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# Price Setting Transactions and the Role of Denominating Currency in FX Markets\*

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## Abstract

This report, commissioned by Sveriges Riksbank, examines the role of currency denomination in international trade transactions. It is divided in two parts. The first part consists of a survey of the price setting and payment practices of a large sample of Swedish exporting firms. The second part analyzes payments data from the Swedish settlement reports from 1999-2002. We examine whether invoicing patterns of Swedish and European companies changed following the creation of the EMU and how the currency denomination of exports differ from that of imports. Finally we consider the possibility that changes in invoicing patterns are correlated with changes in nominal exchange rates. Our main finding is that the same currency to a large extent is used for price setting, invoicing and payment for exports to third parties. We also find that the currency of the customer is the most used and that the euro is replacing the Swedish krona both in transactions with EMU-member countries but outside the EMU. Finally we find some evidence of a weak correlation between aggregate changes in invoicing patterns and changes in the trade weighted exchange rate over the period 1999-2002.

**Keywords:** Invoicing currency, exchange rate pass-through, price setting currency, exchange rate exposure, nominal rigidity

**JEL:** F31, F41, G32.

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# 1 Extended Abstract

This report, commissioned by Sveriges Riksbank, examines the role of currency denomination in international trade transactions. It is divided in two parts. The first part consists of a survey of the price setting and payment practices of a large sample of Swedish exporting firms. The second part analyzes payments data from the Swedish settlement reports. The data we have obtained show Swedish export and import payments and their currency denomination from 1999-2002, the period following the introduction of the euro. We examine whether invoicing patterns of Swedish and European companies changed following the creation of the EMU and how the currency denomination of exports differ from that of imports. Finally we consider the possibility that changes in invoicing patterns can be correlated with changes in nominal exchange rates. We use simple and partial correlations and regression analysis in order to examine any potential co-movements of changes in invoicing patterns and nominal exchange rates.

The following boxes summarize the main findings from the survey study on invoicing practices of Swedish exporting firms

## *Box 1.1 Main results from the survey study*

- **The same currency is largely used for price setting, invoicing and settlement for exports to third parties**
- **The currency of the customer is the most used**
- **The median firm with a price list changes its price once per year**
- **There is considerable variation in the speed with which foreign currency revenue is converted to Swedish kronor**
- **Negotiations are important for the price and for the choice of invoicing currency**
- **Large export markets and large orders make it more likely that the customer's currency is used**
- **To limit the risk of price deviations across countries a limited set of currencies are used for setting price**
- **Swedish kronor is the home currency**
- **An important goal of risk management is to limit the variability of cash flow**

## *Box 1.2 Main results from payment transactions data*

- **Less than half of exports are denominated in Swedish krona (for the sectors where we have data)**
- **The use of the krona differs substantially between industries but is falling over the period 1999-2002 both on the export and on the import side**
- **The fraction of imports denominated in Swedish krona is lower than the fraction of exports – but in some industries the difference is small**
- **The increase in the use of the euro stems from both increased use to EMU member countries and from increased use as a vehicle currency (a currency that is neither that of the importer or the exporter)**
- **As a vehicle currency, the use of the euro was more prevalent than the use of the U.S. dollar in 2002**
- **We find evidence that over the period 1999-2002 aggregate changes in invoicing patterns were correlated with changes in nominal exchange rates**

Below we briefly discuss why the main findings can have implications for exchange rate and monetary policy.

The finding that the same currency to a large extent is used both for setting price and as means of payment, together with the large changes in payment patterns reported in the second part, lead us to conclude that both Swedish and foreign firms to a decreasing extent use the Swedish krona for setting price. Given that export prices tend to be updated infrequently this could imply reduced exchange rate pass-through. This would point to a weakening of the expenditure switching mechanism with regard to Swedish exports but a strengthening of the mechanism with regard to imports. The effects of these changes on exchange rate determination are ambiguous. Some theoretical evidence points to that a greater degree of local currency pricing (pricing in the importers' currency) is associated with a more variable exchange rate.

Our results also imply a weak effect of increases in the trade balance on the exchange rate. Increases in the trade balance can appreciate the domestic currency due to increases in relative demand for home vs. foreign currency. This will be the case if Grassman's law holds (so that exports are mainly denominated in the domestic currency and imports in foreign currency) or if foreign currency denominated export payments are quickly converted into domestic currency. Our results point to that both of these channels are weak, so that increases in net exports results in proportionally smaller increases in relative demand for domestic and foreign currency.

## 2 Introduction

This study concerns the role of currency denomination in international trade transactions. The stylized fact, as well as the usual assumption in theoretical models, has been that in manufactured goods exchange between industrialized countries prices have usually been set in the currency of the exporter. If payments are made in the same currency as prices are set this would imply that an improvement in the trade balance would increase the demand for domestic currency and all else equal be associated with an appreciating currency<sup>1</sup>. There are many complicating factors however. Recent research points to that prices (payments) may not always be set (conducted) in the currency of the exporter. It is also not certain that the same currency is used in all parts of an international trade transaction, so that for example one currency is used for price setting but payments may ultimately be carried out in another currency.

The purpose of this report is to shed some light on these issues. The report is divided in two parts. The first part consists of a survey of the price setting and payment practices of a large sample Swedish exporting firms. The survey will give us answers regarding the factors that determine each, and also if the same currency is used throughout an international trade transaction. The second part will consist of a more quantitative analysis of the Swedish settlement report. The data we have obtained show Swedish export and import payments and their currency denomination. The data is especially interesting since it covers the period 1999-2002, the period following the introduction of the euro. Has invoicing patterns of Swedish and European companies changed following the creation of the EMU? How does the currency denomination of exports differ from imports? These are two questions we seek to answer. Finally we also want to consider the possibility that changes in invoicing patterns can be correlated with changes in nominal exchange rates. We use simple and partial correlations and regression analysis in order to examine any potential co movements of changes in invoicing patterns and nominal exchange rates.

## 3 The currency choice for denominating exports – a questionnaire study

In this Section we report results from a questionnaire study of Swedish firms regarding the choice of currency denomination of exports. The survey was conducted by Statistics Sweden and commissioned by Sveriges Riksbank, both of which may have contributed to the high response rate of 73 percent. For instance, 43 of Sweden's top 50 exporters by value responded to the questionnaire. This

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<sup>1</sup> The correlation between the current account and the nominal exchange rate is far from clear and different models of exchange rate determination leads to different conclusions about the correlation. A positive correlation between the current account and the nominal exchange rate is usually predicted by the so called portfolio balance models, see for instance Sarno and Taylor (2002).

strengthens our confidence in that the answers are informative about the overall currency use for Swedish exports.

### 3.1 Motivation for a survey approach

The last decade has given us many theoretical predictions on the determinants of currency choice by internationally trading firms.<sup>2</sup> This has coincided with an ever increasing focus on the role of price rigidities in models of international macroeconomics. If prices are rigid in the importers' (local currency pricing) or exporters' (producer currency pricing) currency has a large impact on the international transmission of shocks.<sup>3</sup> For instance, Cook and Devereux (2005) argue that US dollar pricing of exports by East Asian countries contributed importantly to the severity of the crisis in their region in the late 1990s. Clearly, the chosen strategy has an impact not only on the macro economy but can also have important consequences for exchange rate exposure at the firm level.<sup>4</sup> It is therefore not surprising that there is a growing interest in empirical evidence on currency use in international trade.

As of yet there are but a handful of empirical papers that examine the determinants of currency choice in international trade.<sup>5</sup> Limitations in the available data imply that there are still large gaps in the empirical knowledge – some of these which the questionnaire study strives to help fill. In particular, a currency serves multiple purposes in a trade transaction; as a unit of account (for setting the price), store of value (if there is trade credit) and medium of exchange (for the actual settlement). The empirical evidence on currency use is frequently based on the currency denomination of payments. But is this the same currency that is used for setting price and in the invoice? The distinction is important, as the macroeconomic consequences of currency choice typically come from pre-set price aspects. A questionnaire study will allow us to disentangle the relationship between the multiple roles that a currency has in trade transactions. The study will also give us the opportunity to look at firm specific determinants of currency invoicing. Finally, the questionnaire study will allow us to draw some inference on invoicing patterns since 2002, the last year of available data from the Balance of Payments statistics on the currency denomination of individual trade transactions that we use in the second part of this report.

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<sup>2</sup> Baron (1979) is an early study of price setting currency when the future exchange rate is uncertain. Donnenfeld and Zilcha (1991), Friberg (1998) and Bacchetta and Van Wincoop (2005) are other contributions to this field. On the choice of currency for the invoice see for instance Viaene and de Vries (1992) and for medium of exchange considerations see for instance Rey (2001).

<sup>3</sup> The seminal contribution in the new open economy macroeconomics is Obstfeld and Rogoff (1995). Betts and Devereux (1996) was perhaps the first to analyze the consequences of different price setting currencies in such a framework, see for instance Devereux and Engel (2003) for a recent contribution to a by now large literature.

<sup>4</sup> Dominguez (1998) for instance examines exchange rate exposure among Japanese firms and stresses the role of dollar invoicing.

<sup>5</sup> An almost exhaustive list is Donnenfeld and Haug (2003), Oi et al (2004), Goldberg and Tille (2006), Kamps (2006), Novy (2006) and Wilander (2006).

## 3.2 Study setup

The questionnaire was sent out by mail in January 2006 by Statistics Sweden. To get a good picture of the importance of various practices for pricing of Swedish exports, the questionnaire was sent to a random sample drawn from the (stratified) population of Swedish exporting firms. We set a lower threshold at firms which exported goods for a total value of at least 20 million Swedish kronor in the preceding year: about 2.2 million euro or 2.7 million US dollars. As mentioned above, to ensure that we had representation in all size classes the population was stratified according to three size classes. Table 3.1 below gives details on the population, the sample and response rates. As seen the population from which the sample was drawn accounts for almost 90 percent of Swedish exports of goods. Exports are highly concentrated and the 50 largest exporters account for more than 50 percent of the exports in the population. These were all included in the sample. In the medium and minor classes of exporters firms were selected by random draws (Statistics Sweden did this and also ensured that the sample was representative with respect to different industries).

**Table 3.1** The population and the sample.

<i>Exporters of goods from Sweden</i>	<i>Number of firms</i>	<i>Share of total export of goods (percent)</i>		
Swedish firms that Export for between 0 and 20 million Swedish kronor (Oct 2004-Oct 2005)	30621	4.7		
Foreign legal entities	37	2.0		
Governmental entities	10	1.0		
Firms not active in November 2005	159	3.7		
<b><i>Population from which sample was drawn</i></b>	<b>2540</b>	<b>88.6</b>		
All firms with exports of goods based on foreign trade statistics for 2004/2005	33367	100		
<i>The sample</i>	<i>Number of firms in stratum</i>	<i>Share of exports of population (percent)</i>	<i>Number of firms in sample</i>	<i>Responding firms (response rate)</i>
Large exporters	50	52.3	50	43 (86 %)
Medium exporters	211	23.9	150	109 (72%)
Minor exporters	2279	23.8	150	106 (71 %)

From Statistics Sweden we also received the export share in revenue in 2005, turnover from exports for 2005, as well as the percentage of export revenue that accrued from EU (including Norway, Iceland and Switzerland), North America

(Canada, Mexico, U.S.) and the rest of the world. We received this for both firms that responded and for firms that were included in the sample but did not respond.

Table 3.2 below gives details on these background characteristics of the firms as well as the self reported share of exports that were to other firms within the same company group and the proportion of different ownership structures. As seen in the table there is little evidence of important systematic differences between respondents and non-respondents. Overall the EU is the most important export market and intra-firm trade accounts for between a third and half of exports for the firms that are part of a company group. Sweden is an open economy and this is reflected in the large share of export earnings in overall earnings. Large firms are more export intensive and export a slightly larger share to destinations other than the EU. A low share of firms classifies themselves as independent. Foreign ownership is substantial across all size classes. Somewhat surprising is the low share of firms that classify themselves as parents. This may partly reflect that many large Swedish firms are partially owned by industrial holding companies.

In the following we report results mainly to reflect the behavior of a representative firm in the population of Swedish exporters (above the threshold value of 20 million SEK) – to do this we have to weigh the responses of the firms. Firstly we need to weigh results by the probability of being sampled which differs across strata. Letting  $N_h$  denote the number of firms in stratum  $h$  and  $n_h$  the number of sampled firms in stratum  $h$  we weigh results by  $N_h/n_h$ . In addition we wish to adjust for non-response which we do by weighting by  $n_h/r_h$  ( $r_h$  denotes the number of firms in stratum  $h$  that returned the questionnaire).<sup>6</sup> Our sample weights are thus given by  $w_h=N_h/r_h$ . To the extent that the behavior of large exporters differs from smaller exporters we also want to weigh results to reflect this. For this reason we also report results where we weigh responses from each firm  $i$  by  $w_h$  \*turnover from exports for firm  $i$  in 2005. We now turn to the presentation of the results.

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<sup>6</sup> See for instance Groves et al (2004).

**Table 3.2.** Some means across different groups.

<i>Stratum</i>	<i>Export share (turnover from exports/total turnover)</i>	<i>Export share to EU</i>	<i>Exp share to North America</i>	<i>Exp share other</i>	<i>Intra-firm exports (if part of concern)</i>	<i>Proportion of firms that are:</i>			
						<i>Parent</i>	<i>Subsidiary of foreign firm</i>	<i>Subsidiary of Swedish firm</i>	<i>Independent</i>
Large (responded)	76.19	66.34	13.61	21.19	41.27	14.28	38.09	45.24	2.38
Large (nonresp)	78.32	68.04	15.73	16.21	n.a.	n.a.	n.a.	n.a.	n.a.
Medium (responded)	70.16	72.08	10.17	20.56	53.66	11.11	48.14	38.89	1.85
Medium (nonresp)	63.85	75.40	9.73	16.29	n.a.	n.a.	n.a.	n.a.	n.a.
Minor (responded)	54.23	83.08	8.94	15.64	35.21	18.27	32.69	39.42	9.62
Minor (nonresp)	50.83	87.00	8.61	12.74	n.a.	n.a.	n.a.	n.a.	n.a.

Note: Columns give means across different strata. Sampling was random within strata.

### 3.3 Which currencies are used?

#### **Result 1: The same currency is largely used for price setting, invoicing and settlement for exports to third parties.**

An overwhelming share of revenue is priced and invoiced in the same currency. In addition the final payment is to a very large extent denominated in the same currency, as reported in Table 3.3. The estimated proportion of Swedish exporters that use the same currency for price setting and invoicing for *all* their export revenue from third parties was 62.72 percent. A further estimated proportion of 24.18 percent use the same currency for 90-99 percent of export revenue. Thus the rule is that exporters use the same currency for setting price and invoicing for at least 90 percent of export revenue from third parties.<sup>7</sup>

In an open ended follow up question we also asked firms to give a brief motivation for why the invoicing currency could differ from the price setting currency. 20 out of the 29 firms that commented this gave some version of the reply that this was a “request from the customer”. Where this was expanded upon the most frequent explanation was that customers wanted the invoice denominated in their own currency. A further three respondents noted that for their products the market setup was such that the price was quoted in another currency – one firm for instance stated that the market price was set in US dollars but the invoice denominated in Euro to European customers. The remaining explanations were that “this is sometimes done for firms that are part of a company group but located in another country than the parent” (2 answers) and 1 answer each for “for netting against the import currencies that we have”, “this may happen when trading houses are used as intermediaries”, and “changing identity of the customer” (i.e. someone orders but then transfers the right to purchase which will result in changes to the currency of invoice).

An estimated proportion of 68.43 percent of Swedish exporters receive payment in the same currency as the currency of invoice for all (100 percent) the export revenue, and a further 23.81 percent receive payment in the same currency for 90-99 percent of their export revenue.<sup>8</sup> Only a handful of firms indicated that the same currency was used for less than 90 percent of revenue.

With respect to why the payment currency could differ from the currency of the invoice 19 firms offered comments on this. 8 of these comments were different versions of customer requests (example: “the customer decides which currency to use, sometimes after checking the exchange rate with us”). 7 of the comments said that when this happened it was because of mistakes or misunderstandings between the customer and the banks. Three mentioned supply problems; that customers in developing countries sometimes had problems in getting hold of Swedish kronor

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<sup>7</sup> If we weigh by the export value the corresponding shares are given in Table 3.3 within parentheses. This does not take account of that some exports are to other firms within the same corporation/company group however. Also using the answer from one question regarding the share of exports that is directed to other firms in the same concern to construct weights we find that 46.7 (100 percent) and 45.2 percent (90-99 percent) of exports to third parties are priced and invoiced in the same currency.

<sup>8</sup> For an estimated 66.32 percent of exports the same currency was used for invoicing and for the actual payment for 100 percent of their export revenue. This proportion was essentially unchanged if we instead use weights to reflect the share of exports to third parties.

and 1 stated that small orders that were invoiced in Swedish kronor were paid in euros.

The share of firms that answered 100 percent in both the questions reported above was 48.4 percent and a further 33.6 percent responded that at least 90 percent of revenue was denominated in the same currency for both the first (price setting currency same as invoicing currency) and later stages of the transaction (invoicing currency same as currency of payment). Thus the responses clearly show that, at least for Sweden the same currency is typically used.<sup>9</sup>

The level of detail in the statistics of currency of denomination for trade varies considerably across countries. In addition some countries report statistics on settlement currency, some on invoicing currency and for some nations it is unclear how the data is collected (Goldberg and Tille, 2006, footnote 20). In this aspect the above evidence is comforting. Further, standard economic models will feature few links between real economic variables (such as the real price of imports or profits of firms) and the currency in which payment is settled. The result reported here however points to that the observed payment currency is also highly correlated with the choice of price setting currency – to the extent that prices are preset this clearly has an economic impact (see further discussion below in section 3.6). One may worry that this result is partially driven by that Swedish firms mainly export to the euro area and to North America, where price setting and invoicing in US dollars and euros respectively is important. The result is more general than that though– if we for instance restrict attention to firms that have at least 70 percent of their export revenue from the rest of the world the shares using the same currency are qualitatively similar as those reported in Table 3.3.<sup>10</sup> At an overarching level we were also interested in what the firms viewed as their main currency for international trade, an issue that we now turn to.<sup>11</sup>

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<sup>9</sup> We focus on trade external to the company group. The reason is that we suspect that mechanisms in intra-firm trade may operate in quite different fashion, see Bernard et. al (2006) for factors affecting intra-firm pricing.

<sup>10</sup> There were 28 respondents that met this requirement. Of these 57.14 percent (21.42 percent) used the same currency for price setting and invoicing for 100 percent (99-90 percent) of revenue. 64.3 percent (14.3 percent) used the same currency for invoicing and settlement for 100 percent (99-90 percent) of revenue.

<sup>11</sup> We note that if firms to a large extent used different currencies for different stages this would in all likelihood have led to a large proportion of firms answering “not relevant”, which was not the case, and we therefore take this answer to support our Result 1.

**Table 3.3** Is the same currency used for price setting, invoicing and payment for exports to third parties?

	Alternative				
	100 % of revenue	90-99 % of revenue	70-89 % of revenue	50-69 % of revenue	0-49 % of revenue
For how large a share of revenue [from exports to third parties] is the invoice denominated in the same currency as price was set in?	62.72 (57.08)	24.18 (32.82)	5.12 (2.96)	1.26 (2.97)	3.57 (1.14)
For how large a share of revenue [from exports to third parties] is the payment denominated in the same currency as the invoice?	68.43 (65.75)	23.81 (29.70)	4.42 (1.46)	.08 (0.13)	.10 (0.77)

Columns report the estimated proportion of Swedish exporters that report the corresponding share of currency use. Results in parentheses are weighted by turnover from exports. Shares do not sum to 100 since some firms that responded to the questionnaire did not respond to these particular questions.

**Table 3.4** Which currency is used for international trade?

*Question in survey: What currency is your main currency for exports? Mark the alternative that corresponds the closest in the respective case.*

	Swedish kronor	The customer's currency	Other currency	We do not have a main currency for exports	Not applicable
For exports to other firms <i>within</i> our company group	25.68 (11.12)	50.76 (64.54)	5.61 (10.70)	2.36 (1.46)	15.59 (12.16)
For exports to other firms <i>external</i> to our company group	26.24 (15.76)	42.10 (55.16)	23.59 (24.24)	3.87 (2.00)	4.20 (2.83)

Columns report the estimated proportion of Swedish exporters that report the corresponding share of currency use. Results in parentheses are weighted by turnover from exports. Shares do not sum to 100 since some firms that responded to the questionnaire did not respond to these particular questions.

## **Result 2: The currency of the customer is the most used.**

We were also interested in *what* currency that was used and therefore asked for the main currency of the firms exports, as reported in Table 3.4. The customer's currency was the main alternative for exports both to other firms (42.1) and for exports within company groups (50.76). For sales to other firms Swedish kronor and a vehicle currency were each the main currency for about a quarter of firms. Larger exporters tended to use the customers currency more at the expense of Swedish kronor. In value weighted terms the share of kronor is down to 15.76 percent for exports to third parties. The share of vehicle currency is lower for trade within the company group – the proportion is down to 5.61 percent. In value weighted terms however the krona and vehicle currencies are about equal. The dominance for the importer's currency is partly driven by the fact that much of Sweden's exports are to EU and North America. If we constrain attention to the firms that export mainly to other destinations the role of vehicle currencies is more important. For instance, of the 26 firms that had at least 70 percent of their exports to other destinations the share that used a third currency for third party exports was 34.6 percent (19.2 percent Swedish kronor, 30.7 percent customer's currency). These results are similar in flavour to those that Wilander (2006) finds in his examination of Swedish settlement reports for a subset of industries for the period 1999-2002. This point to that local currency pricing is a widespread practice among Swedish exporters.<sup>12</sup> An additional result from Table 3.4 is the following.

## **Result 3: Currency choice is similar for exports within the company group as across.**

Much of international trade is conducted within firms – Bernard et al (2006) for instance document that for US multinationals about one third of trade is intra-firm. The self reported fraction of export sales that are intra-firm in our data ranges from 35 to 53 percent across size groups. The literature that examines the prices in intra-firm trade has focused on transfer prices as a way of shifting profits from high- to low-tax locations and on managerial issues in multidivisional firms (see Bernard et al, 2006, for a discussion). Our survey is silent on if the *level* of prices differs systematically between trade within or across firm boundaries. A glance at the shares in Table 3.4 shows that the currency use is broadly similar however. If we look in more detail, 110 of 218 firms that answered both these questions gave the same currency choice for both intra-firm and third party exports. The main difference is that intra-firm transactions are to a lesser degree denominated in a vehicle currency.

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<sup>12</sup> Note that this is in some contrast to results in Grassman's (1973) pioneering work on invoicing. He found that Swedish exports were mainly invoiced in Swedish kronor – indeed that the exporters currency is mainly used for exports is sometimes referred to as Grassman's law. Given the substantial changes in institutional framework since Grassman's study it is not surprising that behavior appears to have changed.

### **3.4 What factors are important for the currency choice of the representative firm?**

The theoretical literature has forwarded a number of explanations for how currency should be set. Some pertain to the preset pricing aspect: Baron (1979) is an early study of price setting currency when the future exchange rate is uncertain. Donnenfeld and Zilcha (1991), Friberg (1998), Bacchetta and Van Wincoop (2005) and Engel (2006b) are other contributions to this field. The focus in these works is on the interaction between the curvature of profits in exchange rates and exchange rate variability. If profits are concave in exchange rates when set in the exporter's currency (which holds across a fairly broad range of functional forms) firms prefer to set price in the importer's currency. Other studies focus on the choice of currency for the invoice - see for instance Viaene and de Vries (1992). Here it is taken as given that the exporter is risk averse and prices and quantities are given. Their setup implies that each party prefers to use his own currency and the greater the bargaining power of the exporter, the larger the share of the invoice will be denominated in the exporter's currency. Lastly, some papers focus on medium of exchange considerations as in for instance Rey (2001). She shows how network effects can lead to a vehicle currency generating lower transactions costs. Goldberg and Tille (2006) set out a modeling framework in which both preset pricing and medium of exchange (settlement currency) considerations play a role – as pointed to above it is indeed valuable to combine several considerations in the same framework. We expect the characteristics of both the exporting and importing country (economic size, depth of financial markets, monetary and exchange rate policy), industry structure (how fierce is competition, how are relative costs of different producers affected by exchange rate changes), individual firm characteristics (what strategy do firms pursue with regards to risk management, what are outside options in bargaining,...) and the deal itself (is it a small order or a large one that has been negotiated extensively) to potentially play a role. The data sets available so far fall short of the level of detail that would be necessary to test predictions on all of the above factors. The empirical literature so far does support a number of explanations but the data sets are typically too narrow to allow a simultaneous test of all the theories. For this reason we asked firms to answer to what extent a number of statements agreed with their reasoning when determining the currency to use. The scale went from “corresponds very well” (coded as 4) to “does not correspond at all” (coded as 1).

Tables 3.5 and 3.6 below we report the mean rank that different statements were given. The statements are ordered in terms of rank, but the differences between subsequent alternatives are frequently not statistically significant and the precise ordering is not our focus. Instead we focus on the distinction between considerations that are recognized as at somewhat important for the representative firm. Therefore we denote the mean ranks that are statistically significant from 2 (“corresponds less well”) at the five percent level with a \* and organize our discussion based on this.

**Table 3.5** The importance of various factors for the choice of price setting currency.

*Question in survey: Answer how well each of the following statements corresponds to your company's choice of price setting currency.*

Statement:	Mean rank (in population of exporters)	Std. err.	Mean rank (weighted by export turnover)	Nobs
We decide the price setting currency ourselves.	2.83*	.090	2.63	215
To limit the risk of price deviations between countries we use a limited number of price setting currencies.	2.73*	.101	2.49	214
For large export markets price is set in the currency of the customer	2.62*	.108	2.89	214
Our choice of price setting currency is determined more by who the customer is than in which country the customer is based.	2.27*	.102	2.27	213
We use the same price setting currency for our exports that our imports are invoiced in	1.87	.092	1.73	212
We adapt our price setting currency following the choice of price setting currency that our competitors use	1.82*	.087	2.24	213
Our price setting currency is always Swedish kronor	1.69*	.102	1.35	215

The rank is calculated as the mean (weighted) where the alternatives were "Corresponds very well" (coded as 4), "Corresponds rather well" (coded as 3), "Corresponds less well" (coded as 2), "Does not correspond at all" (coded as 1). The stars indicate that a two sided Wald test rejects that the mean rank for the corresponding alternative differs from 2 "corresponds less well" at the 5 percent level of significance.

**Table 3.6** The importance of various factors for the choice of invoicing currency

*Question in survey: Answer how well each of the following statements corresponds to your company's choice of invoicing currency.*

Statement:	Mean rank (in population of exporters)	Std. err.	Mean rank (weighted by export turnover)	Nobs
The invoicing currency is determined in negotiations with the customer	3.03*	.087	3.14	236
We decide the invoicing currency ourselves	2.81	.102	2.37	241
Our firm has an explicit policy for how the invoicing currency is to be chosen	2.74*	.087	3.09	240
For large orders we invoice in the currency of the customer	2.30*	.102	2.63	242
We adapt to the invoicing currency that our competitors use	1.83	.086	2.18	241
The expected development of the exchange rate affects the choice of invoicing currency	1.71*	.07	1.57	239
Fees of exchanging currency affect the choice of invoicing currency	1.69*	.065	1.65	240
The set of financial instruments that are available for a particular currency affect our choice of invoicing currency	1.64*	.071	1.81	237
If we use Swedish kronor as invoicing currency the customers demand compensation (for instance in the form of a lower price)	1.63*	.066	1.68	236

The rank is calculated as the mean (weighted) where the alternatives were “Corresponds very well” (coded as 4), “Corresponds rather well” (coded as 3), “Corresponds less well” (coded as 2), “Does not correspond at all” (coded as 1). The stars indicate that a two sided Wald test rejects that the mean rank for the corresponding alternative differs from 2 “corresponds less well” at the 5 percent level of significance.

### 3.4.1 Factors that are important for the choice of currency for the representative firm

#### **Result 4: Negotiations are important for the price and for the choice of invoicing currency**

The highest rank for explanations for the choice of invoicing currency was given to “The invoicing currency is determined in negotiations with the customer” – at 3.03 out of 4. The wishes of firms in such negotiations should depend on the mechanisms that have been studied in the literature, but it may have important consequences that the currency choice ultimately is the outcome of negotiations. Viaene and De Vries (1992) and Donnenfeld and Zilcha (1995) are two papers that examine the currency choice in a bargaining framework. Bargaining was important not only for the currency but also for the price that was set. We asked

what best described the firms pricing decision. Recognizing that firms sell many products, and that practices may differ across products, we asked firms to answer for their company's main product for exports to firms outside the firm group. Answers are reported in Table A.1 in Appendix 1. The estimated proportion of firms that responded that price was determined in negotiations with the customer was 60.02 percent, 37.42 percent use list prices and 2.56 percent that they face an exogenously given price (for instance from a commodity exchange). Thus, negotiations with importers are given a prominent role for both the price itself and for the currency in which this price is denominated on the invoice.

A reasonable assumption for negotiations is that firms typically prefer to use their own currency, other things equal (this is for instance the assumption in Viaene and de Vries, 1992). An early analysis of this issue was made by Magee and Rao (1979). Magee and Rao note that if firms were risk averse and forward markets were nonexistent (or more generally costly to use) then a firm would want compensation for taking on exchange rate risk. To test this we asked firms "if we use Swedish kronor as invoicing currency the customer demands compensation". This alternative got a low rank in the population however. Ultimately the choice of offer price and currency must lie with the exporter. As confirmation of this, the admittedly somewhat vague statement, "We decide the price setting [invoicing] currency ourselves" was given a high mean rank for both the invoicing and price setting currency.

**Result 5: Large export markets and large orders make it more likely that the customer's currency is used**

Many have observed that large markets tend to have their currency used for imports to a greater extent (see for instance Hartmann 1998, p 29 for a discussion). There can be many explanations for this – in terms of the theories discussed above it may for instance be that in a larger market more of your competitors are local (which would promote price setting in the importers currency in a typical setup with pre set prices), that importers in a larger market are on average larger and have a stronger bargaining position (which would lead to store of value considerations pushing in the direction of importers currency) or it that a larger market offers lower transaction costs and less of a role for vehicle currencies. Another potential explanation is that there are costs of setting prices in (and handling) additional currencies. Engel (2006a, p 4) conjectures that the cost of setting prices in different currencies, which "must be one of the most important determinants of the currency of pricing". If there are fixed costs of setting prices in a particular currency a firm would be more willing to incur that cost for a large market. Similarly if there are partly fixed costs of invoicing in an additional currency the exporter would be more willing to do so the larger the order. Both these predictions are supported by the responses.

**Result 6: To limit the risk of price deviations across countries a limited set of currencies are used for setting price**

By now a number of questionnaires have examined the costs of adjusting domestic prices (see for instance Blinder et al 1998, Apel et al, 2005, Fabiani et al, 2005). Many of the considerations that appear in that literature are relevant also in this setting (for instance implicit or explicit contracts of price stability). To avoid an overly long questionnaire we did not include questions which merely mirrored concerns that are also relevant for domestic prices. Arbitrage concerns do not have a close analogue in a domestic setting however; preset prices in

several currencies coupled with fluctuating exchange rates would open up for customers always choosing the cheapest price which could hurt profits. We therefore enquired about this and indeed as seen this explanation was given some weight.

### **3.4.2 Explanations that are given a low mean rank by the representative firm**

#### **Result 7: The currency choice of competitors is not a central concern for most firms**

This was to us a quite surprising finding. The desire to limit involuntary price variation with respect to the prices of competitors is intuitively appealing and figures prominently in the theoretical literature (in for instance Johnson and Pick, 1997, Bacchetta and Van Wincoop, 2005 and Goldberg and Tille, 2006). Empirically there is also some support for it. Wilander (2006) finds that the larger the market share of US exporters in a particular destination, the more likely is it that Swedish exporters receive payment in dollars from that market. Goldberg and Tille (2006) find that the larger the share of a country's exports that are traded on organized exchanges or reference priced (following Rausch's, 1999, classification) the more are US dollars used for export invoicing, after controlling for other factors. Also in our survey the relatively low mean rank hides considerable variation. At the 75<sup>th</sup> percentile the respondents answered that the statement [invoicing currency choice of competitors are important] corresponded "rather well" and at the 95<sup>th</sup> percentile "very well" with a similar pattern for price setting currency.<sup>13</sup> The correlation between the answers to these two questions was 0.63. Thus, it is not warranted to discard this explanation based on the low mean rank in this survey – for some firms it is an important consideration. It does open up for that it's importance is largely limited to firms faced with quite intense competition though.<sup>14</sup>

#### **Result 8: The expected development of the exchange rate matters little for currency choice**

A firm that has beliefs about appreciation of a particular currency would wish to use that as a store of value.<sup>15</sup> If currency markets are reasonably efficient there is of course little reason for a firm to expect that this kind of speculation is profitable. Indeed, on average the statement that the expected development of exchange rates influences the choice of invoicing currency is given a low rank. There was considerable variation in response to this question as well. Three firms gave the highest rank ("corresponds very well") to the statement and a further 23

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<sup>13</sup> In one question we ask firms about their price setting (results in Table A1). For firms that respond that they are price takers we ask them to skip the questions on considerations regarding price setting currency since we feared that it might confuse firms that are price takers to answer a number of questions about price setting. Coding these firms as "very well" for the price setting currency question raises its rank from 1.82 to 1.88, not significantly different from 2.

<sup>14</sup> Firms may have difficulty in disentangling the different factors affecting currency choice however. When exporting to the U.S. many firms use dollars – several mechanisms are likely to pull in this direction and it may be difficult also from the firm's perspective to judge the independent contribution of competitors pricing in US dollars.

<sup>15</sup> See Magee and Rao (1980) for a discussion.

firms gave it the second highest rank (“corresponds rather well”). There are related questions regarding the risk management of currency exposure and we return to these issues below.

**Result 9: The set of financial instruments available in a currency and costs of exchanging currency are not deemed to be important for the currency choice**

This finding was also at first somewhat surprising. Choosing currency to limit transaction costs was one of the first mechanisms that economists theorized about (see for instance Swoboda, 1968 and McKinnon, 1979). However, Swedish exports overwhelmingly go to EU, US or other jurisdictions with rather well developed financial markets and liquid currencies. It seems plausible that transaction costs differences across different currency choices here (kronor, local currency, or US dollars or euros as a vehicle currency) are low enough to take the back seat. Again, for a subset of firms these issues are important. The 90th percentile firm responds that the statements regarding the importance of financial markets and transaction costs correspond “rather well” and 9 (6) firms respond that the availability of financial instruments (costs of exchanging currency) matters corresponds “very well” to their situation. For exports to developing countries these issues may indeed figure prominently and Wilander (2006) finds that across 144 Swedish export destinations less developed financial markets makes it more likely that a vehicle currency is used.

A caveat is also in order here. The literature on the medium of exchange role shows that small differences in transaction costs can have large volume effects. Portes and Rey (1998) for instance stress transaction cost differences for the prospects for the euro to replace the US dollar as the leading international currency. Therefore the distinction between *forex* vehicle and *trade* vehicle is important. To clarify consider the following case: a Swedish exporter and a Canadian importer agree to use Swedish kronor for the transaction. The Swedish firm receives Swedish kronor into its account on the settlement date. This would be reported as the exporter’s currency being used in our questionnaire. The Canadian firm’s bank may of course buy kronor directly by exchanging Canadian dollars for Swedish kronor or use US dollars as a forex vehicle currency (see Hartmann, 1998 for a discussion) for the interbank transfer of funds. That trade and forex vehicles indeed differ can be consistent with data from the latest BIS triannual survey of foreign exchange (BIS, 2004); around 53 percent of the foreign exchange volume against kronor was US dollars and only some 20 percent euros, despite the fact that the euro area is a much larger trading partner and trade vehicle currency use is limited.

**Result 10: If kronor is used the importer does not demand compensation.**

In casual conversation with firms it is often taken as given that firms prefer to deal in their own currency. An early analysis of this issue was made by Magee and Rao (1979). As mentioned above, Magee and Rao note that if firms are risk averse and forward markets are costly to use, then a firm would want compensation (for instance in terms of a lower price) for taking on exchange rate risk. The potential for this mechanism is illustrated by that both prices and currency denomination are frequently the outcome of a bargaining process. To test this we asked firms “if we use Swedish kronor as invoicing currency the customer demands compensation”. This alternative got a low rank in the population however. Again the mean masks some variation: an estimated 1.3 percent of firms find that the

statement corresponds “very well” to the situation and 11.63 percent that it corresponds “rather well”.

Wrapping up: results 7 and 9 are negative results regarding mechanisms that are intuitive and have been explored in the economics literature. The explanations are important for a subset of firms, but according to the answers these issues figure less prominently for the representative Swedish exporter.

### 3.4.3 How often are prices changed?

#### **Result 11: The median firm with a price list changes its price once per year**

Many issues concerning the real impact of exchange rates revolve around price rigidities. We asked the firms which responded that they used price lists to report how frequently they had changed the list price in the last 12 months. These were only 86 firms and we present the raw proportions: None 16.87 percent, 1 time 49.38 percent, 2 times 13.25 percent, 3 times, 3.61 percent, 4 times 6.02 percent, 5-8 times 1.2 percent, 9-12 times 2.4 percent and more than 12 times 2.4 percent. That the median firm adjusts its price once a year is in line with the survey evidence that focuses on domestic prices (Blinder et al 1998, Apel et al, 2005, Fabiani et al, 2005).<sup>16</sup> It is also in line with one of the few studies that examine the stickiness of prices at the “docks”; Gopinath and Rigobon (2006) use very detailed data on US exports and imports collected by the BLS at the border over the 1995-2005 period. They find that the average price last about a year, for both US exports and imports. One may have expected export prices to adjust more frequently given that one may expect the frictionless export prices to be subject to greater shocks.<sup>17</sup> We may also note that, as reported above, the largest proportion of firms stated that their most important price was determined in negotiations with the customer, pointing to negotiation costs as an important source of price rigidity.

## 3.5 Risk Management

We were also motivated by a set of questions regarding the handling of exchange rate risk in the firms, and the key results are presented in Table 3.7 below. For firms that were part of a company group all issues related to risk management might be handled elsewhere in the group. Noting that such respondents might have only second hand knowledge about the actual practices with regard to risk management we asked those who answered that risk- and liquidity management and was external to the firm to skip this block of questions.

#### **Result 12: Swedish kronor is the home currency**

All calculations within a firm need to use a particular unit of account. In terms of risk management firms may wish to limit the variability of cash flows (or purchasing power of owners) as measured in a particular currency. We were interested if this currency was kronor or not, in particular given the widespread

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<sup>16</sup> It may also be noted that some of the studies of the micro data that underlie consumer price indexes point to median adjustments more frequently. Bils and Klenow (2004) report that the median *price* is adjusted every 6 months.

<sup>17</sup> Of course in a setting with state dependent pricing it may not necessarily be the case that prices adjust more frequently since the band of inaction will be a function of both the size and frequency of shocks.

foreign ownership of Swedish firms. These issues were somewhat difficult to express in a way that would not end up confusing respondents. In the end we therefore settled for “which currency does the firm consider to be its home currency”. The answer was overwhelmingly Swedish kronor (91.88 percent of the firms that at least partly managed the exchange rate exposure themselves with 5 percent for euro and the rest for US dollars).

**Result 13: Explicit policies on invoicing and exchange rate risk management are common**

Statements regarding the existence of explicit policies received high recognition. These point to that we can expect the choices to be the result of economic considerations and randomness playing a limited role.

**Result 14: An important goal of risk management is to limit the variability of cash flows**

Whether risk management at the firm level adds value or not is a long standing issue in finance. In a frictionless world along the lines of Modigliani and Miller the answer is negative but theory and empirical work has identified a number of concerns that can lead to hedging increasing the value of the firm (see for instance Froot, Stein and Scharfstein, 1993 or Jin and Jorion, 2006). The theoretical reasons for why risk management can increase the value of the firm focus on the variability of cash flows and this answer is thus well in line with what theory would lead us to predict.

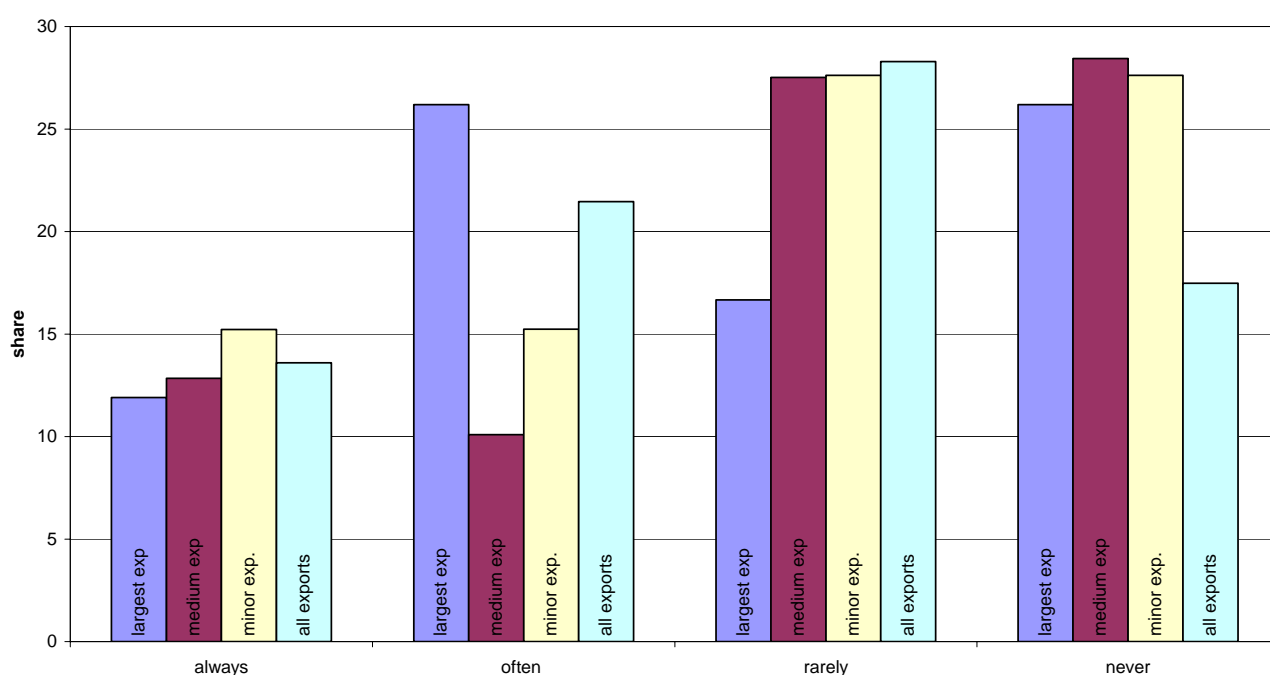
**Result 15: Limiting the variability in the value of assets is also important.**

Received wisdom is that apart from tax considerations there is little reason for firms to hedge the accounting value of assets that are denominated in foreign currency. Nevertheless, different methods of hedging foreign currency assets (such as foreign subsidiaries) are discussed in standard international finance texts (see for instance Shapiro 2003 or Sercu and Uppal, 1995). Indeed the representative firm does attach some weight to this.

**Result 16: There is considerable variation in the speed with which foreign currency revenue is converted to Swedish kronor**

The project that this questionnaire was a part of was initiated to understand the impact on the exchange rate of different invoicing practices. From this perspective it is of some interest to examine when, if ever, firms convert settlements in foreign currency into Swedish kronor. This is clear from the next figure. One might have expected large firms to convert less frequently but this is not the case.

**Figure 1. If payment is in another currency than Swedish kronor, do you then immediately exchange this for Swedish kronor?**



The firms were given the opportunity to explain their choice to this question. 13 firms responded that they have accounts in foreign currency – in a couple of instances explicit mention was made of that these were located outside Sweden in foreign banks or with the group finance division located outside Sweden. 12 firms made reference to extensive use of forward contracts in response to this question. Two of the firms stated that they exchanged currency to Swedish kronor once a month.

**Result 17. There is some leeway to speculate.**

The relatively high rank on the statement “there is the opportunity to take exchange rate positions depending on for instance expected exchange rates....” points to that finance departments have some possibilities to try to go after returns and are not limited to simply hedging exposures. Note that expected developments of the exchange rate were given a low score in the considerations of which currency to use. These observations would fit well with a situation where financial risk management is concentrated in the finance department, as would be suggested by much of the financial literature.

**Table 3.7 Risk Management**

	yes	no	Liquidity and risk handled both by the firm and centrally	Not part of concern	Nobs
<i>Question in survey: Is the management of liquidity and risk centralized to another firm in the concern?</i>	31.47	36.31	18.44	7.96	256
<i>Question in survey: What currency does the firm consider to be its home currency</i>	Swedish kronor	Euro	US Dollars	Other	
(proportion of respondents to this question)	91.87	5	3.12	0	160
<i>Question in survey: Answer how well each of the following statements corresponds to your company's policy to limit exposure to currency risk.</i>	Mean rank	Std err	Nobs		
Our firm has a written policy for management of exchange rate risk	3.10*	.092	155		
An overarching goal for the risk management of the firm is to limit the variability of cash flows	3.04*	.079	155		
An overarching goal for the risk management of the firm is to limit the variability in the value of assets	2.66*	.091	153		
There is the opportunity to take exchange rate positions depending on for instance expected developments of exchange rates and interest rate differentials	2.49*	.092	154		

The rank is calculated as the mean (weighted) where the alternatives were “Corresponds very well” (coded as 4), “Corresponds rather well” (coded as 3), “Corresponds less well” (coded as 2), “Does not correspond at all” (coded as 1). The stars indicate that a two sided Wald test rejects that the mean rank for the corresponding alternative differs from 2 “corresponds less well” at the 5 percent level of significance.

## 3.6 Discussion of the implications of the survey

The results from the survey have implications for several issues. That the same currency to a very large extent is used both for pricing, invoicing and payment eases international comparisons of the currency denomination in international trade, if reporting is done differently in different countries. Moreover, most available data, including the one that is used in the next section of this study, is on the currency in which payment took place. However, examining such data will still tell us something about the price setting currency, since the price setting and payment currency tend to be the same.

The above result, combined with the finding that (median) prices are changed rather infrequently (result 11), potentially also has macroeconomic implications. If the invoicing currency is also the currency in which prices are set, this leads to a clear link between invoicing and exchange rate pass-through. This is consistent with the low exchange-rate pass-through to U.S. import prices and the prevalence of dollar denomination of U.S. imports. Firms switching from using Swedish kronor to using euros to denominate trade would thus tend to increase short run pass-through to Swedish import prices and decrease short run pass-through to Swedish export prices (when expressed in the importer's currency). The extent of the shift, as well as the nominal rigidity of prices, matter for how strong these effects are. In the pass-through literature the exchange rate is typically taken to be exogenous. We may note that the currency used in trade may also have effects on how different shocks are transmitted into the exchange rate – we return with a discussion of these issues in Section 4.3.1.

Many firms do not immediately (or at all), convert foreign currency payments to the home currency (SEK). This means that if foreign currency pricing of exports is prevalent then increases in net exports may not necessarily lead to changes in the demand for SEK, since exporting firms prefer to keep the export payments in foreign currency, perhaps in foreign-currency denominated bank accounts outside Sweden. However, since some firms reported that foreign currency payments were indeed converted, a more appropriate conclusion is probably that increases in net exports do lead to increases in demand for domestic currency, albeit a proportionally smaller increase.

# 4 An analysis of payments data from the Swedish settlement reports

We now turn to analyzing payments data from the Swedish settlement reports. All payments to and from Swedish firms above a threshold level are reported. The level was, in Swedish krona (SEK), 75 000 in 1999, 100 000 in 2000 and 2001 and 150 000 in 2002. The dataset shows within which industry the transaction took place, the trading partner by country, date, the transaction amount in SEK as well as the currency in which payment was made.

On the export side we have payments data from foreign importers for nine industries for the years 1999-2002. On the import side we have payments to foreign exporters for no less than 51 industries, but only for the years 2000-2002.<sup>18</sup> Since all industries on the export side are also covered on the import side we will focus especially on these industries as they also display large heterogeneity in terms of product differentiation, something that can affect invoicing patterns. We will of course also pay attention to the remaining industries. The industries are organized according to the Swedish industrial classification system (SNI) which on the two digit level is roughly equivalent to the North American Industrial classification system (NAIC). The nine industries we will emphasize are: Food, Apparel, Wood Products, Paper and Pulp, Chemicals, Telecom, Optical/Precision and Medical Instruments, Motor Vehicles and Furniture.

## 4.1 The payment data – what does it tell us?

Table 4.1 shows the total fraction of export and import transactions denominated in Swedish krona for each year and industry while table 4.2 shows the equivalent figures for euro-area currencies, which we define as all the currencies that were replaced by the euro, as well as the euro itself. This is because both the euro and the old member country currencies worked as medium of exchange until 2002.

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<sup>18</sup> The export data formed the basis for the investigation in Wilander (2006) and the import data formed the basis for the examination in Hopkins (2006), we are grateful to her for sharing the data.

**Table 4.1** Fraction of the value of export (import) payments denominated in Swedish krona

	1999	2000	2001	2002
Food Products	44,0 (n/a)	41,2 (20,8)	45,6 (18,9)	36,1 (15,7)
Apparel	21,4 (n/a)	14,2 (35,3)	12,8 (27,6)	11,7 (14,0)
Wood Products	47,3 (n/a)	37,5 (28,9)	29,9 (22,7)	26,1 (20,4)
Paper and Pulp	31,1 (n/a)	26,3 (37,9)	26,3 (31,2)	25,8 (21,7)
Chemicals	34,7 (n/a)	32,2 (22,0)	30,7 (13,8)	27,2 (10,7)
Telecom Equipment	25,8 (n/a)	29,4 (6,0)	18,7 (4,9)	14,4 (7,1)
Optical/Precision and Medical Instruments	48,3 (n/a)	44,0 (15,0)	38,9 (9,6)	30,7 (11,2)
Motor Vehicles	79,8 (n/a)	85,5 (18,9)	50,3 (8,9)	41,1 (5,4)
Furniture	44,8 (n/a)	46,5 (26,9)	53,4 (26,8)	59,6 (31,0)

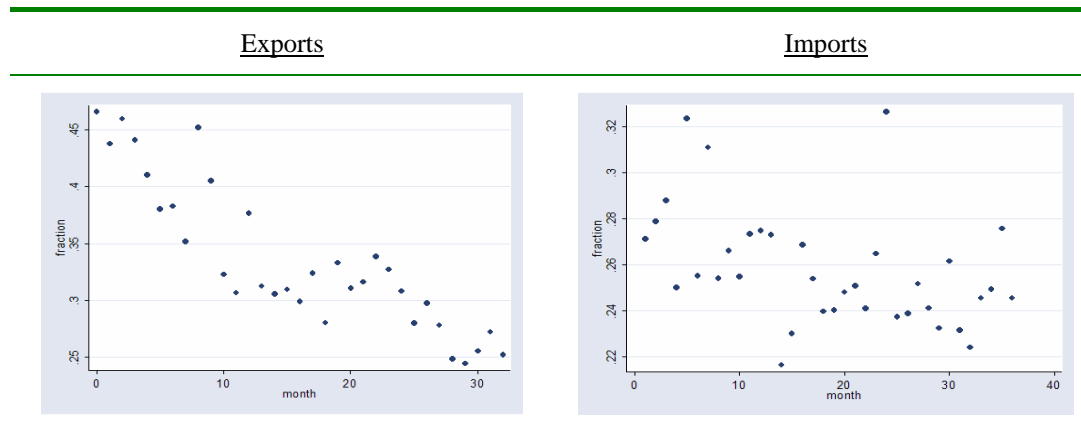
**Table 4.2** Fraction of the value of export (import) payments denominated in Euro-area currencies

	1999	2000	2001	2002
Food Products	24,7 (n/a)	25,1 (49,3)	26,3 (54,5)	37,5 (60,5)
Apparel	42,5 (n/a)	34,9 (37,3)	28,4 (43,2)	38,1 (58,9)
Wood Products	21,2 (n/a)	25,5 (38,9)	28,6 (43,3)	32,1 (45,4)
Paper and Pulp	38,5 (n/a)	35,6 (43,1)	39,7 (49,6)	41,7 (62,8)
Chemicals	28,7 (n/a)	31,7 (45,1)	33,2 (51,5)	40,4 (60,3)
Telecom Equipment	16,0 (n/a)	23,3 (22,0)	25,7 (33,4)	22,6 (34,3)
Optical/Precision and Medical Instruments	15,5 (n/a)	17,0 (29,2)	18,7 (35,6)	25,1 (43,2)
Motor Vehicles	15,3 (n/a)	13,8 (54,5)	23,3 (67,1)	29,5 (69,3)
Furniture	26,8 (n/a)	26,3 (48,8)	20,3 (44,7)	17,8 (53,7)

There are several interesting things to take away from these tables. First, for most of the examined industries, less than half of all exports are denominated in Swedish krona. The krona is more used for denominating exports than for imports even though for some industries the fraction of payments denominated in SEK is roughly equivalent for the export and import side. We can also note that the use of the SEK is falling while the Euro is becoming more heavily used. Interestingly, in 2002 when the euro had replaced all member countries old currencies, the use of the euro was larger (for most industries) on both the import and export side than was the combined use of all the currencies it replaced.

Figure 4.1 show the fraction of Swedish krona for all nine export industries and 51 import industries for each month for the years 2000-2002.

**Figure 4.1** Fraction of trade transaction payments denominated in SEK 2000-2002



The two graphs clearly show the trend towards less use of Swedish krona, especially on the export side but also on import side. In 2002, the difference between the fraction of payments denominated in SEK for exports and imports do not differ all that much. This indication is potentially important; if both exports and imports have similar currency denominations, there is less reason to suspect that changes in net exports will lead to changes in the demand for the domestic currency, especially if domestic firms do not immediately (or at all) convert foreign currency payments to the domestic currency.

Given the large changes in currency denomination, especially for Swedish exports, it could be interesting to see what has accounted for these changes. Table 4.3 shows the currency denomination of all recorded transactions on the export side to EMU member countries, either as SEK, the local currency of the importer or a vehicle currency (a currency that is neither the “home currency” of the exporter or the importer).

**Table 4.3** Currency denomination of exports to EMU countries

	1999	2000	2001	2002
SEK	41%	39%	38%	34%
Local Currency	50%	50%	52%	54%
Vehicle currency (dollar)	7%	9%	9%	10%
Vehicle currency (other)	3%	2%	2%	1%

Note: EMU countries

Table 4.3 show that the Swedish krona is being used less and less in transactions with EMU members, and that the use of the euro, the local currency, is increasing. Table 4.4 show the equivalent numbers for exports outside the EMU and the U.S.

**Table 4.4** Currency denomination of exports to countries other than the U.S. and the EMU countries

	1999	2000	2001	2002
SEK	42%	40%	36%	34%
Local Currency	17%	17%	17%	17%
Vehicle currency (dollar)	23%	23%	23%	22%
Vehicle currency (Euro)	11%	17%	22%	26%
Vehicle Currency (other)	6%	3%	2%	2%

Note: excluding the EMU and U.S.

From Table 4.4 we can see that also outside the EMU, the use of the Swedish krona is falling and the use of the euro as a vehicle currency is increasing rapidly. As we can see from both Table 4.3 and 4.4, this increase has come at the expense of the SEK, and not the dollar. Nonetheless, the use of the euro as a vehicle currency is larger than the use of the dollar, a rather remarkable finding given the U.S. dollar and its role as an international currency.

What can have accounted for the large changes? Can we find plausible theoretical explanations for this shift in currency denomination of Swedish trade from SEK to Euro, or are there simpler mechanisms at work? One possibility could be that international payments in Euro can be conducted at less cost than international payments in other currencies. In fact, this is today the case due to decision by the European parliament in 2001 (2560/2001) that international payments within the European Union conducted in Euro up to a value of 12,500 Euro are not allowed to cost more than a domestic payment. This regulation does not apply to international payments in other currencies. However, since the regulation was put in effect in July 2003, it does not affect our data. It could however impact invoicing decisions in the future, especially since the threshold was increased to 50,000 Euro in 2006. Although the differences in fixed cost between international payments in Euro and other currencies are rather small<sup>19</sup>, it could perhaps matter for frequent intra-firm transactions.

If cost differentials cannot explain the shift in invoicing, can theoretical economic models do the job? Actually, Bachetta and Van Wincoop (2005) show in a theoretical model of optimal price setting currency for exports under pre-set prices<sup>20</sup> that countries forming a monetary union will experience an increase in the use of the union currency in international trade. More specifically, the union's currency will, after a while, be more frequently used than was the sum of the currencies it replaced. The explanation is a simple two-step line of reasoning. First, relative market size of the exporting and importing country matters for the

<sup>19</sup> For example, at the Swedish Bank SEB, the cost of a payment in Euro to an EU country is 10 (50) SEK for payment using internet bank (phone or at bank office), and payment in any other currency is 35 (100) SEK.

<sup>20</sup> Pre-set prices simply refers to the fact that prices are set before the realization of the exchange rate. Hence, if prices are set in the exporter's currency, changes in the exchange rate will lead to changes in import prices, and hence in demand. If prices are set in the currency of the importer, exchange rates changes will not lead to changes in import prices, but the exporter's revenues will change due to a valuation effect, as payments are converted to domestic currency at different rates.

price setting decision; firms want to limit demand fluctuations and therefore set prices in the same currency as competitors<sup>21</sup>. If a fraction of home firms that export set prices in home currency, then the larger is the market share of home, the more attractive is it for a marginal home firm to also set price in home currency. The implication is that to large export destinations where domestic competition is tougher, home firms set prices in local currency, but for smaller export destinations it may be optimal to use home currency. Second, prior to the formation of the currency union, there were both small and large export destinations with varying currency denomination in trade, but after the introduction of a common currency, the entire union act as a single market. Firms exporting to especially smaller countries in the union may then shift denomination of exports, leading to an increase in the use of the union's currency. Moreover, the number of exporting firms from union member countries that share the same home currency has substantially increased to all export destinations, making Euro a more attractive invoicing choice for union exporting firms. The implication is thus that on both the export and import side the use of the union's currency is likely to exceed that of old currencies.

There are of course other potential candidates such as reduced exchange rate volatility and thicker financial markets, reducing the costs associated with hedging foreign currency denominated transactions. However, the effect on exchange rate volatility on optimal invoicing currency is not clear, and we know from the questionnaire study that the set of financial instruments available in a currency is not a major determinant, at least not for exports to countries with already developed financial systems. Nonetheless, one cannot overlook the possibility that the financial deepening in Europe may have contributed to an increase in euro-denominated payments by Swedish firms.

To summarize this section, the analysis from the payments data has told us that:

- *Less than half of the Swedish exports are denominated in Swedish krona*
- *The use of the krona differs substantially between industries but is falling over the period 1999-2002 both on the export and on the import side*
- *The fraction of imports denominated in Swedish krona is lower than the fraction of exports – but in some industries the difference is small*
- *The increase in the use of the euro stems from both increased use to EMU member countries, but also as a vehicle currency*
- *As a vehicle currency, the use of the euro was more prevalent than the use of the U.S. dollar in 2002*

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<sup>21</sup> We know from the survey that many firms did not rank this as an important determinant of the invoicing decision. But the mechanism in Bacchetta and Van Wincoop is slightly more complicated than a pure competition argument. If a fraction of competitors from home country set price in home currency when exporting to foreign, then the larger is the market share of home firms the more will the foreign price index depend on the exchange rate. Since demand for a home firm's products depend on the firm's price relative to the foreign price index, using home currency when many competitors do so will result in smaller differences in relative prices and smaller demand variations than if no competitors set prices in home currency. Some firms may simply have overlooked the link between demand volatility and pricing in competitors' currencies in the questionnaire.

## **4.2 Data after 2002**

As mentioned in the introduction, payments above a certain threshold level had to be reported to the Central Bank. This reporting was done by the commercial bank that facilitated the transaction. After 2002 the Swedish Central Bank no longer carries information on individual payments and their currency denomination. Banks are however still required to report to the Swedish Tax Authority on large payments abroad. Two of the largest commercial banks that we talked to said that this reporting was done electronically once a year. One bank also acknowledged that reporting practices hadn't changed since when they reported to the Swedish Central Bank. However, none of the banks were willing to reveal information regarding export and import payments and their currency denomination. Both recommended that we turned to the Tax Authority for information. The Swedish Tax Authority did however tell us that while they had information regarding export and import payments on a transaction level, they did not have information regarding the currency denomination of payments, only the value (in SEK). If this is indeed the case, then information regarding the currency denomination of Swedish trade can today only be obtained from commercial banks (Statistics Sweden also conducts yearly surveys of Swedish exporting and importing firms for the trade payment settlement statistics, but firms are not required to report the currency denomination of their payments). From our conversations with commercial banks regarding their reporting, we think that it could be the case that the information on the currency denomination of export and import payments is reported to the Tax Authority, but since it may not be used for any purpose the knowledge of this information is limited within the organization.

## **4.3 Are changes in invoicing patterns correlated with exchange rates?**

The shifts in the currency denomination of trade exports and imports have been substantial following the start of the EMU. An increasing fraction of exports are denominated in euro, while the Swedish krona is less used. A similar pattern can be found on the import side. The goal of this section is to quantify the potential correlation between exchange rate changes and changes in currency denomination. Before looking at the data we briefly explore some theoretical arguments for why exchange rates and trade invoicing may be correlated.

### **4.3.1 Exchange rates and trade invoicing: the theoretical arguments**

As discussed, if prices are rigid, invoicing will matter for how exchange rate changes are passed through into import prices. We are now interested in the opposite causality – from prices to exchange rates. Can invoicing patterns affect the behavior of exchange rates? A first mechanism might be to think of a shift from denominating exports in kronor to denominating exports in foreign currency as a one time shift in the demand for kronor. Of course, if firms immediately exchange foreign currency earnings for Swedish kronor then this mechanism would be muted. The survey results pointed to that many firms do not immediately (or at all), convert foreign currency payments to the home currency (SEK) – but we do not know if this pattern has changed over time. One could imagine that a situation where more of firms' imported inputs were priced in

foreign currency (as appears to have been the case) and this would lead to a perception of less need to hold kronor<sup>22</sup>. Without taking stands on the size of effects we note that a switch away from using kronor would be associated with a depreciation of the krona, other things equal. This would be a one time effect however and would not affect the behavior of the krona exchange rate in a new equilibrium – we will in the following see if we can trace any links between changes in the denomination of trade and the krona exchange rate.

There is also some theoretical research that links the *volatility* of exchange rates to the choices made as regards price setting currencies. The literature has focused on the symmetric case where trade, irrespective of the source country, is invoiced either in the importers' currency (local currency pricing, LCP) or in the exporter's currency (producer currency pricing, PCP). In some of the models one can examine how the exchange rate responds to for instance a monetary shock in one country and see how this response varies according to what the (exogenous) proportion of firms that use LCP. Consider the following line of reasoning: if firms set prices in the currency of the importer and infrequently update them, exchange rate changes will not lead to equivalent changes in consumer prices, thus minimizing the expenditure switching effect between domestically and internationally produced goods. The implication is that larger exchange rate changes would be necessary in order to restore equilibrium after for example a supply shock, or other shocks to fundamentals. Local currency pricing, which leads to low exchange rate pass-through, can therefore lead to larger swings in the exchange rate following shocks. The potential for this kind of mechanism was mentioned by Krugman (1989) and has been analyzed formally in for instance Betts and Devereux (1996), Engel and Devereux (2002, 2003), Duarte and Obstfeld (2004) – see Engel (2002) for a discussion.<sup>23</sup> Some observers have noted that the exchange rate between the Swedish krona and the euro has been remarkably stable following the introduction of the euro (indeed, as far as we understand that was one of the motivations for this project). Can these theoretical results help us understand the development of the krona? Note that the evidence points to asymmetries – there's more LCP for Swedish exports to euroland but more PCP for Swedish imports. In this sense the increased use of LCP for Swedish exports points to a decreased degree of expenditure switching (which would point towards increased exchange rate volatility) and the increase of PCP for our imports would point in the direction of more expenditure switching. The balance of these effects is unclear and we note that asymmetries of this kind are a

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<sup>22</sup> For instance through the use of matching currencies motive in invoicing – the statement “we use the same price setting currency for our exports that our imports are invoiced in” got a low mean rank in the survey however (Table 3.5).

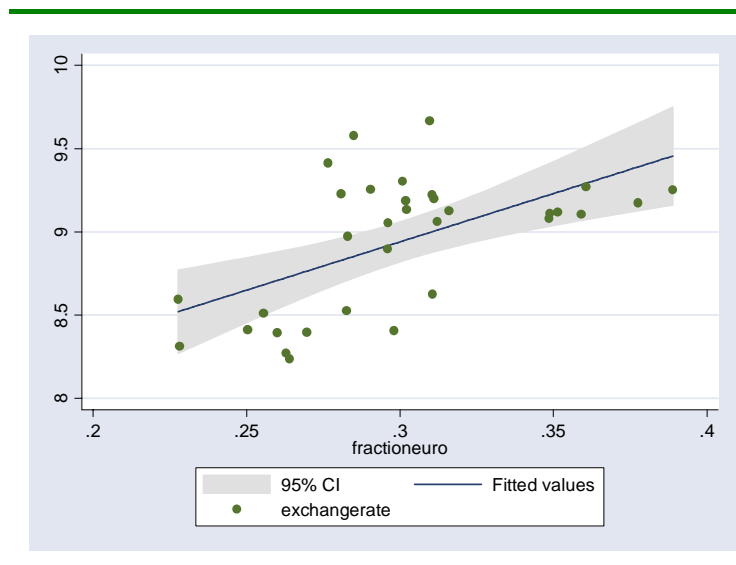
<sup>23</sup> Of course, causality in the other direction is also of interest. The impact of exchange rate volatility on the choice of invoicing currency has been examined both theoretically (see footnote 2 for selected contributions) and empirically (Donnenfeld and Haug (2003), Wilander (2006)). Most theoretical papers are partial equilibrium analyses of the optimal price setting currency under preset prices, and the optimal choice usually depends on functional forms of cost and demand. A general equilibrium analysis is Devereux, Engel and Storgaard (2003) who find that firms prefer to set price in the currency of the country with the most stable monetary policy. This implies a negative correlation between exchange rate pass-through and volatility. Most empirical studies have found that exchange rate volatility do matter (it is statistically significant in regressions explaining currency choice), but the direction is not clear. Donnenfeld and Haug (2003) find that LCP is positively correlated with exchange rate volatility, while Wilander (2006) finds that exchange rate volatility reduces the likelihood of LCP.

potential field for further inquiry. As an example of such work Goldberg and Tille (2006) stress the role of asymmetries in invoicing for expenditure switching – they note that for the US, both imports and exports tend to be invoiced in US dollars. As stressed by for instance Maurice Obstfeld (for instance in Obstfeld, 2002) the models that we have are quite stylized and great caution is still likely to be warranted when drawing policy conclusions from the new open economy macroeconomic models.

### 4.3.2 An analysis of exchange rates and invoicing patterns

We now turn to an examination of links between invoicing patterns and the exchange rate, using the data from 9 industries that we described in Section 4.1. From figure 4.2 we can see that the increase in the use of the Euro has been associated with a depreciation of the SEK against the Euro. Of course this says nothing about cause and effect and other factors that may influence both variables. Changes in invoicing patterns can lead to shifts in demand for foreign versus domestic currencies, but it could also be that expected changes in the exchange rate lead to changes in the invoicing patterns of firms (from the survey results we know however that few firms reported that the expected development of the exchange rate was an important determinant in the invoicing decision).

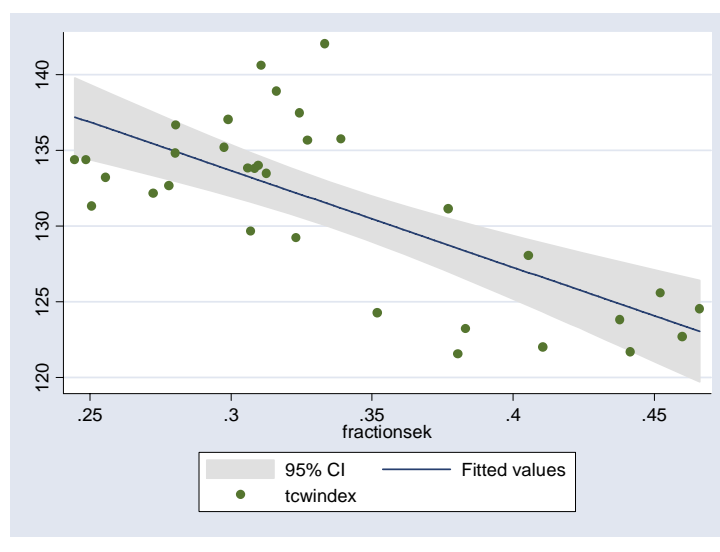
**Figure 4.2** Fraction of monthly export payments denominated in Euro and the Euro/SEK rate



Note: Pearson Correlation Coefficient 0.57

The correlation found between the fraction of invoicing in Euro and the Euro/SEK exchange rate is also found if we look more broadly on invoicing patterns. Figure 4.2 plot the fraction of monthly export payments denominated in SEK and a trade weighted exchange rate index, the TCW – index. As a higher value of the TCW-index is associated with a weaker SEK, the negative slope of the regression line indicates that the fraction of exports denominated in SEK is positively related to the value of the SEK. The correlation is actually stronger at this more “aggregate” level.

**Figure 4.2** Fraction of monthly export payments denominated in SEK and the TCW – index



Note: Pearson Correlation Coefficient -0.7715

Despite the short time series dimension of the data (monthly observations for 1999-2002) we still turn to a more formal analysis of the relationship between changes in invoicing patterns and exchange rates. We first check the time series properties of the trade weighted exchange rate series and the series of the fraction of exports denominated in SEK. We perform Augmented Dickey-Fuller (ADF) and Philips-Perron tests for unit roots, and cannot reject a unit root for neither series in levels. For the first difference of both series we can however reject the null hypothesis of a unit root, implying that both series are integrated of order one, I(1). With integrated data, regressions involving levels of the variables can be misleading, in that conventional t and F-test can reject the hypothesis of no relationship when there might be none, a spurious regression.

We next turn to see if a long-run relationship can be found between the variables by testing for co-integration. With two variables both being integrated of the same order, we use the Engle-Granger test for cointegration.

The approach amounts to performing an ADF test on the residuals from the regression

$$(1) y_t = a + \beta x_t + u_t$$

Where  $y$  is the TCW-index and  $x$  is the fraction of exports invoiced in SEK. The test statistic for the residual from (1) is -2.641. The Engle-Granger 1% critical value is -2.5899, which leads us to conclude that  $\hat{u}$  is stationary. This would indicate that even though both variables are non-stationary, any relationship found between them is not spurious.

Given the result from the cointegration test, we linearly project the logarithm of the TCW index on the logarithm of the fraction of export payments denominated in SEK. Given that the variables are in logs, the coefficients can be interpreted as elasticities, telling us the percentage change in the TCW-index given a percentage change in the fraction of exports denominated in SEK.

Table 4.5 tells the same story as figure 4.2, the 'Fraction SEK' variable is negatively related to the TCW-index. The coefficient on 'Fraction SEK' tells us that a percentage increase in the fraction of exports that is denominated in SEK,

leads to a strengthening of the trade-weighted exchange rate of 0.16 percent. If we include a time-trend in the regression, the coefficient falls to roughly 0.07.

**Table 4.5** OLS Regression of TCW-index on the fraction of export payments denominated in SEK

TCW index	Coefficient	Std. Error*	Newey-West**		
Fraction SEK	-0.1666	.0172835	.0280698	R-Square	0,546
Constant	5.455788	.0632154	.10326296	Obs.	44
Constant					

Note: Variables in logs.

\* Heteroscedasticity Robust Standard Errors, \*\*Newey-West Standard Errors

The results are interesting, but should be viewed as suggestive only. The time-span is short and the methodology used is crude. Moreover, the estimated coefficients are small, implying that shifts in the currency denomination of trade are associated with substantially smaller changes in the value of the exchange rate. For example, the 46% fall in the average fraction of exports invoiced in SEK from the peak in April 1999 (47%) to the low in August 2002 (25%), would have translated into a fall of the SEK (in trade weighted terms) of 3-7%.

## 5 Conclusion

This report has examined trade invoicing practices by Swedish exporting firms, both by means of a survey and by quantitative analysis of the export and import payment transactions data from the Settlement Reports.

The survey results gave us strong results regarding many of the initial objectives that the report set out to answer. One such objective was to disentangle the relationship between the different roles a currency serves in international exchange. The results from the survey tells us that the same currency to a very large extent is used for price-setting, invoicing and payment. We further find, in line with the findings from the analysis of payment transactions data, that the currency of the importer is the most frequently used, and that Swedish firms update their export prices about once a year. An additional interesting finding is that not all firms convert foreign currency payments to Swedish krona immediately.

The analysis of export and import payments data from the Swedish settlement statistics also reveals important insights. The use of the Swedish krona falls both on the export and import side during the period 1999-2002, and the results from the questionnaire study confirm this finding. For some industries, the fraction of payments in krona was only slightly higher on the export side than on the import side, pointing to a weakening of Grassman's law. We further find some indicative evidence that changes in invoicing patterns were correlated with movements in the exchange rate during the period 1999-2002, but a formal regression analysis points to that the effects are likely to be small.

Why are these findings useful and what do they mean for the Swedish krona, as well as for exchange rate and monetary policy?

The finding that the same currency to a large extent is used both for setting price and as means of payment, together with the large changes in payment patterns reported in the second part, lead us to conclude that both Swedish and foreign

firms to a decreasing extent use the Swedish krona for setting price. This is likely to affect the exchange rate pass-through in the short to medium run with counteracting effects on the expenditure switching effects of exchange rates.

Our results also point toward a weaker effect of increases in net exports on the exchange rate, the otherwise intuitive line of reasoning being that an increase in the trade balance will tend to appreciate the domestic currency due to increases in relative demand for domestic vs. foreign currency. This will be the case if Grassman's law holds (so that exports are mainly denominated in the domestic currency and imports in foreign currency) or if foreign currency denominated export payments are quickly converted into domestic currency. Our results point to that both of these channels are weak, so that increases in net exports results in proportionally smaller increases in relative demand for domestic and foreign currency.

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# Appendix

**Table A1** How are export prices set?

<i>Question in survey: Regarding your main product [for exports to third parties], what description matches the firm's price setting best?</i>	Alternative		
	The firm has a list price for the product	The price is decided in negotiations with the customer	The firms price is determined on an international exchange, for instance a commodity exchange
	37.42 (27.59)	60.02 (61.81)	2.56 (10.59)

Columns report the estimated proportion of Swedish exporters that report the corresponding share of currency use. The estimated proportion is given by the responses weighted by the probability of being sampled (three strata). Larger firms export and to illustrate the importance of different policies for the value of Swedish exports we in addition weigh by turnover from exports, these results are reported in the figures within parentheses. Shares do not sum to 100 since some firms that responded to the questionnaire did not respond to these particular questions.

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