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**PRICING STRATEGIES AND THE FIRM'S
EXPOSURE TO EXCHANGE RATE AND MACRO-
ECONOMIC SHOCKS**

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ments are welcome.

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I. Introduction

The purpose of this paper is to demonstrate how a firm's cash flow
sensitivity to changes in the domestic and international macroeconomic
environment depends on its pricing strategy in output markets. The
choice of pricing strategy in terms of invoice currency, adjustability
of price, and credit terms plays a crucial role in both the firm's and
the economy's adjustment to economic disturbances, whether they are
aggregate or relative demand and cost disturbances. Much of the
previous analysis of firms' economic exposure of business operations
(e.g., Flood, 1986; Flood and Lessard, 1986; and Shapiro, 1975) take
exchange rate changes as exogenous and consider potential price and
output effects resulting from these changes. Hekman (1987) considers
the ability of the firm to pass exchange rate changes through to prices,
and demonstrates how this ability depends not on the invoice currency
but on the currency in which major competitors price as well as on
supply and demand elasticities for the firm's product.

Dornbusch (1987) contains an analysis of relative price effects of
exchange rate changes. Applying concepts and theories in the industrial
organizational literature, he demonstrates why relative prices among
industries may change during the macroeconomic adjustment process. One
of Dornbusch's conclusions is that further microeconomic analysis is

necessary to explain relative price adjustment associated with his equilibrium exchange rates. Mann (1986) take one step in this direction by analyzing the effect on profit margins of traded goods of exchange rate shocks, taking into consideration the interdependence between exchange rate changes and aggregate demand.

Our point of departure is that in order to develop microeconomic foundations for relative price effects of exchange rate changes, and, in consequence, for exposure analysis, it is important to recognize that exchange rate changes do not occur in isolation from changes in other macroeconomic variables such as price levels and interest rates. These variables, as well as some relative prices, adjust simultaneously in response to underlying macroeconomic disturbances, such as money supply disturbances, fiscal policy shifts, and general productivity changes. This is the major theme in Oxelheim and Wihlborg (1987) in which the focus is on financial strategies for dealing with commercial as well as financial exposures. Firm-specific pricing strategies influencing the commercial exposure of business operations are taken as given there, however.

We also emphasize the role of confusion between different kinds of disturbances. The combined effect of a disturbance on price variables depends on the nature of the underlying disturbance and firms' perceptions about it.

The importance of the assumption that exchange rate changes are exogenous can be illustrated by comparing the suggestion in, for example, Hekman (1987) that decreased competition increases the ability of the firm to reduce exposure to exchange rate changes, with the result of some macroeconomic models. Under perfect competition there are no relative price effects and, therefore, no exposure of monetary

disturbances. These two propositions are seemingly at odds. An integrated model of exposure and macroeconomic adjustment could recognize both that firm-exposure depends on the nature of disturbances within a specific macroeconomic environment and that the nature of macroeconomic adjustment is a function of firms responses to changes in observable variables such as the exchange rate.

In this paper we analyze exposure of business operations to macroeconomic shocks, arguing that exposure is a function of the pricing strategy of the firm, and that such a strategy may take many different forms with respect to the price-exchange rate relationship. On the aggregate level, these strategies determine macroeconomic relationships between exchange rates and relative prices.

We emphasize exposure analysis for monetary disturbances. They are particularly interesting, since it is necessary to explain why firms do not simply choose strategies with respect to relative prices in order to eliminate any exposure to exchange rate changes associated with monetary disturbances.

Under perfect information about the nature of disturbances, about other firms' perceptions of these disturbances, and under perfect contractual flexibility, firms would optimally react in different ways to exchange rate changes associated with monetary and real disturbances, respectively. However, as has been demonstrated, for example, by Blanchard (1987), there seems to be some explicit as well as implicit contractual rigidity in market prices with respect to both kinds of disturbances, and different firms choose to specify contractual rigidities in different ways. In order to explain rigidity in response to monetary disturbances, in Section III we informally discuss

microeconomic foundations for firms' determination of pricing strategies under the assumptions that they cannot directly observe the nature of disturbances, and that firms have an implicit contract with customers calling for limited price adjustment to temporary cost and demand shocks.

Before embarking on the theoretical analysis of pricing strategies we present in Section II empirical evidence regarding the role of pricing strategy in exposure management, and the degree to which firms adjust price depending on actual events during the contract time. The evidence is based on an interview study of Swedish multinationals and it demonstrates both the importance of pricing strategy for exposure and the degree to which firms are constrained in their choices of strategy.

In the scenario analysis for a hypothetical firm in Section IV, we assume that domestic monetary disturbances occur on the aggregate level. Scenarios are developed for exchange rate, price level and industry price adjustment to the disturbance. Thereafter, we analyze cash flow effects for the firm under different assumptions about its pricing strategy within each scenario. The firm's strategy may be to keep market share, mark-up, or the domestic currency price constant. We are particularly interested in the question of whether a differentiation between firm and industry pricing strategies causes more or less exposure on the firm level relative to the industry level.

The nature of implicit contracts and price rigidities, i.e., pricing strategies, determine macroeconomic adjustment. Though we do not explore this link analytically here, our scenarios are based on different assumptions about this link between strategies on the one hand, and macroeconomic and industry-price variables on the other.

II. Some Empirical Results About Implicit and Explicit Contracts in Practice

In this section we present evidence for pricing strategies and the use of implicit and explicit customer contracts in major Swedish multinationals. Swedish industry is interesting in this context due the economy's vulnerability to exchange rate fluctuations and due to the importance of both international trade and multinational production for the country's industry. Data were collected in 1983-84 through an extensive interview study of top management, including the CEO, of the 20 largest Swedish multinationals including Eletrolux, Ericsson, Saab, Swedish Match and Volvo, representing about 50% of the domestic value added of Swedish manufacturing. The interview lasted over several days and concerned the broad area of managing macroeconomic uncertainty.[1] Three firms belonged to the paper, pulp, and wood industry, three to the chemical/pharmaceutical industry, three to the steel industry, one to the construction industry and nine to the machinery industry.

All firms considered themselves highly vulnerable to macroeconomic disturbances. Asked about the expected gains and losses due to potential economic policy measures, eleven companies ranked a devaluation of the home currency as the most favorable policy measure and two considered it the least favorable. An increase in the domestic long-term interest rate was considered the most negative measure by five companies. Exchange controls on long-term capital flows were also considered very negative.

As emphasized in the exposure literature the perception of market adjustment processes is of vital interest for exposure management. Top

managers had the following opinions about the validity of purchasing power parity and Fisher's international effect, respectively.

Question 1

Do you believe that, in the long term, the exchange rate adjusts with relative inflation rates?

Strongly agree	1	2	3	4	5	Strongly disagree
Number:	4	10	2	2	-	Sum 18.

Question 2

Do differences in interest rates for securities with similar risk and in different currencies reflect expected changes in bilateral exchange rates on the average?

Strongly agree	1	2	3	4	5	Strongly disagree
Number:	1	9	-	3	5	Sum 18.

The belief in a long-run tendency towards purchasing power parity is wide-spread while the attitudes towards the International Fisher Parity relationship are polarized. In the scenario approach we analyze consequences for exposure of different assumptions about exchange rate adjustment relative to purchasing power parity. The degree to which International Fisher Parity holds is crucial for the exposure management strategy as shown, for example, in Oxelheim and Wihlborg (1987).

Next, we turn to the pricing strategies of firms which, to a large extent, determine how commercial operations are exposed. Among 18 companies, 13 answered that the objective behind their pricing responses to macroeconomic disturbance during the last decade had been to protect their market shares. Six companies had the objective of protecting the gross margin. One company appears in both groups. It uses different policies for different parts of the corporation.

One could expect that firms protecting their market shares have little ability to pass on to suppliers and customers increases in cost

or other factors causing a profit squeeze. Implicit and explicit contractual conditions would then remain unaffected by, for example, exchange rate changes. The next three questions relate to implicit contractual arrangements with suppliers and customers:

Question 3

What are the practical opportunities for your company to adjust purchasing operations in response to disturbances in, for instance, the foreign exchange market by changing contract currency, etc.

Very large opportunities	-
Large opportunities	2
Considerable opportunities	6
Small opportunities	12
No opportunities	2

Three companies appear in two groups. The comments to the answers shed additional light on the issues. Many companies buy commodities in the world markets and they are locked in by contractual conditions in the industry supplying goods. Others face dominant sellers in the market and have to accept the contract terms on the supply side. Thus, most firms are unable to protect their profit margins by price adjustment relative to suppliers.

Are there large opportunities to vary contract terms relative to customers thus protecting margins, or are the firms' prices locked in by consideration of market shares?

Question 4

How large are the practical (market, regulatory, and legal) opportunities for your company to increase the price in the export market in order to compensate for unfavorable exchange rate changes?

Very large opportunities	1
Large opportunities	1
Considerable opportunities	6
Small opportunities	12
No opportunities	3

The opportunities to protect profit margins are small. Seven companies with small or no opportunities in Question 3 answered small or no opportunities for compensating price adjustment as well. Among the comments to this question, firms refer to the existence of price controls, cartelization, agreements with E.G., low differentiation of product in the market as explanations for their limited ability. Thus, market structure as well as government regulation seem to influence the ability to adjust price. Four companies had two responses.

Question 5
   How large are the practical opportunities for your company to profit from <u>favorable</u> exchange rate changes relative to export markets by lowering price?

Very large opportunities	-
Large opportunities	6
Considerable opportunities	5
Small opportunities	8
No opportunities	2

Comparing 5 and 6 we can see that some companies with small opportunities to raise prices feel that they have large opportunities to lower them. This difference may be explained by price controls and agreements that prevent firms from raising prices.

Two companies gave two responses. Among the comments to the answers, firms refer to 'implicit' rigidities of price due to customer relations as well as price-elasticities.

The above answers were clarified further by:

Question 6
   How constraining are the following factors in corporate pricing decisions?

A. Foreign institutional factors like currency regulations, price controls, etc.?

	1	2	3	4	5	
Very constraining						Not constraining
Number:	2	4	5	4	3	Sum 18.

B. By foreign payment routines?

	1	2	3	4	5	
Very constraining						Not constraining
Number:	1	3	4	7	3	Sum 18.

The answers indicate that explicit regulations are more important for the limited ability to influence price than payment routines which constitute one part of the contractual arrangements in foreign markets. Nevertheless, both factors are assigned some weight by most firms.

The above questions referred to the perceived ability to adjust price from the point of view of market and regulatory constraints. We turn now to the relative importance of different aspects of the contract in order to cope with exchange rate variability. We want to ask whether firms consider pricing and other contractual arrangements with customers as tools comparable to financial exposure management tools.

Question 7
   What importance do you assign to the following strategies/measures for handling foreign exchange variability on current transactions with foreign customers?

   A. To use SEK as contract currency:

   • with foreign subsidiaries as counterparts

	1	2	3	4	5	
Very important						No importance
Number:	-	-	-	4	13	Sum 17

• with other foreign trading partners

	1	2	3	4	5	
Very important						No importance
Number:	6	5	2	2	2	Sum 17

Comments: Firms tend to centralize exposure management for
subsidiaries by invoicing in local currency, while
firms try to use SEK as contract currency externally
to a larger extent.

B. To use relatively strong or weak currencies as contract
currencies:

• with foreign subsidiaries as counterparts

	1	2	3	4	5	
Very important						No importance
Number:	-	-	-	4	13	Sum 17

• with other foreign trading partners

	1	2	3	4	5	
Very important						No importance
Number:	4	6	1	3	3	Sum 17

Comments: Externally, firms seem to be concerned about their
choice of currency and choose the one that is
considered strong.

C. To change the terms of credit for the transaction:

• with foreign subsidiaries as counterparts

	1	2	3	4	5	
Very important						No importance
Number:	1	8	2	3	3	Sum 17

• with other foreign trading partners

Very important	1	2	3	4	5	No importance
Number:	1	4	6	4	2	Sum 17

Comments: This aspect is important internally since regulations can be evaded by internal loans, while externally it is not very important as a competitive tool.

D. To eliminate the pricing risk by the use of external financial markets:

• with foreign subsidiaries as counterparts

Very important	1	2	3	4	5	No importance
Number:	3	1	2	7	4	Sum 17

• with other foreign trading partners

Very important	1	2	3	4	5	No importance
Number:	3	5	4	3	2	Sum 17

Comments: Externally, the use of, for example, forward markets is important, which may explain that in Question A many firms do not consider it important whether domestic or foreign currencies are used in explicit contracts.

E. To use leads and lags:

• with foreign subsidiaries as counterparts

Very important	1	2	3	4	5	No importance
Number:	4	8	3	1	1	Sum 17

• with other foreign trading partners

Very important	1	2	3	4	5	No importance
Number:	-	2	5	6	4	Sum 17

Comments: Externally, the possibilities to lead and lag seem small, but internally this is an important tool for intra-company transactions.

F. **To use pricing arrangements specifying renegotiations when the exchange rates falls outside a certain interval:**

- with foreign subsidiaries as counterparts

Very important	1	2	3	4	5	No importance
Number:	-	1	1	4	11	Sum 17

- with other foreign trading partners

Very important	1	2	3	4	5	No importance
Number:	1	5	4	5	2	Sum 17

Comments: Externally, renegotiations seem of high importance to about half of the sample.

G. **To emphasize product lines in strong markets in order to protect the total gross margin, instead of letting product lines in a weak market absorb the change in the exchange rate:**

- with foreign subsidiaries as counterparts

Very important	1	2	3	4	5	No importance
Number:	-	2	3	3	9	Sum 17

- with other foreign trading partners

Very important	1	2	3	4	5	No importance
Number:	-	4	4	5	4	Sum 17

Comments: The answers to this question indicate that firms consider it costly to abandon customers in one product market in favor of others for the sake of unfavorable exchange rates.

H. **To arrange for the price to follow a price index:**

- with foreign subsidiaries as counterparts

Very important	1	2	3	4	5	No importance
Number:	-	-	3	3	11	Sum 17

• with other foreign trading partners

Very important	1	2	3	4	5	No importance
Number:	-	2	2	5	8	Sum 17

Comments: Surprisingly, few firms use price indexation.

I. To use a contractual clause specifying an exchange rate
    beyond which the seller or the buyer shall take the loss:

• with foreign subsidiaries as counterparts

Very important	1	2	3	4	5	No importance
Number:	-	-	1	4	12	Sum 17

• with other foreign trading partners

Very important	1	2	3	4	5	No importance
Number:	1	5	5	3	3	Sum 17

Comments: Clauses for sharing of exchange risk seem to be wide-
             spread.

J. To set the price in international currency units like SDR
    or ECU:

• with foreign subsidiaries as counterparts

Very important	1	2	3	4	5	No importance
Number:	-	-	-	2	15	Sum 17

• with other foreign trading partners

Very important	1	2	3	4	5	No importance
Number:	-	-	1	4	12	Sum 17

Comments: Few Swedish firms use these currency-baskets in
             pricing.

K. To change source-country for inputs:

* with foreign subsidiaries as counterparts

	1	2	3	4	5	
Very important						No importance
Number:	-	-	3	6	8	Sum 17

* with other foreign trading partners

	1	2	3	4	5	
Very important						No importance
Number:	1	3	4	5	4	Sum 17

Comments: This question can be compared to G. For external transactions the flexibility in input sourcing is similar to the flexibility in adjustment among product-markets (see also Question 3).

The answers with respect to foreign subsidiaries are not of primary relevance for our purposes since internal arrangements are highly flexible and can be changed for many reasons including exposure and tax management. We provide the answers in comparison with external arrangements, since differences indicate the degree to which the firms are constrained by market conditions. Furthermore, the differences in answers indicate that managers answering the questions have thought through their responses.

Summarizing the results of Questions 7 A-K, it can be noted that many contractual rigidities and constraints exist in dealing with foreign trading partners. Furthermore, SEK is often used for invoicing exports to external trading partners. In a separate question, however, most managers indicated that firms are reducing the use of SEK for invoicing. Several types of contract clauses seem to be used. None of the measures suggested here seems to be of great importance for all firms. Thus, there are large differences among firms in their ability and willingness to use contractual arrangements with foreign partners.

With respect to contract terms referred to in Question 7A-K 15 companies had written instructions for managers' choice of contract and invoice currency. Out of these firms, nine had additional instructions for payment routines.

Finally, we ask specifically about the use of pricing as an exposure management tool in order to check the conventional wisdom that firms do not use pricing as a tool for this purpose, since financial measures are easier and cheaper to adjust on short notice:

Question 8:
  Has the company changed the price on its products in export markets in order to reduce exposure?

Very often	1	2	3	4	5	Never
Number:	-	3	7	3	4	Sum 17

Very satisfactory measure	1	2	3	4	5	Unsatisfactory measure
Number:	1	2	11	2	1	Sum 17

Question 9:
  Has the company changed the price on its products in the domestic market in order to reduce exposure?

Very oftxen	1	2	3	4	5	Never
Number:	-	2	8	2	5	Sum 17

Very satisfactory measure	1	2	3	4	5	Unsatisfactory measure
Number:	-	3	11	-	3	Sum 17

The answers indicate some flexibility in pricing, but a relatively large share of the firms indicate that they never use price as an exposure management tool and/or consider this measure unsatisfactory.

With this background about stylized facts, we have illuminated the limited but not unimportant use of pricing strategies and contractual

clauses in exposure management. There seems to be substantial rigidity in firm prices in foreign and domestic markets as well as in other aspects of the customer contract. Some firms face less rigidity than others, however, and there is substantial variability in the contractual arrangements used in foreign markets. We turn now to the microfoundations for contractural rigidities.

III. Explicit and Implicit Contractual Price Rigidities

In Dornbusch (1987), several reasons were given for a firm adjusting price only partially to an exogenous exchange rate change, which influences the relative competitive position of firms located in different countries. In the previous section, we demonstrated that firms in international competition differ in their ability and willingness to adjust prices in response to exchange rate changes. It seems as if competitive conditions in markets including more or less implicit contractual arrangements with customers induce price rigidity. One wonders, however, why rigidities are not limited to those disturbances requiring relative price adjustment. Why would prices remain rigid after an exchange rate change caused by a monetary disturbance? In this section, we discuss possible microeconomic foundations for rigidity in price adjustment to monetary disturbances. Our point of departure is the literature on implicit contracts. This literature contributes to the explanation of relative price rigidities.

A. Relative Price Rigidities

The literature on price rigidities provides many reasons that firms do not adjust their prices fully when faced with shifts in demand and cost factors. The implicit contract literature emphasizes "continuity

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of association" as a reason for not adjusting price to its market clearing level at all times.[2] If customers are perceived to be risk-averse, then the firm may offer stability of price for some period, thereby taking some of the risk otherwise faced by customers.[3] A second continuity of association argument is based on "asset-specificity," i.e., a buyer and a seller of goods acquire knowledge or assets which are specific to the other party. Long-term contracts between the two parties are valuable under such conditions, since a bilateral monopoly situation has been created to some extent. The buyer may have invested in machinery that operates best with the supplies from a specific firm, and this buyer may value a contract which is fixed in both price and quantity.

The essence of the above arguments is that firms gain in the long run by deviating from short-run profit maximization in their pricing decisions. Inventories may pick up the slack, or the firm could ration output in periods of high demand, while employees are laid off or become underemployed in periods of low demand.

Another type of more explicit price rigidity occurs when orders are taken and prices committed to before delivery. We are less concerned with this type of rigidity here since the precommitted price may be perfectly flexible. It is, of course, an important consideration to determine credit terms and invoice currency in this case as well, but the more interesting issue arises as a result of non-contractural rigidity in price and other contract terms over the longer term. Price rigidity is obviously not an absolute but should be expressed in degrees. List prices may be rigid while there is perfect flexibility between listings. Then increased flexibility may take the form of

shorter periods between listings. Increased flexibility may also take the form of discounting from list prices and decreased flexibility may take the form of a rigidity in the adjustment between listings as well as within listings. In this paper we do not specify what exact explicit or implicit contractual rigidity exists.

The above arguments explain why firms would keep its <u>relative price in the customer's currency</u> rigid when it is faced by <u>temporary cost and demand shifts</u>. It does not explain why firms would keep prices rigid when faced by changes in the general price level caused, for example, by monetary disturbances. Similarly, it does not explain why the firm would choose <u>one</u> currency in which to invoice and offer an implicit rigid price contract for future customers. The latter issue will be addressed first, before turning to monetary disturbances.

B. Choice of Currency in Which to Keep Relative Price Rigid

Assuming all exchange rate changes are real, we would expect from the continuity of association argument that the international firm would offer rigid prices in buyers' currencies when exchange rate changes are perceived to be temporary. However, if the firm sells in several countries, it could be accused of dumping, and of behaving as a discriminating monopolist. Furthermore, if its market power is not complete, commodity arbitrage may occur when the product price differs among countries. For these reasons, the exporting firm may choose or be forced to use one currency in which to offer a rigid real price. This currency may be the domestic price or the foreign currency price, depending on the relative importance of different markets. Grassman (1975) has argued that exporters of manufactured goods typically invoice in domestic currency but this finding has been disputed (Rao and Magee,

1980). It should be noted, however, that choice of invoice currency i.e., the explicit contract currency is a separate question from the issue in which currency price is rigid, i.e., the implicit contract currency. The firm may choose to keep price in a certain market rigid and allow the invoice price in any currency to fluctuate with the exchange rate, or it may adjust price to different degrees in different markets, in which case the "law of one price" is violated.

One example of the difference between the implicit contract currency and the invoice currency is provided by the Swedish paper and pulp industry, which sometimes invoices in German marks but nevertheless must adjust the price in this currency to changes in the Mark-Dollar exchange rate. The reason is that world prices are determined in dollars and, therefore, the dollar is the implicit contract currency.

The implicit contract currency in the export market for an exporting firm and in the domestic market for an import-competing firm would depend on the nature of trade barriers, as well as substitutibility and competition between products originating in different countries as noted by Dornbusch (1987).

C. Monetary Disturbances and Price Rigidity

What explains rigidity of a nominal price in a specific currency? Schultze (1985) asks the following types of questions with respect to wage contracts, but they are equally applicable in our case:

   (i) Why are not nominal prices explicitly indexed to some nominal indicator?

   (ii) Even if contracts are not explicitly indexed, why would not rational buyers and sellers forecast the ultimate equilibrium change in price and set it accordingly?

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(iii) If forecasting the equilibrium price is not feasible, why not
permit swift and large nominal price adjustment in response to
aggregate shocks?

There are obvious problems with indexing in (i), and there are
clearly difficulties with forecasting the ultimate equilibrium price in
(ii), but the third question is harder to answer, since in principle
prices on other goods are observable. Therefore, one would think that
each firm could identify an aggregate disturbance by observing prices in
other industries. There are problems with this argument, however.

Schultze argues with respect to wages, that in an economy where
agents are not sure what information others have, firms may resist
raising prices in response to perceived nominal shocks for fear that
others may not follow in case their information and expectations are
different. They would fear lowering prices, however, since if others do
not follow, they would gain a competitive advantage.[5]

Schultze seems to point to confusion between nominal and real price
and confusion about others' perceptions as the basis for the resistance
to adjust nominal prices upward. We believe that this direction of
analysis is correct though the above argument does not explain downward
rigidity. Assume, however, that firms wish to keep relative prices
rigid to temporary demand shocks and that they are confused about the
source of an increase in demand. Then a money supply increase
(decrease) would not elicit rapid price and output response in any
sector, though in all sectors an increase in demand is observed. Thus,
if judgment on nominal versus real price changes depends on each firm's
observation of others' prices, then no price will change. Thus, if each
firm follows a strategy of holding its relative price constant, then

there need not be any nominal price adjustment to an aggregate demand shock in the short run. For prices to adjust to such a shock, firms must utilize more information than others' prices. Such information exists, however. On the macro-level, a money supply increase must spill over into some markets if commodity prices do not rise. Financial asset prices, including the foreign currency price under flexible exchange rates, would adjust and perhaps overshoot as described in several macroeconomic models. These prices would provide "signals" about the monetary disturbance to the goods markets.

For the prices in goods markets to remain rigid, it is then necessary to introduce confusion about the information contents of financial asset prices as well. We continue the example of a money supply increase causing a shift in the demand for goods, a depreciation, and an interest rate decline. Even if the firm observes these shifts, it is likely that the combination of demand increase and financial asset price adjustment is interpreted as a non-monetary phenomenon with some probability. We need not go into possible scenarios and combinations of disturbances that could create the foundations for such misperceptions, but we can note that both interest rate and exchange rate changes may be caused by many non-monetary factors and changes in expectations about the future.

In general, we would expect some degree of price response by the firm observing the combination of signals that occurs as a result of a money supply increase. As in macro-models with rational expectation, the signals would create a certain expected monetary and real disturbance, respectively, and the firm would adjust price depending on these expectations, its expectation of competitors' reaction, and its

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implicit contract with its customers. There would exist an optimal pricing strategy in response to the firm's observation of signals. The derivation of such strategies must await further research.[6]

We conclude this section by listing a number of factors that would influence the degree of price response by an individual firm to a monetary disturbance.

D.   Factors Influencing the Degree of Price Response to Monetary
     Disturbances and the Nature of Optimal Pricing Strategies.

  1.   The Costs of Relative Price Changes--Product Differentiation
       and the degree of competition.

In industries where the gains from the implicit price contract for continuity of association are small, the price adjusts more fully to perceived cost and demand disturbances. In industries in which many firms produce homogeneous goods continuity of association is unimportant. Such industries would be characterized by high price flexibility to real as well as monetary shocks. In industries with high product differentiation, price adjustment would be less.

  2.   Costs of Inventory and Employment Adjustment

We noted above that the firm that keeps its price rigid when faced by a shift in demand would use either inventories, employment or the utilization of employees as a buffer. High costs associated with these adjustment mechanisms increase the costs of the implicit customer contract based on continuity of association.

  3.   The Currency in Which the Implicit Contract is Strongest

As noted above, the contract may be implicit in foreign currency, in local currency, or in both currencies. In the first case, the domestic currency price is simply the foreign currency price times the

exchange rate. Considerations below apply then to foreign monetary disturbances.

4. The Frequency of Temporary versus Permanent Real Cost and Demand Shifts in the Industry

Following the reasoning of the rational expectations literature, the higher the relative frequency of temporary (permanent) disturbances, the less (more) the relative price would be adjusted to a perceived cost or demand shift.

5. The Frequency of Unanticipated Monetary Versus Real Disturbances

It can be expected that a high frequency of unanticipated monetary disturbances increases the probability that a demand shift is caused by aggregate as opposed to firm-specific disturbances. A high frequency of real disturbances decreases the price response to monetary disturbances. Credibility of announced monetary policies would decrease the extent to which monetary disturbances are unanticipated and increase the speed with which nominal prices adjust.

6. The Noisiness of Financial Asset Prices--Interest Rates and Exchange Rates

Financial asset prices may be driven by shifts in aggregate expectations about future disturbances, in addition to current monetary and real disturbances. Unless individual agents know how others form expectations, there is noise in the signal provided by financial asset prices about current disturbances (see, e.g., Wihlborg, 1987). Inefficiencies in financial markets due to, for example, regulations and transaction costs, would also contribute to a lower information contents of prices (see, e.g., Glick and Wihlborg, 1986).

7. Resources Devoted to Information Acquisition, Gathering, and Analyses

Clearly, the better informed firms are about the sources of disturbances, the less confusion there is and the less rigid are prices to monetary disturbances. The amount of resources devoted to information gathering and analysis may depend on the relative frequency of disturbances and the noisiness of price signals as well as costs of inventory and employment adjustment (see, e.g., Glick and Wihlborg, 1985 and 1987).

IV. A Scenario Analysis of Exposure to Monetary Disturbances

In the preceding section we discussed optimal pricing strategies and explained why individual firms may choose to keep their prices rigid or imperfectly adjusting to monetary, cost, and demand disturbances. Our next step is to analyze how the choice of pricing strategy influences exposure to monetary disturbances.

It is noteworthy that we do not discuss exposure to exchange rate changes, inflation and interest rate changes. The reason is that cash flow effects due to these variables depend on the source of their changes, and these variables adjust simultaneously in a fashion determined by the underlying disturbances.

The exposure of cash flows to monetary disturbances for an individual firm depends not only on the individual firm's pricing strategy, but on the nature of aggregate price-, exchange rate-, and interest rate-adjustment to disturbances. This aggregate adjustment depends in turn on the pricing strategies chosen by firms as an aggregate. This latter connection between aggregate strategy choice and the nature of price, exchange rate, and interest rate adjustment will not be explored formally here. Instead, we assume that on the macro-level and the industry level there is a certain model relating the

adjustment of price variables. The adjustment of industry output price relative to the national price level is as determined by the average pricing strategy in the industry.

A number of scenarios will be specified in terms of inflation, exchange rate, and industry output price. Interest rates are neglected in order to simplify the analyses and focus on exposure of a non-financial nature. We neglect interest rate effects on demand for goods and costs as well.[7] The individual firm may follow the same strategy as other firms in the industry, or it may follow other more rigid or more flexible strategies in the domestic or the foreign currency. An issue is whether a difference between the firm's strategy and the industry strategy causes an increase or a decrease in the cash flow exposure of the firm. We will assume that after one period, there is full information about the disturbance, i.e., there are no real cash flow gains or losses due to a monetary disturbance beyond the first period. In other words, we measure exposure by the absolute magnitude of the real cash flow effect in period 1, after a period 0 in which all prices were in long run equilibrium, and before a period 2 in which equilibrium is restored.

The following highly simplistic strategies are followed by the individual firm for which the local currency (LC) is the home currency, and the US dollar (USD) is the foreign currency in the export market:

1) The firm uses the same strategy (same information) as the industry average. In this case there are no relative price changes between the industry output price in period 1 (OP_1) and the firm output price (FOP_1). This strategy may be called

a fixed market share strategy, since competitive conditions within the industry are constant.

2) The firm keeps the LC-price constant while USD-price = LC-price/e^{LC-USD}, where e^{LC-USD} is the units of LC per USD.

3) The firm keeps the USD-price constant while the LC price = USD-price $\cdot$ e^{LC-USD}.

4) Keep both the USD-price and the LC-price constant. There are deviations from the law of one price (LOP) on the firm level in this case.

Strategies 2, 3, and 4, may or may not be rational. They would be based on the perception that there is no monetary disturbance at all in either the LC-country, the U.S. or in both countries. A fifth strategy may be characterized as a constant profit margin (constant mark-up) strategy under the assumption that input and labor prices follow the national price level in the LC-country.

5) Adjust firm output price (FOP_1^{LC}) with an amount equal to the change in the national price level (P_1^{LC}) and set the foreign currency price equal to $FOP_1^{LC}/e_1^{LC-USC} = FOP_1^{US}$.

For some of the scenarios to be specified, one of the strategies 2, 3, 4, and 5, will coincide with the industry strategy.

Six scenarios will be specified, each of which represents one view of macroeconomic adjustment combined with an industry pricing strategy in response to a monetary disturbance. Macroeconomic adjustment is in itself a function of the economy-wide average pricing strategy. Within each of the six scenarios, we introduce strategies 1) - 5), for the firm, and ask how cash flow exposure is enhanced or reduced by the

difference between the firm's strategy and the industry average strategy in each case.

The model for cash flows and their exposure is similar to that in Oxelheim and Wihlborg (1987), but we limit the analysis to cash flows from sales in the domestic country (LC) and from export sales in one export market (US). By limiting the analysis in this way, we disregard cash flow effects on costs of input and wages, as well as interest rate effects on cash flows.[*] The exposure of sales revenue can be interpreted as the exposure of cash flows if input and factor costs follow the national price level. In period 0, the sales revenue is LC 10 and USD 10 in the two markets, all prices and exchange rates are equal to 1, and taxes are disregarded. In period 1, the firm obtains the following revenues from sales in the home country:

$$
LC\ 10 \cdot P_1^{LC} \cdot \frac{OP_1^{LC}}{P_1^{LC}} \cdot \frac{FOP_1^{LC}}{OP_1^{LC}} \left[1 + \left(\frac{OP_1^{LC}}{P_1^{LC}} - 1 \right) \varepsilon_s^{LC} \right] \left[1 + \left(\frac{FOP_1^{LC}}{OP_1^{LC}} - 1 \right) \varepsilon_d^{LC} \right] \quad (1)
$$

where P_1^{LC} is the price level in period 1 in the LC-country, $\dfrac{OP_1^{LC}}{P_1^{LC}}$ is

the relative industry output price, $\dfrac{FOP_1^{LC}}{OP_1^{LC}}$, is the firm price relative to

the industry price. We disregard effects of deviations from the "Law of One Price" on domestic sales. This relative price is more important for exports and will be considered in cash flows from exports.

The first bracket describes the volume effects due to a change in the relative industry price. The ε_s^{LC} is the supply elasticity in the industry, i.e., it describes the percentage change in output due to a one percent change in the relative industry output price.

The second bracket is the volume effect due to a change in the firm's output price relative to the industry. The ε_d^{LC} is a demand elasticity, i.e., if the firm raises its price more than the industry average, it will lose customers.

The cash flows from export sales in period 1 are:

$$LC \; 10 \bullet P_1^{US} \bullet \frac{OP_1^{US}}{P_1^{US}} \bullet \frac{FOP_1^{US}}{OP_1^{US}} \bullet e^{LC\text{-}USD} \left[1 + \left(\frac{OP_1^{US}}{P_1^{US}} - 1\right)\varepsilon_s^{US}\right]\left[1 + \left(\frac{FOP_1^{US}}{OP_1^{US}} - 1\right)\varepsilon_d^{US}\right]$$

$$\bullet \left[1 + \left(\frac{FOP_1^{US} \bullet e^{LC\text{-}USD}}{FOP_1^{LC}} - 1\right)\varepsilon_s^{US\text{-}LC}\right]$$

The relative prices are defined for the US in a similar way as for the home country. Revenues must be translated to LC at the exchange rate $e^{LC\text{-}USD}$. Volume effects are captured by the next three terms within brackets. The first bracket shows the change in supply to the US market resulting from a change in the relative industry output price. The second bracket demonstrates the demand effect that occurs if the firm's price deviates from the industry-output price. Finally, the third bracket shows the supply effect of a deviation from the "law of one price" for the firm's products, i.e., if the LC price of output is higher in USD than in LC, then the firm increases its supply to the US.

We are now in a position to describe the six scenarios for macroeconomic adjustment and the industry output price in period 1 after a 10% money supply increase.

<u>Scenario A</u>. Full information and perfect nominal flexibility in price on the industry level and in the economy as a whole. Purchasing power parity (PPP), 10% LC inflation. (Industry follows strategy 5.)

$$P_1^{LC} = 1.1, \quad P_1^{US} = 1.0$$

$$OP_1^{LC}/P_1^{LC} = OP_1^{US}/P_1^{US} = 1.$$

$$e^{LC-USD} = 1.1$$

Specific firm strategies
_____

2. $FOP_1^{LC}/OP_1^{LC} = 1/1.1$

    $FOP_1^{US}/OP_1^{US} = 1/1.1$

- -

3. $FOP_1^{LC}/OP_1^{LC} = 1 \bullet 1.1/1.1$

    $FOP_1^{US}/OP_1^{US} = 1$

- -

4. $FOP_1^{LC}/OP_1^{LC} = 1/1.1$

    $FOP_1^{US}/OP_1^{US} = 1$

- -

5. $FOP_1^{LC}/OP_1^{LC} = 1.1/1.1$

    $FOP_1^{US}/OP_1^{US} = (1.1/1.1)/1$

Scenario B. Industries fully informed in economy as a whole. PPP, 10% LC inflation. Industry follows rigid LC price strategy and LOP. (Industry follows strategy 2.)

$$P_1^{LC} = 1.1$$

$$OP_1^{LC}/P_1^{LC} = 1/1.1 \qquad\qquad OP_1^{US}/P_1^{US} = (1/1.1)/1$$

$$e^{LC=USD} = 1.1$$

Specific firm strategies
_____

2. $FOP_1^{LC}/OP_1^{LC} = 1/1$

    $FOP_1^{US}/OP_1^{US} = (1/1.1)/1$

- -

3. $\text{FOP}_1^{LC}/\text{OP}_1^{LC} = 1 \cdot 1.1/1$

   $\text{FOP}_1^{US}/\text{OP}_1^{US} = 1/(1/1.1)$

----

4. $\text{FOP}_1^{LC}/\text{OP}_1^{LC} = 1/1$

   $\text{FOP}_1^{US}/\text{OP}_1^{US} = 1/(1/1.1)$

----

5. $\text{FOP}_1^{LC}/\text{OP}_1^{LC} = 1.1/1$

   $\text{FOP}_1^{US}/\text{OP}_1^{US} = (1.1/1.1)/1$

Scenario C. Industries fully informed economy wide; LC 10% inflation. Exchange rate lags inflation. Industry informed about inflation in both countries and keep relative price constant. (Industry follows strategy 5.)

$P_1^{LC} = 1.1$

$\text{OP}_1^{LC}/P_1^{LC} = 1.1/1.1$ $\qquad \text{OP}_1^{US}/P_1^{US} = 1/1$

$e_1^{LC-USD} = 1.05$

Specific firm strategies

2. $\text{FOP}_1^{LC}/\text{OP}_1^{LC} = 1/1.1$

   $\text{FOP}_1^{US}/\text{OP}_1^{US} = (1/1.05)/1$

----

3. $\text{FOP}_1^{LC}/\text{OP}_1^{LC} = 1 \cdot 1.05/1.1$

   $\text{FOP}_1^{US}/\text{OP}_1^{US} = 1/1$

----

4. $\text{FOP}_1^{LC}/\text{OP}_1^{LC} = 1/1.1$

   $\text{FOP}_1^{US}/\text{OP}_1^{US} = 1/1$

----

5. $\text{FOP}_1^{LC}/\text{OP}_1^{LC} = 1.1/1.1$

   $\text{FOP}_1^{US}/\text{OP}_1^{US} = (1.1/1.05)/1$

Scenario D. Traded goods industries follow world market prices. Non-traded goods industries keep prices rigid. Exchange rate overshooting; LC 10% inflation on the average. Industry produces highly traded good, rigid in USD, LOP. (Industry follows strategy 3.)

$P_1^{LC} = 1.1$

$\text{OP}_1^{LC}/P_1^{LC} = 1 \cdot 1.15/1.1$ $\qquad$ $\text{OP}_1^{US}/P_1^{US} = 1/1$

$e_1^{LC-USD} = 1.15$

Specific firm strategies

2. $\text{FOP}_1^{LC}/\text{OP}_1^{LC} = 1/1.1$

   $\text{FOP}_1^{US}/\text{OP}_1^{US} = (1/1.15)/1$

- -

3. $\text{FOP}_1^{LC}/\text{OP}_1^{LC} = 1 \cdot 1.15/1 \cdot 1.15$

   $\text{FOP}_1^{US}/\text{OP}_1^{US} = 1/1$

- -

4. $\text{FOP}_1^{LC}/\text{OP}_1^{LC} = 1/1.1$

   $\text{FOP}_1^{US}/\text{OP}_1^{US} = 1/1$

- -

5. $\text{FOP}_1^{LC}/\text{OP}_1^{LC} = 1.1/1.15$

   $\text{FOP}_1^{US}/\text{OP}_1^{US} = (1.1/1.15)/1$

Scenario E. Same economy scenario as in D. Exchange rate overshooting, LC 10% inflation. Industry produces less tradeable goods, rigid in both LC and USD. (Industry follows strategy 4.)

$$P_1^{LC} = 1.1$$

$$OP_1^{LC}/P_1^{LC} = 1/1.1 \qquad OP_1^{US}/P_1^{US} = 1/1$$

$$e_1^{LC-USD} = 1.15$$

Specific firm strategies

2. $$FOP_1^{LC}/OP_1^{LC} = 1/1$$

$$FOP_1^{US}/OP_1^{US} = (1/1.15)/1$$

----

3. $$FOP_1^{LC}/OP_1^{LC} = 1\cdot 1.15/1$$

$$FOP_1^{US}/OP_1^{US} = 1/1$$

----

4. $$FOP_1^{LC}/OP_1^{LC} = 1/1$$

$$FOP_1^{US}/OP_1^{US} = 1/1$$

----

5. $$FOP_1^{LC}/OP_1^{LC} = 1.1/1$$

$$FOP_1^{US}/OP_1^{US} = (1.1/1.15)/1$$

Scenario F. All industries interpret disturbance as real and keep prices constant. Exchange rate adjustment equals 10%. (All industries follow strategy 4.)

$$P_1^{LC} = 1.0$$

$$OP_1^{LC}/P_1^{LC} = 1/1 \qquad OP_1^{US}/P_1^{US} = 1/1$$

$$e_1^{LC-USD} = 1.1$$

<u>Specific firm strategies</u>

2. $\quad FOP_1^{LC}/OP_1^{LC} = 1/1$

     $FOP_1^{US}/OP_1^{US} = (1/1.1)/1$

----

3. $\quad FOP_1^{LC}/OP_1^{LC} = 1\cdot 1.1/1$

     $FOP_1^{US}/OP_1^{US} = 1/1$

----

4. $\quad FOP_1^{LC}/OP_1^{LC} = 1/1$

     $FOP_1^{US}/OP_1^{US} = 1/1$

----

5. $\quad FOP_1^{LC}/OP_1^{LC} = 1/1$

     $FOP_1^{US}/OP_1^{US} = (1/1.1)/1$

Before presenting results for the different scenarios, supply and demand elasticities must be specified. We assume that all supply elasticities are .5. In other words, when the domestic industry output price rises as a result of the aggregate demand increase by, say, 10%, firms increase output by 5% ($\varepsilon_s^{LC} = \varepsilon_s^{US} = .5$). Similarly, when there is a 10% increase in the LC-value of the USD-price relative to the LC price, there is a 5% increase in output sold in the US market ($\varepsilon_s^{US-LC} = .5$). The demand elasticity describing the gain or loss in sales as a result of a relative price change between the firm-specific price and the industry-price is either -.5 of -2.0 in both countries ($\varepsilon_d^{LC} = \varepsilon_d^{US} = -.5$ or -2).

Table 1 presents real cash flow changes (in constant units of LC currency) in period relative to period 0, and relative to period 2 when

equilibrium is restored. Exposure to unanticipated money supply disturbances is captured by the absolute value of the figure in the table, since money supply may increase or decrease in future periods.

A few general observations can be made. When the demand elasticity for the firm's product is high and equal to -2, exposure increases when firm strategy differs from industry strategy except in cases C3, C4, and F4. When the demand elasticity is low and equal to -.5, exposure increases in seven cases, decreases in 9 cases, and remains unchanged in the remaining cases when firm strategy differs from industry strategy. Thus, it is not possible to conclude that exposure decreases due to market power. It may in some macroeconomic scenarios but no in others. There is not one strategy that reduces firm exposure in all scenarios. This conclusion holds under both elasticity assumptions. Even when there is a decrease in exposure, it is not possible to say that the strategy is optimal, since it must be evaluated relative to customers as well.

The market share strategy (1) leads to higher exposure than the constant mark-up strategy (5) in all scenarios when the demand elasticity is low except for total cash flows in scenario E. When the demand elasticity is high, the constant market share strategy causes less exposure than the constant mark-up strategy in all scenarios except in scenario E for export cash flows. These results are intuitive since under a constant mark-up strategy volume effects become large when the demand elasticity is high.

We cannot say in general that increased competition causes higher exposure. Increased competition has several dimensions of which the demand elasticity is one. The degree of competition is also reflected

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in the ability to deviate from the law of one price and the degree to which the industry-output price differs from the general price level.

Comparing firm exposure across scenarios in the case when all firms follow the same strategy (strategy 1), we observe the obvious result that when PPP holds and money is neutral, there is no exposure to monetary disturbances.

For export cash flows, the exposure is the highest in Scenario F in which all firms totally misinterpret the monetary disturbance and follow strategy 4 keeping prices constant in all markets. For domestic and total cash flows the exposure is the highest in Scenario B. Here, our industry is totally misinformed following strategy 2, while all other industries adjust perfectly to the monetary disturbance.

FOOTNOTES

1. The companies had to be: 1) listed on the stock exchange, 2) one of the 50 largest exporters, 3) one of the 50 largest Swedish employers in foreign countries, and 4) one of the 50 largest sellers abroad. Of the 20 companies, one was involved in reorganization at the time of the study and one could not answer pricing policy questions. Another highly decentralized corporation answered some, but not all, of the questions.

2. Schultze (1985) reviews this literature in the context of labor market price rigidities.

3. Baily (1974), Azariadis (1975), and others have applied this argument in labor markets.

4. This is a transaction cost argument of the type developed by Williamson (1975).

5. The old oligopoly model of resistance to downward price changes because everybody would follow does not apply since, if it is believed that everybody follows the perceived nominal price change, then there is no resistance to change the nominal price.

6. In the international context it is not uncommon that exporting firms adjust foreign list prices periodically with an amount corresponding to the forward discount on the foreign currency. The discount is seen as the expected depreciation of the foreign currency. The forward rate is not often a good predictor, however, with the consequence that foreign list prices will differ from desired ones. In addition, the discount may reflect expected real exchange rate changes as well as expected inflation. The optimal price response to these disturbances would not be identical.

7. The observation in Question 2 in Section II that firms do not believe that the interest rate differential equals expected exchange rate changes implies that macroeconomic shocks could influence the relative cost of capital among currencies and countries. Thereby, competitive conditions would be affected.

8. In order to analyze exposure to cost shocks and to include cost effects of real exchange rate changes under a constant profit margin strategy, the cost structure of the firm must be specified in more detail. The qualitative results with respect to this strategy would remain unaffected, however, as long as shocks do not originate on the cost side.

Table 1: Real Cash Flow Effects of a 10% Increase in the Domestic Money Supply

		FIRM STRATEGY									
		Marketshare								Constant markup	
		1		2		3		4		5	
		-0.5	-2.0	-0.5	-2.0	-0.5	-2.0	-0.5	-2.0	-0.5	-2.0
	Scenario										
	Export	0	0	-0.5	0.74	Same		0.5	0.5	0	0
A	Domestic	0	0	-0.5	0.74	as 1		-0.5	0.74	0	0
	Total	0	0	-1.0	1.48			0	1.24	0	0
	Export	-1.32	-1.32	Same		-0.93	-2.36	-0.48	-1.98	-0.93	-2.36
B	Domestic	-1.32	-1.32	as 1		-0.93	-2.36	-1.32	-1.32	-0.93	-2.36
	Total	-2.64	-2.64			-1.86	-4.72	-1.80	-3.30	-1.86	-4.72
	Export	-0.67	-0.67	-0.69	-0.04	-0.45	-0.45	-0.22	-0.22	-0.24	-0.95
C	Domestic	0	0	-0.50	0.74	-0.24	0.41	-0.50	0.74	0	0
	Total	-0.67	-0.67	-1.19	0.70	-0.69	-0.04	-0.71	0.53	-0.24	-0.95
	Export	0.45	0.45	-0.32	1.46	Same		1.24	1.24	0.22	0.87
D	Domestic	0.69	0.69	-0.10	1.72	as 1		-0.10	1.72	0.45	1.12
	Total	1.15	1.15	-0.42	3.19			1.14	2.96	0.67	1.99
	Export	1.24	1.24	-0.32	1.46	0.45	0.45	Same		0.22	0.87
E	Domestic	-1.32	-1.32	-1.32	-1.32	-0.77	-3.01	as 1		-0.93	-2.36
	Total	-0.08	-0.08	-1.64	0.14	-0.32	-2.56			-0.71	-1.49
	Export	1.55	1.55	0.45	1.82	1.00	1.00	Same		0.45	1.82
F	Domestic	0	0	0	0	0.45	-1.20	as 1		0	0
	Total	1.55	1.55	0.45	1.82	1.45	-0.20			0.45	1.82

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