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Pricing-to-Market Effects in Foreign Trade Prices. Evidence from a Cointegration Approach for Germany

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Pricing-to-Market Effects in Foreign Trade Prices. Evidence from a Cointegration Approach for Germany

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Abstract

The article analyzes the impact of exchange rate changes on German export and import prices. The analytical framework is a mark-up model which is based on the assumption that the markets under consideration are imperfectly competitive as well as segmented. Hence, firms will no longer set prices at marginal costs, but charge a mark-up on costs to earn above normal profits. The mark-up is not fixed, but can be adjusted in response to demand pressure and competitive pressure in the relevant market. Consequently, firms can practice price discrimination. We find evidence that domestic and foreign producers follow different price setting strategies: German exporters largely pass-through exchange rate changes; i.e. an appreciation of domestic currency is reflected in a significant increase in export prices (expressed in terms of foreign currency) indicating that German exporters have significant market power and/or face a fairly inelastic export demand curve. Foreign exporters to Germany, however, largely follow a pricing-to-market strategy; i.e. they absorb price increases due to an appreciation of foreign currency into their profit margins in order to stabilize export prices (expressed in terms of domestic currency). Thus, they can protect market shares in the highly competitive German market.

Keywords: export prices, import prices, exchange rate pass-through, pricing to market, error correction model

JEL Codes: C51, E31, F31

1 Introduction

There is a sizable body of literature analyzing the extent to which exchange rate changes are passed-through into traded goods prices and explaining why exchange rate fluctuations are not fully reflected in foreign trade prices.[1] A central argument is that exporters' pricing decisions depend heavily on competitive pressure in relevant markets. If exporting firms fix export prices in domestic currency, an appreciation of domestic currency automatically leads to an increase in foreign currency export prices. If exchange rate changes are fully reflected in these prices, exporters practice *full exchange rate pass-through.* Such price setting behavior will only be successful in the medium and long term if exporters will not risk to lose market shares. This means that they either have significant market power and/or that they face a fairly inelastic export demand curve. Since competitive pressure is typically high in relevant markets and demand is rather price elastic, it is reasonable to assume that exporters will not be able to practice a 100 % exchange rate pass-through but rather follow a *pricing-to-market* (PTM) strategy; i.e. they will not (or only slightly) increase foreign currency export prices absorbing (at least partially) the reduction in domestic currency prices in their profit margins.[2]

Another explanation for PTM are volatile exchange rates. As long as exporters are uncertain whether exchange rate changes are permanent or not, they will postpone any price adjustment since it is also accompanied by costs (menu costs). PTM is an appropriate pricing strategy if exporters face temporary exchange rate fluctuations. But it can also be a reasonable strategy in the long run if firms sell in imperfectly competitive as well as segmented markets.[3] Under conditions of imperfect competition, pricing will no longer be at marginal costs, and firms would be in a favorable position to charge a mark-up on costs to earn above normal profits. The mark-up is not fixed but – due to the assumption of market

[1]For a survey see Menon (1996).

[2]Pricing-to-market means that exchange rate changes are not fully passed-through into traded goods prices (Krugman 1986, p.3). Therefore, the terms *pricing-to-market* and *partial exchange rate pass-through* have the same meaning.

[3]In segmented markets, trade barriers, transportation costs, information problems etc. prevent an effective arbitrage that typically removes differences in prices of the same good. Therefore, producers can charge different prices for the same good in segmented markets.

segmentation – can be adjusted in response to demand pressure in the relevant market. Thus, exporting firms can absorb exchange rate fluctuations into their profit margins leaving foreign currency export prices unchanged. In this context, PTM is strategic pricing leading to different prices for identical goods across different markets.

The article analyzes the impact of exchange rate changes on German export and import prices. The analytical framework is a mark-up model from which we derive the functional form of the export price and the import price equation (Section 2). These equations serve as starting points for the empirical investigation of German foreign trade prices. In Section 3, the data is presented. The econometric analysis including unit root and cointegration tests as well as the estimation and interpretation of the export price and the import prices equation are reported in Section 4. In Section 5, we summarize our main results and draw final conclusions.

2 Theoretical framework

In this section we derive the functional form of the export price and the import price equation from a mark-up model employed in several previous studies (Athukorala and Menon 1995; Ketelsen and Kortelainen 1996; Naug and Nymoen 1996; Clostermann 1998; Bache 2002; Warmedinger 2004). This model is based upon the assumption that firms sell differentiated products in imperfectly competitive markets. Since these markets are also segmented due to trade barriers, transportation costs, etc. arbitrage that typically removes differences in prices of the same good is limited. Consequently, firms can charge different prices for the same good in different markets. The mark-up model provides an appropriate analytical framework for the analysis of German foreign trade prices, since Germany's exports and imports are to a large extent manufactured goods that are typically viewed as being highly differentiated goods that are frequently sold in imperfectly competitive and segmented markets.[4]

Assume that a representative domestic producer sets his export price (in domestic

[4] In 2003, 74 % of German imports and 88 % of German exports were manufactured goods.

currency) (PX) as a mark-up (π) on his marginal production costs (C).

$$PX = (1 + \pi) \cdot C. \tag{1}$$

The mark-up is not constant, but can vary in response to demand pressure (DP^*) as well as competitive pressure in the relevant market.[5] Foreign competitor's marginal production costs (C^*) in relation to domestic producer's marginal costs (C) can serve as a measure of domestic producer's price competitiveness. Since foreign competitor's marginal costs are measured in foreign currency, they have to be converted into domestic currency using the corresponding external value (EV).[6] The mark-up can be written as follows:

$$(1 + \pi) = \alpha \cdot \left(\frac{C^*}{EV \cdot C} \right)^{\beta} \cdot DP^{*\psi}, \tag{2}$$

with $\alpha \neq 0$, $\beta \geqq 0$ and $\psi \geqq 0$. Substituting (2) into (1) and taking logarithms leads to a linear expression for export prices (in domestic currency). The lower case letters indicate that the variables are in logs.

$$px = \gamma + \beta(c^* - ev) + (1 - \beta)c + \psi dp^*, \tag{3}$$

with $\gamma = \ln \alpha$. The functional form of the import prices (in logs) (pim) can be derived analogously to the functional form of the export prices:

$$pm = \lambda + \phi c + (1 - \phi)(c^* - ev) + \eta dp. \tag{4}$$

If we want to analyze German imports from a single country or a small group of countries, equation (4) is an appropriate starting point. Since the focus of our study is on macroeconomic foreign trade prices, however, the variable proxying demand pressure in the importing country is only appropriate in the export price equation. In the import price equation it does not make sense, because an increase in German imports will unlikely lead to raising import prices, since the import supply provided by the rest of the world is totally elastic. The results from studies for Germany, however, strongly support the view that prices for raw materials serving as inputs in energy production (p_{oil}) play an important role in

[5] The asterisk indicates that the time series refers to the foreign country.

[6] The external value is defined as foreign currency per unit of domestic currency. A rise (fall) in the external value implies an appreciation (depreciation) of the domestic currency.

explaining German import prices (Clostermann 1998, Warmedinger 2004). Thus, the modified import price equation (in domestic currency) is

$$pm = \lambda + \phi c + (1 - \phi)(c^* - ev) + \nu p_{oil}. \tag{5}$$

The coefficients β in equation (3) and ϕ in equation (5) measure to what extent exporting firms consider the marginal production costs of their foreign competitors in their own price-setting decisions. Assuming that marginal costs are not influenced by exchange rate changes[7] and can therefore be viewed as *given*, the parameters β and ϕ measure the degree to which exporting firms absorb exchange rate changes into their profit margins in order to influence their foreign currency export prices.[8] β and ϕ are therefore called *pricing-to-market coefficients*. The extent to which exchange rate changes are reflected in foreign currency export prices depends on exporters' position in the market. If they risk to lose market shares, they will absorb any price increasing effect coming from an appreciation of the domestic currency in their profit margins. Consequently, the export prices in terms of foreign currency will c.p. remain unchanged. If they do not face any competition in the market, however, an appreciation of domestic currency is fully reflected in foreign currency export prices. In this case, profit margins will c.p. remain unchanged. It is likely that exporting firms neither practice complete pricing to market ($\beta = 1$, $\phi = 1$) nor full exchange rate pass-through ($\beta = 0$, $\phi = 0$) but rather partially absorb exchange rate changes in their profit margins; i.e. $0 < \beta < 1$ and $0 < \phi < 1$ respectively.[9]

Equations (3) and (5) impose two restrictions. First, the coefficients of c^* and ev are equal. Second, the coefficients of $(c^* - ev)$ and c sum to one. Athukorala and Menon (1995) point out that these restrictions may not hold in practice. The first restriction implies that a 1 % change in foreign marginal production costs has the same impact on foreign trade prices as a 1 % change in exchange rates. This

[7]This is a rather strong assumption since exchange rate changes are likely to influence prices of imported inputs.

[8]If exporting firms fix export prices in domestic currency, an appreciation (depreciation) of the domestic currency increases (decreases) automatically the export prices in terms of foreign currency.

[9]Example: $\beta = 0.3$ implies that in response to a 10 % increase in his currency, an exporter reduces his mark-up by 3 %, hence the foreign currency export price increases c.p. by approximately 7 %.

is a strong simplification, since it is likely that firms are more willing to absorb exchange rate changes (particularly if they assume that these changes are only temporary) in their profit margins than changes in their marginal production costs. The second restriction may not hold since aggregated price indices that are used as proxies for domestic and foreign marginal costs differ with regard to the composition of the baskets of goods as well as to the method of calculation. In this study, we impose only the first restriction. The coefficients of $(c^* - ev)$ and c, however, are left unrestricted in the estimation. But the restriction is explicitly tested afterwards using the Wald test.

3 Data

The estimation equations are based on seasonally unadjusted quarterly data for the period 1980:1-2004:3. Time series for Germany contain figures for West Germany until 1990:4 and figures for a unified Germany afterwards. Export prices (PX) and import prices (PM) are the indices of export prices and import prices of goods taken from the National Accounts Statistics. In a mark-up model, exporters determine export prices as a mark-up on their marginal production costs. Since marginal costs are unobservable at the macroeconomic level, we have to assume that the marginal costs of domestic as well as foreign producers are well-captured by appropriate macroeconomic price indices. In this study, we test various price indices: As proxies for the marginal costs of domestic firms we use the German producer price index (PPI), the final demand deflator (P_{gdpm}), and the consumer price index (CPI). As proxies for the marginal costs of foreign firms we calculate foreign producer price indices as well as foreign consumer price indices.[10] These indices are weighted averages of price indices of 15 of Germany's major trading partners. The country weights correspond to the respective country's share in German exports and imports respectively. Foreign price indices based on export weights are used in export price equations, price indices based on import weights are used in import price equations. In the export price equation we also use a foreign price index which is a weighted average of the final demand deflators of 19 trading partners $(PA19x_{pgdpm})$. The oil price in euro (P_{oil}) serves as a proxy for energy prices in the import price equation, whereas new orders for

[10] A detailed description of how these indices are calculated are given in the appendix.

exported manufactured goods (*Order*) serve as a proxy for demand pressure in the export price equation. Since the time series are transformed into logs, the estimated coefficients can be interpreted as elasticities. Graphs of the time series used as well as a listing of data sources are given in the appendix.

4 Econometric analysis

4.1 Unit root and cointegration tests

All time series under consideration are integrated in levels and stationary in first differences (see Table 1, appendix).[11] Thus, a cointegration analysis is appropriate. Since there are $n > 2$ variables in the models corresponding to equation (3) and (5), up to $n - 1$ linear independent cointegration vectors could exist. Therefore, we apply the Johansen cointegration test to determine the number of cointegration vectors. The Johansen (1995) procedure is based on a multivariate VAR model which can be reparameterized as a vector error correction model (VECM). In the first step, a vector autoregression is set up, with the lag order determined by using the Akaike information criterion. Then the corresponding VECM is estimated to test for the number of cointegrating vectors using the trace test. Since the data are seasonally unadjusted, centered seasonal dummies are used. Regarding the linear trend specification, it is initially assumed that there are linear trends in the levels of the data, but no trend in the cointegration vectors. However, it could be necessary to include a linear time trend in the cointegration vectors to account for the fact that the composition of the baskets of goods underlying the national price indices varies over time.[12] Consequently, if no cointegration relationship is detected in the first step, the Johansen procedure is rerun assuming that there is a linear trend in the cointegration vectors.

Equations (3) and (5) serve as starting points for the estimation of German export and import prices. Regarding the export (import) prices, we test whether export (import) prices, orders received from abroad (oil price), as well as the proxies for the marginal costs of domestic and foreign producers form a cointegration relationship. Since we consider various proxies for the marginal costs of

[11]Eviews 5.1 was used for econometric analysis.

[12]See also Clostermann (1998), footnote 32.

domestic and foreign producers, we test all possible combinations of these variables. For our research question, however, only those combinations of variables are of interest that meet the following requirements: there is exactly one cointegration relationship, the adjustment coefficient in the export price (import price) equation of the VECM has a negative sign and is statistically significant, and the variables forming the cointegration relationship have the right signs and are statistically significant. Regarding the export prices, we find a single long-run relationship that meets these requirements: export prices, orders received from abroad, the German final demand deflator, the foreign final demand deflator, and a linear trend form this cointegration relationship, which is significant at the 5% level. Regarding the import prices, there is also a single long-run relationship: the cointegration vector includes the import prices, the oil price, the German final demand deflator, the foreign consumer price index, and a linear trend. This cointegration relationship is significant at the 1% level (see Table 2 und 3, appendix).

4.2 Export price and import price equations

In the following, we report the single equation error correction models for the export prices and the import prices. The models are derived applying the "'general to specific"' approach: the estimation procedure starts with four lags for all variables and insignificant ones are excluded one by one. The error correction terms are estimated using nonlinear least squares. Since the time series are transformed into logs, the estimated coefficients can be interpreted as elasticities. For ease of presentation we use the following notation: P and P^* denote proxies for the marginal costs of domestic and foreign producers; csd stands for centered seasonal dummies. Furthermore, a set of impulse dummies is needed to correct for outliers: $i9003$ accounts for changes in the National Accounts Statistics due to German unification; $i0002$ in the export price equation and $i8701$ in the import price equation are necessary to avoid deviations from normality in the regression errors. T-values of the estimated coefficients are indicated in parentheses. For the residual and specification tests p-values are given in brackets.

Export price equation

$$\Delta \ln PX_t =$$

$$\underset{(-5.61)}{-0.24} [\ln PX_{t-1} \underset{(-7.3)}{-0.82} \ln P_{t-1} \underset{(-3.5)}{-0.18} \ln P^*_{t-1} \underset{(-4.4)}{-0.14} \ln Order_{t-1} \underset{(5.7)}{+0.004} Trend]$$

$$\underset{(2.4)}{+0.21} \Delta \ln PX_{t-1} \underset{(-1.6)}{-0.11} \Delta \ln PX_{t-3} \underset{(3.5)}{+0.24} \Delta \ln PX_{t-4}$$

$$\underset{(-2.1)}{-0.15} \Delta \ln PX_{t-5} \underset{(-2.2)}{-0.14} \Delta \ln PX_{t-6} \underset{(2.9)}{+0.23} \Delta \ln P_t$$

$$\underset{(5.7)}{+0.16} \Delta \ln P^*_t \underset{(2.4)}{+0.07} \Delta \ln P^*_{t-1} \underset{(-4.7)}{-0.14} \Delta \ln P^*_{t-2} \underset{(3.2)}{+0.03} \Delta \ln Order_{t-2}$$

$$\underset{(2.7)}{+0.01} csd_1 \underset{(0.5)}{+0.001} csd_2 \underset{(-1.3)}{-0.002} csd_3 \underset{(-0.7)}{-0.09} \underset{(-2.6)}{-0.01} i9003 \underset{(-3.3)}{-0.01} i0002 + \hat{u}_t$$

$\bar{R}^2$=0.74, S.E. of regr.=0.003, LM(1)=[0.92], LM(4)=[0.42], ARCH(1)=[0.79], ARCH(4)=[0.76], White test=[0.14], RESET test=[0.64], NORM=[0.53], Cusum/Cusum^2: stable

In the export price equation, the adjustment coefficient is highly significant, indicating a cointegration relationship at the 1% level.[13] The reported diagnostic tests show that the model fits the data well. The usual misspecification tests (White's Heteroscedasticity Test and Ramsey's RESET test) do not signal any problem. The residuals are not autocorrelated and they are approximately normally distributed. Finally, the CUSUM tests indicate parameter stability.

Let's have a look at the long-run relationship: The cointegration relationship is between the export prices, new orders (which serve as a measure of demand pressure in the market), the domestic price level (which serves as a proxy for the marginal costs of the German exporters), the foreign price level (which serves as a proxy for the marginal costs of the foreign competitors), and the linear trend (which accounts for changes in the composition of the baskets of goods, which form the basis of the national price indices). The estimated long-run elasticity of export prices with respect to the domestic price level (P) is about 0.8; the estimated long-run elasticity with respect to the foreign price level (P^*) is about 0.2. Since we assess the price setting behavior of German exporters, the coefficient of

[13]The critical value for this specification is -4.97. See Hassler (2004), Table 4.

P^* is the pricing-to-market coefficient. The estimated long-run elasticities can be interpreted as follows: Given a 10% appreciation of domestic currency, German exporters reduce their mark-up by about 2%, hence prices in the buyer's currency increase only by about 8%. This leads us to the conclusion that German exporters have a remarkable market power and/or that they face a fairly inelastic export demand curve. This interpretation seems to be reasonable against the background that a sizeable part of German exports are investment goods like machines or production facilities which are typically tailored to the specific requirements of foreign customers. Consequently, these customers depend heavily on their suppliers: changing the supplier is nearly impossible in the short-term and costly in the medium-term. In the export price equation, the short-run adjustment is carried out by lagged changes of the endogenous variable, contemporaneous changes of the domestic and the foreign price level as well as lagged changes of the foreign price level and new orders. It is remarkable, that German exporters focus primarily on their own costs not only in the long run but also in the short run supporting the interpretation given above.

Import price equation

$$
\begin{aligned}
&\Delta \ln PM_t = \\
&\underset{(-5.91)}{-0.50}\,[\ln PM_{t-1} \underset{(-5.5)}{-0.68} \ln P_{t-1} \underset{(-3.2)}{-0.33} \ln P^*_{t-1} \underset{(-10.0)}{-0.10} \ln P_{Oil_{t-1}} \underset{(8.3)}{+0.005}\, Trend] \\
&\underset{(3.5)}{+0.34}\,\Delta \ln PM_{t-1} \underset{(2.4)}{+0.20}\,\Delta \ln PM_{t-2} \underset{(1.2)}{+0.12}\,\Delta \ln PM_{t-3} \underset{(1.4)}{+0.11}\,\Delta \ln PM_{t-4} \\
&\underset{(2.4)}{+0.19}\,\Delta \ln PM_{t-5} \underset{(-2.0)}{-0.53}\,\Delta \ln P_{t-1} \underset{(-3.2)}{-0.72}\,\Delta \ln P_{t-2} \underset{(-2.7)}{-0.67}\,\Delta \ln P_{t-3} \\
&\underset{(6.1)}{+0.06}\,\Delta \ln P_{Oil_t} \underset{(1.9)}{+0.02}\,\Delta \ln P_{Oil_{t-1}} \underset{(-1.9)}{-0.02}\,\Delta \ln P_{Oil_{t-2}} \underset{(-2.1)}{-0.02}\,\Delta \ln P_{Oil_{t-4}} \\
&\underset{(2.8)}{+0.02}\, csd_1 \underset{(2.1)}{+0,02}\, csd_2 \underset{(0.6)}{+0.01}\, csd_3 \underset{(1.0)}{+0.28} \underset{(-4.4)}{-0.05} i8701 \underset{(-2.7)}{-0.03}\, i9003 + \hat{u}_t
\end{aligned}
$$

$\bar{R}^2$=0.69, S.E. of regr.=0.009, LM(1)=[0.39], LM(4)=[0.57], ARCH(1)=[0.33], ARCH(4)=[0.58], White test=[0.47], RESET test=[0.50], NORM=[0.53], Cusum/Cusum^2: stable

In the import price equation, the adjustment coefficient is highly significant, indicating a cointegration relationship at the 1% level.[14] The reported diagnostic tests show that the model fits the data quite well. Again, the misspecification tests do not signal any problem; the residuals are not autocorrelated and are approximately normally distributed. Finally, the CUSUM tests indicate parameter stability.

The cointegration relationship is between the import prices, the foreign price level (which serves as a proxy for the marginal costs of the foreign exporters), the domestic price level (which serves as a proxy for the marginal costs of the German competitors), the oil price (which serves as a proxy for energy prices), and a linear trend. The estimated long-run elasticity of import prices with respect to the domestic price level (P) is about 0.7; the estimated long-run elasticity with respect to the foreign price level (P^*) is about 0.3. Since we now assess the price setting behavior of foreign suppliers, the coefficient of P is the pricing-to-market coefficient. Unlike German exporters, foreign exporters follow the pricing-to-market strategy to a large extent: Given a 10 % increase in the foreign exporters' currency, they reduce their mark up by about 7 %, hence prices in the buyer's currency increase only by about 3 %. This result is remarkable but not implausible. Germany is the third largest economy in the world. The estimation results support the view, that the competitive pressure in this market is very high and that foreign suppliers have to practice pricing-to-market in the long run in order to protect market shares. In the import price equation, the short-run adjustment is carried out by lagged changes of the endogenous variable, lagged changes of the German price level, contemporaneous and lagged changes of the oil price. The fact that foreign exporters do not focus on their own costs even in the short run is a further indication of a high competitive pressure in the German market.

Finally, we have to check whether the restriction that the coefficients of P and P^* sum to one is supported by the data. Regarding the export price equation, we cannot reject the null hypothesis (H_0), that the coefficients sum to one, at the 5 % level; regarding the import price equation, we cannot reject H_0 at the 10 % level. These results are remarkable because of two reasons. The mark up model is a concept that requires information about producers' marginal costs which are

[14] The critical value for this specification is -4.97. See Hassler (2004), Table 4.

unobservable at the macroeconomic level and must therefore be approximated by aggregated (macroeconomic) price indices. Moreover, in the import price equation we even use different price indices to model the domestic and the foreign price level.

5 Conclusion

Our study provides evidence that domestic and foreign producers follow different price setting strategies: German exporters largely pass-through exchange rate changes into export prices (expressed in terms of foreign currency) indicating that they have significant market power and/or face a fairly inelastic export demand curve. Our estimation results for the export prices are consistent with findings reported by Clostermann (1996, 1998). In contrast to the price setting behavior of German exporters, foreign exporters to Germany largely absorb price increases due to exchange rate changes into their profit margins in order to stabilize export prices (expressed in terms of domestic currency). They follow a pricing-to-market strategy in order to protect market shares in the highly competitive German market. In our study, we report an estimated long run elasticity of import prices with respect to the domestic price level, which is the pricing-to-market coefficient, of about 0.7, which is rather high compared to results reported by other studies for Germany: Clostermann (1998) estimates a long run elasticity of about 0.3 whereas Warmedinger (2004) reports a PTM coefficient of about 0.4. However, since the three studies differ significantly with regard to the estimation period as well as to the variables used to explain German import prices, the results are rather difficult to compare.

As already discussed in detail, the mark-up model is based on the assumption that producers determine export prices as a mark-up on their marginal costs which are unobservable at the macroeconomic level. Therefore, we have to assume that marginal costs are well-captured by appropriate macroeconomic price indices. It is remarkable that restrictions derived from a model which has microeconomic foundations are supported by macroeconomic data. In particular, since we have used aggregated price indices to model domestic and foreign production costs which differ not only with regard to the calculation method and the composition of the baskets of goods, but also with regard to the price indices used. Remember, that in the import price equation the domestic price level is proxied by the German final demand deflator whereas the foreign price level is proxied by foreign consumer prices. Against this background, it would be interesting to analyze whether our results are robust if we would base our estimations on disaggregated data reflecting price developments of certain categories of goods. This would be an interesting task for further research.

6 Appendix

6.1 Calculation of foreign price indices

In this study, marginal production cost of foreign firms are proxied by foreign producer price indices as well as foreign consumer price indices. These indices are weighted averages (geometric) of national price indices of 15 of Germany's major trading partners. The country weights correspond to the country's share in German exports and imports respectively. Since these shares change over time, country weights change too. Foreign price indices based on export (import) weights are used in the export (import) price equations. The countries considered for the export weighted foreign price indices are the EMU member countries, Switzerland, the United Kingdom, the United States, and Sweden. Exports to these countries make up about 70 % of total German exports. The countries considered for the import weighted foreign price indices are the EMU member countries, Switzerland, the United Kingdom, the United States, and Japan. Imports from these countries make up about 60 % of total German imports. Since the 1990s, China, the Czech republic, Poland, Hungary, and Russia gained significant weight in Germany's foreign trade. However, these countries are not considered in the group of Germany's major trading partners since the time series provided by these countries are still too short.

In the export price equation we also use a foreign price index based on the final demand deflators of 19 industrial countries. This price index can easily be calculated on the basis of the indicator of the price competitiveness of the German economy (based on the final demand deflators compared to 19 trading partners) published by the German Bundesbank. This indicator (I) is a real external value[15] which has the following form:

$$I = \frac{EV \cdot P}{P^*}, \tag{6}$$

with EV denoting the real effective external value, P and P^* standing for the German final demand deflator and the foreign final demand deflator respectively. Dividing the domestic price index (P) by the indicator (I) multiplied by 100 gives the foreign price index in terms of domestic currency:

$$\frac{P^*}{EV} = \frac{P}{I} \cdot 100. \tag{7}$$

[15]For the calculation of the indices and the determination of the country weights see Deutsche Bundesbank (1985); Deutsche Bundesbank (1989, 1998).

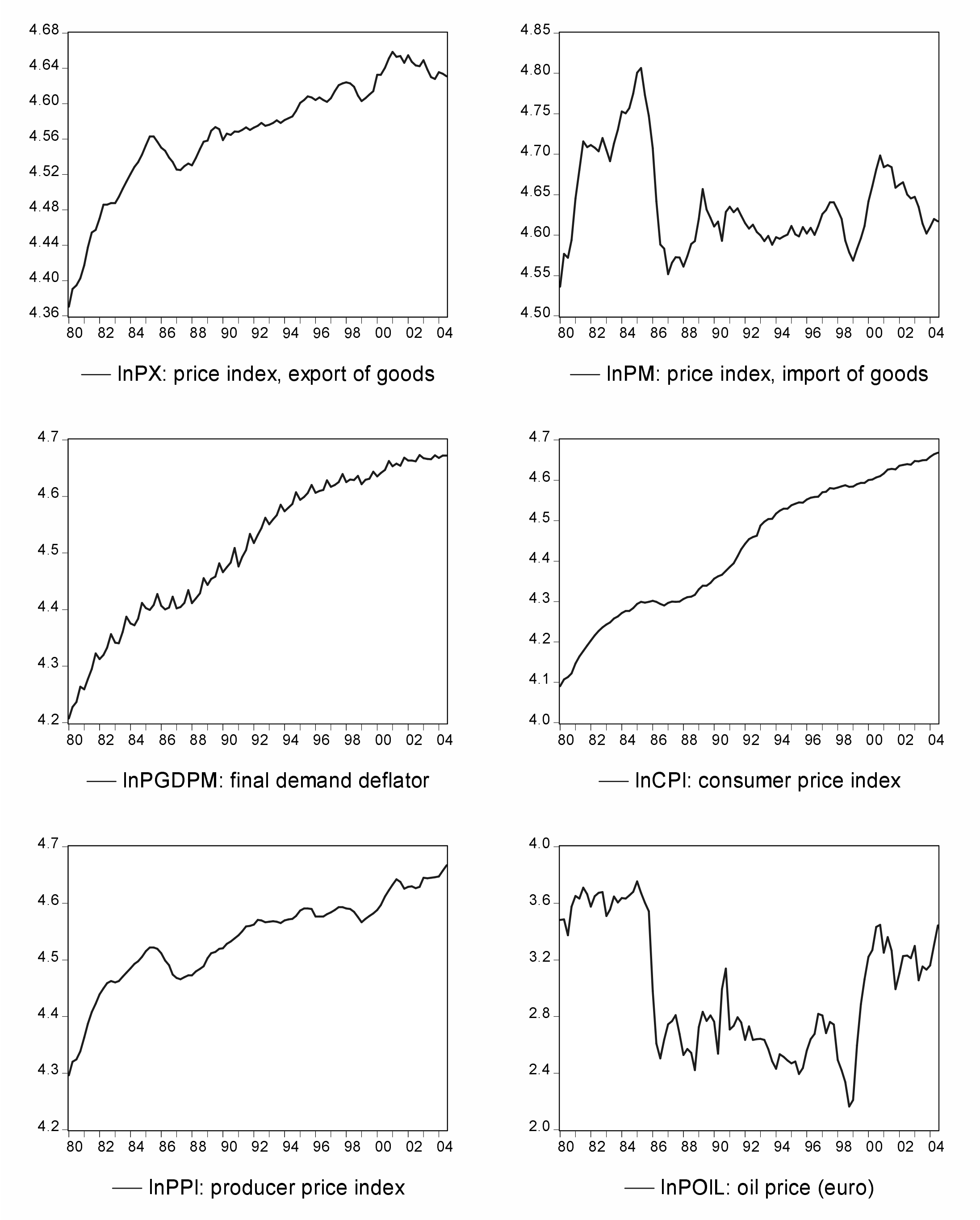
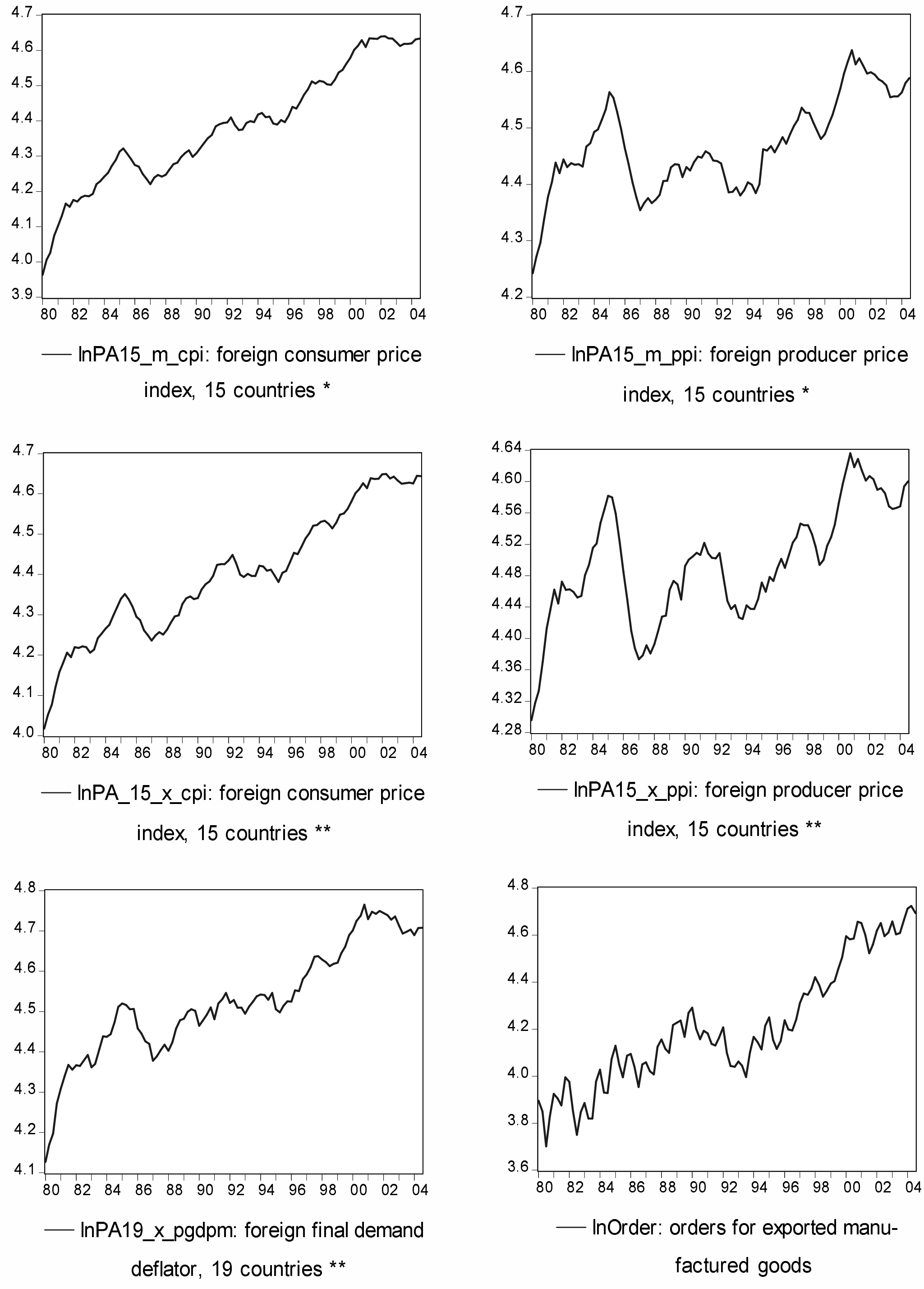


Figure 1: Domestic prices and oil price (in logs), 1980:1-2003:4



* prices are weighted by the respective country's share in German imports

** prices are weighted by the respective country's share in German exports

Figure 2: Foreign prices and new orders received from abroad (in logs), 1980:1-2003:4

Augmented Dickey-Fuller Tests						
	Levels			First differences		
Variables	**Lags**	**Deterministics**	**Test statistics**	**Lags**	**Deterministics**	**Test statistics**
$\ln PX$	1, 4, 5, 7, 8	c, t	-2.89	4, 7, 10	c	-6.64***
$\ln PM$	1-3, 5, 11	c	-2.00	2-4, 11, 12	–	-6.76***
$\ln P_{gdpm}$	4	c, t, csd	-1.87	3, 4, 5	c, csd	-8.00***
$\ln P_{cpi}$	1,3-5	c, t,	-2.74	1-4	c	-3.53***
$\ln P_{ppi}$	1, 3, 4, 8	c, t	-3.05	3, 6, 9	c	-5.26***
$\ln P_{oil}$	1-3, 5, 6	c	-2.31	1, 3, 4	–	-7.59***
$\ln PA19x_{pgdpm}$	1-5, 7, 8, 11	c, t	-2.97	2-5, 7	c	-8.43***
$\ln PA15x_{cpi}$	1, 3, 10, 11	c, t	-3.42	3, 4, 7, 10	c	-6.38***
$\ln PA15x_{ppi}$	1-3, 5, 10	c, t	-2.25	2-5, 9	c	-6.60***
$\ln PA15m_{cpi}$	1, 3, 10, 12	c, t	-3.40	2-5, 7, 10	c	-7.24***
$\ln PA15m_{ppi}$	1, 2	c, t	-2.83	2-5	c	-8.07***
$\ln Order$	1, 4, 6, 8	c, t, csd	-1.86	1-5, 8	c, csd	-5.27***
c: constant, t: trend, csd: centered seasonal dummies, *** denote significance at 1% level.						

Table 1: Unit root tests, 1980:1-2004:3

Normalized cointegrating coefficients (t-values in parentheses)				
$\ln PX$	$\ln PGDPM$	$\ln PA19x_{pgdpm}$	$\ln Order$	$Trend$
1.00	-0.81	-0.19	-0.14	0.004
	[-8.08]	[-4.51]	[-4.09]	[6.17]

Adjustment coefficients of EC term in VECM (t-values in parentheses)				
Equation	$D(\ln PX)$	$D(\ln PGDPM)$	$D(\ln PA19x_{pgdpm})$	$D(lnOrder)$
Adjustment coefficient	-0.22	0.17	0.24	0.67
	[**-2.20**]	[1.84]	[0.71]	[0.93]

H_0: number of cointegrating vectors	Eigenvalue	Trace statistic	critical value at 5% level	critical value at 1% level
none *	0.2754	67.25	62.99	70.05
at most 1	0.2090	37.62	42.44	48.45
at most 2	0.1153	16.06	25.32	30.45
at most 3	0.0506	4.78	12.25	16.26

EC term: error correction term; VECM: Vector error correction model.

*: denotes rejection of hypothesis at the 5% level.

Table 2: Export prices: error correction term and trace test, 1980:1-2004:3

Normalized cointegrating coefficients (t-values in parentheses)				
$\ln PM$	$\ln PGDPM$	$\ln PA15m_{cpi}$	$\ln P_{Oil}$	$Trend$
1.00	-0.69 [-6.12]	-0.37 [-3.49]	-0.10 [-10.34]	0.006 [9.62]

Adjustment coefficients of EC term in VECM (t-values in parentheses)				
Equation	D($\ln PM$)	D($\ln PGDPM$)	D($\ln PA15m_{cpi}$)	D($\ln P_{Oil}$)
Adjustment coefficients	-0.47 [**-3.54**]	-0.12 [**-3.30**]	-0.30 [**-2.52**]	1.62 [1.23]

H_0: number of cointegrating vectors	Eigenvalue	Trace statistic	critical value at 5% level	critical value at 1% level
none **	0.3547	72.42	62.99	70.05
at most 1	0.1478	31.68	42.44	48.45
at most 2	0.1063	16.81	25.32	30.45
at most 3	0.0661	6.36	12,25	16.26

EC term: error correction term; VECM: Vector error correction model.

**: denotes rejection of hypothesis at the 1% level.

Table 3: Import prices: error correction term and trace test, 1980:1-2004:3

Data sources

Variable	Source
Index of export prices (goods) Index of import prices (goods) Final demand deflator	DIW Berlin, Quarterly National Accounts
Oil price (UK-Brent) in US-$	IMF, International Financial Statistics
Index of consumer prices	OECD, Main Economic Indicators
Index of producer prices	OECD, Main Economic Indicators
Indicator of the price competitiveness of the German economy (based on the final demand deflators compared to 19 trading partners)	Deutsche Bundesbank, Reihe YX900D
Bilateral nominal external values of the US-$	IMF, International Financial Statistics
Orders for exported manufactured goods, Volume	OECD, Main Economic Indicators
German exports and imports of goods by countries (special trade)	Federal Statistical Office Germany, Segment 4016

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