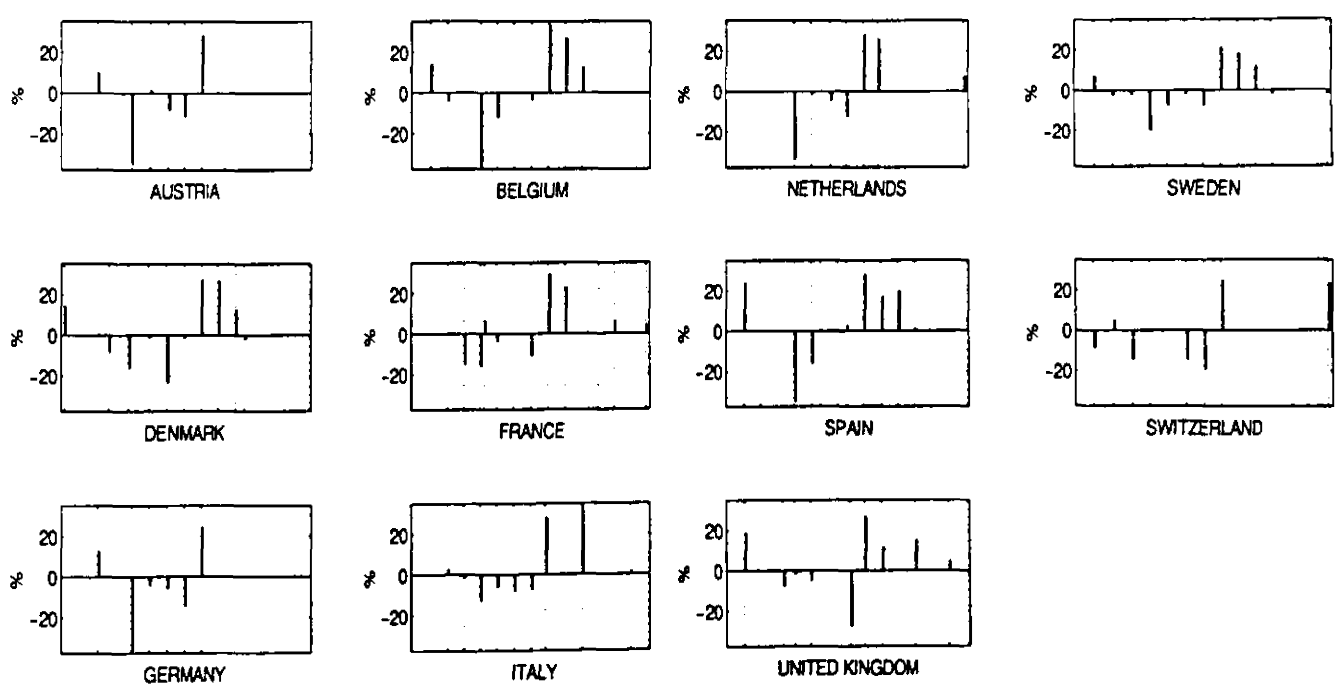

Figure 4.75: Newsweek. $PT^{1/\tilde{s}^A_{j\tau}}$. Dec77-Jun92.

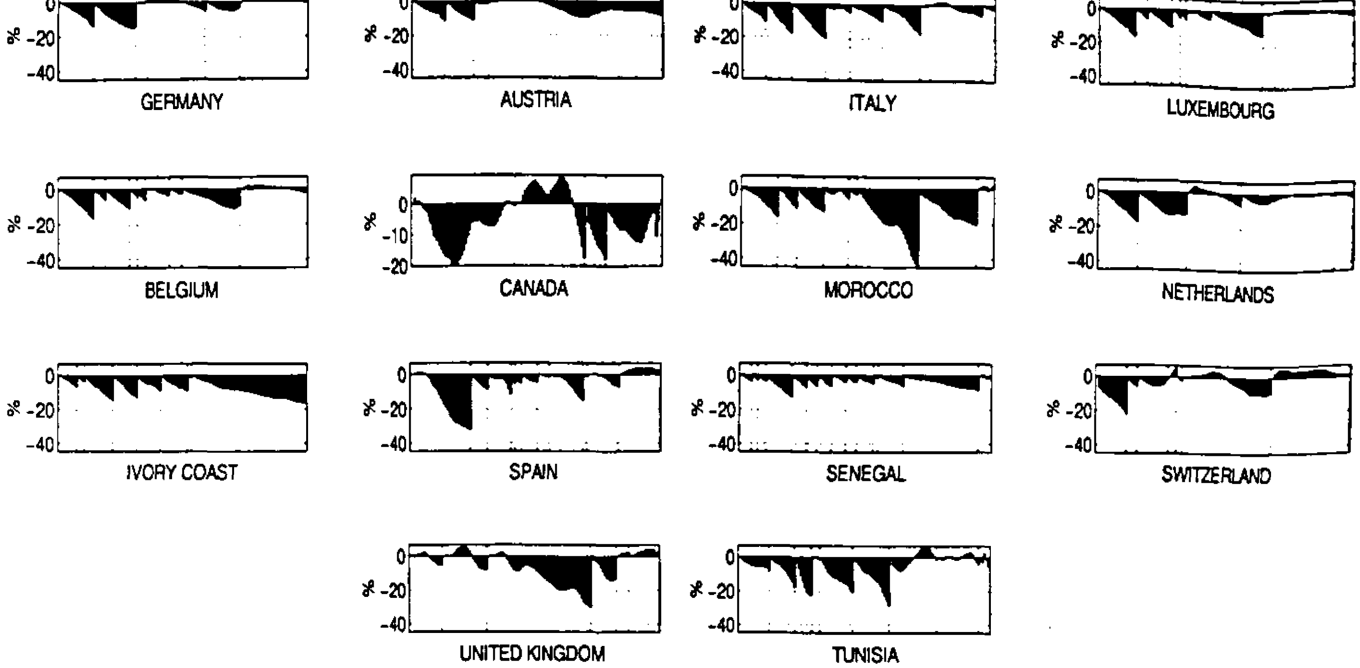

Figure 4.76: Le Figaro. $1/\tilde{s}^{A}_{j\tau}$. Oct78-Dec88.

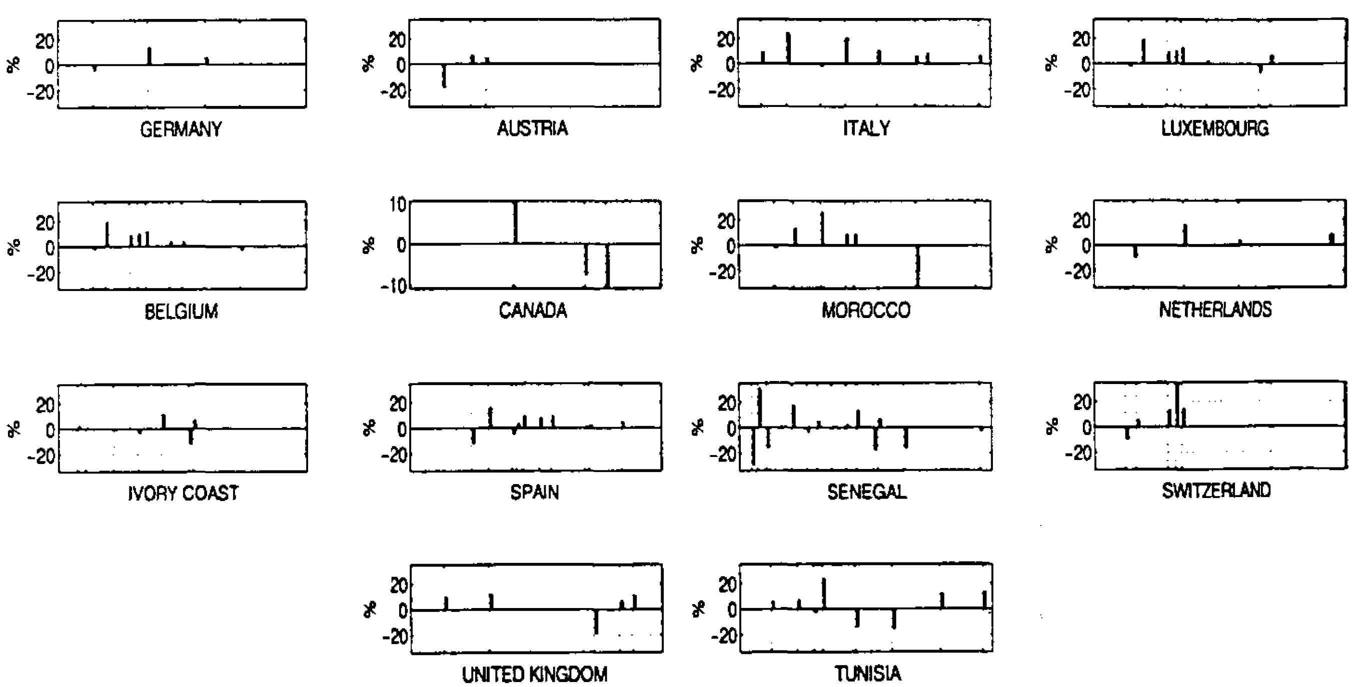

Figure 4.77: Le Figaro. $PT^{1/\tilde{s}^{A}_{j\tau}}$. Oct78-Dec88.

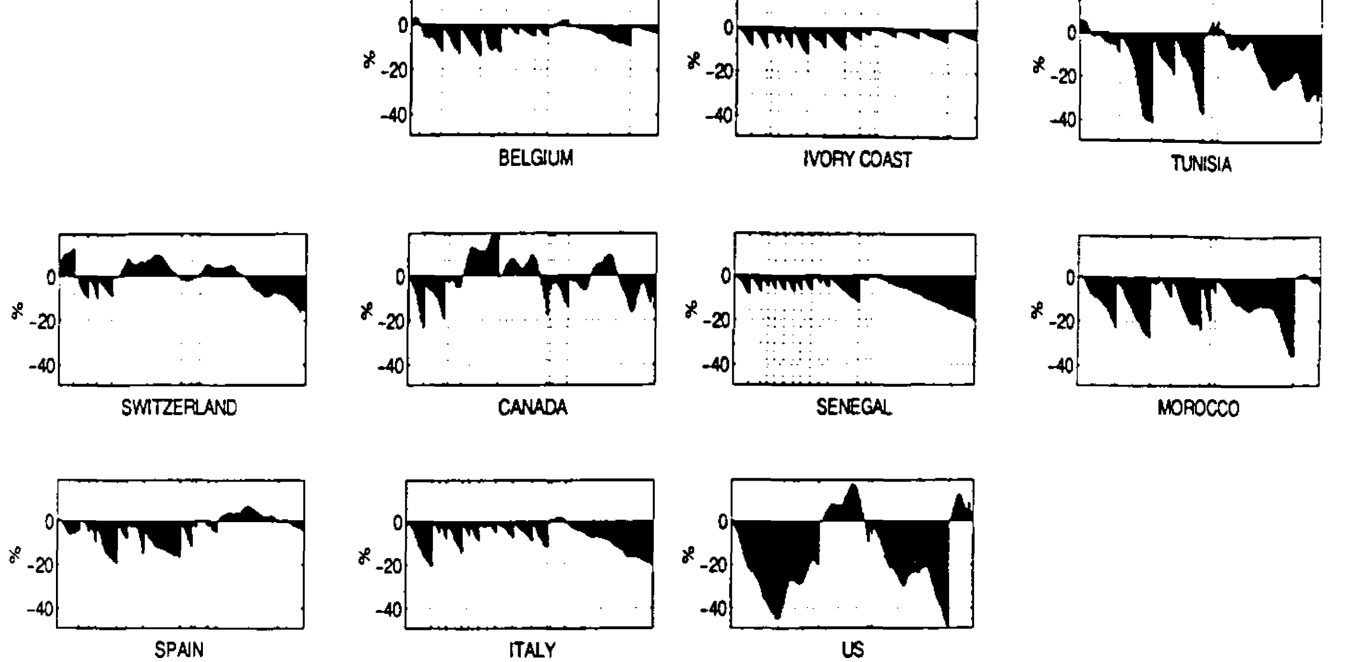

Figure 4.78: Le Nouvel Observateur. $1/\tilde{s}^{A}_{j\tau}$. Oct77-May92.

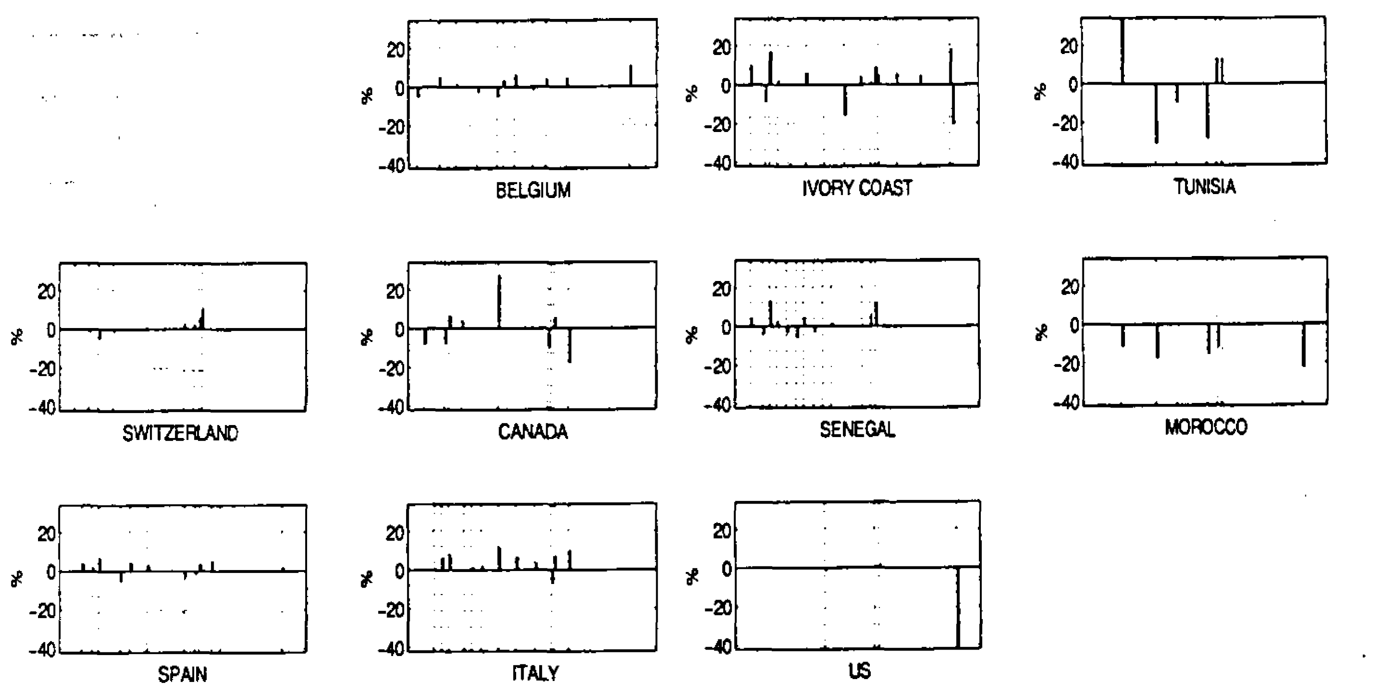

Figure 4.79: Le Nouvel Observateur. $PT^{1/\tilde{s}^{A}_{j\tau}}$. Oct77-May92.

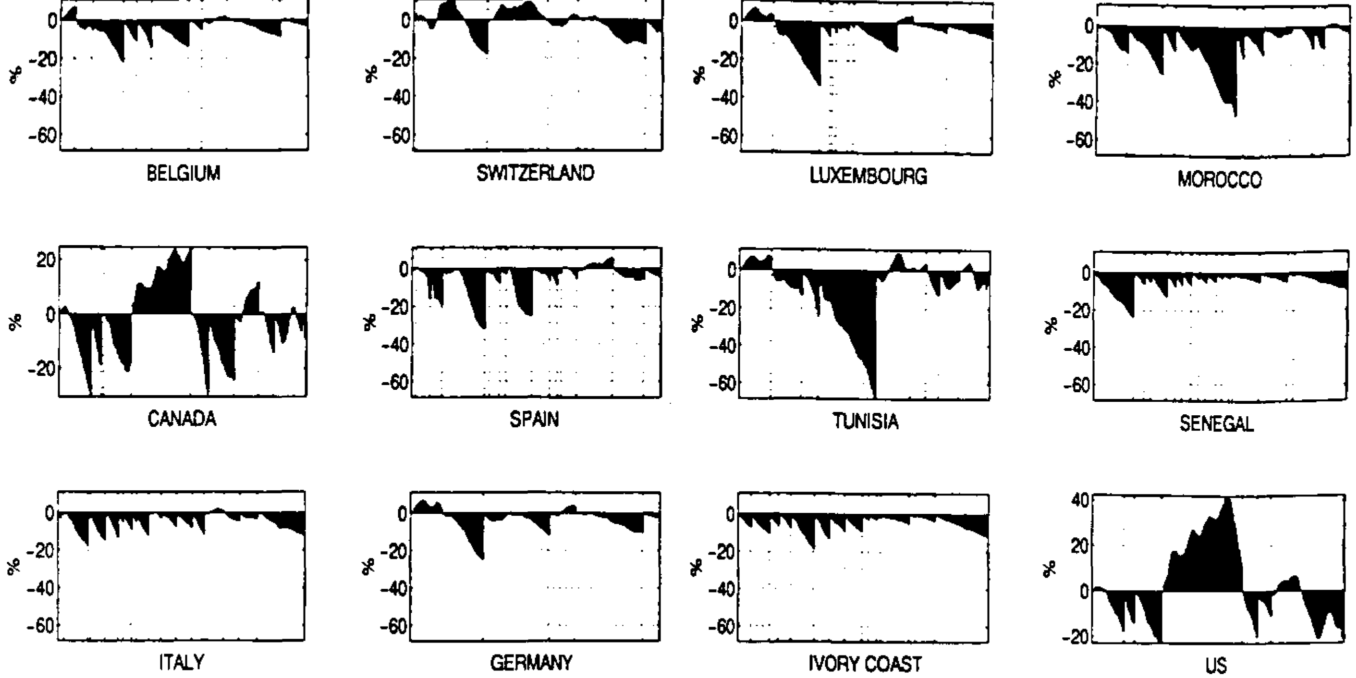

Figure 4.80: Le Point. $1/\tilde{s}^A_{j\tau}$. Mar76-May92.

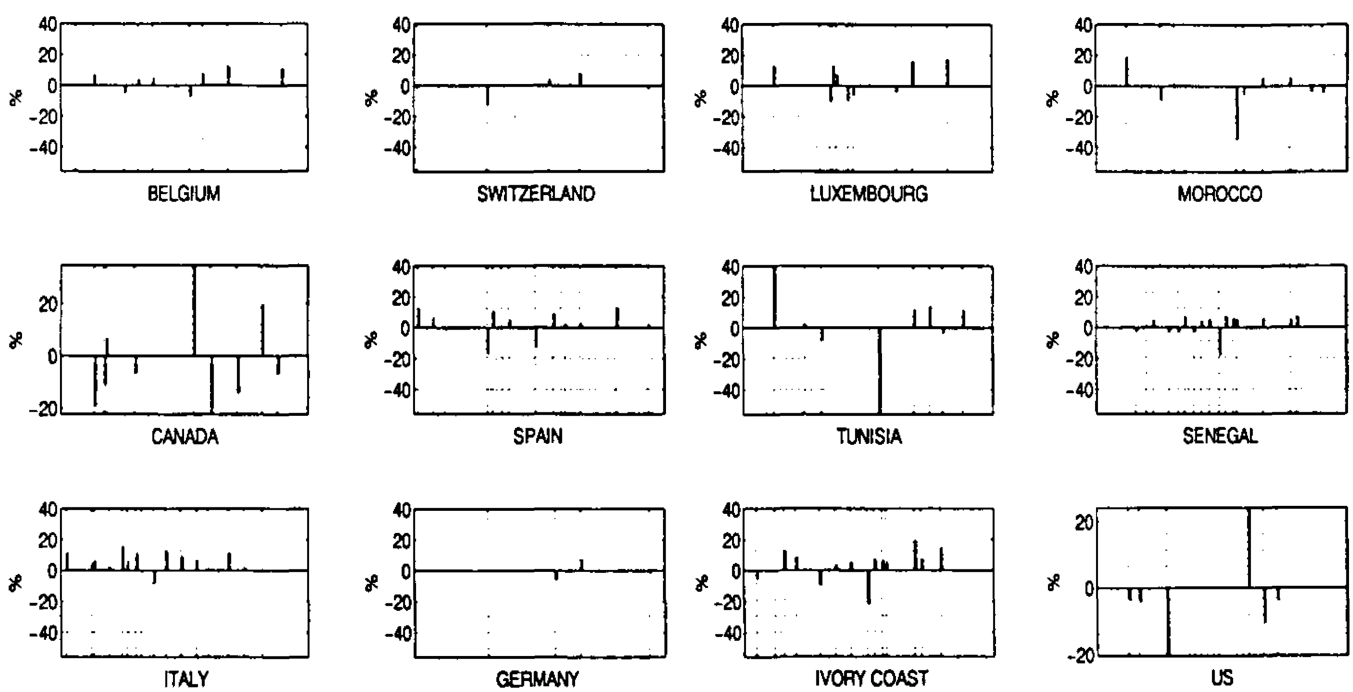

Figure 4.81: Le Point. $PT^{1/\tilde{s}^A_{j\tau}}$. Mar76-May92.

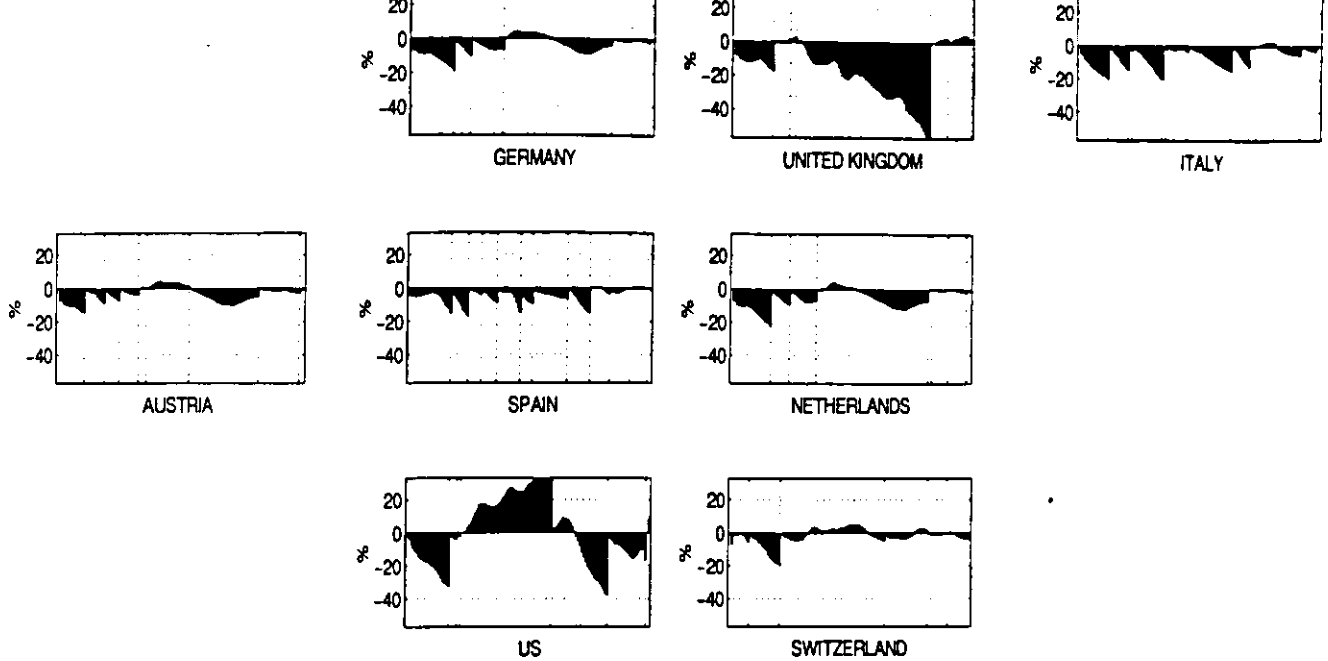

Figure 4.82: L'Express. $1/\tilde{s}^A_{j\tau}$. Mar78-Dec88.

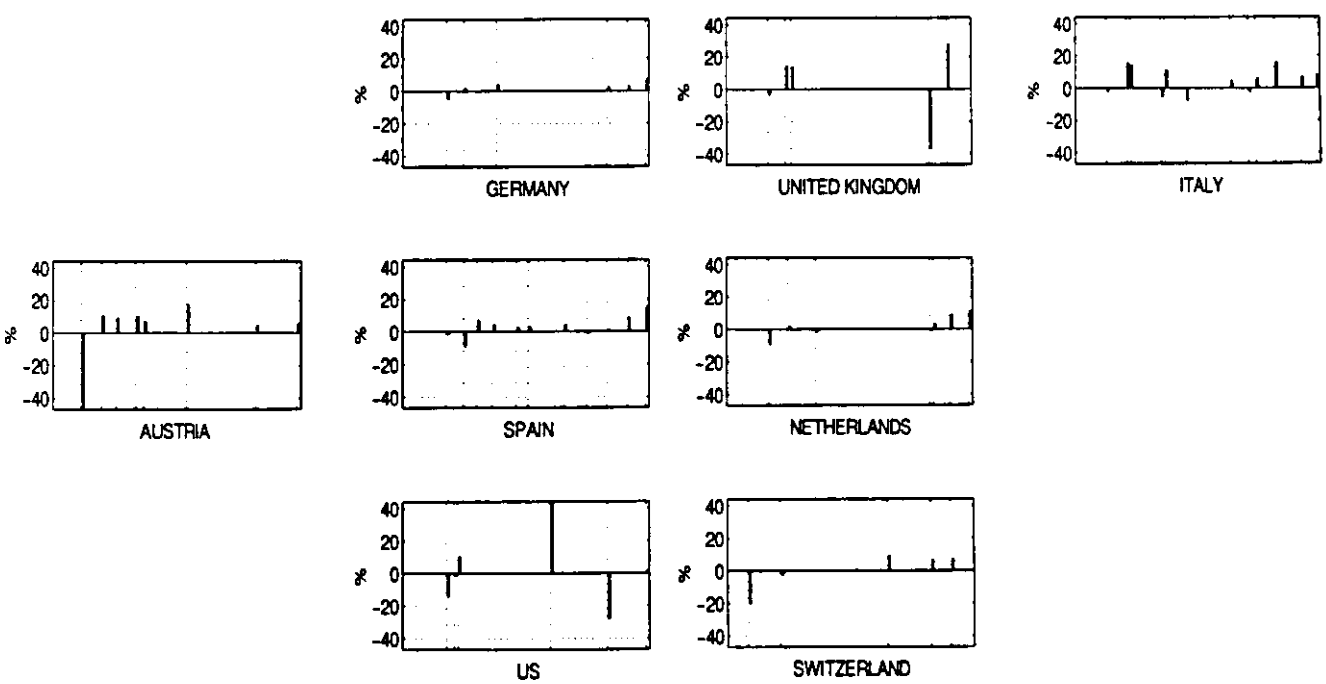

Figure 4.83: L'Express. $PT^{1/\tilde{s}^A_{j\tau}}$. Mar78-Dec88.

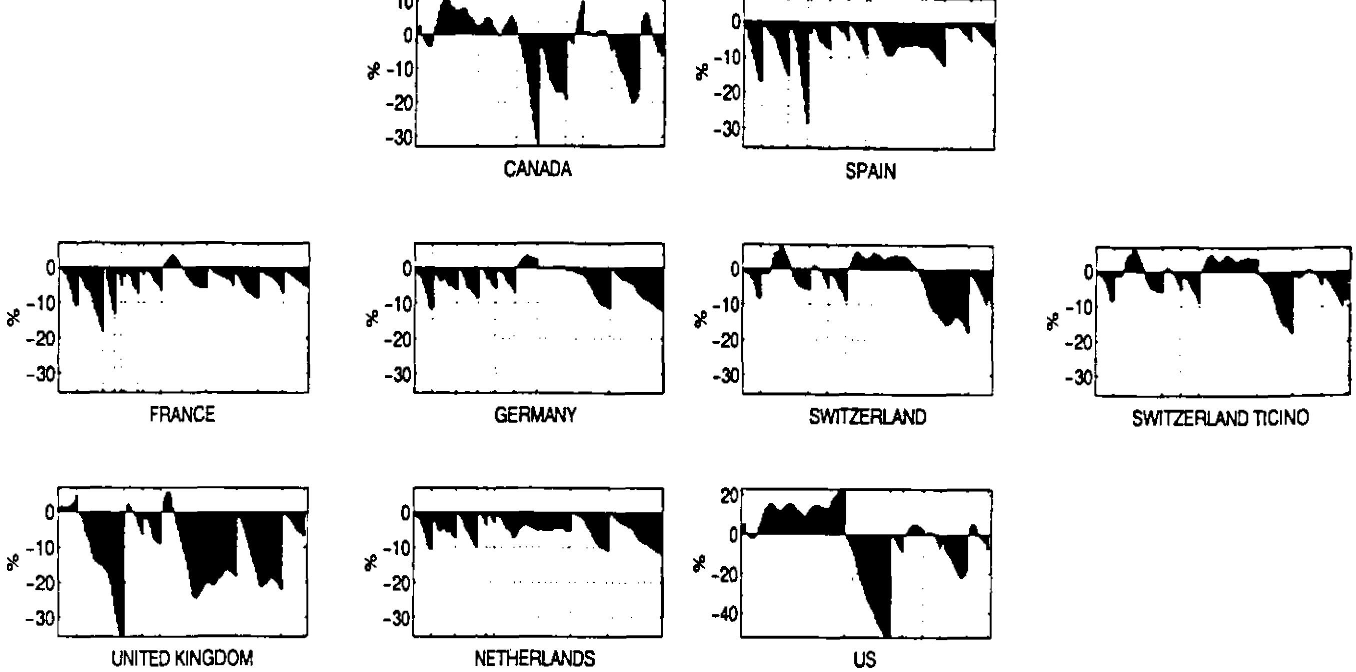

Figure 4.84: Il Mondo. $1/\tilde{s}^{A}_{j\tau}$. Feb8-June92.

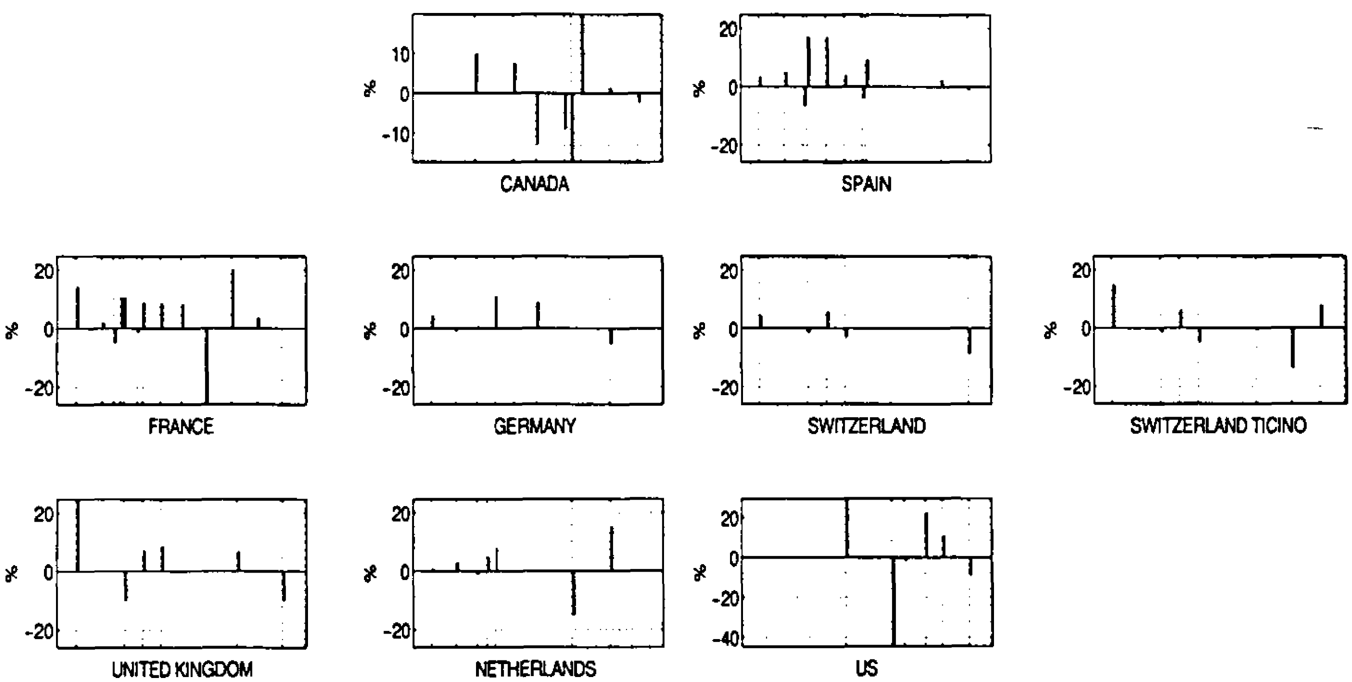

Figure 4.85: Il Mondo. $PT^{1/\tilde{s}^{A}_{j\tau}}$. Feb80-Jun92.

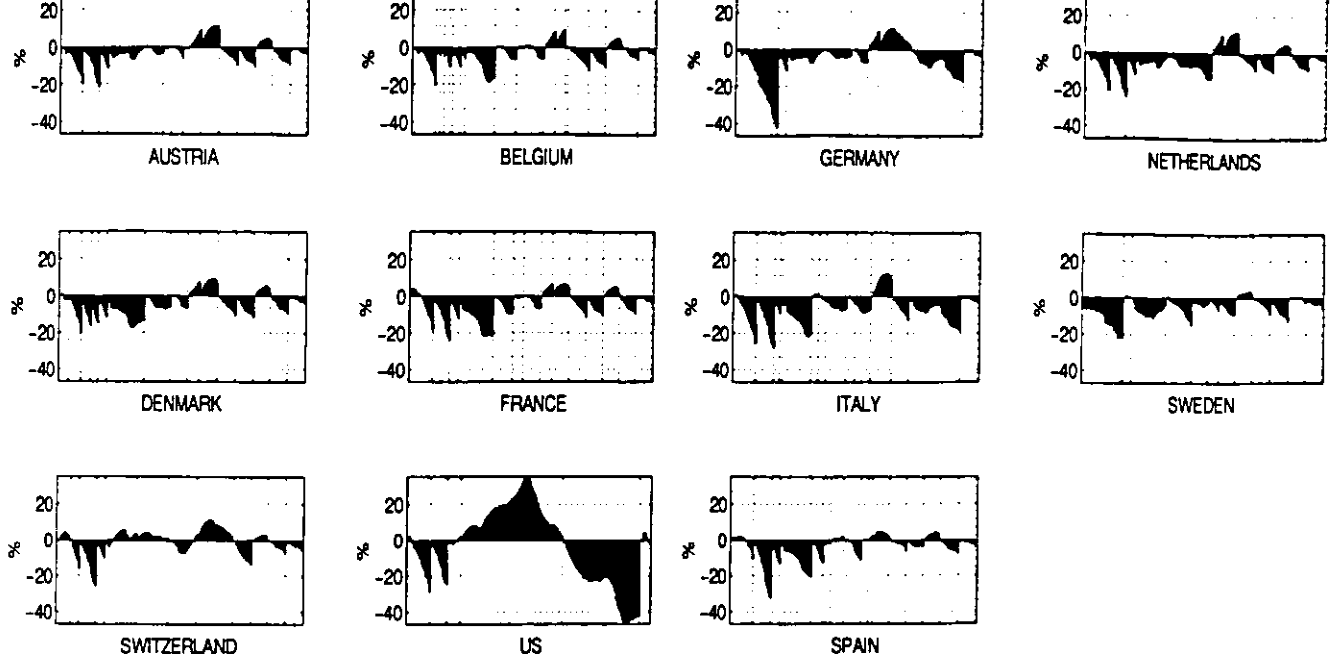

Figure 4.86: The Economist. $1/\tilde{s}^A_{j\tau}$. Mar78-May92.

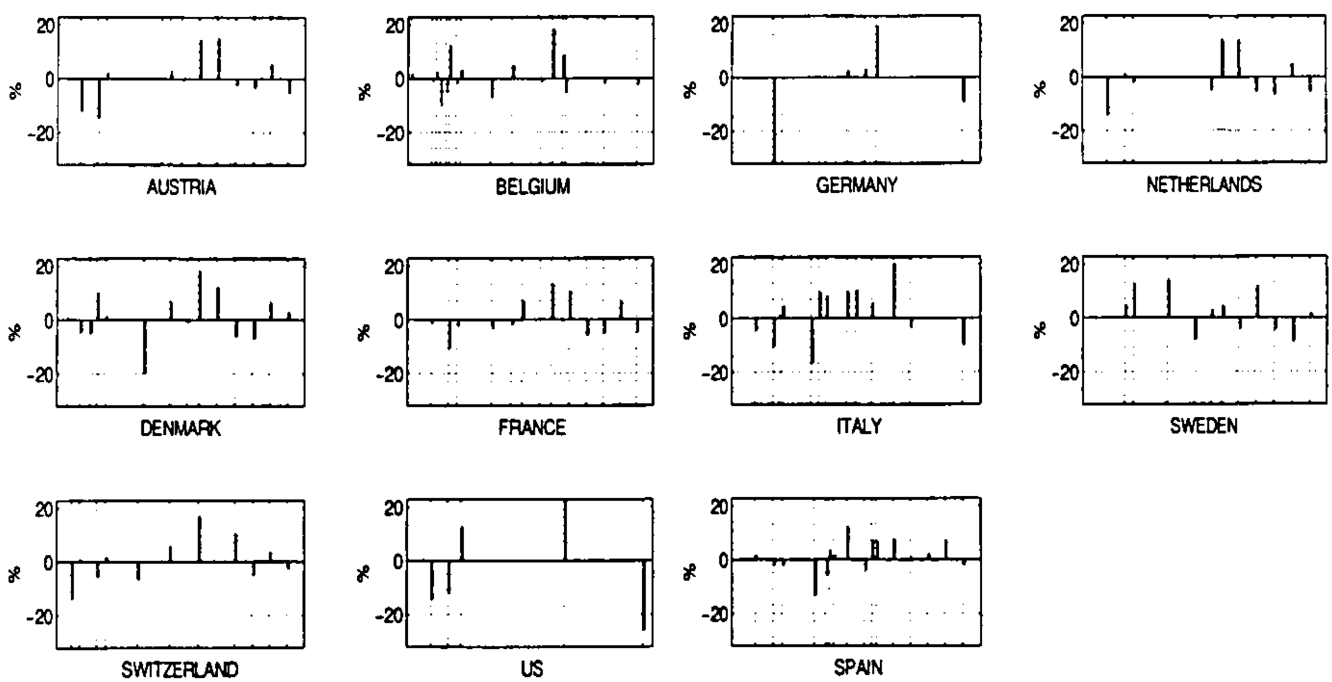

Figure 4.87: The Economist. $PT^{1/\tilde{s}^A_{j\tau}}$. Mar78-May92.

Tables

Table 4.9: Logit Estimates of the (R_i, R_I) Pricing Scheme: **Cross-Magazine Models (Type I)**. 1981-1992†

	Model A.1	Model A.2	Model A.3	Model A.1	Model A.2	Model A.3
	Belgium			**Germany**		
T^J_{nt}		0.87	0.43		0.14	0.52
		(2.01)	(1.75)		(0.27)	(1.67)
$\mathbf{P}^J_t$	125.26	191.26		-98.94	-132.15	
	(3.28)	(3.07)		(-1.15)	(-1.39)	
$SINC^J_{nt}$	3.34	3.63		3.12	3.10	
	(8.53)	(8.06)		(7.95)	(7.47)	
$\tilde{\mathbf{P}}^J_{nt}$		3.54	9.21		7.91	2.73
		(0.09)	(3.49)		(1.99)	(1.83)
$\Delta P^J_{n\tau-1}$		-5.88	-1.11		7.31	13.80
		(-0.98)	(-1.41)		(1.56)	(1.73)
$\log L^c$	-140.97	-65.68	-60.98	-104.61	-49.72	-47.64
	Italy			**Spain**		
T^J_{nt}		1.30	0.28		0.39	0.14
		(2.09)	(0.96)		(0.87)	(0.55)
$\mathbf{P}^J_t$	89.74	221.89		34.59	50.95	
	(2.60)	(2.30)		(2.14)	(1.43)	
$SINC^J_{nt}$	2.92	1.82		4.03	3.97	
	(9.34)	(3.94)		(9.56)	(9.51)	
$\tilde{\mathbf{P}}^J_{nt}$		-0.45	3.05		-0.89	1.97
		(-1.10)	(3.10)		(-0.28)	(2.06)
$\Delta P^J_{n\tau-1}$		-5.55	-4.10		-3.22	-2.71
		(2.24)	(1.92)		(-1.48)	(-1.92)
$\log L^c$	-160.64	-87.09	-80.92	-202.60	-76.38	-77.14
	Switzerland			**U.S.**		
T^J_{nt}		-1.18	0.02		0.27	0.17
		(-1.70)	(0.09)		(0.48)	(0.33)
$\mathbf{P}^J_t$	353.61	227.31		-47.67	-37.98	
	(1.92)	(1.78)		(-0.35)	(-0.26)	
$SINC^J_{nt}$	4.77	6.04		1.99	2.00	
	(6.23)	(5.16)		(6.18)	(6.16)	
$\tilde{\mathbf{P}}^J_{nt}$		33.95	2.10		-2.07	0.88
		(2.55)	(0.40)		(-0.27)	(0.12)
$\Delta P^J_{n\tau-1}$		14.65	4.16		-2.49	-3.43
		(1.78)	(0.61)		(-1.83)	(-2.28)
$\log L^c$	-114.73	-33.61	-28.15	-75.24	-54.44	-54.67

† The numbers in parenthesis are asymptotic t-statistics.

Table 4.10: Logit Estimates of the Average Fixed Effect ($\bar{\theta}_{T_w}$ and $\bar{\theta}^*_{T_w}$) of (R_i, R_I) Pricing Scheme: **Cross-Magazine Model I.A.3.** 1981-1992 †

Period	$\bar{\theta}_{T_w}$	$\bar{\theta}^*_{T_w}$	$\%\Delta P^J_{nT}$	I_T	P^J_t	Period	$\bar{\theta}_{T_w}$	$\bar{\theta}^*_{T_w}$	$\%\Delta P^J_{nT}$	I_T	P^J_t
Belgium						**Germany**					
1981-84	-4.64	-6.06	13.12	3.33	8.35 (0.55)	1981-84	-2.67	-2.24	11.72	3.33	4.13 (0.13)
1985-88	-4.35	-6.93	8.52	3.67	3.71 (0.34)	1985-88	-3.98	-5.82	4.70	2.67	1.12 (0.08)
1989-92	-4.35	-7.83	9.75	5.33	3.35 (0.41)	1989-92	-4.86	-7.68	5.50	2.33	2.11 (0.29)
Hausman Test*=4.40						Hausman Test=28.75					
Italy						**Spain**					
1981-84	-4.09	-7.71	19.82	5.00	10.75 (0.23)	1981-84	-4.28	-4.78	19.52	4.67	18.12 (0.33)
1985-88	-4.16	-8.18	7.37	4.67	5.19 (0.13)	1985-88	-4.18	-4.15	7.72	6.67	8.82 (0.25)
1989-92	-4.02	-7.60	3.40	4.67	5.12 (0.40)	1989-92	-3.85	-3.89	3.77	7.67	6.83 (0.61)
Hausman Test=3.16						Hausman Test=5.02					
Switzerland						**US**					
1981-84	-5.02	-9.28	7.77	2.33	3.37 (0.15)	1981-84	-5.23	-4.74	9.07	1.33	4.07 (0.18)
1985-88	-8.05	-12.50	7.70	2.67	1.36 (0.08)	1985-88	-3.76	-3.65	9.67	2.00	2.82 (0.09)
1989-92	-4.41	-7.83	7.52	3.07	3.12 (0.33)	1989-92	-2.57	-2.42	10.20	2.33	2.97 (0.25)
Hausman Test=20.26						Hausman Test=30.58					

† The numbers in parenthesis are the standard deviations.

* χ^2_3 critical value = 12.84.

Table 4.11: Logit Estimates of the (R_i, R_I) Pricing Scheme: **Cross-Market Models (Type II)**.†

Businessweek

	Model A.1	Model A.2	Model A.3	Model B.1	Model B.2	Model B.3
T^n_{jt}		-0.03	-0.18			
		(-0.16)	(-1.31)			
$\mathbf{P}^n_{jt}$	38.28	35.58		59.67	50.60	
	(1.95)	(1.92)		(2.02)	(1.94)	
$SINC^n_{jt}$	3.05	3.04				
	(10.89)	(10.82)				
$\mathbf{P}^n_{jt}$		0.82	2.50		-0.42	1.25
		(0.38)	(1.52)		(-0.26)	(0.89)
$\Delta P^n_{j\tau-1}$		-0.24	0.89		1.11	0.97
		(-0.20)	(0.93)		(1.06)	(0.96)
I^n_{jt}				2.42	2.97	
				(5.09)	(5.28)	
T^n_{1t}					0.47	0.47
					(1.98)	(1.86)
$\mathbf{P}^n_{1t}$				230.41	183.12	
				(4.23)	(2.82)	
$\mathbf{P}^n_{1t}$					-8.74	-8.41
					(-2.13)	(-2.35)
$\log L^c$	-263.52	-179.59	-179.78	-233.54	-204.15	-235.17

Fortune

	Model A.1	Model A.2	Model A.3	Model B.1	Model B.2	Model B.3
T^n_{jt}		0.35	0.70		0.57	0.56
		(0.97)	(3.02)		(2.29)	(2.39)
$\mathbf{P}^n_{jt}$	33.78	52.44		10.80	-20.93	
	(0.50)	(0.51)		(0.92)	(-0.81)	
$SINC^n_{jt}$	3.33	3.31				
	(10.27)	(9.68)				
$\mathbf{P}^n_{jt}$		-0.44	-0.39		0.67	0.37
		(-0.11)	(-0.21)		(0.28)	(0.20)
$\Delta P^n_{j\tau-1}$		-2.76	6.44		8.56	7.48
		(-0.38)	(1.62)		(1.96)	(1.90)
$\mathbf{P}^n_{1t}$				472.60	575.29	
				(4.64)	(4.60)	
$\log L^c$	-171.04	-79.18	-80.58	-168.26	-157.72	-167.21

Newsweek

	Model A.1	Model A.2	Model A.3	Model B.1	Model B.2	Model B.3
T^n_{jt}		0.34	0.31		0.61	0.49
		(1.41)	(2.51)		(3.52)	(3.33)
$\mathbf{P}^n_{jt}$	62.61	53.87		30.54	24.47	
	(2.18)	(1.18)		(1.54)	(0.91)	
$SINC^n_{jt}$	3.13	3.13	5.08			
	(15.21)	(14.67)	(3.30)			
$\mathbf{P}^n_{jt}$		4.84	3.35		4.96	6.41
		(1.44)	(1.49)		(2.44)	(4.02)
$\Delta P^n_{j\tau-1}$		-7.55			-4.03	-3.18
		(-2.10)			(-1.79)	(-1.39)
$\mathbf{P}^n_{1t}$				15.44	148.07	
				(0.12)	(1.11)	
$\log L^c$	-268.07	-149.22	-157.23	-302.16	-281.43	-282.66

† The numbers in parenthesis are asymptotic t-statistics.

Table 4.12: Logit Estimates of the (R_i, R_I) Pricing Scheme: **Cross-Market Models (Type II)** (cont.).

Le Figaro

	Model A.1	Model A.2	Model A.3	Model B.1	Model B.2	Model B.3
T^n_{jt}		0.47	0.06		0.41	0.10
		(2.22)	(0.53)		(2.18)	(0.70)
$\mathbf{P}^n_{jt}$	55.50	87.75		54.05	67.87	
	(2.42)	(3.09)		(2.94)	(2.88)	
$SINC^n_{jt}$	2.54	2.57				
	(12.69)	(12.50)				
$\mathbf{P}^n_{jt}$		2.64	6.17		3.39	3.67
		(1.25)	(3.71)		(2.17)	(1.98)
$\Delta P^n_{j\tau-1}$		-2.69	-3.80		-2.81	-2.89
		(-1.62)	(-2.01)		(-1.73)	(-1.82)
$\mathbf{P}^n_{It}$				117.39	88.51	
				(2.04)	(1.69)	
$\log L^c$	-285.52	-147.87	-143.28	-260.52	-248.99	-253.61

Le Nouvel Observateur

	Model A.1	Model A.2	Model A.3	Model B.1	Model B.2	Model B.3
T^n_{jt}		0.58	0.12			
		(3.22)	(1.09)			
$\mathbf{P}^n_{jt}$	32.60	66.89		27.63	48.72	
	(1.35)	(2.44)		(1.40)	(2.87)	
$SINC^n_{jt}$	2.84	3.04				
	(14.86)	(14.46)				
$\mathbf{P}^n_{jt}$		2.66	2.44		1.77	1.88
		(1.35)	(1.89)		(1.50)	(1.72)
$\Delta P^n_{j\tau-1}$		-4.26	-4.12		-2.44	-2.98
		(-1.87)	(-2.08)		(-1.62)	(-1.71)
I^n_{jt}				1.62	2.09	
				(6.38)	(7.20)	
T^n_{It}					-0.64	-0.75
					(-3.10)	(-4.53)
$\mathbf{P}^n_{It}$				73.89	89.85	
				(2.13)	(1.80)	
$\mathbf{P}^n_{It}$					0.20	12.06
					(0.03)	(3.27)
$\log L^c$	-222.39	-145.69	-153.14	-242.71	-142.71	-155.79

Le Point

	Model A.1	Model A.2	Model A.3	Model B.1	Model B.2	Model B.3
T^n_{jt}		0.51	0.39			
		(3.11)	(2.83)			
$\mathbf{P}^n_{jt}$	66.29	96.17		46.62	33.59	
	(3.55)	(4.10)		(2.65)	(1.78)	
$SINC^n_{jt}$	2.80	2.85				
	(14.73)	(14.47)				
$\mathbf{P}^n_{jt}$		-0.95	3.81		4.28	4.73
		(-0.53)	(3.16)		(4.10)	(4.65)
$\Delta P^n_{j\tau-1}$		-2.13	-1.82		-1.11	-1.40
		(-2.10)	(-2.11)		(-0.66)	(-0.82)
I^n_{jt}				0.68	1.04	
				(2.13)	(3.06)	
T^n_{It}					-0.21	-0.38
					(-1.15)	(-2.57)
$\mathbf{P}^n_{It}$				19.68	54.29	
				(0.60)	(1.20)	
$\mathbf{P}^n_{It}$					5.93	6.08
					(1.39)	(1.02)
$\log L^c$	-204.78	-184.13	-172.88	-357.43	-250.98	-206.84

† The numbers in parenthesis are asymptotic t-statistics.

Table 4.13: Logit Estimates of the (R_i, R_I) Pricing Scheme: **Cross-Market Models (Type II)** (cont.).

L'Express

	Model A.1	Model A.2	Model A.3	Model B.1	Model B.2	Model B.3
T^n_{jt}		0.66	0.75			
		(2.18)	(2.67)			
$\mathbf{P}^n_{jt}$	62.64	80.19		44.28	41.76	
	(2.45)	(3.17)		(2.07)	(1.88)	
$SINC^n_{jt}$	3.21	3.33				
	(11.72)	(11.21)				
$\tilde{\mathbf{P}}^n_{jt}$		-0.85	2.46		2.27	3.10
		(-0.27)	(2.28)		(2.41)	(1.97)
$\Delta P^n_{j\tau-1}$		-6.59	-2.29		-2.53	-2.18
		(-2.60)	(-1.83)		(-2.09)	(-1.20)
I^n_{jt}				0.49	0.27	
				(1.01)	(0.83)	
T^n_{It}					-0.59	-0.38
					(-2.43)	(-1.75)
$\mathbf{P}^n_{It}$				-22.11	-113.73	
				(-0.53)	(-2.10)	
$\tilde{\mathbf{P}}^n_{It}$					10.54	6.06
					(2.59)	(2.01)
$\log L^c$	-253.98	-137.52	-144.09	-247.06	-224.19	-229.28

Il Mondo

	Model A.1	Model A.2	Model A.3	Model B.1	Model B.2	Model B.3
T^n_{jt}		0.34	0.43			
		(1.28)	(2.82)			
$\mathbf{P}^n_{jt}$	43.91	23.95		32.14	11.01	
	(1.75)	(1.88)		(1.90)	(1.65)	
$SINC^n_{jt}$	3.08	3.09				
	(14.10)	(13.61)				
$\tilde{\mathbf{P}}^n_{jt}$		2.03	1.73		4.35	3.85
		(1.40)	(1.24)		(2.40)	(2.31)
$\Delta P^n_{j\tau-1}$		-4.97	-3.59		-2.79	-3.42
		(-2.23	(2.22))		(-1.88)	(-2.16)
I^n_{jt}				2.34	3.91	
				(8.31)	(7.88)	
T^n_{It}					-1.26	-1.15
					(-4.97)	(-5.32)
$\mathbf{P}^n_{It}$				20.61	24.48	
				(1.71)	(1.61)	
$\tilde{\mathbf{P}}^n_{It}$					-1.19	15.92
					(-0.17)	(3.69)
$\log L^c$	-210.03	-136.29	-138.46	-264.39	-224.43	-254.38

The Economist

	Model A.1	Model A.2	Model A.3	Model B.1	Model B.2	Model B.3
T^n_{jt}		0.07	0.48			
		(0.28)	(3.84)			
$\mathbf{P}^n_{jt}$	85.00	86.69		40.20	26.12	
	(3.80)	(2.70)		(2.10)	(2.14)	
$SINC^n_{jt}$	2.87	2.90				
	(17.86)	(16.63)				
$\tilde{\mathbf{P}}^n_{jt}$		3.75	2.28		4.05	5.05
		(1.99)	(1.88)		(2.48)	(3.59)
$\Delta P^n_{j\tau-1}$		-8.27	-4.55		-3.92	-4.37
		(-2.26)	(-1.81)		(-2.38)	(-1.95)
I^n_{jt}				2.29	1.99	
				(10.75)	(7.80)	
T^n_{It}					0.42	0.61
					(1.91)	(3.47)
$\mathbf{P}^n_{It}$				24.84	5.01	
				(1.84)	(1.09)	
$\tilde{\mathbf{P}}^n_{It}$					-1.25	4.65
					(-0.22)	(1.80)
$\log L^c$	-312.68	-213.04	-217.19	-261.69	-230.08	-237.45

† The numbers in parenthesis are asymptotic t-statistics.

Table 4.14: Logit Estimates of the Average Fixed Effect ($\bar{\theta}_{T_w}$ and $\bar{\theta}^*_{T_w}$) of (R_i, R_I) Pricing Scheme: **Cross-Market Model II.A.3.**†

Period	$\bar{\theta}_{T_w}$	$\bar{\theta}^*_{T_w}$	$\%\Delta P^n_{j\tau}$	$\bar{I}_T$	$\mathbf{P}^n_{jt}$	Period	$\bar{\theta}_{T_w}$	$\bar{\theta}^*_{T_w}$	$\%\Delta P^n_{j\tau}$	$\bar{I}_T$	$\mathbf{P}^n_{jt}$
Businessweek						**Fortune**					
1981-84	-7.07	-9.95	14.24	10.33	7.99	1983-85	-2.84	-3.09	14.83	4.33	5.97
					(0.50)						(0.50)
1984-87	-3.64	-4.74	9.06	5.67	3.48	1986-88	-4.77	-4.87	-13.98	6.67	3.45
					(0.26)						(0.24)
1988-92	-4.07	-5.49	12.45	3.67	4.42	1989-92	-8.25	-8.02	9.70	3.00	4.03
					(0.40)						(0.43)
Hausman Test*=25.80						Hausman Test=30.12					
Newsweek						**Le Figaro**					
1978-82	-4.20	-3.48	12.05	10.67	9.32	1978-81	-4.18	-7.09	13.15	14.00	9.70
					(0.49)						(0.52)
1983-87	-4.19	-3.76	9.00	16.67	5.12	1982-84	-4.16	-6.93	9.05	10.33	7.17
					(0.42)						(0.45)
1988-92	-4.47	-4.38	9.20	7.23	4.18	1985-88	-4.04	-6.51	7.34	7.33	2.42
					(0.36)						(0.48)
Hausman Test=7.06						Hausman Test=4.58					
Le Nouvel Observateur						**Le Point**					
1978-82	-2.95	-2.30	11.17	13.16	10.38	1976-81	-4.44	-6.28	13.12	15.00	9.31
					(0.62)						(0.60)
1983-87	-3.72	-4.17	7.85	16.07	6.57	1982-87	-4.18	-6.24	9.25	17.67	6.91
					(0.47)						(0.47)
1988-92	-7.82	-9.09	6.03	2.33	4.16	1988-92	-4.37	-6.06	10.31	7.33	3.74
					(0.47)						(0.47)
Hausman Test=27.05						Hausman Test=3.80					
L'Express						**Il Mondo**					
1978-81	-4.10	-5.32	9.82	7.00	9.91	1980-83	-3.87	-4.24	15.22	8.00	8.15
					(0.58)						(0.50)
1982-84	-4.23	-6.23	10.68	5.00	7.19	1984-87	-3.58	-4.17	7.86	9.00	3.70
					(0.54)						(0.32)
1985-88	-3.58	-5.08	10.88	8.33	2.72	1988-92	-3.77	-4.42	9.82	7.33	4.41
					(0.45)						(0.38)
Hausman Test=6.31						Hausman Test=3.49					
The Economist											
1978-82	-7.17	-8.62	11.57	15.00	9.24						
					(0.49)						
1983-87	-3.89	-4.56	8.13	16.00	5.07						
					(0.41)						
1988-92	-2.60	-1.69	6.74	14.33	4.13						
					(0.37)						
Hausman Test=25.42											

† The numbers in parenthesis are the standard deviations.
* χ^2_3 critical value = 12.84.

Table 4.15: Logit Estimates of the Market Fixed Effect α_{jt}^{n} of (R_i, R_I) Pricing Scheme: **Cross-Market Model II.A.3.†**

	Busin	Fortu	Newsw	Figar	Nouve	Point	Expre	Mondo	Econo
Aus	0.12	8.67	-2.24	-2.24			-0.23		0.92
	(3.50)	(1.36)	(3.05)	(2.56)			(4.12)		(4.05)
Bel	1.20	9.87	-1.46	-2.59	0.28	-0.11			1.60
	(4.91)	(2.39)	(2.36)	(2.58)	(2.10)	(4.60)			(4.86)
Den	-0.30	7.91	-3.04						0.37
	(3.09)	(2.34)	(3.65)						(3.03)
Fra	-0.49	7.73	-3.14					-0.17	0.19
	(2.69)	(1.34)	(4.75)					(3.17)	(3.02)
Ger	-1.28	6.54	-4.10	-3.81		-1.51	-2.13	-0.53	-0.59
	(2.08)	(2.30)	(2.84)	(1.96)		(4.04)	(3.07)	(1.23)	(5.08)
Neth	-1.30	13.25	1.71	-3.86			-2.10	-0.65	-0.50
	(4.68)	(1.49)	(3.78)	(4.36)			(4.08)	(1.19)	(2.04)
Ita	4.03	11.56	-4.10	-0.45	3.58	2.01	3.18		4.38
	(1.16)	(3.43)	(2.74)	(3.38)	(3.25)	(3.15)	(3.26)		(3.17)
Swe	-0.31		-3.14						0.34
	(3.49)		(2.55)						(3.00)
Uk	-2.63	10.80	-4.22	-4.73			-3.42	-1.18	
	(4.28)	(3.42)	(3.04)	(2.48)			(3.03)	(2.21)	
Jap	2.88	6.42							
	(4.13)	(1.30)							
Spa	1.88	5.04	-5.47	-1.78	1.38	0.57	1.15	0.93	2.43
	(1.62)	(2.27)	(3.35)	(2.11)	(3.72)	(2.11)	(4.14)	(3.13)	(4.27)
Us					-2.47	-1.88	-2.70	-0.76	-1.11
					(3.09)	(5.28)	(4.08)	(2.20)	(2.05)
Can				-4.07	-2.43	-1.85		-0.72	
				(3.37)	(4.89)	(4.05)		(3.20)	
IvoC				-0.94	2.30	1.31			
				(3.14)	(3.43)	(4.32)			
Lux				-2.60		-0.15			
				(4.28)		(5.60)			
Mor				-3.79	-1.32	-1.43			
				(4.26)	(1.49)	(6.00)			
Sen				-0.92	2.32	1.28			
				(5.14)	(3.53)	(3.12)			
Tun				0.60	3.16	2.95			
				(3.06)	(2.59)	(4.05)			

† Asymptotic t-statistics in parenthesis

Table 4.16: Mean and Standard Deviation of Bilateral Relative Prices, $DLOP_{jk,t}$.

Businessweek

	Aus	Bel	Den	Fra	Ger	Neth	Ita	Swe	Swit	Uk	Us	Jap
Bel	0.83											
	(0.09)											
Den	0.88	1.07										
	(0.11)	(0.15)										
Fra	0.95	1.14	1.09									
	(0.11)	(0.12)	(0.15)									
Ger	0.80	0.96	0.91	0.84								
	(0.09)	(0.10)	(0.09)	(0.08)								
Neth	0.90	1.08	1.03	0.95	1.18							
	(0.09)	(0.11)	(0.13)	(0.06)	(0.12)							
Ita	0.96	1.15	1.09	1.01	1.20	1.07						
	(0.26)	(0.27)	(0.25)	(0.23)	(0.24)	(0.24)						
Swe	0.78	0.94	0.89	0.83	0.98	0.87	0.84					
	(0.16)	(0.16)	(0.12)	(0.14)	(0.14)	(0.14)	(0.14)					
Swit	0.86	1.04	0.99	0.91	1.09	0.96	0.94	1.13				
	(0.12)	(0.11)	(0.16)	(0.10)	(0.11)	(0.11)	(0.19)	(0.18)				
Uk	1.07	1.28	1.21	1.13	1.33	1.19	1.15	1.39	1.24			
	(0.19)	(0.21)	(0.20)	(0.18)	(0.14)	(0.20)	(0.24)	(0.23)	(0.17)			
Us	1.09	1.30	1.22	1.14	1.35	1.20	1.13	1.37	1.24	1.01		
	(0.32)	(0.33)	(0.28)	(0.29)	(0.29)	(0.29)	(0.15)	(0.22)	(0.25)	(0.20)		
Jap	0.53	0.63	0.61	0.56	0.67	0.59	0.58	0.69	0.62	0.51	0.52	
	(0.11)	(0.10)	(0.15)	(0.10)	(0.16)	(0.10)	(0.20)	(0.16)	(0.13)	(0.15)	(0.17)	
Spa	1.02	1.23	1.17	1.08	1.29	1.14	1.12	1.33	1.20	0.98	1.00	1.98
	(0.13)	(0.12)	(0.17)	(0.11)	(0.17)	(0.11)	(0.26)	(0.21)	(0.17)	(0.18)	(0.25)	(0.29)

Average of Means and Standard Deviations

Aus	Bel	Den	Fra	Ger	Neth	Ita	Swe	Swit	Uk	Us	Jap	Spa
0.88	1.08	1.02	0.94	1.14	0.99	0.97	1.18	1.05	0.84	0.86	1.81	0.87
(0.14)	(0.15)	(0.06)	(0.13)	(0.15)	(0.14)	(0.21)	(0.19)	(0.15)	(0.15)	(0.20)	(0.37)	(0.12)

Fortune

	Aus	Bel	Den	Fra	Ger	Ita	Jap	Nether	Spa	Swit
Bel	0.93									
	(0.13)									
Den	1.10	1.19								
	(0.24)	(0.23)								
Fra	1.14	1.25	1.05							
	(0.21)	(0.27)	(0.13)							
Ger	1.15	1.27	1.07	1.01						
	(0.30)	(0.37)	(0.22)	(0.14)						
Ita	1.18	1.28	1.07	1.03	1.05					
	(0.25)	(0.29)	(0.11)	(0.08)	(0.26)					
Jap	0.71	0.77	0.67	0.64	0.65	0.63				
	(0.10)	(0.10)	(0.13)	(0.14)	(0.16)	(0.15)				
Nether	1.20	1.32	1.10	1.05	1.06	1.03	1.72			
	(0.24)	(0.31)	(0.14)	(0.05)	(0.16)	(0.08)	(0.15)			
Spa	1.04	1.11	0.96	0.93	0.94	0.91	1.47	0.89		
	(0.17)	(0.07)	(0.18)	(0.19)	(0.23)	(0.20)	(0.19)	(0.20)		
Swit	1.05	1.15	0.97	0.93	0.93	0.91	1.51	0.88	1.04	
	(0.21)	(0.26)	(0.15)	(0.10)	(0.07)	(0.13)	(0.37)	(0.09)	(0.26)	
Uk	1.41	1.53	1.29	1.24	1.27	1.20	2.00	1.18	1.38	1.35
	(0.38)	(0.41)	(0.28)	(0.30)	(0.42)	(0.28)	(0.53)	(0.31)	(0.36)	(0.25)

Average Means and Standard Deviations

Aus	Bel	Den	Fra	Ger	Ita	Jap	Nether	Spa	Swit	Uk
1.09	1.19	0.99	0.95	0.96	0.92	1.60	0.90	1.06	1.04	0.78
(0.22)	(0.25)	(0.16)	(0.14)	(0.20)	(0.14)	(0.35)	(0.14)	(0.23)	(0.18)	(0.16)

Table 4.17: Mean and Standard Deviations of Bilateral Relative Prices, $DLOP_{jk,t}$ (cont.)

Newsweek

	Aus	Bel	Den	Fra	Ger	Ita	Nether	Swe	Spa	Swit
Bel	1.17									
	(0.11)									
Den	1.19	1.02								
	(0.10)	(0.09)								
Fra	1.15	0.98	0.96							
	(0.08)	(0.07)	(0.07)							
Ger	1.06	0.92	0.90	0.94						
	(0.05)	(0.10)	(0.09)	(0.10)						
Ita	1.22	1.05	1.03	1.07	1.15					
	(0.09)	(0.10)	(0.08)	(0.06)	(0.12)					
Nethe	1.18	1.02	1.00	1.04	1.11	0.97				
	(0.07)	(0.07)	(0.07)	(0.06)	(0.09)	(0.08)				
Swe	1.11	0.96	0.94	0.97	1.05	0.91	0.94			
	(0.07)	(0.09)	(0.08)	(0.08)	(0.07)	(0.07)	(0.08)			
Spa	1.21	1.03	1.02	1.05	1.14	0.99	1.02	1.09		
	(0.16)	(0.08)	(0.12)	(0.10)	(0.18)	(0.12)	(0.12)	(0.14)		
Swit	1.03	0.89	0.87	0.90	0.97	0.85	0.87	0.93	0.87	
	(0.08)	(0.13)	(0.10)	(0.11)	(0.07)	(0.10)	(0.09)	(0.09)	(0.17)	
Uk	1.33	1.15	1.12	1.16	1.25	1.09	1.13	1.19	1.11	1.30
	(0.13)	(0.16)	(0.13)	(0.14)	(0.13)	(0.11)	(0.14)	(0.10)	(0.17)	(0.15)

Averages of Means and Standard Deviations

Aus	Bel	Den	Fra	Ger	Ita	Nether	Swe	Spa	Swit	Uk
1.65	0.98	0.96	1.00	1.09	0.93	0.97	1.04	0.95	1.13	0.86
(0.09)	(0.09)	(0.09)	(0.08)	(0.10)	(0.08)	(0.08)	(0.09)	(0.12)	(0.14)	(0.10)

Le Figaro

	Ger	Aus	Bel	Can	IvC	Spa	Uk	Ita	Lux	Mor	Neth	Sen	Swi
Aus	0.59												
	(0.07)												
Bel	1.42	2.47											
	(0.19)	(0.57)											
Can	1.00	1.71	0.72										
	(0.17)	(0.19)	(0.15)										
IvC	0.78	1.32	0.56	0.78									
	(0.11)	(0.09)	(0.11)	(0.09)									
Spa	1.19	2.06	0.85	1.23	1.58								
	(0.13)	(0.38)	(0.12)	(0.25)	(0.34)								
Uk	1.31	2.23	0.94	1.33	1.70	1.12							
	(0.20)	(0.26)	(0.19)	(0.22)	(0.20)	(0.24)							
Ita	1.07	1.87	0.76	1.11	1.43	0.90	0.84						
	(0.18)	(0.48)	(0.09)	(0.28)	(0.37)	(0.13)	(0.21)						
Lux	1.44	2.49	1.01	1.47	1.90	1.22	1.12	1.35					
	(0.19)	(0.56)	(0.03)	(0.32)	(0.45)	(0.18)	(0.23)	(0.15)					
Mor	1.86	3.17	1.32	1.86	2.41	1.59	1.43	1.78	1.31				
	(0.31)	(0.47)	(0.25)	(0.19)	(0.35)	(0.37)	(0.21)	(0.47)	(0.25)				
Neth	1.12	1.93	0.80	1.15	1.47	0.95	0.88	1.07	0.80	0.62			
	(0.05)	(0.22)	(0.11)	(0.17)	(0.20)	(0.11)	(0.13)	(0.17)	(0.11)	(0.11)			
Sen	0.82	1.39	0.59	0.82	1.05	0.70	0.63	0.79	0.58	0.44	0.73		
	(0.14)	(0.13)	(0.13)	(0.08)	(0.09)	(0.17)	(0.09)	(0.22)	(0.13)	(0.05)	(0.12)		
Swi	1.29	2.25	0.90	1.33	1.72	1.09	1.02	1.21	0.89	0.71	1.15	1.65	
	(0.27)	(0.70)	(0.10)	(0.38)	(0.57)	(0.22)	(0.31)	(0.19)	(0.10)	(0.17)	(0.27)	(0.54)	
Tun	0.86	1.23	0.68	0.92	1.12	0.40	0.78	0.74	0.60	0.39	0.69	1.16	1.03
	(0.13)	(0.12)	(0.14)	(0.09)	(0.11)	(0.14)	(0.10)	(0.17)	(0.15)	(0.25)	(0.21)	(0.18)	(0.15)

Averages of Means and Standard Deviations

Ger	Aus	Bel	Can	Ivo	Spa	Uk	Ita	Lux	Mor	Nether	Sen	Swi	Tun
1.15	2.05	0.79	1.17	1.54	0.97	0.88	1.09	0.78	0.59	1.02	1.47	0.91	1.40
(0.16)	(0.35)	(0.12)	(0.20)	(0.28)	(0.17)	(0.16)	(0.21)	(0.11)	(0.10)	(0.15)	(0.19)	(0.28)	(0.18)

Table 4.18: Mean and Standard Deviations of Bilateral Relative Prices. $DLOP_{jk,t}$ (cont.)

Le Nouvel Observateur

Market	Fra	Bel	Swit	Can	Spa	Ita	IvoC.	Tun	Sen	Mor
Bel	0.95									
	(0.10)									
Swit	0.75	0.79								
	(0.10)	(0.07)								
Can	0.76	0.80	1.01							
	(0.19)	(0.15)	(0.17)							
Spa	0.80	0.85	1.08	1.10						
	(0.09)	(0.06)	(0.09)	(0.21)						
Ita	0.68	0.73	0.93	0.93	0.86					
	(0.09)	(0.10)	(0.13)	(0.16)	(0.10)					
IvoC.	0.70	0.74	0.94	0.96	0.87	1.03				
	(0.07)	(0.08)	(0.11)	(0.19)	(0.06)	(0.11)				
Tun	0.63	0.78	0.94	1.03	0.81	1.10	1.07			
	(0.11)	(0.09)	(0.08)	(0.18)	(0.05)	(0.10)	(0.10)			
Sen	0.73	0.77	0.98	1.00	0.91	1.07	1.05	1.04		
	(0.10)	(0.07)	(0.08)	(0.18)	(0.06)	(0.12)	(0.08)	(0.80)		
Mor	1.16	1.19	1.51	1.50	1.41	1.69	1.63	1.46	1.54	
	(0.47)	(0.38)	(0.45)	(0.39)	(0.44)	(0.60)	(0.56)	(0.28)	(0.46)	
Us	0.67	0.70	0.89	0.88	0.83	0.98	0.96	0.98	0.91	0.63
	(0.19)	(0.15)	(0.16)	(0.08)	(0.17)	(0.21)	(0.22)	(0.22)	(0.17)	(0.19)

Averages of the Means and Standard Deviations.

Fra	Bel	Swit	Can	Spa	Ita	IvoC.	Tun	Sen	Mor	Us
0.80	0.81	1.11	1.11	1.02	1.22	1.19	1.10	1.13	0.76	1.29
(0.15)	(0.12)	(0.16)	(0.22)	(0.14)	(0.20)	(0.18)	(0.13)	(0.15)	(0.26)	(0.28)

Le Point

	Fra	Bel	Swit.	Can	Spa	Ita	Ger	Us	Mor	Tun	Sen	IvoC
Bel	1.01											
	(0.15)											
Swit	0.86	0.84										
	(0.21)	(0.11)										
Can	0.89	0.88	1.05									
	(0.25)	(0.16)	(0.15)									
Spa	0.95	0.95	1.14	1.11								
	(0.15)	(0.07)	(0.13)	(0.20)								
Ita	0.80	0.81	1.00	0.97	0.87							
	(0.12)	(0.17)	(0.31)	(0.32)	(0.22)							
Ger	0.83	0.81	0.97	0.95	0.86	1.05						
	(0.19)	(0.09)	(0.05)	(0.12)	(0.09)	(0.25)						
Us	0.84	0.82	0.97	0.93	0.86	1.05	0.99					
	(0.28)	(0.19)	(0.13)	(0.08)	(0.18)	(0.32)	(0.13)					
Mor	1.53	1.48	1.75	1.70	1.56	1.95	1.80	1.84				
	(0.56)	(0.37)	(0.27)	(0.33)	(0.36)	(0.71)	(0.30)	(0.36)				
Tun	0.75	0.73	0.97	0.95	0.87	1.00	0.99	0.98	0.62			
	(0.09)	(0.05)	(0.15)	(0.14)	(0.10)	(0.14)	(0.10)	(0.23)	(0.14)			
Sen	0.79	0.78	0.95	0.92	0.83	0.99	0.97	1.00	0.56	1.02		
	(0.11)	(0.06)	(0.15)	(0.17)	(0.09)	(0.16)	(0.13)	(0.21)	(0.15)	(0.09)		
IvoC	0.71	0.71	0.87	0.85	0.76	0.90	0.89	0.92	0.52	0.94	0.91	
	(0.08)	(0.08)	(0.17)	(0.21)	(0.10)	(0.16)	(0.16)	(0.24)	(0.15)	(0.15)	(0.08)	
Lux	1.06	1.05	1.27	1.23	1.11	1.35	1.30	1.34	0.75	1.20	1.35	1.48
	(0.17)	(0.08)	(0.15)	(0.23)	(0.08)	(0.29)	(0.13)	(0.28)	(0.17)	(0.15)	(0.13)	(0.18)

Averages of Means and Standard Deviations.

Fra	Bel	Swit.	Can	Spa	Ita	Ger	Us	Mor	Tun	Sen	IvoC	Lux
0.93	0.92	1.12	1.09	0.98	1.20	1.15	1.19	0.62	1.13	1.20	1.34	0.87
(0.20)	(0.13)	(0.17)	(0.21)	(0.14)	(0.18)	(0.17)	(0.24)	(0.15)	(0.16)	(0.18)	(0.25)	(0.13)

Table 4.19: Mean and Standard Deviations of Bilateral Relative Prices, $DLOP_{jk,t}$ (cont.)

L'Express

	Ger	Aus	Spa	Us	Uk	Ita	Nether	Swit
Aus	0.79							
	(0.13)							
Spa	1.22	1.58						
	(0.09)	(0.20)						
Us	0.95	1.24	0.79					
	(0.16)	(0.26)	(0.15)					
Uk	1.28	1.68	1.06	1.38				
	(0.16)	(0.38)	(0.16)	(0.32)				
Ita	1.12	1.45	0.92	1.21	0.89			
	(0.16)	(0.26)	(0.13)	(0.27)	(0.16)			
Nether	1.07	1.40	0.88	1.17	0.85	0.98		
	(0.05)	(0.21)	(0.07)	(0.26)	(0.10)	(0.14)		
Swit	1.09	1.41	0.89	1.18	0.87	0.99	1.01	
	(0.10)	(0.17)	(0.07)	(0.26)	(0.15)	(0.15)	(0.09)	
Fra	1.24	1.60	1.02	1.36	0.99	1.13	1.16	1.14
	(0.17)	(0.25)	(0.11)	(0.38)	(0.21)	(0.16)	(0.15)	(0.12)

Averages of Means and Standard Deviations.

Ger	Aus	Spa	Us	Uk	Ita	Nether	Swit	Fra
1.09	1.45	0.87	1.19	0.48	0.98	1.01	1.00	0.87
(0.12)	(0.23)	(0.10)	(0.26)	(0.14)	(0.15)	(0.12)	(0.13)	(0.14)

Il Mondo

	Ita	Can	Fra	Ger	Uk	Nether	Spa	Swit	SwitTic
Can	0.46								
	(0.08)								
Fra	0.53	1.20							
	(0.05)	(0.28)							
Ger	0.47	1.07	0.90						
	(0.03)	(0.19)	(0.10)						
Uk	0.53	1.17	1.00	1.11					
	(0.05)	(0.16)	(0.15)	(0.13)					
Nether	0.56	1.25	1.07	1.19	1.08				
	(0.05)	(0.17)	(0.14)	(0.10)	(0.12)				
Spa	0.60	1.36	1.13	1.26	1.15	1.07			
	(0.06)	(0.33)	(0.09)	(0.13)	(0.18)	(0.16)			
Swit	0.55	1.21	1.05	1.15	1.05	0.97	0.93		
	(0.07)	(0.14)	(0.19)	(0.11)	(0.12)	(0.09)	(0.17)		
SwitTic	0.58	1.29	1.11	1.23	1.11	1.03	0.99	1.06	
	(0.07)	(0.14)	(0.19)	(0.12)	(0.13)	(0.08)	(0.18)	(0.03)	
Us	0.44	0.96	0.84	0.93	0.83	0.78	0.75	0.81	0.76
	(0.08)	(0.07)	(0.18)	(0.19)	(0.11)	(0.12)	(0.17)	(0.13)	(0.12)

Averages of Means and Standard Deviations.

Ita	Can	Fra	Ger	Uk	Nether	Spa	Swit	SwitTic	Us
0.52	1.30	1.09	1.23	1.10	1.02	0.96	1.06	0.99	1.37
(0.05)	(0.20)	(0.15)	(0.13)	(0.13)	(0.11)	(0.14)	(0.13)	(0.12)	(0.22)

Table 4.20: Mean and Standard Deviation of Bilateral Relative Prices, $DLOP_{jk,t}$ (cont.)

The Economist

	Aus	Bel	Den	Fra	Ger	Neth	Ita	Swe	Swit	Uk	Us
Bel	1.09										
	(0.07)										
Den	1.04	0.95									
	(0.07)	(0.06)									
Fra	1.10	1.01	1.06								
	(0.05)	(0.06)	(0.07)								
Ger	1.04	0.96	1.01	0.95							
	(0.07)	(0.08)	(0.08)	(0.06)							
Neth	1.04	0.98	1.00	0.95	1.00						
	(0.05)	(0.06)	(0.05)	(0.05)	(0.06)						
Ita	0.96	0.89	0.93	0.88	0.93	0.93					
	(0.09)	(0.09)	(0.11)	(0.10)	(0.12)	(0.12)					
Swe	0.94	0.86	0.90	0.85	0.90	0.90	0.98				
	(0.08)	(0.07)	(0.07)	(0.06)	(0.07)	(0.06)	(0.14)				
Swit	0.97	0.89	0.94	0.88	0.93	0.93	1.01	1.04			
	(0.06)	(0.06)	(0.06)	(0.07)	(0.07)	(0.05)	(0.12)	(0.08)			
Uk	1.49	1.37	1.44	1.36	1.44	1.44	1.56	1.60	1.55		
	(0.18)	(0.12)	(0.17)	(0.17)	(0.22)	(0.17)	(0.19)	(0.23)	(0.20)		
Us	1.04	0.95	1.00	0.94	1.00	1.00	1.09	1.10	1.07	0.69	
	(0.24)	(0.20)	(0.22)	(0.20)	(0.20)	(0.20)	(0.29)	(0.20)	(0.24)	(0.14)	
Spa	1.09	1.00	1.06	1.00	1.06	1.06	1.14	1.17	1.13	0.74	1.11
	(0.06)	(0.07)	(0.07)	(0.07)	(0.11)	(0.08)	(0.12)	(0.10)	(0.09)	(0.09)	(0.28)

Averages of Means and Standard Deviations.

Aus	Bel	Den	Fra	Ger	Neth	Ita	Swe	Swit	Uk	Us	Spa
1.07	0.97	1.03	0.96	1.03	1.03	1.12	1.15	1.11	0.69	1.08	0.97
(0.09)	(0.08)	(0.09)	(0.08)	(0.10)	(0.08)	(0.17)	(0.11)	(0.10)	(0.08)	(0.24)	(0.09)

Table 4.21: Import-Currency Price Stabilization Regressions. Businessweek.

Model 1.1

Market	Aus	Bel	Den	Fra	Ger	Neth	Ita	Swe	Uk	Jap	Spa
α_j	0.79	0.94	0.98	0.75	1.08	0.87	0.80	1.10	-0.07	5.56	0.80
	(0.16)	(0.09)	(0.13)	(0.11)	(0.13)	(0.08)	(0.03)	(0.12)	(0.15)	(0.68)	(0.12)
ρ	0.96	0.95	0.90	0.96	0.92	0.95	0.89	0.76	0.95	0.97	0.97
R^2	0.99	0.98	0.97	0.98	0.99	0.98	0.84	0.83	0.97	0.97	0.96
$D.W.$	1.61	1.76	1.96	1.92	1.48	1.71	1.93	2.23	1.87	1.95	2.09

Model 1.2

Market	Aus	Bel	Den	Fra	Ger	Neth	Ita	Swe	Uk	Jap	Spa
α_j	3.83	4.11	1.95	2.18	1.57	1.46	5.58	1.15	-0.07*	5.65	3.73
	(0.36)	(0.64)	(0.33)	(0.32)	(0.06)	(0.16)	(1.18)	(0.22)	(0.15)	(0.68)	(0.83)
$p_{1t}(1)$	0.09*	0.26	0.49	0.41	0.15*	0.15	0.39	1.12	0.42	0.91	1.13
	(0.11)	(0.15)	(0.16)	(0.14)	(0.06)	(0.13)	(0.17)	(0.15)	(0.13)	(0.14)	(0.18)
s_{jt}	-0.77	-0.61	-0.39	-0.62	-0.63	-0.54	-0.40	-0.30	-0.65	-0.55*	-0.50
	(0.13)	(0.02)	(0.15)	(0.16)	(0.05)	(0.14)	(0.16)	(0.11)	(0.17)	(0.13)	(0.17)
ρ	0.96	0.95	0.90	0.96	0.92	0.95	0.89	0.76	0.95	0.97	0.97
R^2	0.99	0.98	0.97	0.98	0.99	0.98	0.84	0.83	0.97	0.97	0.96
$D.W.$	1.92	1.85	1.74	1.84	1.63	1.86	1.85	1.84	1.87	1.95	1.95

Model 1.3

Market	Aus	Bel	Den	Fra	Ger	Neth	Ita	Swe	Uk	Jap	Spa
α_j	4.29	4.16	2.37	2.44	1.65	1.66	3.67	1.28	0.29	5.46	4.07
	(0.20)	(0.31)	(0.26)	(0.23)	(0.06)	(0.12)	(0.75)	(0.13)	(0.11)	(0.46)	(0.22)
s_{jt}	-0.67	-0.45	-0.35	-0.41	-0.54	-0.46	-0.17	-0.22	-0.57	-0.48	-0.30
	(0.07)	(0.08)	(0.12)	(0.11)	(0.05)	(0.09)	(0.10)	(0.05)	(0.12)	(0.09)	(0.04)
ρ	0.83	0.81	0.87	0.91	0.90	0.87	0.82	0.58	0.90	0.92	0.76
R^2	0.99	0.98	0.97	0.98	0.99	0.98	0.84	0.83	0.97	0.97	0.96
$D.W.$	1.80	1.81	1.80	1.91	1.77	1.85	1.96	2.12	1.83	1.89	1.86

* Not statistically significant at 5%

Numbers in parentheses are the s.d. of the estimates

Hypothesis Testing: Equal Parameters across Destinations

	Model 1.1	F-stat	Model 1.2	F-stat	Model 1.3	F-stat
α_j	0.84	1.04*	1.47	6.67	1.60	20.86
	(0.02)		(0.04)		(0.03)	
$p_{1t}(1)$			0.16	2.57		
			(0.04)			
s_{jt}			0.91	1.39*	0.82	2.13*
			(0.04)		(0.05)	

* Not statistically significant at 5%⇒ Constraint not rejected at 5%

Numbers in parentheses are the s.d. of the estimates

Tests Statistics for the Models

	Likelihood Ratio Test			F Tests		
	Chi-squared	d.f.	Prob value	F	num. denom.	Prob value
Model 1.3 vs. Model 1.1	583.12	11	0.00	63.13	11, 1617	0.00
Model 1.3 vs. Model 1.2	876.17	2	0.00	104.46	2, 1617	0.00

Table 4.22: Import-Currency Price Stabilization Regressions. Fortune.

Model 1.1

Market	Aus	Bel	Den	Fra	Ger	Ita	Nether	Spa	Uk
α_j	1.58	1.63	1.56	1.48	1.46	1.48	1.44	1.57	1.35
	(0.11)	(0.13)	(0.09)	(0.09)	(0.14)	(0.07)	(0.10)	(0.15)	(0.06)
ρ	0.96	0.97	0.93	0.92	0.91	0.88	0.90	0.92	0.79
R^2	0.93	0.97	0.92	0.93	0.90	0.86	0.93	0.89	0.85
D.W.	1.88	1.51	1.76	1.71	1.84	1.88	1.81	1.63	1.80

Model 1.3

Market	Aus	Bel	Den	Fra	Ger	Ita	Nether	Spa	Uk
α_j	7.59	8.43	5.14	6.19	6.05*	11.82	9.80	14.65	0.97
	(3.22)	(2.33)	(2.32)	(2.16)	(7.21)	(4.68)	(3.96)	(4.12)	(2.92)
s_{jt}	-0.30	-0.61	-0.38	-0.54	-0.29	-0.42	-0.50	-0.60	-0.49
	(0.24)	(0.18)	(0.22)	(0.21)	(0.38)	(0.27)	(0.24)	(0.21)	(0.29)
$\hat{\rho}$	0.91	0.93	0.93	0.95	0.94	0.91	0.96	0.94	0.92
R^2	0.70	0.87	0.59	0.72	0.40	0.46	0.53	0.88	0.30
D.W.	1.93	1.93	1.95	1.97	1.93	1.93	2.00	1.93	1.90

* Not statistically significant at 5%

Numbers in parentheses are the s.d. of the estimates

Hypothesis Testing:
Equal Parameters across Destinations

	Model 1.1	F-stat	Model 1.3	F-stat
α_j	1.48	1.75*	2.82	26.76
	(0.03)		(0.06)	
s_{jt}			0.42	1.83*
			(0.05)	

* Not statistically significant at 5%⇒

⇒ Constraint not rejected at 5%

Numbers in parentheses are the s.d. of the estimates

Tests Statistics for the Models

	Likelihood Ratio Test			F Tests		
	Chi-squared	d.f.	Prob value	F	num. denom.	Prob value
Model 1.3 vs. Model 1.1	1544.17	9	0.00	236.01	9,1207	0.00
Model 1.3 vs. Model 1.2	921.63	2	0.00	453.52	2,1207	0.00

Table 4.23: Import-Currency Price Stabilization Regressions. Newsweek.

Model 1.1

Market	Aus	Bel	Den	Fra	Ger	Ita	Nether	Swe	Spa	Uk
α_j	0.74	0.54	0.60	0.56	0.65	0.46	0.59	0.58	0.52	-0.06
	(0.11)	(0.06)	(0.07)	(0.10)	(0.07)	(0.13)	(0.07)	(0.10)	(0.11)	(0.23)
ρ	0.98	0.97	0.99	0.98	0.99	0.99	0.96	0.96	0.97	0.97
$\bar{R}^2$	0.98	0.97	0.99	0.97	0.99	0.98	0.99	0.98	0.99	0.99
$D.W.$	2.13	1.78	1.84	2.04	1.89	1.94	2.05	1.75	1.65	1.70

Model 1.3

Market	Aus	Bel	Den	Fra	Ger	Ita	Nether	Swe	Spa	Uk
α_j	1.34	0.55	0.07*	0.39	0.88	-3.55	0.49	0.17*	-0.03*	0.22
	(0.24)	(0.23)	(0.18)	(0.13)	(0.06)	(0.51)	(0.08)	(0.15)	(0.50)	(0.11)
s_{jt}	-0.23	-0.01*	0.25	0.12	-0.29	0.58	-0.09*	0.25	0.12*	-0.36
	(0.09)	(0.06)	(0.09)	(0.07)	(0.07)	(0.07)	(0.09)	(0.08)	(0.11)	(0.14)
ρ	0.91	0.93	0.86	0.94	0.93	0.92	0.84	0.97	0.97	0.97
$\bar{R}^2$	0.98	0.97	0.99	0.97	0.99	0.98	0.99	0.98	0.99	0.99
$D.W.$	1.56	1.66	1.74	1.54	1.92	1.31	1.79	1.55	1.69	1.84

Hypothesis Testing:
Equal Parameters across Destinations

	Model 1.1	F-stat	Model 1.3	F-stat
α_j	0.59	0.73*	0.68	8.71
	(0.04)		(0.06)	
s_{jt}			-0.21	5.90*
			(0.03)	

* Not statistically significant at 5%⇒

⇒ Constraint not rejected at 5%

Numbers in parentheses are the s.d. of the estimates

Tests Statistics for the Models

	Likelihood Ratio Test			F Tests		
	Chi-squared	d.f.	Prob value	F	num. denom.	Prob value
Model 1.3 vs. Model 1.1	110.02	10	0.00	11.249	10, 1890	0.00
Model 1.3 vs. Model 1.2	106.58	2	0.00	10.882	2, 1889	0.00

Table 4.24: Import-Currency Price Stabilization Regressions.Le Figaro.

Model 1.1

Market	Ger	Aus	Bel	Can	IvoC	Spa	Uk	Ita	Lux	Mor	Nether	Sen	Tun
α_j	2.48	3.20	2.12	2.46	18.35	2.31	2.25	2.48	2.13	2.06	2.39	38.51	6.14
	(0.06)	(0.48)	(0.21)	(0.10)	(20.90)	(0.08)	(0.14)	(0.06)	(0.22)	(0.20)	(0.03)	(9.40)	(0.11)
ρ	0.97	0.92	0.94	0.95	0.98	0.96	0.94	0.98	0.92	0.99	0.85	0.97	0.95
R^2	0.99	0.97	0.99	0.96	0.98	0.98	0.98	0.98	0.99	0.97	0.99	0.94	0.96
$D.W.$	2.14	1.93	1.95	2.01	1.92	2.07	1.96	1.93	2.02	1.93	1.82	1.94	1.72

Model 1.3

Market	Ger	Aus	Bel	Can	IvoC	Spa	Uk	Ita	Lux	Mor	Nether	Sen	Tun
α_j	0.54	4.25	2.91	1.18	23.39	2.40	-0.02*	-13.75	3.68	1.96	0.74	25.79	6.28
	(0.17)	(0.12)	(0.59)	(0.07)	(19.84)	(0.78)	(0.35)	(2.28)	(0.62)	(0.01)	(0.19)	(32.55)	(0.06)
s_{jt}	-1.38	-1.12	-0.40	-0.84	-1.77	-0.03*	-0.96	0.94	-0.81	-0.84	-1.47	-1.69	-0.41
	0.16)	(0.13)	(0.31)	(0.05)	(5.07)	(0.27)	(0.15)	(0.43)	(0.33)	(0.06)	(0.20)	(8.32)	(0.13)
ρ	0.84	0.85	0.83	0.90	0.88	0.95	0.95	0.89	0.84	0.71	0.82	0.78	0.94
R^2	0.99	0.97	0.99	0.96	0.98	0.98	0.98	0.98	0.99	0.97	0.99	0.94	0.96
$D.W.$	2.06	1.83	1.93	2.01	1.92	2.02	1.86	1.97	1.90	1.85	1.93	1.96	1.94

* Not statistically significant at 5%

Numbers in parentheses are the s.d. of the estimates

Hypothesis Testing:
Equal Parameters across Destinations

	Model 1.1	F-stat	Model 1.3	F-stat
α_j	2.38	1.01*	1.66	46.86
	(0.04)		(0.01)	
s_{jt}			0.72	3.94
			(0.05)	

* Not statistically significant at 5%⇛

⇛ Constraint not rejected at 5%

Numbers in parentheses are the s.d. of the estimates

Tests Statistics for the Models

	Likelihood Ratio Test			F Tests		
	Chi-squared	d.f.	Prob value	F	num. denom.	Prob value
Model 1.3 vs. Model 1.1	3421.74	13	0.00	834.79	13, 1692	0.00
Model 1.3 vs. Model 1.2	3851.16	2	0.00	1109.96	2,1691	0.00

Table 4.25: Import-Currency Price Stabilization Regressions. Le Nouvel Observateur.

Model 1.1

Market	Bel	Can	Spa	Ita	IvoC.	Tun	Sen	Mor	Us
α_j	2.33	2.93	2.50	2.82	3.14	-1.43*	2.84	2.05	2.99
	(0.45)	(0.30)	(0.38)	(0.20)	(0.23)	(2.87)	(0.24)	(0.67)	(0.19)
ρ	0.93	0.95	0.98	0.95	0.88	0.94	0.95	0.88	0.91
R^2	0.98	0.99	0.98	0.97	0.98	0.95	0.94	0.94	0.95
$D.W.$	1.97	1.35	2.00	1.93	1.95	2.00	1.79	2.14	1.57

Model 1.2

Market	Bel	Can	Spa	Ita	IvoC.	Tun	Sen	Mor	Us
α_j	3.01	0.41	1.98	1.49	-8.98*	5.88	4.08*	1.61	0.56
	(0.68)	(0.14)	(0.46)	(2.10)	(21.49)	(0.14)	(13.68)	(0.09)	(0.09)
$p_{1t}(1)$	0.66	0.37	0.71	0.62	0.75	0.49	0.54	0.36	0.28
	(0.04)	(0.04)	(0.04)	(0.07)	(0.05)	(0.06)	(0.05)	(0.04)	(0.03)
s_{jt}	-1.12	-0.90	-0.37	-0.04*	0.54*	-1.08	-0.71	-0.78	-0.91
	(0.32)	(0.06)	(0.17)	(0.40)	(5.49)	(0.12)	(3.50)	(0.08)	(0.04)
ρ	0.93	0.95	0.88	0.95	0.88	0.94	0.95	0.88	0.91
R^2	0.98	0.99	0.98	0.97	0.98	0.95	0.94	0.94	0.95
$D.W.$	1.88	1.93	1.91	1.93	1.85	1.88	1.98	1.82	2.01

Model 1.3

Market	Bel	Can	Spa	Ita	IvoC.	Tun	Sen	Mor	Us
α_j	3.61	1.25	4.99	2.14	-6.55*	7.11	8.95	2.24	1.11
	(0.66)	(0.11)	(0.40)	(1.81)	(17.74)	(0.11)	(14.62)	(0.10)	(0.12)
s_{jt}	-1.25	-0.97	-0.24	0.12*	0.25*	-0.83	-1.30	-0.78	-0.92
	(0.32)	(0.04)	(0.13)	(0.35)	(4.53)	(0.08)	(3.74)	(0.07)	(0.04)
ρ	0.93	0.80	0.92	0.86	0.82	0.74	0.87	0.88	0.91
R^2	0.98	0.99	0.98	0.97	0.98	0.95	0.94	0.94	0.95
$D.W.$	1.88	1.93	1.91	1.86	1.78	1.88	1.96	2.02	2.01

* Not statistically significant at 5%
Numbers in parentheses are the s.d. of the estimates

Hypothesis Testing: Equal Parameters across Destinations

	Model 1.1	F-stat	Model 1.2	F-stat	Model 1.3	F-stat
α_j	2.26	142.6*	1.55	64.45	2.77	20.84*
	(0.04)		(0.07)		(0.05)	
$p_{1t}(1)$			0.36	13.77		
			(0.02)			
s_{jt}			0.88	1.38*	0.87	2.63
			(0.03)		(0.05)	

* Not statistically significant at 5% ⇒ Constraint not rejected at 5%
Numbers in parentheses are the s.d. of the estimates

Tests Statistics for the Models

	Likelihood Ratio Test			F Tests		
	Chi-squared	d.f.	Prob value	F	num. denom.	Prob value
Model 1.3 vs. Model 1.1	4026.92	9	0.00	1735.13	9, 1738	0.00
Model 1.3 vs. Model 1.2	4333.37	2	0.00	2102.95	2, 1737	0.00

Table 4.26: Import-Currency Price Stabilization Regressions. Le Point.

Model 1.1

Market	Bel	Can	Spa	Ita	Ger	Us	Mor	Tun	Sen	IvoC	Lux
α_j	2.16	2.61	2.36	2.82	1.08	0.56	0.02*	-2.43	2.92	2.93	1.82
	(0.39)	(0.27)	(0.36)	(0.17)	(0.07)	(0.08)	(0.73)	(3.18)	(0.15)	(0.07)	(0.44)
ρ	0.95	0.90	0.94	0.93	0.93	0.90	0.89	0.98	0.90	0.89	0.94
R^2	0.98	0.99	0.98	0.96	0.94	0.99	0.98	0.95	0.97	0.97	0.98
D.W.	2.12	1.96	2.18	2.12	2.39	1.95	2.06	2.03	1.85	1.97	2.03

Model 1.2

Market	Bel	Can	Spa	Ita	Ger	Us	Mor	Tun	Sen	IvoC	Lux
α_j	2.59	0.27	1.73	-1.10*	1.08	0.56	1.03	5.48	12.60*	13.38*	2.61
	(0.57)	(0.10)	(0.37)	(2.01)	(0.07)	(0.08)	(0.10)	(0.08)	(19.94)	(20.91)	(0.61)
$p_{1t}(1)$	0.57	0.36	0.70	0.75	0.24	0.27	0.45	0.51	0.62	0.72	0.54
	(0.04)	(0.02)	(0.03)	(0.07)	(0.03)	(0.02)	(0.04)	(0.04)	(0.04)	(0.04)	(0.05)
s_{jt}	-0.82	-0.90	-0.33	0.36*	-0.92	-0.81	-0.58	-0.99	-1.73*	-3.16*	-0.82
	(0.26)	(0.06)	(0.14)	(0.39)	(0.09)	(0.04)	(0.10)	(0.09)	(5.10)	(5.35)	(0.28)
ρ	0.85	0.90	0.84	0.93	0.93	0.90	0.89	0.88	0.90	0.89	0.90
R^2	0.98	0.99	0.98	0.96	0.94	0.99	0.98	0.95	0.97	0.97	0.98
D.W.	1.90	1.76	1.78	2.07	1.94	1.86	2.03	2.03	1.75	1.87	2.03

Model 1.3

Market	Bel	Can	Spa	Ita	Ger	Us	Mor	Tun	Sen	IvoC	Lux
α_j	3.90	0.97	2.48	-0.24*	1.40	1.20	2.38	6.80	9.86	9.71	4.41
	(0.51)	(0.11)	(0.38)	(1.78)	(0.09)	(0.08)	(0.11)	(0.12)	(17.27)	(16.66)	(0.48)
s_{jt}	-0.90	-0.85	-0.18	0.46	-1.03	-0.79	-0.76	-0.91	-1.82	-1.35	-1.28
	(0.25)	(0.05)	(0.13)	(0.34)	(0.09)	(0.03)	(0.07)	(0.09)	(4.42)	(4.26)	(0.23)
ρ	0.85	0.85	0.85	0.94	0.91	0.87	0.85	0.90	0.88	0.89	0.87
R^2	0.98	0.99	0.98	0.96	0.94	0.99	0.98	0.95	0.97	0.97	0.98
D.W.	1.90	1.88	1.93	2.07	2.09	2.08	2.22	2.13	1.67	1.87	2.19

Hypothesis Testing: Equal Parameters across Destinations

	Model 1.1	F-stat	Model 1.2	F-stat	Model 1.3	F-stat
α_j	2.64	3.72	1.71	86.45	2.08	232.40
	(0.02)		(0.11)		(0.03)	
$p_{1t}(1)$			0.25	34.24		
			(0.01)			
s_{jt}			0.82	2.06*	0.65	3.05
			(0.02)		(0.01)	

* Not statistically significant at 5% ⇒ Constraint not rejected at 5%
Numbers in parentheses are the s.d. of the estimates

Tests Statistics for the Models

	Likelihood Ratio Test			F Tests		
	Chi-squared	d.f.	Prob value	F	num. denom.	Prob value
Model 1.3 vs. Model 1.1	4308.24	11	0.00	1128.34	11, 2314	0.00
Model 1.3 vs. Model 1.2	1595.89	2	0.00	1139.42	2, 2314	0.00

Table 4.27: Import-Currency Price Stabilization Regressions. L'Express.

Model 1.1

Market	Ger	Aus	Spa	Us	Uk	Ita	Nether
α_j	2.52	2.73	2.37	2.57	2.27	2.45	2.47
	(0.04)	(0.22)	(0.10)	(0.13)	(0.14)	(0.05)	(0.02)
ρ	0.90	0.91	0.92	0.95	0.89	0.93	0.88
R^2	0.98	0.98	0.98	0.99	0.97	0.96	0.98
D.W.	1.89	1.73	1.77	1.82	2.04	1.74	2.03

Model 1.2

α_j	0.94	4.13	0.43*	0.15	-1.33	-4.53	1.00
	(0.16)	(0.50)	(0.84)	(0.17)	(0.46)	(3.01)	(0.16)
$p_{1t}(1)$	0.13	0.14	0.48	0.32	0.31	0.60	0.14
	(0.05)	(0.11)	(0.09)	(0.06)	(0.07)	(0.10)	(0.05)
s_{jt}	-1.29	-1.46	0.28*	-0.95	-1.25	1.05	-1.26
	(0.15)	(0.30)	(0.32)	(0.06)	(0.18)	(0.58)	(0.16)
ρ	0.95	0.90	0.90	0.93	0.93	0.93	0.95
R^2	0.98	0.98	0.98	0.99	0.97	0.96	0.98
D.W.	1.90	1.88	1.73	1.79	1.80	1.85	1.86

Model 1.3

α_j	1.18	5.38	1.81	0.67	-1.05	-11.20	1.35
	(0.10)	(0.39)	(0.78)	(0.15)	(0.37)	(2.30)	(0.09)
s_{jt}	-1.41	-1.39	0.07*	-0.97	-1.33	1.47	-1.21
	(0.11)	(0.25)	(0.29)	(0.06)	(0.14)	(0.44)	(0.12)
ρ	0.76	0.91	0.72	0.86	0.85	0.83	0.86
R^2	0.98	0.98	0.98	0.99	0.97	0.96	0.98
D.W.	1.87	1.88	1.73	1.79	1.80	1.66	2.04

* Not statistically significant at 5%
Numbers in parentheses are the s.d. of the estimates

Hypothesis Testing: Equal Parameters across Destinations

	Model 1.1	F-stat	Model 1.2	F-stat	Model 1.3	F-stat
α_j	2.47	1.44*	0.83	1.71*	1.04	29.74
	(0.04)		(0.08)		(0.05)	
$p_{1t}(1)$			0.20	3.73		
			(0.03)			
s_{jt}			0.92	5.63	1.17	10.11
			(0.05)		(0.03)	

* Not statistically significant at 5% ⇒ Constraint not rejected at 5%
Numbers in parentheses are the s.d. of the estimates

Tests Statistics for the Models

	Likelihood Ratio Test			F Tests		
	Chi-squared	d.f.	Prob value	F	num. denom.	Prob value
Model 1.3 vs. Model 1.1	304.655	7	0.00	50.137	7, 1022	0.00
Model 1.3 vs. Model 1.2	337.456	2	0.00	56.416	2, 1021	0.00

Table 4.28: Import-Currency Price Stabilization Regressions. Il Mondo.

Market	Can	Fra	Ger	Uk	Nether	Spa	SwitTic	Us
Model 1.1								
a_j	8.35	8.33	8.38	8.33	8.18	8.14	8.21	8.31
	(0.10)	(0.02)	(0.05)	(0.03)	(0.05)	(0.11)	(0.08)	(0.15)
ρ	0.90	0.85	0.86	0.85	0.82	0.84	0.90	0.96
R^2	0.98	0.97	0.98	0.97	0.99	0.98	0.97	0.98
D.W.	1.81	1.89	1.66	1.80	2.01	1.99	1.78	1.84
Model 1.2								
a_j	0.65	0.40*	-3.16	-4.74	-1.19	-0.71	-0.93	0.13*
	(0.40)	(2.10)	(0.40)	(1.09)	(0.60)	(0.32)	(0.43)	(0.69)
$p_{it}(1)$	0.47	1.10	0.43	0.80	0.49	1.14	0.40	0.36
	(0.03)	(0.05)	(0.03)	(0.04)	(0.05)	(0.02)	(0.04)	(0.05)
s_{jt}	-0.60	0.11*	-1.27	-0.90	-0.89*	0.06*	-0.91	-0.78
	(0.06)	(0.43)	(0.08)	(0.14)	(0.14)	(0.10)	(0.08)	(0.10)
ρ	0.80	0.79	0.86	0.85	0.82	0.64	0.90	0.96
R^2	0.98	0.97	0.98	0.97	0.99	0.98	0.97	0.98
D.W.	1.81	2.38	2.46	2.16	2.01	2.40	2.07	1.84
Model 1.3								
a_j	5.41	3.68	1.72	4.12	2.46	6.14	3.40	3.27
	(0.66)	(1.73)	(0.40)	(1.18)	(0.77)	(0.44)	(0.43)	(0.74)
s_{jt}	-0.37	-0.72	-0.99	-0.53	-0.92	-0.40	-0.82	-0.72
	(0.06)	(0.33)	(0.07)	(0.14)	(0.13)	(0.11)	(0.07)	(0.09)
ρ	0.83	0.82	0.92	0.91	0.89	0.78	0.92	0.97
R^2	0.98	0.97	0.98	0.97	0.99	0.98	0.97	0.98
D.W.	1.81	1.92	1.83	1.95	2.01	1.66	2.03	1.94

* Not statistically significant at 5%
Numbers in parentheses are the s.d. of the estimates

Hypothesis Testing: Equal Parameters across Destinations

	Model 1.1	F-stat	Model 1.2	F-stat	Model 1.3	F-stat
a_j	8.40	19.12	0.83	13.75	3.47	9.52
	(0.02)		(0.08)		(0.16)	
$p_{it}(1)$			0.19	29.85		
			(0.03)			
s_{jt}			0.87	13.48	0.70	8.75
			(0.05)		(0.02)	

* Not statistically significant at 5% ⇒ Constraint not rejected at 5%
Numbers in parentheses are the s.d. of the estimates

Tests Statistics for the Models

	Likelihood Ratio Test			F Tests		
	Chi-squared	d.f.	Prob value	F	num. denom.	Prob value
Model 1.3 vs. Model 1.1	395.67	8	0.00	57.11	8, 1321	0.00
Model 1.3 vs. Model 1.2	435.30	2	0.00	63.77	2, 1320	0.00

Table 4.29: Import-Currency Price Stabilization Regressions. The Economist.

Model 1.1

Market	Aus	Bel	Den	Fra	Ger	Neth	Ita	Swe	Us	Spa
α_j	0.45	0.31	0.37	0.33	0.39	0.37	0.47	0.51	0.94	0.35
	(0.06)	(0.06)	(0.06)	(0.07)	(0.05)	(0.05)	(0.08)	(0.08)	(0.05)	(0.09)
ρ	0.98	0.96	0.96	0.87	0.96	0.97	0.88	0.84	0.91	0.95
R^2	0.98	0.97	0.98	0.99	0.97	0.97	0.98	0.99	0.95	0.98
$D.W.$	1.88	1.91	1.96	2.08	1.72	1.87	1.87	1.96	1.97	1.91

Model 1.2

Market	Aus	Bel	Den	Fra	Ger	Neth	Ita	Swe	Us	Spa
α_j	3.69	2.30	1.82	2.57	1.75	1.34	5.46	2.42	0.94	5.06
	(0.22)	(0.40)	(0.28)	(0.15)	(0.09)	(0.08)	(0.97)	(0.27)	(0.05)	(0.30)
$p_{it}(1)$	0.50	0.85	0.84	0.87	0.40	0.62	1.09	0.81	0.45	1.06
	(0.03)	(0.03)	(0.04)	(0.02)	(0.03)	(0.03)	(0.05)	(0.03)	(0.04)	(0.03)
s_{jt}	-1.02	-0.47	-0.58	-0.97	-1.10	-0.71	-0.65	-0.83	-1.00	-0.91
	(0.07)	(0.10)	(0.11)	(0.06)	(0.07)	(0.06)	(0.13)	(0.12)	(0.09)	(0.06)
ρ	0.93	0.87	0.94	0.78	0.92	0.93	0.88	0.84	0.91	0.85
R^2	0.98	0.97	0.98	0.99	0.97	0.97	0.98	0.99	0.95	0.98
$D.W.$	1.88	1.81	1.92	1.75	1.90	1.94	1.90	1.74	1.97	1.81

Model 1.3

Market	Aus	Bel	Den	Fra	Ger	Neth	Ita	Swe	Us	Spa
α_j	3.75	2.44	2.02	2.68	1.74	1.32	7.48	2.69	0.93	5.22
	(0.20)	(0.40)	(0.28)	(0.14)	(0.08)	(0.09)	(0.86)	(0.27)	(0.05)	(0.31)
s_{jt}	-1.04	-0.61	-0.66	-1.02	-1.09	-0.69	-0.92	-0.95	-0.99	-0.94
	(0.06)	(0.09)	(0.11)	(0.06)	(0.07)	(0.06)	(0.11)	(0.12)	(0.09)	(0.06)
ρ	0.89	0.86	0.94	0.78	0.92	0.93	0.88	0.84	0.91	0.85
R^2	0.98	0.97	0.98	0.99	0.97	0.97	0.98	0.99	0.95	0.98
$D.W.$	1.88	1.86	1.92	1.85	1.91	1.94	1.95	1.79	1.97	1.81

* Not statistically significant at 5%
Numbers in parentheses are the s.d. of the estimates

Hypothesis Testing: Equal Parameters across Destinations

	Model 1.1	F-stat	Model 1.2	F-stat	Model 1.3	F-stat
α_j	0.57	2.18*	1.50	14.59	1.53	15.89
	(0.03)		(0.06)		(0.06)	
$p_{it}(1)$			0.64	44.14		
			(0.02)			
s_{jt}			0.91	6.14	0.94	4.72
			(0.03)		(0.03)	

* Not statistically significant at 5% ⇒ Constraint not rejected at 5%
Numbers in parentheses are the s.d. of the estimates

Tests Statistics for the Models

	Likelihood Ratio Test			F Tests		
	Chi-squared	d.f.	Prob value	F	num. denom.	Prob value
Model 1.3 vs. Model 1.1	200.43	10	0.00	21.01	10, 1857	0.00
Model 1.3 vs. Model 1.2	262.49	2	0.00	27.97	2, 1856	0.00

Table 4.30: Real Exchange Rate Pass-through Tests.†

Businessweek

Period	Aus	Bel	Den	Fra	Ger	Neth	Ita	Swe	Swit	Uk	Jap	Spa
1981-92	-0.52	-0.42	-0.60	-0.59	-0.48	-0.68	-0.32	-0.26	-0.77	-0.70	-0.59	-0.60
	(0.18)	(0.16)	(0.20)	(0.13)	(0.29)	(0.17)	(0.18)	(0.21)	(0.19)	(0.08)	(0.10)	(0.22)
1981-84	-0.38	-0.39	-0.48	-0.41	-0.39	-0.42	-0.25	-0.21	-0.67	-0.23	-0.65	-0.34
	(0.57)	(0.60)	(0.73)	(0.25)	(0.29)	(0.28)	(0.77)	(0.39)	(0.39)	(0.07)	(0.09)	(0.10)
1985-92	-0.61	-0.51	-0.66	-0.62	-0.61	-0.68	-0.54	-0.41	-0.81	-0.78	-0.89	-0.53
	(0.45)	(0.39)	(0.80)	(0.21)	(0.15)	(0.11)	(0.25)	(1.22)	(1.67)	(0.13)	(0.14)	(1.44)

Fortune

Period	Aus	Bel	Den	Fra	Ger	Neth	Ita	Swe	Swit	Uk	Jap	Spa
1983-92	-0.38	-0.62	-0.47	-0.71	-0.49	-0.53	-0.53		-0.58	-0.62	-0.77	-0.37
	(0.49)	(0.09)	(0.31)	(0.21)	(0.10)	(0.20)	(0.15)		(0.19)	(0.22)	(0.18)	(0.31)
1983-84	-0.23	-0.10	-0.04	-0.32	-0.30	-0.44	-0.34		-0.48	-0.21	-0.47	-0.32
	(0.23)	(0.10)	(0.41)	(0.21)	(0.23)	(0.09)	(0.06)		(0.15)	(0.18)	(0.24)	(0.10)
1985-92	-1.15	-1.05	-0.80	-0.69	-1.03	-0.93	-0.62		-0.69	-0.89	-0.33	-0.56
	(0.21)	(0.19)	(0.05)	(0.10)	(0.21)	(0.13)	(0.26)		(0.08)	(0.12)	(0.21)	(0.11)

Newsweek

Period	Aus	Bel	Den	Fra	Ger	Neth	Ita	Swe	Swit	Uk	Jap	Spa
1977-92	-0.38	-0.46	-0.21	-0.32	-0.41	-0.19	-0.21	-0.20	-0.76	-0.54		-0.38
	(0.11)	(0.08)	(0.05)	(0.10)	(0.08)	(0.14)	(0.16)	(0.07)	(0.07)	(0.12)		(0.10)
1981-84	-0.69	-0.60	-0.73	-0.11	-0.75	-0.60	-0.18	-0.25	-0.70	-0.62		-0.35
	(0.12)	(0.15)	(0.20)	(0.19)	(0.29)	(0.14)	(0.18)	(0.14)	(0.21)	(0.11)		(0.10)
1985-92	-0.69	-0.40	-0.43	-0.71	-0.67	-0.64	-0.69	-0.75	-1.05	-0.89		-0.70
	(0.10)	(0.21)	(0.11)	(0.21)	(0.30)	(0.18)	(0.14)	(0.15)	(0.23)	(0.12)		(0.10)

The Economist

Period	Aus	Bel	Den	Fra	Ger	Neth	Ita	Swe	Swit	US	Jap	Spa
1978-92	-0.86	-0.85	-0.72	-0.60	-0.78	-0.79	-0.60	-0.84	-0.76	-0.41		-0.78
	(0.13)	(0.20)	(0.14)	(0.24)	(0.11)	(0.11)	(0.32)	(0.26)	(0.16)	(0.21)		(0.15)
1978-84*	-0.74	-0.54	-0.44	-0.54	-0.11	-0.04	-0.62	-0.77	0.16	-1.10		-0.48
	(0.16)	(0.21)	(0.13)	(0.25)	(0.11)	(0.14)	(0.26)	(0.23)	(0.15)	(0.24)		(0.12)
1985-92**	-1.10	-0.90	-1.11	-0.91	-1.21	-1.17	-0.87	-1.03	-1.24	-0.59		-0.88
	(0.19)	(0.25)	(0.18)	(0.27)	(0.14)	(0.15)	(0.23)	(0.30)	(0.11)	(0.28)		(0.13)

Le Figaro

Period	Ger	Aus	Bel	Can	Spa	Uk	Us	Ita	Lux	Nether	Swit
1978-88	-1.10	-1.35	-0.72	-0.45	-0.29	-0.92		-0.35	-1.30	-1.54	-0.94
	(0.01)	(0.06)	(0.01)	(0.03)	(0.01)	(0.05)		(0.01)	(0.02)	(0.01)	(0.04)
1982-88	-1.03	-0.65	-0.42	-1.20	-0.55	-1.11		-0.73	-1.14	-1.69	-1.21
	(0.02)	(0.05)	(0.02)	(0.05)	(0.02)	(0.06)		(0.02)	(0.01)	(0.01)	(0.03)

Le Nouvel Observateur

Period	Ger	Aus	Bel	Can	Spa	Uk	Us	Ita	Lux	Nether	Swit
1977-92			-0.80	-0.84	-0.69		-0.88	-0.21			-0.63
			(0.24)	(0.09)	(0.34)		(0.09)	(0.20)			(0.15)
1982-87			-0.97	-0.62	-0.36		-0.58	-0.35			-0.11
			(0.27)	(0.11)	(0.24)		(0.10)	(0.15)			(0.24)
1988-92			-1.17	-1.07	-0.94		-1.33	-0.85			-1.21
			(0.19)	(0.13)	(0.20)		(0.05)	(0.13)			(0.10)

Le Point

Period	Ger	Aus	Bel	Can	Spa	Uk	Us	Ita	Lux	Nether	Swit
1976-92	-0.89		-0.74	-0.58	-0.31		-0.50	-0.29			-0.78
	(0.21)		(0.15)	(0.11)	(0.21)		(0.09)	(0.18)			(0.09)
1982-87	-0.72		-0.41	-0.15	-0.27		-0.30	-0.57			-0.88
	(0.17)		(0.14)	(0.15)	(0.28)		(0.13)	(0.11)			(0.15)
1988-92	-1.06		-1.11	-1.06	-0.74		-1.03	-0.60			0.68
	(0.26)		(0.20)	(0.19)	(0.17)		(0.09)	(0.31)			(0.07)

L'Express

Period	Ger	Aus	Bel	Can	Spa	Uk	Us	Ita	Lux	Nether	Swit
1978-88	-1.19	-1.25			-0.13	-1.01	-0.64	-0.25		-1.16	-0.65
	(0.21)	(0.58)			(0.31)	(0.24)	(0.13)	(0.47)		(0.18)	(0.16)
1982-88	-1.06	-0.57			-0.85	-0.47	-0.31	-0.83		-1.14	-0.87
	(0.34)	(0.69)			(0.39)	(0.44)	(0.23)	(0.52)		(0.25)	(0.29)

Il Mondo

Period	Ger	Aus	Bel	Can	Spa	Uk	Us	Ita	Fra	Nether	Swit†
1981-92	-1.21			-0.42	-0.45	-0.95	-0.55		-0.97	-0.61	-0.83
	(0.19)			(0.21)	(0.25)	(0.28)	(0.11)		(0.31)	(0.31)	(0.06)
1981-87	-1.01			-0.13	0.82	-0.38	-0.35		-0.74	-0.18	-0.10
	(0.19)			(0.14)	(0.30)	(0.20)	(0.01)		(0.33)	(0.16)	(0.09)
1988-92	-0.48			-0.38	-0.15	-1.11	-0.78		-0.16	-1.57	0.33
	(0.10)			(0.34)	(0.05)	(0.48)	(0.44)		(0.36)	(0.38)	(0.15)

† Numbers in parentheses are the s.d. of the estimates. Estimation sub-samples for the US are 1981-1984, 1985-19##, depending on the ending dates of the series in each magazine. (*) 1978-1981 for Austria, Germany, Nether-

Table 4.31: Cointegration Tests (ADF) †.

	Busweek	**Le Nou Ob**	**Le Point**	**L'Expres**	**Il Mondo**	**Economist**
C.V.	**-3.44**	**-3.43**	**-3.43**	**-3.44**	**-3.43**	**-3.44**
Aus	-2.40			-1.67		-3.08
	-2.49			-2.82		-3.02
Bel	-1.91	-1.79	-2.35			-2.83
	-3.12	-3.44*	-4.68*			-3.99*
Den	-2.69					-2.37
	-2.65					-3.55*
Fra	-2.40				-2.22	-2.38
	-3.22				-3.44*	-3.36
Ger	-2.62		-2.37	-1.77	-0.18	-3.47*
	-2.86		-4.73*	-2.88	-4.08*	-3.53*
Neth	-1.72			-1.89	-2.61	-3.45*
	-3.65*			-2.67	-3.44*	-3.49*
Ita	-2.22	-1.86	-1.55	-2.55		-2.21
	-3.45*	-4.21*	-4.56*	-3.29		-4.26*
Swe	-2.45					-3.51*
	-3.46*					-3.95*
Swit	-2.44	-1.88	-3.11	-1.84	-2.23[a]	-3.79*
	-2.95	-3.28	-4.04*	-3.55*	-3.82*[b]	-3.59*
Uk	-2.02			-2.12	-2.92	
	-2.75			-2.51	-3.46*	
Us		-1.77	-1.73	-2.44	-2.13	-2.03
		-2.73	-3.62	-1.46	-2.56	-3.89*
Can		-1.74	-2.23		-2.44	
		-2.95	-3.81*		-3.64*	
Spa	-1.72	-3.12	-3.83*	-1.89	-1.59	-2.27
	-3.30	-4.02*	-4.09*	-3.07	-3.46*	-3.98*
Mor		-1.99	-2.12			
		-3.53*	-4.46*			
Sen		-2.57	-2.78			
		-4.99*	-4.46*			
Ivo		-2.56	-2.97			
		-5.12*	-5.38*			
Tun		-0.61	-1.19			
		-4.49*	-3.92*			
Lux			-2.13			
			-4.43*			

† First row, ADF unrestricted test on the residual obtained from a regression of $w_{jt}(1)$ on $p_{it}(1)$. Second row, ADF test for the first difference specification, Model 4.1

* Statistically significant at 5%

[a] In Swit Ticino, t-stat=-3.63*

[b] In Swit Ticino, t-stat=-3.14

Table 4.32: Logit Estimates of the (W_i, W_d) Pricing Scheme: **Cross-Magazine Models (Type I)**. 1981-1992†

	Model A.1	Model A.2	Model A.3	Model B.1	Model B.2	Model B.3
		Belgium			**Germany**	
$\tilde{T}^j_{nt}$		0.76	-0.34		0.14	0.61
		(1.46)	(-1.40)		(0.27)	(1.82)
$\mathbf{P}^j_t$	125.76	196.57		-92.09	-138.83	
	(3.28)	(3.02)		(-0.90)	(-1.36)	
$SINC^j_{nt}$	3.33	3.85		3.12	3.11	
	(8.50)	(7.68)		(7.95)	(7.45)	
$\dot{\mathbf{P}}^j_t$		3.89	9.96		8.54	3.08
		(1.15)	(3.57)		(1.89)	(1.46)
$\Delta P^j_{n\tau-1}$		-0.22	-1.69		6.98	12.79
		(-0.86)	(-1.61)		(0.51)	(1.37)
$\mu^j_{s,nt}$	3.46	16.61		-3.16	4.32	
	(0.16)	(0.77)		(-0.13)	(0.16)	
$\sigma^j_{s,nt}$	0.05	-0.02		-0.09	-0.08	
	(0.28)	(-0.12)		(-0.80)	(-0.36)	
$\tilde{\mu}^j_{s,nt}$		2.19	1.70		-0.59	-0.95
		(2.11)	(2.28)		(-0.14)	(-0.31)
log L^c	-140.14	-58.77	-65.74	-104.61	-47.64	-49.72
		Italy			**Spain**	
$\tilde{T}^j_{nt}$		1.05	-0.36		0.18	0.25
		(1.42)	(-1.01)		(0.35)	(0.92)
$\mathbf{P}^j_t$	100.77	293.49		33.77	-21.56	
	(1.63)	(2.41)		(1.09)	(-0.44)	
$SINC^j_{nt}$	2.90	3.09		4.02	4.57	
	(9.35)	(7.83)		(9.59)	(8.36)	
$\dot{\mathbf{P}}^j_t$		-7.95	4.35		-8.53	-5.51
		(-1.80)	(0.91)		(-2.13)	(-2.23)
$\Delta P^j_{n\tau-1}$		-3.08	-1.25		-5.44	-6.92
		(1.60)	(1.43)		(-1.25)	(-1.86)
$\mu^j_{s,nt}$	20.45	34.83		5.12	65.15	
	(0.96)	(1.40)		(0.28)	(2.42)	
$\sigma^j_{s,nt}$	-0.10	-0.11		0.12	0.05	
	(-0.30)	(-0.48)		(0.30)	(0.23)	
$\tilde{\mu}^j_{s,nt}$		18.72	19.94		22.32	13.65
		(4.59)	(6.78)		(4.51)	(5.50)
log L^c	-125.78	-64.68	-86.71	-179.42	-59.44	-77.34
		Switzerland			**U.S.**	
$\tilde{T}^j_{nt}$		-1.24	0.04		0.17	0.01
		(-1.76)	(0.15)		(0.30)	(0.02)
$\mathbf{P}^j_t$	363.83	258.00		69.24	102.02	
	(1.86)	(1.87)		(0.34)	(0.46)	
$SINC^j_{nt}$	4.81	6.18		2.01	2.00	
	(6.23)	(4.97)		(6.07)	(5.91)	
$\dot{\mathbf{P}}^j_t$		31.65	2.97		-0.36	1.12
		(2.28)	(0.53)		(-0.04)	(0.15)
$\Delta P^j_{n\tau-1}$		16.53	3.70		-2.64	-3.11
		(1.88)	(0.53)		(-1.90)	(-1.98)
$\mu^j_{s,nt}$	-27.32	-21.22		-35.43	-29.42	
	(-0.80)	(-0.67)		(-1.88)	(-1.42)	
$\sigma^j_{s,nt}$	0.02	0.04		0.25	0.20	
	(-0.30)	(-0.48)		(2.21)	(1.90)	
$\tilde{\mu}^j_{s,nt}$		1.35	-0.99		-3.41	-4.20
		(0.32)	(-0.45)		(-1.53)	(-2.06)
log L^c	-114.58	-47.80	-43.27	-72.67	-51.22	52.75

† The numbers in parenthesis are asymptotic t-statistics.

Table 4.33: Logit Estimates of the Average Fixed Effect ($\bar{\theta}_T$ and $\bar{\theta}_T^*$) of the (W_t, W_d) Pricing Scheme: **Cross-Magazine Model I.A.3.** 1981-1992†

Period	$\bar{\theta}_T$	$\bar{\theta}_T^*$	$\%\Delta P_r$	I_T	$\bar{P}_T^j$	$\bar{S}_{nT}^j$	$\bar{\theta}_T$	$\bar{\theta}_T^*$	$\%\Delta P_r$	I_T	$\bar{P}_T^j$	$\bar{S}_{nT}^j$
			Belgium						**Germany**			
1981-84	-5.87	-7.70	11.95	3.33	10.23	-23.99	-1.78	-2.09	8.31	3.33	3.89	-0.15
					(0.55)	(1.04)					(0.13)	(1.07)
1984-87	-3.24	-4.17	8.22	3.67	3.71	22.24	-4.30	-2.98	5.47	2.67	1.72	30.35
					(0.34)	(1.00)					(0.08)	(1.06)
1988-91	-1.93	-2.20	6.37	5.33	4.21	8.52	-7.57	-7.32	6.42	2.33	2.60	6.46
					(0.41)	(1.07)					(0.29)	(1.07)
Hausman Test*=17.12							Hausman Test=30.10					
			Italy						**Spain**			
1981-84	-3.66	-7.47	13.56	5.00	13.37	-25.02	-4.48	-4.51	12.22	4.67	18.01	-28.72
					(0.23)	(1.01)					(0.33)	(1.07)
1984-87	-3.72	-8.92	9.24	4.67	5.79	10.29	-3.47	-3.79	8.09	6.67	11.03	10.4
					(0.13)	(1.04)					(0.25)	(0.85)
1988-91	-3.28	-7.37	9.55	4.67	5.32	4.65	-3.66	-3.16	10.01	7.67	8.03	9.30
					(0.40)	(0.96)					(0.61)	(0.93)
Hausman Test=4.20							Hausman Test=4.48					
			Switzerland						**US**			
1981-84	-8.16	-7.31	9.01	2.33	4.18	13.08	-6.84	-4.11	8.10	1.33	5.02	65.27
					(0.15)	(1.20)					(0.18)	(0.92)
1984-87	-6.78	-4.08	6.39	2.67	2.16	26.43	-3.93	-2.23	7.79	2.00	3.22	-38.44
					(0.08)	(1.07)					(0.09)	(1.25)
1988-91	-3.71	-2.98	5.05	3.07	4.02	-0.11	-1.51	-0.85	6.80	2.33	3.37	8.55
					(0.33)	(1.02)					(0.25)	(1.47)
Hausman Test=19.30							Hausman Test=32.67					

† The numbers in parenthesis are asymptotic t-statistics.

* χ_4^2 critical value = 14.86.

Table 4.34: Logit Estimates of the (W_i, W_d) Pricing Scheme: **Cross-Market Models** (Type II).

	Model A.1	Model A.2	Model A.3	Model B.1	Model B.2	Model B.3
Businessweek						
$\tilde{T}^n_{jt}$		-0.77	-0.91			
		(-2.77)	(-4.25)			
$\mathbf{P}^n_{jt}$	41.45	13.86		50.46	69.23	
	(1.71)	(1.35)		(1.72)	(1.77)	
$SINC^n_{jt}$	3.02	2.98				
	(10.39)	(9.50)				
$\mathbf{P}^n_{jt}$		-1.44	-1.75		-6.54	-3.01
		(-1.68)	(-1.88)		(-2.63)	(-1.50)
$\Delta P^n_{j\tau-1}$		-2.24	-1.70		-1.96	-2.10
		(-1.52)	(-1.43)		(-1.50)	(-1.71)
$\mu^n_{e,jt}$	-5.35	-14.66		-14.22	-25.20	
	(-0.67)	(-1.47)		(-1.67)	(-2.39)	
$\sigma^n_{e,jt}$	0.10	0.13		0.12	0.15	
	(2.12)	(1.84)		(2.30)	(1.73)	
$\tilde{\mu}^n_{e,jt}$		8.71	8.47		7.02	6.42
		(6.29)	(7.19)		(6.65)	(6.75)
$\delta^n_{(1j)t}$		-0.14	-0.17		-0.19	-0.19
		(-1.96)	(-3.08)		(-3.60)	(-4.12)
I^n_{1t}				2.34	2.76	
				(4.90)	(4.23)	
T^n_{1t}					0.19	-0.13
					(0.51)	(-0.49)
$\mathbf{P}^n_{1t}$				173.50	177.16	
				(2.78)	(2.13)	
$\mathbf{P}^n_{1t}$					-6.92	-4.21
					(-1.25)	(-0.99)
$\log L^c$	-218.14	-147.28	-172.00	-283.54	-204.09	-225.07
Fortune						
$\tilde{T}^n_{jt}$		-0.11	1.36		-0.10	1.31
		(-0.17)	(2.08)		(-0.15)	(2.01)
$\mathbf{P}^n_{jt}$	35.60	40.00		4.83	9.53	
	(0.52)	(0.36)		(0.12)	(0.08)	
$SINC^n_{jt}$	3.34	3.46			3.37	
	(10.25)	(8.67)			(8.20)	
$\mathbf{P}^n_{jt}$		3.09	4.62		3.82	4.72
		(0.72)	(2.16)		(0.84)	(2.20)
$\Delta P^n_{j\tau-1}$		-1.63	-1.26		2.28	1.35
		(-1.20)	(-1.29)		(0.27)	(0.31)
$\mu^n_{e,jt}$	1.91	7.32		5.80	4.44	
	(1.13)	(1.46)		(0.55)	(0.27)	
$\sigma^n_{e,jt}$	0.19	0.14		0.14	0.13	
	(2.00)	(1.70)		(1.91)	(2.03)	
$\tilde{\mu}^n_{e,jt}$		7.18	7.25		7.85	7.09
		(4.17)	(5.75)		(4.24)	(5.40)
$\mathbf{P}^n_{1t}$				461.57	547.50	
				(4.61)	(2.53)	
$\log L^c$	-149.07	-67.95	-80.57	-188.97	-166.77	-167.51

Table 4.35: Logit Estimates of the (W_i, W_d) Pricing Scheme: **Cross-Market Models (Type II)** (cont.).

Newsweek

	Model A.1	Model A.2	Model A.3	Model B.1	Model B.2	Model B.3
T^n_{jt}		1.18	1.69		1.22	1.73
		(2.47)	(4.09)		(2.47)	(4.11)
$\mathbf{P}^n_{jt}$	64.06	22.09		36.31	27.96	
	(2.17)	(1.41)		(1.83)	(1.52)	
$SINC^n_{jt}$	3.13	3.04			3.08	
	(15.16)	(14.18)			(14.01)	
$\mathbf{P}^n_{jt}$		7.05	5.19		7.75	5.77
		(1.96)	(3.42)		(2.12)	(3.53)
$\Delta P^n_{j\tau-1}$		-6.58	-1.98		-5.73	-1.84
		(-2.84)	(-1.90)		(-2.47)	(-1.83)
$\mu^n_{\varepsilon,jt}$	1.70	3.68		2.41	4.95	
	(1.17)	(1.79)		(1.39)	(1.61)	
$\sigma^n_{\varepsilon,jt}$	0.10	0.13		0.12	0.15	
	(2.12)	(1.84)		(2.30)	(1.73)	
$\tilde{\mu}^n_{\varepsilon,jt}$		1.83	5.36		1.19	5.22
		(1.11)	(5.00)		(0.69)	(4.78)
$\mathbf{P}^n_{1t}$				23.48	-145.76	
				(0.19)	(-0.61)	
log L^c	-257.14	144.84	-157.21	-367.21	-311.78	-201.10

Le Figaro

	Model A.1	Model A.2	Model A.3	Model B.1	Model B.2	Model B.3
T^n_{jt}		0.49	-0.10		0.49	0.06
		(1.88)	(-0.63)		(1.76)	(0.35)
$\mathbf{P}^n_{jt}$	49.82	126.27		50.75	124.35	
	(2.08)	(4.09)		(2.73)	(3.92)	
$SINC^n_{jt}$	2.64	2.77			2.77	
	(12.66)	(11.29)			(11.14)	
$\mathbf{P}^n_{jt}$		-10.64	-2.43		-10.48	-5.01
		(-3.44)	(-2.03)		(-3.14)	(-1.95)
$\Delta P^n_{j\tau-1}$		0.95	-1.19		0.75	-0.41
		(0.37)	(-0.47)		(0.28)	(-0.15)
$\mu^n_{\varepsilon,jt}$	-43.50	-35.38		-23.61	-35.82	
	(-3.27)	(-2.34)		(-2.00)	(-2.33)	
$\sigma^n_{\varepsilon,jt}$	0.06	-0.13		0.05	0.01	
	(1.01)	(-0.48)		(0.74)	(0.28)	
$\tilde{\mu}^n_{\varepsilon,jt}$		17.10	16.84		17.08	16.70
		(8.23)	(9.11)		(8.22)	(9.09)
$\mathbf{P}^n_{1t}$				146.89	44.41	
				(1.30)	(0.25)	
log L^c	-301.70	-194.30	-143.05	-298.26	-191.27	-258.64

Table 4.36: Logit Estimates of the (W_i, W_d) Pricing Scheme: **Cross-Market Models (Type II)** (cont.).

Le Nouvel Observateur

	Model A.1	Model A.2	Model A.3	Model B.1	Model B.2	Model B.3
T^n_{jt}		0.25	-0.50			
		(1.16)	(-3.56)			
$\mathbf{P}^n_{jt}$	40.89	76.67		23.46	62.98	
	(1.65)	(2.85)		(1.15)	(2.07)	
$SINC^n_{jt}$	2.90	2.90			3.01	
	(13.94)	(12.75)			(12.56)	
$\mathbf{P}^n_{jt}$		2.69	1.99		2.07	1.74
		(1.20)	(1.23)		(1.58)	(1.50)
$\Delta P^n_{j\tau-1}$		-2.19	-1.72		-3.00	-1.68
		(-1.82)	(-1.79)		(-1.09)	(-1.75)
$\mu^n_{s,jt}$	-15.96	-11.10		-26.70	-13.33	
	(-1.09)	(-0.74)		(-2.30)	(-0.87)	
$\sigma^n_{s,jt}$	0.10	0.07		0.12	0.11	
	(0.69)	(0.39)		(0.80)	(0.38)	
$\tilde{\mu}^n_{s,jt}$		6.94	9.16		7.67	7.32
		(4.27)	(7.68)		(4.88)	(6.76)
$\delta^n_{(1j)t}$		-0.05	-0.08		-0.09	-0.11
		(-1.92)	(-1.53)		(-1.67)	(-1.85)
I^n_{1t}				1.61	-0.85	
				(6.31)	(-1.53)	
T^n_{1t}					-0.09	-0.70
					(-0.33)	(-3.99)
$\mathbf{P}^n_{1t}$				88.52	-22.91	
				(2.49)	(-0.34)	
$\mathbf{P}^n_{1t}$					4.28	11.50
					(1.81)	(2.93)
$\log L^c$	-323.53	-203.94	-219.57	-335.16	-201.91	-212.78

Le Point

	Model A.1	Model A.2	Model A.3	Model B.1	Model B.2	Model B.3
T^n_{jt}		0.36	-0.09			
		(2.09)	(-0.74)			
$\mathbf{P}^n_{jt}$	70.53	110.00		39.79	83.12	
	(3.69)	(4.61)		(2.18)	(3.73)	
$SINC^n_{jt}$	2.89	-28.24			3.07	
	(14.15)	(-2.52)			(13.00)	
$\mathbf{P}^n_{jt}$		2.99	3.24		0.52	3.33
		(3.51)	(2.30)		(0.34)	(2.67)
$\Delta P^n_{j\tau-1}$		-2.03	-1.49		-1.17	-1.39
		(-0.97)	(-0.86)		(-0.56)	(-0.80)
$\mu^n_{s,jt}$	-26.37	-2.42		-26.34	-26.18	
	(-2.31)	(-1.21)		(-2.58)	(-2.31)	
$\sigma^n_{s,jt}$	-0.17	-0.10		0.12	-0.05	
	(-1.20)	(-1.01)		(1.04)	(-0.77)	
$\tilde{\mu}^n_{s,jt}$		2.91	2.61		3.29	2.39
		(13.69)	(4.17)		(3.97)	(4.01)
$\delta^n_{(1j)t}$		-0.05	-0.04		-0.04	-0.06
		(-1.12)	(-1.12)		(-1.20)	(-1.38)
I^n_{1t}				0.68	-1.12	
				(2.12)	(-2.68)	
T^n_{1t}					-0.11	-0.37
					(-0.51)	(-2.46)
$\mathbf{P}^n_{1t}$				34.30	22.51	
				(1.03)	(0.38)	
$\mathbf{P}^n_{1t}$					-1.83	-1.20
					(-0.34)	(-0.87)
$\log L^c$	-328.89	-262.61	-255.80	-355.80	-201.48	-214.07

Table 4.37: Logit Estimates of the (W_i, W_d) Pricing Scheme: **Cross-Market Models (Type II)** (cont.).

	Model A.1	Model A.2	Model A.3	Model B.1	Model B.2	Model B.3
			L'Express			
T^n_{jt}		0.70	0.75			
		(1.72)	(2.91)			
$\mathbf{P}^n_{jt}$	67.73	97.39		37.28	77.24	
	(2.56)	(2.32)		(1.68)	(2.07)	
$SINC^n_{jt}$	3.49	3.58			3.96	
	(10.94)	(9.96)			(9.84)	
$\mathbf{P}^n_{jt}$		-2.00	-2.78		2.81	2.51
		(-0.51)	(-2.33)		(0.91)	(1.26)
$\Delta P^n_{j\tau-1}$		-6.68	-4.45		-6.67	-3.59
		(-2.15)	(-2.40)		(-2.00)	(-1.97)
$\mu^n_{s,jt}$	-7.97	-12.47		-17.67	-12.66	
	(-0.42)	(-0.58)		(-1.32)	(-0.53)	
$\sigma^n_{s,jt}$	0.08	0.05		0.02	0.02	
	(0.41)	(0.28)		(0.57)	(0.30)	
$\tilde{\mu}^n_{s,jt}$		6.75	6.27		8.36	7.28
		(3.76)	(4.52)		(4.45)	(4.97)
$\delta^n_{(1j)t}$		-0.18	-0.27		-0.17	-0.23
		(-2.93)	(-5.33)		(-2.89)	(-4.29)
I^n_{1t}				0.44	-1.20	
				(0.91)	(-1.79)	
T^n_{1t}					-0.36	-0.42
					(-1.09)	(-1.94)
$\mathbf{P}^n_{1t}$				-11.55	-149.49	
				(-0.27)	(-1.61)	
$\mathbf{P}^n_{1t}$					2.23	4.25
					(0.40)	(1.35)
$\log L^c$	-208.61	-105.23	-118.60	-211.50	-100.50	-128.45
			Il Mondo			
T^n_{jt}		0.94	1.69			
		(2.00)	(4.67)			
$\mathbf{P}^n_{jt}$	59.96	44.45		22.66	9.58	
	(1.50)	(0.68)		(1.75)	(2.13)	
$SINC^n_{jt}$	3.40	3.43			4.09	
	(12.62)	(11.77)			(9.77)	
$\mathbf{P}^n_{jt}$		1.94	2.55		4.48	2.08
		(1.18)	(1.15)		(1.88)	(1.76)
$\Delta P^n_{j\tau-1}$		-3.19	-4.20		-1.83	-5.39
		(-1.63)	(-2.07)		(-1.35)	(-2.58)
$\mu^n_{s,jt}$	-52.64	-47.04		-37.41	-48.45	
	(-2.92)	(-2.38)		(-2.76)	(-2.35)	
$\sigma^n_{s,jt}$	0.08	0.03		0.10	-0.03	
	(0.25)	(0.30)		(0.92)	(-0.50)	
$\tilde{\mu}^n_{s,jt}$		6.38	6.44		5.21	2.82
		(3.09)	(4.44)		(2.60)	(1.87)
$\delta^n_{(1j)t}$		-0.14	-0.19		-0.10	-0.02
		(-3.18)	(-5.09)		(-2.64)	(-0.87)
I^n_{1t}					-1.61	
					(-2.03)	
T^n_{1t}				2.37	0.66	-1.11
				(8.33)	(1.53)	(-4.88)
$\mathbf{P}^n_{1t}$				46.16	23.05	
				(1.45)	(2.03)	
$\mathbf{P}^n_{1t}$					3.47	5.37
					(1.34)	(3.35)
$\log L^c$	-188.77	-98.45	-106.12	-182.39	-97.86	-150.64

Table 4.38: Logit Estimates of the (W_i, W_d) Pricing Scheme: **Cross-Market Models (Type II)** (cont.).

The Economist

	Model A.1	Model A.2	Model A.3	Model B.1	Model B.2	Model B.3
T^{n}_{jt}		0.83	1.54			
		(1.93)	(6.26)			
$\mathbf{P}^{n}_{jt}$	91.73	83.33		39.58	30.42	
	(3.91)	(1.85)		(2.04)	(0.71)	
$SINC^{n}_{jt}$	3.06	3.23			3.61	
	(16.68)	(14.17)			(13.23)	
$\mathbf{P}^{n}_{jt}$		4.33	1.49		10.23	7.41
		(0.99)	(0.70)		(2.68)	(3.92)
$\Delta P^{n}_{j\tau-1}$		-4.99	3.79		-4.26	0.50
		(-2.00)	(2.48)		(-2.86)	(2.20)
$\mu^{n}_{e,jt}$	-14.37	-24.20		-7.95	-22.63	
	(-0.87)	(-1.32)		(-0.72)	(-1.11)	
$\sigma^{n}_{e,jt}$	0.13	0.10		0.06	0.04	
	(1.05)	(1.10)		(0.70)	(0.48)	
$\bar{\mu}^{n}_{e,jt}$		12.40	15.86		12.16	13.58
		(4.76)	(9.03)		(4.70)	(7.94)
$\delta^{n}_{(1j)t}$		-0.33	-0.44		-0.27	-0.23
		(-5.15)	(-8.22)		(-5.03)	(-5.96)
I^{n}_{1t}				2.27	-0.88	
				(10.63)	(-1.92)	
T^{n}_{1t}					-0.37	0.65
					(-1.00)	(3.60)
$\mathbf{P}^{n}_{1t}$				-28.83	-4.73	
				(-0.97)	(-0.04)	
$\mathbf{P}^{n}_{1t}$					3.81	1.49
					(2.37)	(2.47)
log L^{c}	-310.84	-158.62	-182.38	-323.44	-157.63	-237.19

Table 4.39: Logit Estimates of the Average Fixed Effect ($\bar{\theta}_T$ and $\bar{\theta}^*_T$) of the (W_i, W_d) Pricing Scheme: **Cross-Market Model II.A.3.**†

Period	$\bar{\theta}_T$	$\bar{\theta}^*_T$	$\%\Delta P_r$	I_T	$\bar{P}_T$	S^n_{jT}	Period	$\bar{\theta}_T$	$\bar{\theta}^*_T$	$\%\Delta P_r$	I_T	$\bar{P}_T$	S^n_{jT}
Businessweek							**Fortune**						
1981-84	-5.87	-7.77	14.24	10.33	7.99	-48.57	1983-85	-1.78	-2.59	14.83	4.33	5.97	-13.90
					(0.50)	(1.21)						(0.50)	(1.65)
1984-87	-3.24	-4.14	9.06	5.67	3.48	47.1	1986-88	-4.30	-2.30	-13.98	6.67	3.45	32.63
					(0.26)	(1.07)						(0.24)	(1.27)
1988-92	-1.83	-2.69	12.45	3.67	4.24	6.19	1989-92	-7.97	-7.28	9.70	3.00	4.03	1.15
					(0.40)	(1.51)						(0.43)	(1.59)
Hausman Test*=28.20							Hausman Test=31.00						
Newsweek							**Le Figaro**						
1978-82	-3.66	-7.47	12.05	10.67	9.32	-28.29	1976-81	-4.48	-3.51	13.15	14.00	9.70	6.20
					(0.49)	(1.44)						(0.52)	(0.76)
1983-87	-3.72	-6.92	9.00	16.67	5.12	20.00	1982-87	-3.47	-3.79	9.05	10.33	7.17	3.04
					(0.42)	(1.59)						(0.45)	(0.79)
1988-92	-3.28	-6.37	9.20	7.23	4.18	12.5	1988-92	-2.96	-2.16	7.34	7.33	2.42	1.30
					(0.36)	(1.50)						(0.48)	(0.93)
Hausman Test=6.44							Hausman Test=17.75						
Le Nouvel Observateur							**Le Point**						
1978-82	-2.95	-2.30	11.17	13.16	10.38	8.29	1978-81	-4.44	-6.28	13.12	15.00	9.31	10.18
					(0.62)	(0.94)						(0.60)	(0.93)
1983-87	-3.72	-4.17	7.85	16.07	6.57	-7.43	1982-84	-4.18	-6.24	9.25	17.67	6.91	1.14
					(0.47)	(0.95)						(0.47)	(0.93)
1988-92	-6.82	-8.09	6.03	2.33	4.16	-1.86	1985-88	-4.37	-6.06	10.31	7.33	3.74	-1.86
					(0.45)	(0.93)						(0.44)	(0.81)
Hausman Test=26.62							Hausman Test=4.10						
L'Express							**Il Mondo**						
1978-81	-4.10	-5.32	9.82	7.00	9.91	7.52	1980-83	-3.87	-4.24	15.22	8.00	8.15	31.99
					(0.58)	(1.05)						(0.50)	(1.03)
1982-84	-4.23	-6.23	10.68	5.00	7.19	16.50	1984-87	-3.58	-4.17	7.86	9.00	3.70	3.03
					(0.54)	(0.80)						(0.32)	(0.94)
1985-88	-3.58	-5.08	10.88	8.33	2.72	-1.76	1988-92	-3.77	-4.42	9.82	7.33	4.41	-1.28
					(0.45)	(0.94)						(0.38)	(0.78)
Hausman Test=7.63							Hausman Test=5.11						
The Economist													
1978-82	-7.17	-8.62	11.57	15.00	9.24	-17.3							
					(0.49)	(1.06)							
1983-87	-3.89	-4.56	8.13	16.00	5.07	19.4							
					(0.41)	(0.86)							
1988-92	-2.60	-1.69	6.74	14.33	4.13	1.76							
					(0.37)	(0.68)							
Hausman Test=27.06													

† The numbers in parenthesis are asymptotic t-statistics.

* χ^2_4 critical value = 14.86.

Table 4.40: Logit Estimates of the Market Fixed Effect α^n_{jt} of the (R_i, R_d) Pricing Scheme: **Cross-Market Model II.A.3.†**

	Busin	Fortu	Newsw	Figar	Nouve	Point	Expre	Mondo	Econo
Aus	-5.37	-9.31	-46.38	-16.12			-7.26		4.03
	(-2.45)	(-4.17)	(-3.25)	(-2.65)			(-6.35)		(2.38)
Bel	-3.48	-8.60	-48.69	-24.92	2.36	-0.27			3.56
	(-3.57)	(-4.19)	(-4.38)	(-4.06)	(2.04)	(-3.54)			(2.80)
Den	-4.19	-9.97	-48.65						3.46
	(-2.84)	(-6.46)	(-5.62)						(3.08)
Fra	-4.87	-10.37	-47.62					-0.27	2.83
	(-2.34)	(-7.76)	(-6.81)					(-5.01)	(4.23)
Ger	-3.30	-10.20	-46.97	-19.39		-1.56	-9.51	-0.64	2.96
	(-3.23)	(-3.05)	(-4.50)	(-3.15)		(-4.52)	(-5.74)	(-3.33)	(5.79)
Neth	-4.46	-10.75	-48.47	-20.51			-10.01	-0.76	3.03
	(-4.03)	(-3.35)	(-3.00)	(-6.54)			(-5.74)	(-4.53)	(6.47)
Ita	-4.35	-11.31	-49.67	-25.00	5.43	3.51	-8.53		6.05
	(-5.22)	(-4.46)	(-4.06)	(-5.30)	(3.31)	(3.46)	(-4.80)		(4.28)
Swe	-2.97		-47.68						4.37
	(-4.54)		(-2.52)						(4.77)
Uk	-6.18	-11.91	-49.90	-20.52			-11.25	-1.29	
	(-4.45)	(-4.94)	(-4.18)	(-3.34)			(-7.02)	(-6.24)	
Jap	1.16	-6.08							
	(3.79)	(-4.01)							
Spa	-5.39	-9.68	-48.00	-23.61	3.34	1.00	-9.02	0.83	3.95
	(-4.91)	(-4.01)	(-3.60)	(-4.10)	(5.36)	(3.95)	(-4.72)	(5.55)	(6.45)
Us					-0.17	-2.00	-9.05	-0.87	2.98
					(-4.04)	(-2.32)	(-4.53)	(-6.05)	(3.31)
Can				-18.73	-0.14	-2.20		-0.83	
				(-4.14)	(-4.53)	(-2.41)		(-4.14)	
IvoC				-21.22	4.28	2.82			
				(-3.20)	(4.68)	(2.61)			
Lux				-24.99		-0.48			
				(-2.45)		(-4.54)			
Mor				-25.68	0.85	-3.28			
				(-5.63)	(3.01)	(-2.71)			
Sen				-21.30	4.24	2.51			
				(-3.06)	(3.88)	(3.00)			
Tun				12.43	5.33	16.67			
				(4.83)	(2.72)	(3.02)			

† Asymptotic t-statistics in parenthesis

Appendix

A1. Description of the Data

Businessweek. 13 series from January 1981 to May 1992.

Markets: Italy, Netherlands, Belgium, Denmark, Japan, Sweden, Austria, Switzerland, Spain, USA, France, Germany and United Kingdom.

Fortune. 11 series from February 1983 to Mar 1992. The series for the price in Japanese Yen has remained constant during the whole period.

Markets: Italy, Netherlands, Belgium, Denmark, Japan, Austria, Switzerland, Spain, France, Germany and United Kingdom.

Newsweek. 11 series from December 1977 to Jun 1992. Prices in Switzerland, Netherlands and Germany are 6 months left-censored. Therefore, the first spell is slightly underweighted.

Markets: Italy, Netherlands, Belgium, Denmark, Sweden, Austria, Switzerland, Spain, France, Germany and United Kingdom.

Le Figaro Magazin. 15 series from October 1978 to December 1988. Price in French Francs ends in December 1984.

Markets: Italy, Netherlands, Belgium, Austria, Switzerland, Spain, USA, France, Ivory Coast, Senegal, Tunisia, Morocco, Canada, Germany, Luxembourg and United Kingdom.

Le Nouvel Observateur. 11 series from October 1977 to May 1992.

Markets: Italy, Belgium, Switzerland, Spain, USA, France, Ivory Coast, Senegal, Tunisia, Canada and United Kingdom.

Le Point. 13 series from March 1976 to May 1992.

Markets: Italy, Belgium, Switzerland, Spain, USA, France, Ivory Coast, Senegal, Tunisia, Morocco, Canada, Germany, Luxembourg and United Kingdom.

L'Express. 9 series from March 1978 to December 1988.

Markets: Italy, Netherlands, Austria, Switzerland, Spain, USA, France, Germany and United Kingdom.

Il Mondo. 10 series from February 1980 to June 1992.

Markets: Italy, Netherlands, Switzerland, Switzerland-Ticino Region, Spain, USA, France, Canada, Germany and United Kingdom.

The Economist. 12 series from March 1978 to May 1992. The last price spell in Deutschmarks is left-censored for 26 months.

Markets: Austria, Italy, Netherlands, Belgium, Denmark, Sweden, Switzerland, Spain, USA, France, Germany and United Kingdom.

TOTAL NUMBER OF PRICE SERIES = 105

Questionnaire
on Newsstand Prices of Magazines and Newspapers

<u>PLEASE,</u>
<u>ONCE COMPLETED, SEND TO:</u>

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The information that you provide in this questionnaire is totally confidential, and I guarantee that the identity of the respondants will remain completely unknown. Its purpose is to aid on the understanding on price adjustment rules, and it will be used for my research on newsstand prices of magazines and newspapers that is a part of my Ph.D. dissertation to be defended at the European University Institute. I will be pleased to send you some of the results obtained upon request. Thank you very much in advance.

This questionnaire intends to test some theories on pricing by firms that sell home and abroad. The most important issue to test is how sticky prices are, and which are the determinants of the staggered behaviour of prices in domestic and foreign markets. The questionnaire poses some questions on the pricing behaviour, in general, and on the transmission of the exchange rate changes into export prices. Completing this questionnaire will contribute greatly to the understanding of price adjustment since there are many theories that explain these phenomena but no empirical counterpart exists. Therefore, the understanding of the data on newsstand prices of magazines and newspapers may be largely improved by your responses to these questions. An important caveat: Exchange rate is defined as the number of currency units of the producer's country per unit of foreign currency.

Part 1

QUESTION 1. From the study of the series of prices of magazines and newspapers it can be observed that prices in home country and in each of the foreign markets in which the magazine is sold, do not change too frequently.

How often do the prices of your magazine (newspaper) change in a typical year?

☐ More than 12 times per year

☐ Between 6 and 12 times per year

☐ Between 2 and 5 times per year

☐ Once per year

☐ Less than once per year

☐ Once per two years

☐ Less than once per two years

How often do you consider the possibility of adjusting your prices, independently of the fact that you really change them?

☐ More than 12 times per year

☐ Between 6 and 12 times per year

☐ Between 2 and 5 times per year

☐ Once per year

☐ Less than once per year

☐ Once per two years

☐ Less than once per two years

QUESTION 2. From the point of view of microeconomic theory, economists are interested to know how long price adjustment lag behind shocks to sales and cost.

How much time normally elapses after a significant INCREASE IN SALES before you raise your prices?

___ months

How much time normally elapses after a significant DECREASE IN SALES before you reduce your prices?

___ months

How much time normally elapses after a significant INCREASE IN COSTS before you raise your prices?

___ months

How much time normally elapses after a significant DECREASE IN COSTS before you reduce your prices?

___ months

How much time normally elapses after a significant INCREASE IN THE EXCHANGE RATES before you reduce your prices?

___ months

How much time normally elapses after a significant INCREASE IN THE EXCHANGE RATE before you increase your prices?

___ months

How much time normally elapses after a significant INCREASE IN THE HOME INFLATION before you increase your prices?

___ months

How much time normally elapses after a significant INCREASE IN THE FOREIGN MARKET INFLATION before you increase your prices?

___ months

QUESTION 3. **Which of the following sentences reflects more accurately the pricing of magazines (newspapers)?**

☐ We prefer to adjust prices frequently for a small amount.

☐ We prefer to change prices unfrequently and wait for a large and substantial adjustment in the price.

☐ None of the sentences above are correct.

Part 2

Next block of questions inquires about ten theories on pricing in home and foreign market themselves. We begin succinctly summarizing these explanations.

QUESTION 4. A set of questions for some theories about the determinants of price change are formulated. The aim of this questions is to get an idea of which theoretical constructions work better for the speed and size of price change of your magazine (newspaper). A list of 10 current theories in the economic and marketing literature is shown with a brief explanation.

4.1. DELIVERY SERVICE: The idea is that price is but one of several elements that matter to buyers. Rather than cut (raise) prices when sales are low (high), firms might prefer to provide more (less) delivery services, so prices do not change soon.

How important is this in explaining the speed of price adjustment of your magazine (newspaper)?

☐ Totally unimportant

☐ Of minor importance

☐ Moderately important

☐ Very important

☐ Do not know/cannot answer

4.2. STRATEGIC PRICE COORDINATION: Firms are often supposed to be very sensitive to their competitor's price change. Once other firms move, they follow quickly. If not, they do not change prices.

How important is this in explaining the FREQUENCY OF PRICE ADJUSTMENT of your magazine (newspaper)?

☐ Totally unimportant

☐ Of minor importance

☐ Moderately important

☐ Very important

☐ Do not know/cannot answer

How important is this in explaining the SIZE OF PRICE ADJUSTMENT of your magazine (newspaper)?

☐ Totally unimportant

☐ Of minor importance

☐ Moderately important

☐ Very important

☐ Do not know/cannot answer

4.3. COST-BASED PRICING: Prices are based on costs, and prices do not rise until costs rise.

How important is the Cost-Based Pricing in explaining the FREQUENCY OF PRICE ADJUSTMENT of your magazine (newspaper)?

☐ Totally unimportant

☐ Of minor importance

☐ Moderately important

☐ Very important

☐ Do not know/cannot answer

How important is the Cost-Based Pricing in explaining the SIZE OF THE PRICE ADJUSTMENT of your magazine (newspaper)?

☐ Totally unimportant

☐ Of minor importance

☐ Moderately important

☐ Very important

☐ Do not know/cannot answer

4.4. IMPLICIT CONTRACTS: It is sometimes suggested that firms have implicit understandings with their customers which proscribe price movements when markets are tight.

Do these implicit contracts exist?

☐ Yes

☐ Sometimes

☐ No

☐ Do not know/cannot answer

If your response is positive, how important are implicit contracts with buyers in explaining the FREQUENCY OF PRICE ADJUSTMENT of your magazine (newspaper)?

☐ Totally unimportant

☐ Of minor importance

☐ Moderately important

☐ Very important

☐ Do not know/cannot answer

4.5. EXPLICIT NOMINAL CONTRACTS: It has been suggested that written contracts with dealers govern price adjustment while they remain in force.

How important is this theory in explaining the FREQUENCY OF PRICE ADJUSTMENT of your magazine (newspaper)?

☐ Totally unimportant

☐ Of minor importance

☐ Moderately important

☐ Very important

☐ Do not know/cannot answer

How important is this theory in explaining the SIZE OF PRICE ADJUSTMENT of your magazine (newspaper)?

☐ Totally unimportant

☐ Of minor importance

☐ Moderately important

☐ Very important

☐ Do not know/cannot answer

If you are a firm for which this explanation is at least moderately decisive in any of the last two questions,

How are these implicit agreements?

☐ It is established a average price to last for a long enough period in order to save on transaction costs associated with adjusting new price lists frequently.

☐ Contrary to the last statement, flexible prices will emerge in order to avoid any advantage of a fixed price in the short run from any of the parts, when sale and cost conditions may have changed.

☐ None of the statements above are correct.

4.6. COST OF PRICE ADJUSTMENT: It is sometimes suggested that firms incur special cost of price adjustment whenever they change prices. These costs are typically the physical cost of a new tag for the magazine or the informative costs that the firm incurs until all consumers perceive the new price. It has been also said that frequent changes in prices are disliked by consumers.

Do your recognize the existence of these costs of price adjustment?

☐ Yes

☐ Sometimes

☐ No

☐ Do not know/cannot answer

If your answer is positive, how important are these costs in explaining THE FREQUENCY OF PRICE ADJUSTMENT of your magazine (newspaper)?

☐ Totally unimportant

☐ Of minor importance

☐ Moderately important

☐ Very important

☐ Do not know/cannot answer

4.7. PRICE, SALES AND MARKUPS: When you increase prices,

☐ Markup increases

☐ Markup remains constant

☐ Markup decreases

☐ Do not know/cannot answer

When you cut prices,

☐ Markup increases

☐ Markup remains constant

☐ Markup decreases

☐ Do not know/cannot answer

If markups shift at the event of a price adjustment, **how important are these changes in explaining THE SIZE OF PRICE ADJUSTMENT of your magazine (newspaper)?**

☐ Totally unimportant

☐ Of minor importance

☐ Moderately important

☐ Very important

☐ Do not know/cannot answer

4.8. SUNK COSTS: It is sometimes said that first establishment costs in a new market may preclude price increases if higher prices could reduce firm's market share and sales, and could induce an exit from the market.

Do you recognize the existence of these sunk costs?

☐ Yes

☐ Sometimes

☐ No

☐ Do not know/cannot answer

How important are sunk costs in explaining the FREQUENCY OF PRICE ADJUSTMENT of your magazine (newspaper)?

☐ Totally unimportant

☐ Of minor importance

☐ Moderately important

☐ Very important

☐ Do not know/cannot answer

4.9. PRICING POINTS: It is sometimes believed that certain prices are psychological barriers that firms are reluctant to cross.

Do you accept that are prices that cannot be change because they are psychological barriers for buyers?

☐ Yes

☐ Sometimes

☐ No

☐ Do not know/cannot answer

How important are these pricing points in explaining the FREQUENCY OF PRICE ADJUSTMENT of your magazine (newspaper)?

☐ Totally unimportant

☐ Of minor importance

☐ Moderately important

☐ Very important

☐ Do not know/cannot answer

4.10. JUDGING QUALITY BY PRICE: Finally, it has been suggested that a change in price is interpreted by consumers as a change in quality of the product sold.

How important is the belief that consumers may infer from price change that a shift in the quality of the product has occurred, in the speed of price adjustment?

☐ Totally unimportant

☐ Of minor importance

☐ Moderately important

☐ Very important

☐ Do not know/cannot answer

If you are a firm for which this explanation is at least moderately decisive,

How important is it that consumer judge quality by price in discouraging an increase in price?

☐ Totally unimportant

☐ Of minor importance

☐ Moderately important

☐ Very important

☐ Do not know/cannot answer

Part 3

This part consists of more specific questions about how some state variables are related with the pricing routines in foreign markets. From the observation of the data of prices of magazines in several countries, it could be inferred that these prices neither react completely nor inmediately to these variables fluctuations.

QUESTION 5. How important is the general level of inflation in each market in which the magazine (newspaper) is sold, in explaining the SIZE OF THE CHANGE in the price?

☐ Totally unimportant

☐ Of minor importance

☐ Moderately important

☐ Very important

☐ Do not know/cannot answer

QUESTION 6. How important is the general level of inflation in each market in which the magazine (newspaper) is sold, in explaining the FREQUENCY OF ADJUSTMENT in the price?

☐ Totally unimportant

☐ Of minor importance

☐ Moderately important

☐ Very important

☐ Do not know/cannot answer

QUESTION 7. How important is an increase of the exchange rate in determining a PRICE DECREASE in a foreign market?

☐ Totally unimportant

☐ Of minor importance

☐ Moderately important

☐ Very important

☐ Do not know/cannot answer

QUESTION 8. How important is a decrease of the exchange rate in determining a PRICE INCREASE in a foreign market?

☐ Totally unimportant

☐ Of minor importance

☐ Moderately important

☐ Very important

☐ Do not know/cannot answer

QUESTION 9. How important is the level of the exchange rate volatility in determining a INCREASE IN THE FREQUENCY OF PRICE ADJUSTMENT in a foreign market?

☐ Totally unimportant

☐ Of minor importance

☐ Moderately important

☐ Very important

☐ Do not know/cannot answer

QUESTION 10. How important is the level of the exchange rate volatility in determining a PRICE INCREASE in a foreign market?

☐ Totally unimportant

☐ Of minor importance

☐ Moderately important

☐ Very important

☐ Do not know/cannot answer

QUESTION 11. Give a valuation from 1 to 5 to the following variables that you may take into account when you decide your price in a foreign market. (You may give equal values to more than one variable)

☐ Changes in the exchange rate

☐ Changes in the general price level of the foreign country

☐ Changes in the general price level of your country

☐ Shifts in sales in the foreign market

☐ Changes in transportation and mailing costs

☐ Changes in competitors' prices in the foreign market

☐ Changes in domestic inputs (wages, price of paper, etc...)

☐ Changes in foreign inputs (wages, price of paper, etc...)

☐ Changes in the domestic price of your magazine (newspaper) that act as a reference point for the rest of the prices.

QUESTION 12. When you fix prices in foreign markets, do you tend to treat each market separately or independently?

☐ Yes

☐ Sometimes

☐ No

☐ Do not know/cannot answer

QUESTION 13. When you fix prices in foreign markets, **do you tend to SYNCHRONIZE price adjustments each market to save cost of adjustment?**

☐ Yes

☐ Sometimes

☐ No

☐ Do not know/cannot answer

QUESTION 14. **Which of the following sentences reflects more accurately the pricing of magazines (newspapers)?**

☐ We prefer to adjust prices frequently for a small amount.

☐ We prefer to change prices unfrequently and wait for a large and substantial adjustment in the price.

☐ None of the sentences above are correct.

The questionnaire has finished. If you want to make any additional comment on your answers, use the blank lines below. Thank you very much.

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