

Changes in import pricing behaviour: the case of Germany

Kerstin Stahn



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Editorial Board:

Heinz Herrmann
Thilo Liebig
Karl-Heinz Tödter

Deutsche Bundesbank, Wilhelm-Epstein-Strasse 14, 60431 Frankfurt am Main,
Postfach 10 06 02, 60006 Frankfurt am Main

Tel +49 69 9566-0

Telex within Germany 41227, telex from abroad 414431

Please address all orders in writing to: Deutsche Bundesbank,
Press and Public Relations Division, at the above address or via fax +49 69 9566-3077

Internet <http://www.bundesbank.de>

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Abstract

Since changes in import prices feed into consumer prices and thus might affect monetary policy decisions, policymakers need to establish whether or not German importers' long-run pricing behaviour has changed. Of particular interest are any shifts in the importance of cost pass-through and pricing-to-market for import pricing in Germany that may have occurred since the 1990s. We analyse pricing in single equations for 11 product categories because the factors influencing the pricing behaviour, eg competitive pressure, may well have developed differently on the individual product markets. The Saikkonen (1991) approach is applied to test the import price levels for changes in the impact of their determinants. After aggregating the findings for the individual product categories, we find that, on the whole, pricing-to-market has increased, whereas cost pass-through via foreign costs and exchange rates is lower, but not via commodity prices.

Keywords: import pricing, cost pass-through, exchange rate pass-through, pricing-to-market, Germany.

JEL classification: C22, F41.

Non-technical summary

Inflation in the OECD countries has been on a downward trend over recent decades, though commodity prices have risen sharply since 2000. By contrast, the first oil price shock during the late 1970s and the second, which occurred in the early 1980s, led to much stronger consumer price inflation. Globalisation, which leads to increasing competition on the product markets, is often given as one reason for the downward trend in inflation. This leads us to suggest that importers in Germany might have changed their pricing behaviour. This paper examines this hypothesis for the German case empirically. We investigate whether evidence points to a shift in importers' price-setting. We analyse, in particular, whether pricing-to-market (PTM), which is domestic competitors' influence on price-setting, has been better suited to describe pricing behaviour than cost pass-through (CPT), for which the foreign, exporting enterprises' costs and the commodity prices is decisive, since the 1990s. This is what theoretical deviations would tell us to expect to happen when competition increases.

Our empirical analysis distinguishes between various product categories, as we expect competitive pressure and thus pricing behaviour in individual markets to differ. Theory suggests that CPT is more likely to be expected and, in contrast, PTM is less likely prevalent for sectors with homogeneous goods than for sectors with heterogeneous goods. We examine 11 categories of tradable goods. For some of the categories we anticipate that the goods comprised there are rather homogeneous (food, textiles, paper products, petroleum products, chemicals, plastic products, metals, computers, motor vehicles), whereas for the others we assume that heterogeneity is more likely (machinery, electrical equipment). However, overall, the hypothesis is not backed by empirical evidence.

Subsequently, we address the core question of changes in importers' price-setting. Our hypothesis, that after 1990 PTM became more important compared to CPT, is confirmed for several sectors (machinery and food in particular), but not for others. However, aggregating the results across the sectors under review supports our core hypothesis on the whole. In particular, with respect to the examined sectors taken together, changes in foreign costs and exchange rate changes seem to be passed through to import prices to a lesser extent than previously. However, this does not hold for commodity prices.

Nicht technische Zusammenfassung

In den Ländern der OECD sind die Inflationsraten während der letzten Dekaden gefallen, obwohl zum Beispiel die Rohstoffpreise seit dem Jahr 2000 kräftig gestiegen sind. Demgegenüber hatten der erste und der zweite Ölpreisschock in den siebziger und Anfang der achtziger Jahre zu deutlich höheren Inflationsraten bei den Verbraucherpreisen geführt. Als ein Grund für die rückläufigen Inflationsraten wird häufig die Globalisierung genannt, die zu einem verschärften Wettbewerb auf den Gütermärkten geführt hat. Dies legt die Vermutung nahe, dass die Importeure ihr Preissetzungsverhalten geändert haben. In diesem Papier wird dieser These für Deutschland empirisch nachgegangen. Es wird untersucht, ob es Hinweise dafür gibt, dass die Importeure ihr Preissetzungsverhalten nach 1990 verändert haben. Insbesondere wird analysiert, ob seit den neunziger Jahren *Pricing-to-market* (PTM), bei dem der Einfluss der heimischen Konkurrenten für die Preissetzung bedeutsam ist, besser geeignet ist, das Preissetzungsverhalten zu beschreiben, als das sogenannte *Cost pass-through* (CPT), bei dem die Kosten der ausländischen Exportunternehmen und die Rohstoffpreise entscheidend sind. Dies wäre nach unseren theoretischen Ableitungen bei schärferem Wettbewerb zu erwarten.

Bei unserer empirischen Analyse unterscheiden wir nach verschiedenen Gütergruppen, da davon auszugehen ist, dass der Wettbewerbsdruck und damit das Preissetzungsverhalten auf den einzelnen Märkten unterschiedlich ist. Nach der Theorie ist CPT für Industrien mit homogenen Gütern eher zu erwarten und PTM dagegen eher weniger verbreitet als für Industrien mit heterogenen Gütern. Wir analysieren 11 Gruppen handelbarer Güter. Bei einigen der Gruppen kann man davon ausgehen, dass die dort zusammengefassten Güter ziemlich homogen sind (Nahrungsmittel, Textilien, Papierprodukte, Mineralölerzeugnisse, chemische Erzeugnisse, Kunststoffprodukte, Metalle, Computer, Fahrzeuge), während bei anderen eher von Heterogenität auszugehen ist (Maschinen, elektrische Ausrüstung). Insgesamt bestätigen unsere ersten empirischen Untersuchungen diese These allerdings nicht.

Anschließend wenden wir uns der Kernfrage nach Veränderungen im Preissetzungsverhalten der Importeure zu. Unsere Hypothese, dass PTM nach 1990 gegenüber CPT wichtiger geworden ist, lässt sich für einige Industriebereiche bestätigen (insbesondere für Maschinenbau und Nahrungsmittel), für andere allerdings nicht. Aggregiert man die Ergebnisse über die untersuchten Industrien auf, wird unsere Kernthese allerdings im Großen und Ganzen gestützt. Insbesondere scheinen, betrachtet man die untersuchten Industrien zusammen, Änderungen in den Produktionskosten des Auslandes und Wechselkursveränderungen weniger auf die Importpreise durchzuschlagen als früher. Für Rohstoffpreise gilt das allerdings nicht.

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Changes in import pricing behaviour: the case of Germany*

1 Introduction

Empirical investigation of German imports suggests that sensitivity to relative prices varies considerably between total imports and non-energy imports, between imports from euro-area partners and non-euro-area countries and between long and short estimation periods.¹ While the first two observations in the list could indicate differences in import price-setting by category of goods and region, the last item may point to a change in import pricing behaviour over time. The fact that consumer price inflation in major industrialised countries, which is to a certain degree also fed by import price inflation, has been on a downward trend over the past three decades might also suggest a shift in import price-setting. Globalisation, which involves intensifying competition on the individual product markets, is just one of the many reasons given for this development.²

This raises the question as to whether increasing competition might have induced importers to gear their price-setting less to their own costs, which are represented by the foreign, exporting enterprises' costs (converted to domestic currency), and more strongly to domestic competitors' prices. Such a change in import pricing behaviour would correspond to a shift in importance from cost pass-through (CPT) - which also includes exchange rate pass-through (ERPT) if transmission is via exchange rates - to pricing-to-market (PTM). As the factors influencing import price-setting could have developed differently on the individual product markets, the analysis distinguishes between 11 product categories of varying degrees of homogeneity and shares of

*Deutsche Bundesbank, Economics Department, Wilhelm-Epstein-Str. 14, D-60431 Frankfurt am Main, Germany, E-mail: kerstin.stahn(at)bundesbank.de. The paper represents the author's personal opinions and does not necessarily reflect the views of the Deutsche Bundesbank. The author would like to thank Jörg Breitung, Heinz Herrmann, Manfred Scheuer and Karl-Heinz Tödter for their valuable suggestions and comments. All remaining errors are the author's alone.

¹See Stirböck (2006), pp 21, 24.

²See, for example, BIS (2005), pp 18-19.

imported input use. Comparisons with export pricing can also be drawn, as empirical evidence has already been provided showing that, since the 1990s, CPT has decreased and PTM has increased for German exporting firms, ie exporter pricing behaviour has weakened with respect to their cost situation and strengthened with respect to foreign competitors' prices.³ However, the estimation results of export price-setting cannot be carried over to import prices. It is only in a symmetrical two-country model that exporters and importers display identical pricing behaviour. By contrast, German exports and imports differ considerably depending on category of goods and regions of origin and destination. Therefore, the analysis of import price-setting must be regarded as complementary to export pricing investigations. This also implies that it makes sense to estimate exporter and importer price-setting separately.

This paper begins with an overview of studies investigating shifts in import price-setting empirically and giving potential reasons for changes in import pricing. We next analyse the long-term pricing behaviour empirically for individual categories of imported goods. To illustrate the estimation model, the underlying theoretical approach is derived from an importer's profit calculation, and the data set is described. The paper concludes by presenting and interpreting the estimation results.

2 Overview of the literature

This section begins by presenting empirical findings on changes in import price-setting. As many studies observe a decline in CPT, potential reasons for this development are outlined and studied as to whether they may apply to the German case.

2.1 Evidence for shifts in import pricing

Most studies analysing changes in price-setting investigate shifts connected with the establishment of EMU or long-term shifts which mostly take place in the early or the mid-1990s. If EMU has led to increasing price convergence between the member countries, this would also have influenced import price-setting. Empirical evidence is not clear, though. Anderton (2003) finds that EU members which do not belong to the euro area exhibit lower ERPT for exports to the EMU than exporters from outside the EU. As greater price harmonisation within the EU

³See Stahn (2007), p 310 ff.

Table 1: Studies analysing changes in long-run CPT to German overall import prices

Author	Sample	Elasticities ⁵	Change
Campa/Goldberg (2004), p 9	1975-1987 1988-1999		–0.04 ⁶
BIS (2005), p 17	1971-1989 1990-2004	0.37*** 0.28***	–0.09 ⁿ
Campa/Goldberg (2006), p 31	1975-1994 1995-2004	1.00* 0.68	–0.32 ⁿ
Ihrig et al (2006), p 30	1975-1994 1995-2004	0.38 ⁿ 0.29 ⁿ	–0.09

may have contributed to this, the establishment of a unified economic area is one potential factor influencing the price-setting of enterprises.⁴ Brissimis and Kosma (2005) also observe a shift in import pricing owing to EMU. By contrast, in Campa et al (2005), the evidence is not convincing.

Studies focussing on long-term shifts in German import pricing, which are mostly set in the early or mid-1990s, are presented in Table 1. However, empirical evidence of a decrease in CPT to aggregate import prices is not firm. Research on changes in importers' pricing behaviour by product category is more scant. Campa and Goldberg (2004) and (2006) detect for Germany that the decrease in CPT to import prices differs noticeably by category of goods.⁷

For other countries, empirical evidence of a decline in CPT into overall import prices is also mixed. An indication that the pricing behaviour changes little over time appears to be provided by Hahn (2003) and Warmedinger (2004), who, for a sample covering both the pre- and the post-1990 period, examine the largest euro-area countries individually and the aggregated euro area. Their findings are largely consistent with Anderton et al (2004), who only use data going back to 1990.⁸ The appropriate procedure to retrieve shifts in price-setting, however, is to compare

⁴See Anderton (2003), pp 15 ff. Nevertheless, this result could also be due to the fact that small non-EU countries are more likely to be price takers than large non-EU countries. Furthermore, strong CPT for imports from the United States might have contributed to the higher CPT from countries outside the EU. This could be because US exporters, as may be assumed, invoice their exports in US dollars.

⁵The asterisks indicate a significance level of 1% (***) /5% (**) /10% (*). The abbreviation *n* signifies that the elasticity is not tested for statistical significance.

⁶Insignificant at the 5% level.

⁷See Table 6 in section 3.3.1 for an overview of studies.

⁸See Hahn (2003), p 18, and Warmedinger (2004), pp 12 and 18.

the post-1990 estimation results with the findings for the pre-1990 sample. Using this method, Bailliu and Fujii (2004) indeed detect a weakening in CPT for 11 industrialised countries since the early 1990s. Campa and Goldberg (2005), too, find a decrease since the 1990s for 15 out of 21 countries.⁹ However, in many countries the fall is statistically insignificant, making the case for a decrease ambiguous. This is consistent with Ihrig et al (2006), who observe a decline in CPT to import prices for the G-7 countries since the 1990s, which is statistically insignificant for four countries. Research on shifts in CPT to consumer prices, which is conducted for numerous countries, is a further source of evidence for a fall in CPT to import prices, as the effect of exchange rates on import prices usually feeds to consumer prices.¹⁰

2.2 Reasons for a decline in cost pass-through

There are a host of arguments in favour of a downward trend in CPT to import prices, though the empirical evidence is still mixed. However, with respect to many points, theory and empirical findings may also allow the opposite conclusion.

One oft-mentioned reason for a decline in CPT is, as already stated, growing competition on goods markets. This argument is disputable insofar as intensified competition could also induce enterprises to become price takers, which would lead to an increase in CPT.¹¹

Shifts in the composition of imported goods from products with a strong pass-through to products with a weak pass-through might also play a role for the decline in CPT.¹² Outsourcing to low-cost countries is just one possible cause of such sectoral shifts, as this presumably affects low-tech import products for which pass-through is especially high. Even though the argument may apply to aggregated price indices to a certain degree, it holds less with increasing disaggregation of the product categories under review. In addition, there is evidence that shifts in the composition of US and Japanese imported goods only partly explain the decrease in CPT in these countries.¹³

⁹See Campa and Goldberg (2005), p 684.

¹⁰See Bailliu and Fujii (2004), p 28, Gagnon and Ihrig (2004), p 325, and Frankel et al (2005). However, for Germany, Gagnon and Ihrig (2004) and Ihrig et al (2006), p 31, find nearly unchanged CPT to consumer prices.

¹¹See Hellerstein (2005) for evidence for the US beer market.

¹²According to Campa and Goldberg (2002), p 19 ff, this is the most important reason for changes in the time profile of CPT. By contrast, Hahn (2007), p 26 ff, finds that shifts in the sectoral structure have only slightly influenced the impact of exchange rate shocks on both aggregate euro area prices and output.

¹³See Marazzi et al (2005), pp 38-39, Otani et al (2003), p 14 ff, and Otani et al (2005), p 11.

Table 2: Shares of invoicing currencies in German imports

Time period	Share of invoicing currency	
	Domestic currency	US dollar
1976-1989	42% → 53%	32% → 22%
1990-2000	52% — 58%	17% → 27%
2002-2007	72% — 78%	18% — 25%

The lower inflation expectations due to stronger orientation of monetary policy worldwide to price stability could also have contributed to the fall in CPT.¹⁴ Such a stable environment might induce market participants to regard exchange rate fluctuations as temporary. Enterprises could then be induced to absorb exchange rate movements in their profit margins. The possibility that low or less volatile inflation may involve a weaker pass-through of exchange rate changes to import or consumer prices is observed by several studies.¹⁵ Again, these results are controversial; other empirical analysis assess the role of macro determinants such as inflation or money growth rates, exchange rate volatility or real GDP on CPT to be negligible.¹⁶

In addition, factors influencing the supply-side of the domestic economy might have caused the decline in CPT. The factors named include institutional conditions such as product and labour market deregulation, technological progress and productivity growth.¹⁷

Furthermore, the degree of CPT could have been affected by the choice of the invoicing currency. A weakening in CPT can be expected if import price-setting in domestic currency increases (which is equivalent to a decrease in import pricing in foreign currency) as the foreign, exporting enterprises' costs, which are passed-through to domestic import prices, are denominated in foreign currency and converted to domestic currency using the exchange rates.¹⁸ Table 2 shows the shares of German imports invoiced in domestic currency units, ie D-Mark or euro, and

¹⁴See BIS (2005), p 19.

¹⁵See Gagnon and Ihrig (2004), p 323 ff, Baillu and Fujii (2004), p 20, Frankel et al (2005), Choudri and Hakura (2001), p 15 ff, or the simulations by Taylor (2000), p 1400 ff. See Laflèche (1996), p 23, for a description of both the direct and indirect transmission channel of exchange rate changes to consumer prices.

¹⁶See Campa and Goldberg (2002), p 19 ff.

¹⁷See BIS (2005), p 19.

¹⁸See Flodén and Wilander (2005), p 186 ff, and Déés et al (2008), p 27.

in US dollars in German total imports.¹⁹ Arrows are given if a trend in shares can be detected during the respective period.

On the whole, for the post-unification period, import price-setting in domestic currency was more widely practised than before German unification. This indicates that German importers' invoicing practices might have helped weaken CPT.

Lastly, developments in intra-firm trade could have influenced importers' price-setting. As intra-firm trade is supposed to have increased in industrialised countries, one would expect that CPT to import prices may have declined.²⁰ However, empirical evidence for Germany does not exist²¹, and evidence for the USA is not clear.²²

A good way of establishing which of the above arguments are the most valid is to estimate, and test for significance, changes in the importance of CPT and PTM for enterprises' import pricing behaviour. Moreover, we will estimate CPT and PTM simultaneously, whereas many studies concentrate only on one impact. The focus here is on German import price-setting; because Germany is the largest EMU member state, shifts in price-setting are assumed to feed into consumer prices not only in Germany, but also the euro area, and thus might affect monetary policy decisions. In addition, inflation rates in Germany have been relatively low throughout the period under review. This implies that shifts in pricing behaviour cannot be attributed to periods of high or volatile inflation rates.

Although the pricing behaviour of German enterprises has already been examined for export prices, the results cannot be applied to import pricing as German exports and imports vary considerably across categories of goods as well as depending on regional destination and origin. It is only in a symmetrical two-country model that exporters and importers display identical price-setting behaviour. Therefore, investigating import pricing is a complement to analysing export pricing. This also means that it is appropriate to model importer and exporter price-setting

¹⁹See Deutsche Bundesbank for the pre-1989 period and Ifo Institute for post-1989 data. The domestic currency before 2001 is the D-Mark, for the 1991-2000 period D-Mark and euro and from 2002 onwards exclusively euro. The year 2001 is excluded due to uncertainties while the euro was being introduced. Period-on-period changes in the shares could be influenced in part by the fact that the composition of the responding enterprises might have changed.

²⁰See Menon (1995), p 204 ff.

²¹In 2001, the Federal Statistical Office of Germany detected on the basis of a survey that the share of intra-trade in Germany is about 25% for goods exports to and 38% for imports from EU countries. See Ebert (2002), p 382. As the survey comprises only trade with EU countries and respondent enterprises account merely for 2% of total German foreign trade, these findings might not be carried over to overall foreign trade, though.

²²See Eden and Rodriguez (2004) and Clausing (2001), pp 24-25.

independently. Nevertheless, a comparison of the estimation results for export and import price-setting still yields useful information.

The timing of the behavioural shift in German import pricing is crucial for the empirical results. Shifts connected with the establishment of the euro area might provide unreasonable findings since the period of EMU is still rather short for a time series analysis. Moreover, the establishment of EMU coincided with two other events. First, the new-economy bubble burst, leading to a downswing in economic activity worldwide. Secondly, the external value of the domestic currency against non-euro-area countries, after a considerable depreciation, started to appreciate. Therefore, it may be difficult to separate these influences from the impact of EMU on import pricing. Analysing changes in pricing behaviour since the 1990s seems to be a more promising approach. These shifts might be due to an increase in competitive pressure as the evolution of the Asian emerging economies and central and east European transition countries into important participants on the international product markets has caused a noticeable change in Germany's foreign trade and FDI flows.

Moreover, as competitive pressure and other factors influencing importer price-setting probably have developed differently on the individual goods markets, the analysis distinguishes between 11 product categories. The categories contain at least one or combine at most three 2-digit category codes. Given that we are investigating import pricing since the mid-1970s, there are two advantages to analysing less deeply disaggregated price indices. One is that shifts in price-setting owing to changes in the composition of a highly aggregated price index are lessened. The other is that the considerable shifts in the composition of very deeply disaggregated German price indices are likewise reduced. Moreover, long time series of less deeply disaggregated price or cost indices are more likely to be found for foreign prices or costs, too. By contrast, studies examining price-setting for individual goods using firm-level or very deeply disaggregated price indices do not face these problems as they generally focus on only relatively short observation periods.

3 Has long-term German import pricing behaviour changed?

3.1 Theoretical approach

Basic assumptions of the underlying mark-up model include imperfect monopolistic competition according to the Chamberlin model and strategic behaviour on the part of importers.²³ It is assumed that enterprises which import products of category i set their prices (P_i^m) in domestic currency units. Then, import prices are fixed by raising the unit costs by a profit margin (π_i). The domestic importers' unit costs are the foreign, exporting enterprises' costs of product category i (P_i^f), which are denominated in foreign currency. As imported goods are priced in domestic currency units, (P_i^f) is converted to this currency using the nominal external value of the domestic currency against the most important trading partners for product category i (W_i). A rise in this variable signifies an appreciation of the domestic currency.

$$P_{it}^m = (1 + \pi_{it}) \cdot \frac{P_{it}^f}{W_i}. \quad (1)$$

Competitive pressure on product market i determines the mark-up ($1 + \pi_{it}$) and is represented by the relation between domestic competitors' prices (P_i^h) and import prices for product category i , which are both denominated in domestic currency:

$$(1 + \pi_{it}) = \left(\Psi_i \frac{P_{it}^h}{P_{it}^m} \right)^{\theta_i}, \quad \theta_i \geq 0, \Psi_i > 0. \quad (2)$$

The parameter θ_i reflects the intensity of competitive pressure on product market i , and Ψ_i is a constant. Written in logarithms, which are represented by lower-case letters, equations (1) and (2) yield

$$p_{it}^m = \phi_i \cdot p_{it}^h + (1 - \phi_i) \cdot (p_{it}^f - w_{it}) + \theta_i \psi_i, \quad \phi_i = \frac{\theta_i}{1 + \theta_i}. \quad (3)$$

The pricing-to-market (PTM) effect, which indicates the degree to which domestic importers gear prices to those of their domestic competitors, is reflected by the first term. PTM is complete

²³See Dornbusch (1987), p 99 ff, and Clostermann (1996), pp 9-10, for the theoretical derivation of the extended Dixit-Stiglitz model.

if ϕ_i is one. In this case, import prices are determined only by domestic competitors' prices.²⁴ This means that variations in the importers' profit margins would fully absorb the exchange rate fluctuations. The full burden of exchange rate changes then falls to the importers' profits.

The cost pass-through (CPT) effect, which represents the degree to which domestic enterprises adjust import prices to their own cost situation, is described by the second term. The importers' cost situation is determined by the foreign, exporting enterprises' unit costs, which are denominated in foreign currency and converted to domestic currency units by using the exchange rates. The transmission channel via the exchange rate is usually denoted as the exchange rate pass-through (ERPT) effect, even though in this paper it is also captured by the term CPT. Complete CPT requires the parameter ϕ_i to take the value of zero. In this case, importers fix their prices solely with foreign enterprises' costs in mind. By contrast, both foreign costs and domestic competitors' prices play a role in importers' price-setting if ϕ_i takes a value between zero and one, which represents incomplete CPT.²⁵

Equation (3) shows that an increase in competitive pressure θ_i , which involves a rise in the value of ϕ_i , implicates a weakening in CPT and a strengthening in PTM. By using empirical estimations, this paper tries to find out how large the behavioural parameters ϕ_i are.²⁶

With regard to the estimation approach, the theoretically derived pricing behaviour from equation (3) is widened by loosening two homogeneity restrictions. First, the impacts of the individual determinants no longer need to sum up to one. Second, import prices no longer need to adjust to the same extent in terms of amount to changes in foreign unit costs and the nominal external value.²⁷ For instance, since exchange rate fluctuations are difficult to predict, importing enterprises could respond more sensitively to changes in foreign unit costs than to changes in the external value.²⁸

²⁴The limit of ϕ_i is one if $\theta_i \rightarrow \infty$.

²⁵Goldberg and Knetter (1997) present studies finding incomplete long-run pass-through, which may arise through imperfect competition in segmented markets and the enterprises' market power.

²⁶Studies where the impact of PTM and CPT on import prices is estimated simultaneously include, for example, Clostermann (1996), Ketelsen and Kortelainen (1996), Naug and Nymoen (1996), Yang (1997), Bache (2002), Anderton (2003), Warmedinger (2004) and Stephan (2005).

²⁷By contrast, the estimations of Warmedinger (2004) include these two homogeneity restrictions. Bache (2002), p 27, could not reject the hypothesis that the impact of the nominal exchange rate and the foreign cost variable are equal by terms of value.

²⁸See Hung et al (1993), p 5. Other reasons why this restriction does not apply are differences in the compilation of the indices - see Athukorala and Menon (1995), pp 535-536 - and the high degree of aggregation of the indices - see Mahdavi (2000), p 72. In addition, menu costs might explain why import prices do not react to temporary exchange rate movements. See Delgado (1991). However, factoring a trend into the estimation model might solve this problem. See Clostermann (1996), p 15, and Stephan (2005), p 10.

Another point to be considered is that the foreign exporters' costs may be influenced more strongly by changes in the prices of commodities or intermediate goods than by changes in other cost components. This could matter particularly in cases in which commodities are an important input in foreign enterprises' manufacturing process and would mean that the price-setting of domestic importers is likewise more strongly oriented to the prices of commodities or intermediate goods from abroad than to the other components of foreign unit costs. Therefore, commodity prices in domestic currency units (p_q^r) are included as an supplementary influence channel of CPT. Then, the corresponding equation for import pricing behaviour is:

$$p_{it}^m = \beta_{i1}p_{it}^h + \beta_{i2}p_{it}^f - \beta_{i3}w_{it} + \beta_{i4}p_{qt}^r + c_i. \quad (4)$$

β_{i1} reflects the PTM effect via domestic competitors' prices. β_{i2} , β_{i3} and β_{i4} show the cost pass-through (more precisely, in the case of β_{i3} the exchange rate pass-through). c_i is a constant. In the following, ERPT falls under CPT effects, unless mentioned explicitly otherwise. The coefficients take economically plausible values if $\beta_{i1}, \beta_{i2}, \beta_{i3}, \beta_{i4} \geq 0$.

With equation (3) in mind, sharper competitive pressure involves a strengthening in PTM (β_{i1}) and a weakening in CPT ($\beta_{i2}, \beta_{i3}, \beta_{i4}$). These theoretical findings are the primum mobile to form and examine empirically the following core hypothesis:

- CPT has decreased and PTM has increased since the beginning of the 1990s, as competitive pressure is assumed to have accelerated.

However, we will first examine the following hypothesis. This analysis is aimed to provide long-term estimation results which will allow us to establish the empirically plausible background for the core hypothesis:

- CPT is stronger, and PTM weaker, for homogeneous products than for heterogeneous products, as the price elasticity of demand is - in absolute terms - larger for homogeneous products than for heterogeneous products.²⁹

²⁹More precisely, it is the convexity of the demand curve that matters. For the theoretical derivation, see Marston (1990), p 219 ff, and Goldberg and Knetter (1997), pp 1252-1253. For US and Canadian data, this hypothesis is confirmed by Engel (1993), p 48.

As we will be comparing the results for import and export pricing behaviour, the corresponding hypotheses should be examined as well. For exporters, which set prices in domestic currency, CPT captures the impact of the exporters' own cost situation and is therefore denoted cost pass-through (CPT). PTM reflects the impact of the foreign competitors' prices, converted to domestic currency using the exchange rates, which implies that PTM affects export price-setting through both foreign competitors' prices, denominated in foreign currency, and the exchange rates. This means, that for export pricing, the determinants representing PTM are those which characterise CPT for import pricing and vice versa. However, with respect to CPT and PTM, the core hypothesis examined for export pricing is the same as for import pricing. The hypothesis checking the long-term plausibility is also the same for export and import price-setting even though the reasoning differs, as competitive pressure is lower for exports of heterogeneous goods than for those of homogeneous goods.³⁰

3.2 Estimation approach and data

3.2.1 Estimation approach

Long-term import price-setting is estimated in levels, as at least one cointegrating relationship between the sectoral import prices and the respective determinants is detected.³¹ The advantage of using levels over studies in which first differences are estimated - owing to the rejection of a cointegrating relationship - is that identifying long-run effects of the determinants requires us to sum up the estimated coefficients of the current and the lagged first differences.³² The problem connected with that method is that the results could be determined by the number of lags factored into the model.

The long-run relationship for each import price category is estimated using a single equation, although this implies the assumption that the regressors influence the dependent variable but not vice versa. As, at least for some categories, domestic prices may be influenced by import price trends,³³ the possibility of endogeneity is dealt with by factoring the leads and lags

³⁰See Stahn (2007), p 298 ff.

³¹See the appendix for the results of the trace test.

³²Approximating import prices by import unit values might lead to the rejection of cointegration as the unit values still include period-by-period changes in the composition of imports. By contrast, import prices are based on a constant composition of goods. Nevertheless, unit values are frequently used in empirical investigations, particularly in a sectoral breakdown, as equivalent foreign trade prices are often not available.

³³See Hung et al (1993), p 6, on this point.

of the regressors' first differences into the equation, according to the asymptotically efficient approach of Saikkonen.³⁴ The number of leads and lags is restricted to one as to maximise the degrees of freedom. We use the Newey-West covariance estimator to take autocorrelation and heteroscedasticity into account. The data is non-seasonally adjusted on a quarterly basis. The regression equation is

$$p_{it}^m = \beta_i' x_{it} + \sum_{j=-1}^1 \gamma_{ij}' \Delta x_{it+j} + c_i + \sum_{l=0}^2 \delta_{il} s_{t-l} + u_{it} \quad (5)$$

with $x_{it}' = \left(p_{it}^h, p_{it}^f, w_{it}, p_{qt}^r \right)$.

Variables which are not yet defined are seasonal variables s , the first differences of the logarithmic system variables Δ , and the residual u_i .

Supposing that competitive pressure has increased since the 1990s in particular, the estimation results for the period before and after German unification may differ. Therefore, the regressions are carried out for the sub-samples 1976 Q1-1990 Q4 and 1991 Q1-2008 Q1. However, for some product categories the appropriate point in time for the change in long-term import price-setting is 1990 Q1, for machinery even 1986 Q1, as this provides a better fit.

Shifts in long-term pricing behaviour are modelled by allowing changes in the influence of the constant and each regressor. This case is implemented by carrying out the estimation across the complete observation period 1976-2008 and factoring a dummy variable for each regressor and the constant into the estimation equation. The estimation coefficients of the constant and the regressors then directly provide the elasticities for the pre-unification sample. The elasticities of the dummy variables capture changes in the impact of the import price determinants occurring in the period after German unification in comparison to the period before.³⁵ The advantage of this approach is that the changes in the constant and the regressors can be checked for statistical significance. Moreover, shifts in PTM and CPT are estimated simultaneously, whereas many studies concentrate on only one impact. The correspondent estimation equation is

³⁴See Saikkonen (1991).

³⁵See Judge et al (1988), pp 428-429.

$$\begin{aligned}
p_{it}^m = & \hat{\beta}_i' x_{it} + \sum_{j=-1}^1 \hat{\gamma}_{ij}' \Delta x_{it+j} + \hat{c}_i + \sum_{l=0}^2 \hat{\delta}_{il} s_{t-l} \\
& + \left(\tilde{\beta}_i' x_{it} + \sum_{j=-1}^1 \tilde{\gamma}_{ij}' \Delta x_{it+j} + \tilde{c}_i + \sum_{l=0}^2 \tilde{\delta}_{il} s_{t-l} \right) \cdot dum + v_{it}
\end{aligned} \tag{6}$$

where *dum* is a dummy variable which is - dependent on the product category under review - zero prior to 1986 Q1 or 1990 Q1 or 1991 Q1 and one from the respective point in time onwards, and v_i the residual.

It holds that

$$\beta_{i1} = \hat{\beta}_{i1} + \tilde{\beta}_{i1}, \beta_{i2} = \hat{\beta}_{i2} + \tilde{\beta}_{i2}, \beta_{i3} = \hat{\beta}_{i3} + \tilde{\beta}_{i3}, \beta_{i4} = \hat{\beta}_{i4} + \tilde{\beta}_{i4},$$

with $\beta_{i1}, \beta_{i2}, \beta_{i3}, \beta_{i4}$ from equation (5) for the post-unification period.

3.2.2 Data set

The import price indices of the 11 product categories under review contain 2- or 3-digit category codes according to the German Product Classification for Production Statistics (*Güterverzeichnis für Produktionsstatistiken*, GP).³⁶ As the structure of the GP was significantly revised in 1995, group indices by product category are created for the old and the new GP and linked for 1995 (see Table 3). These group indices comprise one or several sub-indices with product categories which largely match with respect to the old and the new GP. The sub-indices are grouped by their weight in the price index for total imports for the corresponding base years. The second column in the table contains the abbreviation for the product groups that is used in the following.

To give an idea about the structure of German imports by category of goods, we present their percentage share in overall import volume for the year 2006. Table 3 shows that the analysis focuses on manufactured goods as the underlying model of imperfect monopolistic competition assumes that importers have price-setting power. The investigation excludes those categories of goods where importers would most probably gear their import prices more to world market prices, which contain products where a uniform pricing behaviour is highly unlikely or which have only a very small share in total imports.

³⁶The data source is the Federal Statistical Office.

Table 3: Consolidated product categories according to the GP

Group		Code	GP 1989	Code	GP 1995/2002	Share (%)
I	Food	68	Food products	15	Food products and beverages	4.6
II	Textiles	63	Textiles	17	Textiles	4.3
		64	Clothing, made-up textiles	18	Clothing	
III	Paper products	56	Paper and pulp products	21	Pulp, paper and paper products	2.2
		57	Publishing, printing and reproduction	22	Publishing, printing and reproduction of recorded media	
IV	Petroleum products	22	Refined petroleum products	232	Refined petroleum products	2.4 ³⁷
V	Chemicals	40	Chemical products	24	Chemicals and chemical products	11.8
VI	Plastic products	58	Plastic products	25	Rubber and plastic products	2.5
		59	Rubber products			
VII	Metals	27	Iron ore	27	Basic metals	8.9
		28	Non-ferrous metals, non-ferrous metal ores	28	Fabricated metal products	
		29	Cast metal products			
		30	Fabricated steel products, rail vehicles			
		31	Products from wire drawing plants, cold rolling mills, steel forming			
		38	Iron, sheet metal and metal products			
VIII	Machinery	32	Machinery (including tractors)	29	Machinery	7.6
IX	Computers	50	Office machinery and computers	30	Office machinery and computers	4.3
X	Electrical equipment	36	Electrical equipment	31	Electrical machinery and apparatus	14.4
		37	Precision and optical instruments, watches, clocks	32	Radio, TV and communication equipment and apparatus	
				33	Medical, precision and optical instruments, watches, clocks	
XI	Motor vehicles	33	Road vehicles (excluding tractors)	34	Motor vehicles and parts	10.2

³⁷The share in volume includes coke and nuclear fuel products, which have a minor weight compared to refined

The difficulty in estimating import pricing behaviour by product category consists in finding suitable sectoral time series for domestic competitors' prices and foreign unit costs. German producer prices, which are available in the same sectoral breakdown as import prices, would lend themselves as a proxy for sectoral domestic competitors' prices.³⁸ However, if the PTM effect is captured by sectoral domestic producer prices, the estimated elasticities are nearly one or considerably larger than one for several product categories. Moreover, in many cases a rise in PTM is detected, whereas a fall in PTM is observed if domestic price variables which do not contain imported goods are used. In addition, if commodity prices are included as determinants, their impact is lower than in regressions where domestic competitors' prices are approximated by price variables which exclude imported goods.³⁹ This may be because the share of imported intermediate goods in the domestic manufacturing process increased considerably during the 1990s.⁴⁰

To avoid the upward bias in the estimated PTM effect and the downward bias in CPT via the commodity prices when using domestic sectoral producer prices, domestic price variables which exclude imported goods, such as the German GDP deflator or unit labour costs of the German business sector, are employed as a proxy for domestic competitors' prices. However, neither time series is available in a sectoral breakdown corresponding to import prices. As a consequence, for some product categories the estimated elasticities are economically implausible. Furthermore, in some cases the direction of change in PTM depends on the specification of the CPT effects. These findings may justify the exclusion of the PTM effect from the regression for some product categories.⁴¹ In contrast to import prices, export price estimations in the corresponding sectoral breakdown, in which German sectoral unit costs are approximated by domestic sectoral producer prices, provide plausible impacts of CPT for most of the 11 product categories under review.⁴² Apparently, the factors which distort the estimated PTM effect on import prices if domestic competitors' prices are approximated by sectoral producer prices have little or no effect on export price estimations.

petroleum products, however.

³⁸As changes in the structure of the GP in 1995 have also influenced producer prices, the method corresponding to import prices is used to link producer price indices by product group in 1995.

³⁹See Table 10 in the appendix for estimation results which approximate domestic competitors' prices by sectoral producer prices.

⁴⁰For the import content of goods produced in Germany, see Table 9 in the appendix.

⁴¹Many studies likewise concentrate their analysis on CPT.

⁴²See Stahn (2007), p 13.

Aggregates of the total sales deflators or the unit labour costs of the business sector of Germany's 19 most important trading partners are used as approximations of the foreign, exporting enterprises costs for product category i . This is because foreign costs, broken down by categories which correspond to the GP, are available neither for a representative group of trading partners nor for the complete observation period. The group of the 19 partner countries include Germany's 11 euro-area trading partners (in the composition until December 2006) as well as Canada, Denmark, Japan, Norway, Sweden, Switzerland, the United Kingdom and the United States. Foreign unit labour costs, which do not capture prices of domestic or foreign intermediate goods or raw materials, are the appropriate approximation, particularly if commodity prices are included as an additional regressor. As they are available only since 1976 Q1, the variable is approximated by a positive trend before this point in time. Moreover, as they are also available only up to 2006 Q2, the time series is approximated by the growth rate of the foreign unit labour costs of the total economy after this point in time. To simplify the following presentation, CPT via the foreign unit labour costs is also captured by the term "foreign cost" effects. By contrast, for export prices the aggregated total sales deflators of 19 trading partners emerged as an appropriate approximation of the foreign competitors' prices for the product categories under review, yielding feasible estimation results for the PTM effect.⁴³

The weighting of the 19 country-specific time series incorporates the importance of bilateral trade relations between the German economy and the individual trading partners as well as competition in markets outside the EMU. Before 1999, the weights are based on the regional breakdown of Germany's overall exports and imports for the years 1995 to 1997 and, since then, on Germany's trade structure during 1999 to 2001. However, with respect to the weighting several points have to be borne in mind.⁴⁴ Firstly, the shares of the 19 trading partners in Germany's total foreign trade and their weights within this group of countries have changed considerably over the observation period. In addition, the group of 19 trading partners does not reflect the increasing importance of the central and eastern European transition countries or Asian emerging market economies for German imports since the 1990s. Furthermore, the regional composition and the changes in the regional composition of Germany's imports differ distinctly across the individual product categories.

Using sector-specifically aggregated time series by selecting the most important trading partners for each product category separately is indeed preferable to identifying the major partner countries by their share in total imports. The required time series - especially those broken down

⁴³See again Stahn (2007), p 13.

⁴⁴See Table 7 and Stahn (2007), p 319 ff, for the composition of German exports and imports in a breakdown by region and product category.

by product category - are often not available for the entire analysis period under review. It therefore makes sense to focus on the 19 trading partners with the largest share in German overall imports. However, this implies, at least for some product categories, that those countries may be excluded whose cost trends are asserted to be the reason for a potential change in German enterprises' import pricing behaviour. Incorporating third market effects does not alleviate this problem either.

Moreover, calculating the weights of the trading partners' time series on the basis of a very short time period implies that the foreign trade structure is assumed to be unchanged throughout a long analysis period. However, the year-on-year changes in the regional structure of imports by product category could be considerable. Consequently, major differences between the actual weights and the weights of the base years may emerge even if sectoral weights are used. Therefore, for each product category, sector-unspecific weights within the group of the 19 most important trading partners appear to be an appropriate and manageable approximation. However, the estimation results might show that the differences in the regional import structure between the individual product categories may be reflected in the size and the significance level of the CPT effects.

The only product category for which sector-specific foreign costs are used is, for both import and export prices, group IX (computers). This is due to the fact that for computers, the trend in import prices (as well as the trend in export prices) is downward,⁴⁵ whereas the trend in the aggregated foreign total sales deflator or the aggregated foreign unit labour costs is upward. As it is plausible to expect that the foreign, exporting enterprises' costs for computers have - consistently with the trade prices - also trended downward, the aggregated foreign total sales deflator or unit labour costs appear to be inappropriate regressors. For this reason, a time series approximating foreign costs for computers is created by linking US producer prices for computer manufacturers (available from 1991) with US producer prices for calculating and accounting machines and parts (1976 Q1-1990 Q4) and typewriters (1976 Q1-1983 Q4) or typewriters, word processors and parts (1985 Q3-1990 Q4). Using this procedure assumes that the foreign exporters' costs for computers (denominated in foreign currency) have moved similarly to the US producer prices for these products.

⁴⁵Hedonic price measurement could have contributed to the downward trend in import prices of computers, as they have undergone considerable technological progress. The same applies to imports of electrical equipment since 2000. However, even import prices for plastic products, which are regarded as belonging to the low-tech sector, have declined since the 1990s.

The sector-specific nominal external values, which capture the impact of exchange rates on import pricing, are approximated using the nominal external value against Germany's 19 most important trading partners or the nominal US dollar/domestic currency exchange rate. The nominal external value is used for six of the 11 product categories (food, paper products, chemicals, plastic products, machinery and motor vehicles). The weighting of the 19 countries corresponds to the weighting applied to the aggregated foreign total sales deflators or unit labour costs. For the other imported product categories, the nominal US dollar/domestic currency exchange rate is used. This seems appropriate for sectors for which major foreign producers are located in Asian countries, which strongly orientate their currencies to the US dollar (textiles, metals, computers, electrical equipment), or where raw materials, which are mainly invoiced in US dollars, play an important role in the manufacturing process (petroleum products). For simplification, CPT via the nominal external value of the domestic currency is also covered by the term "exchange rate" effects. By contrast, for export price estimations the sector-specific nominal external values are approximated by the US dollar only for computers, whereas for the other product categories the nominal external value against the 19 trading partners, with the weighting being also sector-unspecific, was used.

To capture the impact of commodity costs, we use the HWWI commodity price indices for food, crude oil, iron ore and discarded metal, cellulose and spun yarn, which are denominated in US dollars and, for some product categories, are converted to domestic currency. As the indices for cellulose and spun yarn are not available before 1978 Q4, they are assumed to take the corresponding value (in US dollars) for the entire period before this point in time. Consequently, as both indices are included in the estimation equation after conversion to domestic currency units, changes before 1978 Q4 are exclusively due to fluctuations of the domestic currency against the US dollar.

Numerous combinations of the various indicators for PTM and CPT have been estimated. The regressions show that in most cases PTM and CPT via the foreign cost component depend heavily on the chosen indicator. By contrast, the elasticities of the exchange rates are considerably more robust with respect to size and direction of change. The following criteria are applied to choose for each product category the most appropriate specification of the import price equation, which is presented in Table 4.

1. The estimated elasticities should exhibit economically plausible, ie non-negative, values.
2. The elasticities should not be much larger than one.

3. The PTM effect is eliminated from the regression if its direction of change or the direction of change in CPT depends on its specification.
4. The direction of change in CPT and PTM should not change if the restriction $\beta_{i2} = \beta_{i3}$ is introduced, ie the assumption of identical impacts of the foreign costs - calculated in foreign currency - and the exchange rates.

Table 4 shows that for the import price estimations, with respect to the time series which are used, the specification differs notably between the individual product categories. By contrast, for individual export price categories the identical specification of the estimation equations - with the exception of computers - turned out to be appropriate.

Table 4: Specification of import price equations

Group	Sample	p^h	p^f	w	p^r	Structural break	adj. R^2	S.E. ⁴⁶
I Food	WG G	—	Foreign unit labour costs	External value	Food (domestic curr.)	1991	0.91 0.66	0.02 0.02
II Textiles	WG G	—	Foreign unit labour costs	US dollar/ domestic curr.	Spun yarn (domestic curr.)	1990	0.99 0.95	0.01 0.01
III Paper products	WG G	—	Foreign unit labour costs	External value	Cellulose (domestic curr.)	1991	0.98 0.52	0.01 0.03
IV Petroleum products	WG G	—	—	US dollar/ domestic curr.	Crude oil (US dollar)	1990	0.99 0.99	0.04 0.04
V Chemicals	WG G	—	Foreign unit labour costs	External value	Crude oil (domestic curr.)	1990	0.96 0.92	0.02 0.02
VI Plastic products	WG G	Domestic unit labour costs	Foreign unit labour costs ⁴⁷	External value	Crude oil (domestic curr.)	1991	0.99 0.90	0.01 0.01
VII Metals	WG G	—	Foreign unit labour costs	US dollar/ domestic curr.	Iron ore (US dollar)	1990	0.96 0.94	0.03 0.04
VIII Machinery	WG G	Domestic GDP deflator	Foreign total sales deflator	External value	—	1986	1.00 1.00	0.01 0.00
IX Computers	WG G	Domestic GDP deflator	US producer prices for computers	US dollar/ domestic curr.	—	1991	0.87 0.94	0.03 0.10
X Electrical equipment	WG G	Domestic unit labour costs	Foreign unit labour costs	US dollar/ domestic curr.	—	1991	0.99 0.98	0.01 0.01
XI Motor vehicles	WG G	Domestic unit labour costs	Foreign total sales deflator	External value	—	1990	0.98 0.99	0.01 0.01

⁴⁶Figures for adjusted R^2 and the standard error (S.E.) from estimations across the individual sub-samples. However, as the estimation model includes the leads and lags of the regressors' first differences, the figures for adjusted R^2 should be interpreted with caution.

⁴⁷Using US producer prices for plastic products and the US dollar/domestic currency exchange rate provides the same qualitative result.

3.3 Estimation results

The long-run estimation results for import prices are presented in Table 5. The t-values are in square brackets. The results for the west German sample are termed "WG" and stem, like the shifts in price-setting, from equation (6). The findings for the pan-German sample, capturing for most product categories (except machinery) unified Germany only, are termed "G" in the table and come from equation (5). The asterisks (*) signify significance levels of 1% (***) / 5% (**) / 10% (*). A positive (negative) sign for the change in the impact of the influence factors indicates that CPT or PTM has strengthened (weakened).

3.3.1 Examining the results for plausibility

We start by providing an overview of the estimated CPT and PTM effects. Then, we analyse the impact of the degree of homogeneity on import pricing.

Overview of long-run CPT and PTM effects

The estimation results indicate that CPT is an important determinant for German import price-setting: positive elasticities of the foreign, exporting enterprises costs, which are - above all - statistically significant for most product categories, take values from 0.28 to 0.87 for the west German sample and from 0.05 to 0.49 for unified Germany.⁴⁸ The impact of the exchange rates, on the whole, covers a similar range of values (up to 1.08 for the pre-unification period and 0.93 for the post-unification sample).

For CPT via the commodity prices, which is an important effect for the food, textiles, paper products, chemicals, plastic products and metals sectors, the elasticities' range is also relatively wide, up to 0.86 for the west German sample and 0.94 for the pan-German period. The largest elasticities are found for petroleum products. This result is due to the fact that crude oil is by far the most important input factor for this sector.

⁴⁸For the euro area as a whole, Anderton et al (2004), pp 22-23, find a noticeably higher CPT into manufactured imported goods for the post-unification period as enterprises pass through 50% to 70% of the changes in foreign costs, denominated in euro.

Table 5: Long-run impact of import price determinants

Group		Sample	p^h	[t-value]	p^f	[t-value]	w	[t-value]	p^r	[t-value]
I	Food	WG	—	—	0.44***	[8.00]	0.45**	[2.77]	0.20***	[5.62]
		G	—	—	0.23***	[3.44]	0.08	[0.92]	0.15***	[4.06]
		Change	—	—	−0.20**	[−2.28]	−0.36*	[−1.98]	−0.05	[−1.01]
II	Textiles	WG	—	—	0.38***	[27.07]	0.01	[0.32]	0.10***	[3.67]
		G	—	—	0.25***	[12.32]	0.15***	[21.45]	−0.00	[−0.31]
		Change	—	—	−0.13***	[−5.15]	0.14***	[3.68]	−0.11***	[−3.41]
III	Paper products	WG	—	—	0.55***	[11.55]	0.63***	[8.55]	0.00	[0.00]
		G	—	—	−0.13**	[−2.58]	0.21**	[2.26]	0.16***	[3.08]
		Change	—	—	−0.68***	[−10.50]	−0.42***	[−3.61]	0.16**	[2.67]
IV	Petroleum products	WG	—	—	—	—	1.08***	[27.35]	0.86***	[52.28]
		G	—	—	—	—	0.85***	[20.84]	0.94***	[95.73]
		Change	—	—	—	—	−0.22***	[−3.75]	0.07***	[3.70]
V	Chemicals	WG	—	—	0.74***	[6.56]	0.82***	[3.61]	0.08***	[3.95]
		G	—	—	0.05	[0.69]	−0.25***	[−3.23]	0.11***	[9.67]
		Change	—	—	−0.69***	[−5.08]	−1.07***	[−4.46]	0.03	[1.44]
VI	Plastic products	WG	0.29**	[2.10]	0.30***	[4.03]	0.36***	[8.35]	0.02***	[2.90]
		G	−0.06	[−0.74]	−0.45***	[−6.35]	−0.27***	[−5.54]	0.05***	[4.94]
		Change	−0.35**	[−2.16]	−0.75***	[−7.08]	−0.62***	[−9.47]	0.03***	[2.88]
VII	Metals	WG	—	—	0.50***	[7.42]	0.20***	[6.08]	0.66***	[4.40]
		G	—	—	0.17	[1.14]	0.35***	[3.63]	0.46***	[9.08]
		Change	—	—	−0.33**	[−2.04]	0.15	[1.44]	−0.20	[−1.25]
VIII	Machinery	WG	−0.46	[−1.64]	0.87***	[6.93]	0.50***	[19.83]	—	—
		G	0.23***	[4.98]	0.37***	[11.81]	0.29***	[14.30]	—	—
		Change	0.69**	[2.43]	−0.50***	[−3.88]	−0.21***	[−6.22]	—	—
IX	Computers	WG	0.35***	[6.50]	−0.55	[−1.26]	0.33***	[8.11]	—	—
		G	−0.72	[−0.76]	0.49***	[7.68]	0.93***	[5.64]	—	—
		Change	−1.07	[−1.08]	1.04**	[2.34]	0.60***	[3.34]	—	—
X	Electrical equipment	WG	−0.05	[−0.52]	0.28***	[6.67]	0.21***	[39.54]	—	—
		G	0.70***	[7.07]	−1.18***	[−23.11]	0.27***	[15.16]	—	—
		Change	0.75***	[5.58]	−1.45***	[−21.50]	0.07***	[3.47]	—	—
XI	Motor vehicles	WG	0.31*	[1.74]	0.19**	[2.73]	−0.03	[−0.39]	—	—
		G	0.36***	[13.34]	0.32***	[23.27]	0.05	[1.65]	—	—
		Change	0.05	[0.27]	0.13*	[1.81]	0.08	[0.95]	—	—

For PTM effects, robust results are found for five out of the 11 product categories (plastic products, machinery, computers, electrical equipment, motor vehicles). The PTM elasticities likewise exhibit a large scope of values, with a maximum of 0.35 for the first sub-sample and 0.70 for the second sub-sample. In contrast to CPT, only half of the estimated elasticities are statistically significant. One possible explanation is that for some product categories, the domestic competitors' prices may not be reflected adequately by the domestic GDP deflator, especially if commodities are a major cost component for domestic producers; another is that the unit labour costs are sector-unspecific. In addition, it should be borne in mind that, as commodity prices

in US dollars can be assumed to be identical for all domestic and foreign producers if transport costs are neglected, the impact of the commodity prices might also capture, at least in part, PTM effects.

When examined for economic plausibility, we find that, for the pre-unification period, four out of 33 elasticities - namely machinery, computers, electrical equipment and motor vehicles - show a negative sign, though none is statistically significant at the 5% level. For the post-unification sample, this is the case for eight elasticities (in the sectors textiles, computers, chemicals, paper products, plastic products, electrical equipment, the impact is statistically significant for the four lattermost categories). However, all in all the estimation results are plausible, for the west German period somewhat more so than for the pan-German sample.

On the whole, with respect to the statistical significance, CPT is the prominent determinant for German import pricing. Furthermore, with respect to the size of the impacts, in most cases CPT is stronger or at least as strong as PTM. Only for one out of 10 estimations (electrical equipment, for one sub-sample) is PTM noticeably larger than CPT. For export price-setting, the dominance of CPT over PTM is also more pronounced: For all sectors except computers, CPT via domestic producer prices is noticeably stronger than PTM via the foreign competitors' prices or the exchange rates.⁴⁹

As CPT for most of the import product categories is substantial, German importers apparently have sufficient market power to pass through their costs to domestic customers, even in homogeneous goods markets. In consequence, the behaviour of enterprises importing relatively homogeneous products is still described appropriately by the model of imperfect competition rather than the price-taking model.

Impact of the degree of homogeneity

We begin by examining the hypothesis that CPT is stronger, and PTM weaker, for homogeneous products than for heterogeneous products, as the price elasticity of demand is - in absolute terms - larger for homogeneous products.

Imports of machinery will be designated the comparison group for heterogeneous goods, as these products capture a vast range of varying application areas and are, above all, most

⁴⁹For more on the estimation results for export price-setting, see Stahn (2007), p 307.

often custom-manufactured. The other product categories are held to be composed of more homogeneous goods.

For machinery import price-setting, CPT is a remarkable 0.87 (foreign costs) and 0.50 (exchange rates) for the west German sample and 0.37 (foreign costs) and 0.29 (exchange rates) for unified Germany. The impact of the foreign costs for machinery imports, compared with the other product categories, thus ranks first in size for the pre-unification period and second (below computers) for the post-unification sample. With respect to the exchange rates, for both periods CPT via the exchange rates is stronger only for petroleum products. However, examining the sub-samples separately shows that for machinery import prices the elasticities of the exchange rates rank fourth (below paper products, petroleum products and chemicals for the first sample and below petroleum products, metals and computers for the second sample). For chemicals, the strong segmentation of the chemicals market may have contributed to the sizeable elasticities of the foreign costs and the exchange rates during the pre-1990 period (values of 0.74 and 0.82). Moreover, the high concentration of suppliers could also have played a role.⁵⁰

PTM for machinery imports shows economically plausible elasticities for unified Germany only (value of 0.23). However, for the two homogeneous product categories which exhibit positive PTM effects for this sub-sample (electrical equipment, motor vehicles), the impact of the domestic competitors' prices is larger. For electrical equipment, the strong PTM (elasticity of 0.70 for the pan-German sample) may be because this category contains many hi-tech products such as medical, precision and optical instruments, for which the price elasticity of demand is - in absolute terms - smaller than for more homogeneous products.

To summarise, with respect to CPT via the foreign costs, the hypothesis is confirmed solely for computers during the pan-German sample. With respect to CPT via the exchange rates, the hypothesis holds only for petroleum products and, in one sub-sample, for paper products, chemicals, metals and computers. With respect to PTM, the hypothesis does not hold at all.

When comparing export and import price-setting, one should consider that, with respect to CPT and PTM, the hypotheses for the export and import side are the same even though the determinants which characterise CPT for export price-setting represent PTM for import price-

⁵⁰See Dornbusch (1987) for the theory behind these arguments. He also shows that the relative market shares of domestic and foreign firms influence the degree of CPT. In the case of Germany, Feinberg (1986), p 67, finds that in industrial sectors with high concentration, CPT into domestic prices is stronger, even though these observations are not very distinct. Studies which observe stronger CPT in more heavily segmented sectors are presented in Goldberg and Knetter (1997). Jeanfils (2008), p 35 ff, theoretically examines the impact of trade openness on ERPT. See also Sbordon (2008) for the impact of trade openness on inflation.

setting and vice versa. What import and export pricing have in common is that the hypothesis holds more for CPT than for PTM. However, the export and import pricing behaviour differ in that, for export pricing, the hypothesis is confirmed for more product categories than for import pricing: With regard to CPT the hypothesis holds for most product categories, whereas for import pricing it is met for only five (CPT via the exchange rates) and one (CPT via the foreign costs) of the categories. With regard to PTM via the foreign competitors' prices it holds for three categories of export goods (textiles, electrical equipment, motor vehicles) and with regard to PTM via the exchange rates for six categories (food, paper and petroleum products, chemicals, electrical equipment, motor vehicles), whereas the hypothesis does not hold for any category of import goods.

On the whole, for many import products the empirical evidence conflicts with the hypothesis. This could be due to the fact that the time series approximating foreign costs and the exchange rates might not adequately capture the group of the most important producing countries in this market or that the variables representing domestic competitors' prices and foreign costs are sector-unspecific and thus may not reflect the trends in sectoral prices and costs appropriately.⁵¹ Moreover, import pricing behaviour is determined by various factors, whose influence might interfere with each other and could therefore differ considerably by sector, whereas the hypotheses examined above merely highlight two aspects of import price-setting.⁵² In line with this reasoning, equation (3) in section 3.1 allows us to derive the supply-sided explanation that the greater the substitutability between domestic products and import goods is, the weaker CPT is and the stronger PTM is, which conflicts with the first, demand-sided, hypothesis, and might thus have also contributed to the rejection of the hypotheses.⁵³

Table 6 presents the estimation results of other studies by category of goods, with the coefficients given in absolute values. The findings of Campa/Goldberg (2004) and (2006) likewise show that the more homogeneous the imported goods are (eg energy, raw materials and non-manufacturing products compared with manufactured goods), the stronger is CPT. The exception, however, is the food sector with comparatively weak CPT, however, which may be due to the fact that the consumers' preferences for these products vary considerably across countries. Moreover, they observe impacts of the exchange rate on import prices of the German food and manufacturing sector which are close to this paper's results.

⁵¹ See Table 7 for the share of the countries of origin in German imports by sector.

⁵² Asymmetries in the response of trade prices to exchange rate shocks might also play a role. However, for import prices non-linearities are difficult to detect. See Bussière (2007), p 26 ff.

⁵³ An econometric approach which captures both the impact of price elasticities of demand and competitive pressure in the individual goods market on import pricing is presented by Goldberg and Knetter (1997), p 1263 ff.

By contrast, except for machinery imports, the findings of Campa/González Mínguez (2002) differ, in some cases decidedly, from the estimations in this paper. This might be because the authors use import unit values, whereas this paper analyses import prices. Another possible reason is that they look at extra euro-area import pricing, whereas this paper focuses on German importers' price-setting with respect to all countries of origin.⁵⁴

Table 6: Studies analysing long-run CPT on German sectoral import prices

Author	Sample	Endogenous variable	Determinants	Elasticities	Change
Campa/González Mínguez (2002), p 35	1989-2001	Extra euro-area import unit values	Nominal effective exchange rates		
		Food		1.01	
		Mineral fuels		1.01	
		Chemicals		1.18	
		Machinery		0.26	
		Electric equipment		0.87	
		Vehicles		0.38	
		Home equipment, Clothing		0.88	
		Precision equipment		1.13	
Campa/Goldberg (2004), p 27, 31	1975-1999	Import prices	Nominal effective exchange rates		(1989-1999) to (1975-1988)
		Food		0.48	−0.19
		Energy		2.00	−1.60
		Raw materials		1.11	−0.47
		Manufacturing		0.50	−0.18
		Non-manufacturing		1.33	−1.06
Campa/Goldberg (2006), p 31	1975-1994	Import prices	Nominal effective exchange rates		(1995-2004) to (1975-1994)
		Food		0.55	−0.11
		Energy		2.64	−2.10
		Raw materials		1.45	−0.52
		Manufacturing		0.54	0.13
		Non-manufacturing		1.69	−1.06

⁵⁴However, Menon (1995), who presents an overview of 43 empirical studies which predominantly cover the period before 1990, concludes that the empirical results are very sensitive with respect to the applied data and method.

3.3.2 Changes in import pricing behaviour since the 1990s

In this section, we will examine the core hypothesis that, since the 1990s, CPT has decreased and PTM has increased. First, we investigate the hypothesis for the individual product categories under review. Then, using the individual results, we will identify the outcome in an aggregated perspective.

Core hypothesis with respect to the individual product categories

The results show that, with regard to the product categories for which PTM and the respective CPT effects are estimated simultaneously, the core hypothesis is confirmed only for the machinery sector. With respect to the categories for which solely CPT is analysed, the hypothesis applies - taking all respective CPT effects into account - just for food products. This implies that for most sectors the estimation results conflict with the core hypothesis. These findings are consistent with the export price estimations, where the core hypothesis is only met by the motor vehicle and the machinery sectors. Conversely, for import and export pricing the sectors which conflict with the core hypothesis coincide to a large extent.

However, with regard to the affirmation of the core hypothesis, the picture for import pricing improves when the different impacts are looked at separately, which again corresponds to the results for export pricing. For import price-setting, taking exclusively CPT via the foreign costs and not all CPT effects into account, a decline in this influence, which is consistent with the core hypothesis, is found for all sectors except for computers and motor vehicles. However, the considerable declines might owe at least something to the fact that, since the 1990s, sectoral foreign costs may be less appropriately reflected by sector-unspecific total sales deflators or unit labour costs in the definition of the national accounts.

By contrast, the estimation results for CPT via the exchange rates and the commodity prices conflict with the core hypothesis more often. With respect to CPT via the exchange rates, an increase is observed for five sectors (textiles, metals, computers, electrical equipment, motor vehicles). For the first four product categories in the list, where CPT is captured by the US dollar/domestic currency exchange rate, this may reflect the fact that emerging market economies, in particular in Asia, which strongly orientate their currencies to the US dollar, have evolved into major exporters on these goods markets (see Table 7 for the shares of German sectoral imports by region). Thus, for the pre-unification period, this bilateral exchange rate may match the sector-

Table 7: Categories of German imported goods by region

Share 2006 in total import value in % ⁵⁵		Euro- area	European transition	Other European	North American	Japan	Other Asian	OPEC
		countries						
I	Food	56.5	8.1	9.0	2.7	0.1	4.2	0.5
II	Textiles	23.7	15.7	4.7	1.2	0.4	26.2	0.4
III	Paper products	50.9	9.1	29.9	4.4	0.3	1.5	0.0
IV	Petroleum products	20.6	33.1	25.5	0.7	0.1	0.1	15.7
V	Chemicals	56.0	4.5	20.0	11.7	2.0	3.0	0.2
VI	Plastic products	46.2	25.6	7.8	3.3	3.9	6.7	0.0
VII	Metals	46.0	20.8	14.6	2.7	0.8	5.9	0.4
VIII	Machinery	39.0	16.3	20.1	7.7	5.9	6.6	0.1
IX	Computers	21.6	4.9	4.5	8.4	11.4	48.0	0.0
X	Electrical equipment	24.1	15.1	11.3	12.5	7.1	25.4	0.3
XI	Motor vehicles	48.4	18.0	10.5	7.6	6.8	3.5	0.0
	All products	38.4	15.6	15.0	7.2	3.3	11.7	1.4

specific trading partners less adequately than for the pan-German sample. For motor vehicles, the rise might be due to the increasing share of imported intermediate goods used in the manufacturing process. For computers, the strengthening in CPT via foreign costs and exchange rates alike may be explained by the development of computers into highly homogeneous products, for which the price elasticity of demand has - in absolute terms - increased since the 1990s.

Moreover, CPT via commodity prices has increased for four sectors (chemicals, paper, plastic and petroleum products). This might be explained by importers being able to pass through commodity costs rather than the other components of the foreign, exporting enterprises' costs

⁵⁵Definition of product categories (SITC two-digit codes) and regions: food (01-09, 11, 41-43), textiles (65, 84), paper products (25, 64), petroleum products (33), chemicals (51-59), plastic products (62), metals (67-69), machinery (72-74), computers (75), electrical equipment (71, 76-77, 87-88), motor vehicles (78); euro area: Austria, Belgium, Finland, France, Greece, Ireland, Italy, Luxembourg, Netherlands, Portugal, Spain; European transition countries: Armenia, Azerbaijan, Bosnia-Herzegovina, Bulgaria, Croatia, Czech Republic, Estonia, Federal Republic of Yugoslavia, Georgia, Hungary, Kazakhstan, Kyrgyzstan, Latvia, Lithuania, Macedonia, Moldova, Poland, Republic of Belarus, Rumania, Russian Federation, Slovakia, Slovenia, Tajikistan, Turkmenistan, Ukraine, Uzbekistan; other European countries: Cyprus, Denmark, Malta, Norway, Sweden, Switzerland, United Kingdom; North America: Canada, United States; other Asian countries: Brunei Darussalam, China, Hong Kong, Indonesia, Malaysia, Philippines, Singapore, South Korea, Taiwan, Thailand; OPEC: Algeria, Iran, Iraq, Kuwait, Libya, Nigeria, Qatar, Saudi Arabia, United Arab Emirates, Venezuela.

to domestic customers.⁵⁶ This increase is overcompensated by the simultaneous decline in CPT via both the foreign costs and the exchange rates, though. Consequently, for these products the decline in the influence of the foreign costs and the exchange rates should be regarded as the prevailing change in CPT.

With respect to PTM, for two out of the five relevant product categories (plastic products and computers) the findings disagree with the core hypothesis. However, the fact that import prices of both categories are on a downward trend since the 1990s, whereas the time series capturing domestic competitors' prices (the German GDP deflator and German unit labour costs) are, on the whole, trending upwards, could have contributed to this result.

Core hypothesis with respect to the overall outcome

By offsetting the import shares of product categories which exhibit an increasing influence of the respective regressor with the import shares of product categories which show a decreasing influence, we obtain the overall shift in CPT or PTM (see Table 8). The shares in overall import volume are calculated for the year 2006. The results presented in the table distinguish between statistically significant and insignificant shifts.

With respect to significant shifts, the balanced import shares show that, firstly, the decrease in CPT via the foreign costs is the dominant import pricing behaviour. Moreover, this observation

Table 8: Import shares of product categories with shifts in CPT or PTM

Determinant	p^h		p^f		w		p^r	
Direction of shift	↑	↓	↑	↓	↑	↓	↑	↓
All shifts	32%	7%	14%	56%	47%	31%	19%	18%
Significant shifts (5% level)	22%	3%	4%	56%	23%	27%	7%	4%
Sectors	VIII, X	VI	IX	I, II, III, V, VI, VII, VIII, X	II, IX, X	III, IV, V, VI, VIII	III, IV	II
Insignificant shifts	10%	4%	10%	0%	24%	4%	12%	14%
Sectors	XI	IX	XI		VII, XI	I	V	I, VII

⁵⁶Marazzi et al (2005), p 39, also find for US import prices that an increasing share of the exchange rate's impact now goes directly through the commodity price channel.

is supported by the slight dominance of the decline in CPT via exchange rates.⁵⁷ This result is in line with export pricing, where CPT captures the enterprises' own cost situation.⁵⁸

It is only when taking the statistically insignificant changes into account as well that the rise in CPT via the exchange rate channel is the prevailing behaviour for import pricing; however, this would conflict with the core hypothesis. Moreover, CPT via the commodity prices has slightly strengthened with respect to significant shifts, which also disagrees with the core hypothesis. However, measured in balanced shares of import or export volume, the weakening of CPT for import price-setting is much larger than for export price-setting.

Looking only at statistically significant shifts, the second predominating behaviour for import pricing is the strengthening of PTM. This finding likewise corresponds with the export price estimations, for which PTM captures the foreign competitors' prices, converted to domestic currency. There, the rise in PTM via the exchange rates is clearly the dominating export pricing behaviour, even though the increase in PTM via the foreign prices prevails only slightly.

To summarise the results for import pricing, in the main the core hypothesis is confirmed for PTM and for CPT via the foreign costs and the exchange rates, whereas it conflicts for CPT via the commodity prices. Nevertheless, the weakening of CPT via the foreign prices is so pronounced that a case could be made for it being the prevailing effect.

4 Conclusion

Empirical evidence has already been provided that, since the 1990s, the price-setting of German exporters has weakened with respect to their own cost situation (CPT) and strengthened with respect to the foreign competitors' prices (PTM). As German exports and imports differ considerably across category of goods as well as regions of destination and origin, we have elected to analyse importer and exporter pricing behaviour separately. This paper therefore studies the price-setting of German importers; in order to permit a comparison with export price-setting, it distinguishes between various product categories in a corresponding sectoral composition. How-

⁵⁷By contrast, Déés et al (2008), pp 28-29, do not find a decline in ERPT for major industrialised countries since the 1990s.

⁵⁸When comparing the overall outcome for import and export pricing, it should be borne in mind that the individual product categories' shares in total imports or exports may vary considerably. For instance, for textiles, the import share is distinctly larger than the corresponding export share, whereas the opposite is the case for machinery and motor vehicles. See Table 3 and Stahn (2007), p 308.

ever, for import pricing, with respect to the time series capturing the impact of the importers' own costs (CPT) and the impact of the domestic competitors' prices (PTM), the specification of the estimation equations varies notably among the individual product categories under review. By contrast, for export pricing, specifying the individual product categories' estimation equations identically - with one exception - turned out to be appropriate.

We have examined importer pricing against two hypotheses. The first hypothesis states that CPT is stronger, and PTM weaker, for homogeneous products than for heterogeneous products. The estimations of export and import pricing share the trait that, for several product categories, the results conflict with the hypothesis, even though the hypothesis holds more for CPT than for PTM. By contrast, for import pricing the hypothesis is confirmed for fewer product categories than for export pricing.

The second - and core - hypothesis presumes that, as competition increases, CPT becomes weaker and PTM stronger. With respect to the aggregated perspective, for import pricing this holds for PTM and for CPT via the foreign costs and the exchange rates, whereas it conflicts for CPT via the commodity prices. Nevertheless, on the whole these findings could have contributed to the muted impact of the recent increase in commodity prices on import and consumer price inflation. Moreover, the results for import pricing correspond to those for export pricing, for which the core hypothesis is also confirmed with respect to CPT and to PTM via both the foreign prices and the exchange rates. By contrast, import and export pricing differ insofar as, measured in balanced shares of import or export volume, the weakening in CPT for import pricing is more pronounced than for export pricing.

However, in assessing the estimation results, several aspects should be borne in mind. First, the hypotheses examined above highlight only three channels of influence on import price-setting. Import pricing behaviour, though, is determined by various factors, whose individual impacts may interfere with each other and therefore deliver results which conflict with the hypotheses or make a comparison of the sectoral findings more difficult. Second, the estimation results may also have been influenced by shifts in the group of important trading partners, which may lead to the relevant indicator capturing their composition adequately solely for one sub-sample. Third, the use of sector-unspecific determinants could have played a role, as in some cases they might not be an appropriate reflection of the trend in sectoral import prices.

5 Appendix

Import content of goods produced in Germany

Table 9: Share of imported intermediate goods in the domestic manufacturing process by sector

Code	GP 1995/2002	Share in % ⁵⁹			Change in pp. 1995-2000 (2000-2005)
		1995	2000	2005	
15.1-15.8	Food	19.8	21.5		1.6
15.9	Beverages	16.4	19.3		2.9
17	Textiles	28.3	33.7		5.4
18	Clothing	38.3	46.0		7.7
21.1	Pulp, paper, paperboard	36.6	38.7		2.2
21.2	Articles of paper and paperboard	26.0	30.5		4.5
22.1	Publishing	9.7	9.9		0.2
22.2-22.3	Printing, reproduction of recorded media	15.1	19.4		4.2
23	Coke, refined petroleum products, nuclear fuel	72.7	81.3		8.6
24.4	Pharmaceuticals	25.8	33.3		7.5
24 (excl. 24.4)	Chemicals	23.0	35.3		12.4
24	Chemicals		(32.7)	(31.1)	(-1.6)
25.1	Rubber products	22.3	26.4		4.1
25.2	Plastic products	24.6	30.5		5.8
27.1-27.3	Basic iron, steel, ferro-alloys, tubes	26.3	34.2		7.9
27.4	Basic precious and non-ferrous metals	56.3	61.6		5.3
27.5	Casting of metals	17.0	24.8		7.8
28	Fabricated metal products	17.9	21.0		3.2
29	Machinery	18.9	24.1		5.1
			(23.0)	(21.7)	(-1.3)
30	Office machinery, computers	35.1	48.6		13.5
31	Electrical machinery and apparatus	16.4	21.0		4.6
32	Radio, TV, communication equipment and apparatus	31.8	38.7		6.9
33	Medical, precision and optical instruments, watches, clocks	14.2	19.2		5.0
34	Motor vehicles and parts	25.8	32.7		6.9
			(32.7)	(33.5)	(0.8)

⁵⁹Figures in brackets from Federal Statistical Office (2006), p 50, otherwise own calculations based on data from Federal Statistical Office (2002). Data in brackets are based on slightly different calculation methods and, for the year 2005, are available only for three individual product categories. Therefore the change in shares is shown for the period with identical calculation method. The year 1991 is excluded from the comparison as the adjustment process following German unification may have considerably affected individual sectors.

Import price regressions including domestic producer prices by category

For each category of imported goods, sector-specific domestic competitors' prices are approximated by domestic sectoral producer prices.⁶⁰ The specification of the CPT effects is identical to those given in Table 4. At a significance level of 5%, the trace test rejects the hypothesis that no cointegrating relationship exists between the sectoral import prices and their determinants.⁶¹

Table 10: Long-run impact of import price determinants using domestic sectoral producer prices

Group		Sample	p^h	[t-value]	p^f	[t-value]	w	[t-value]	p^r	[t-value]
I	Food	WG	1.07***	[5.19]	0.08	[1.15]	0.33***	[2.94]	0.10***	[3.18]
		G	1.63***	[7.15]	-0.59***	[-4.58]	0.18***	[3.34]	-0.02	[-0.47]
		Change	0.56*	[1.83]	-0.67***	[-4.53]	-0.15	[-1.23]	-0.12**	[-2.43]
II	Textiles	WG	-0.79***	[-4.43]	0.74***	[9.35]	0.16***	[3.88]	-0.00	[-0.11]
		G	0.33*	[1.81]	0.18***	[4.42]	0.15***	[21.14]	-0.01	[-0.49]
		Change	1.12***	[4.37]	-0.56***	[-6.17]	-0.01	[-0.29]	-0.00	[-0.12]
III	Paper products	WG	0.01	[0.05]	0.54***	[7.47]	0.63***	[6.13]	0.00	[0.03]
		G	-0.97**	[-2.39]	0.27	[1.67]	0.23*	[1.79]	0.26***	[3.30]
		Change	-1.04**	[-2.17]	-0.23	[-1.20]	-0.40**	[-2.34]	0.26***	[2.96]
IV	Petroleum products	WG	0.02	[0.39]	—	—	1.06***	[26.38]	0.85***	[24.62]
		G	-0.04	[-0.81]	—	—	0.85***	[21.80]	0.96***	[37.15]
		Change	-0.06	[-0.83]	—	—	-0.21***	[-3.80]	0.11**	[2.52]
V	Chemicals	WG	1.52***	[21.78]	-0.37***	[-6.90]	-0.27***	[-4.12]	0.02***	[2.89]
		G	1.44***	[16.92]	-0.02	[-0.42]	0.29***	[6.21]	-0.02*	[-1.95]
		Change	-0.08	[-0.67]	0.36***	[5.12]	0.56***	[7.12]	-0.03***	[-3.10]
VI	Plastic products	WG	0.09	[0.65]	0.40***	[4.09]	0.33***	[4.25]	0.02***	[2.86]
		G	1.08***	[7.77]	-0.85***	[-28.60]	-0.00	[-0.09]	0.03***	[3.86]
		Change	0.98***	[4.75]	-1.24***	[-12.26]	-0.34***	[-3.76]	0.01	[1.38]
VII	Metals	WG	0.86***	[2.86]	0.19	[1.34]	0.16***	[4.35]	0.28**	[2.02]
		G	2.76***	[11.70]	-0.90***	[-8.27]	0.13***	[2.88]	-0.17***	[-2.96]
		Change	1.90***	[5.04]	-1.08***	[-6.31]	-0.03	[-0.56]	-0.46***	[-3.00]
VIII	Machinery	WG	0.20	[0.28]	0.56	[1.61]	0.46***	[14.29]	—	—
		G	0.31***	[4.19]	0.27***	[4.80]	0.27***	[21.18]	—	—
		Change	0.11	[0.16]	-0.29	[-0.81]	-0.19***	[-5.45]	—	—
IX	Computers	WG	-0.53***	[-3.99]	-1.54***	[-3.55]	0.42***	[6.47]	—	—
		G	0.90***	[9.65]	0.12***	[3.19]	0.29***	[4.12]	—	—
		Change	1.45***	[9.21]	1.66***	[3.82]	0.13	[1.33]	—	—
X	Electrical equipment	WG	-0.29***	[-4.47]	0.34***	[17.89]	0.21***	[65.86]	—	—
		G	1.74***	[6.28]	-0.65***	[-8.39]	0.23***	[8.37]	—	—
		Change	2.03***	[6.74]	-0.99***	[-12.26]	0.02	[0.75]	—	—
XI	Motor vehicles	WG	0.84***	[8.46]	0.04	[1.02]	0.24***	[4.68]	—	—
		G	1.16***	[6.55]	-0.34***	[-3.08]	0.11**	[2.21]	—	—
		Change	0.32	[1.54]	-0.38***	[-3.19]	-0.13*	[-1.80]	—	—

⁶⁰For the 11 categories of goods, the hypothesis that the levels of the domestic sectoral producer prices are I(1) is not rejected at a significance level of 5%. See Stahn (2007), p 323.

⁶¹The only exception is computers for the west German sample, where the λ_{max} test rejects this hypothesis.

Tests for the integrated order of the variables

To test the time series used in equation (5) and (6) for their integrated order, the ADF test is performed.⁶² It is shown that the null hypothesis - the levels of the time series are I(1) - is not rejected at a significance level of 5% (for foreign unit labour costs at the 1% significance level).

Table 11: Tests for the integrated order of the variables

Variables	Test statistic	Model ⁶³	Lags	Variables	Test statistic	Model	Lags
Import prices				Domestic competitors' prices			
I Food	-2.52	<i>c, tr</i>	1	Domestic			
II Textiles	-2.48	<i>c, tr, s</i>	1-2	GDP deflator	-1.12	<i>c, tr, s</i>	4
III Paper prod.	-1.80	<i>c, tr</i>	1-2; 5	Domestic unit			
IV Petrol. prod.	-1.37	<i>c, tr</i>	1	labour costs	-0.25	<i>c, tr</i>	0
V Chemicals	-2.08	<i>c, tr</i>	1; 5-6	Exchange rates			
VI Plastic prod.	-2.02	<i>c, tr, s</i>	1	External value			
VII Metals	-1.49	<i>c, tr, s</i>	1	domestic currency	-3.15	<i>c, tr, s</i>	1
VIII Machinery	-1.81	<i>c, tr, s</i>	1-2; 5	US dollar/			
IX Computers	2.99	<i>c, tr</i>	1	domestic currency	-2.01	<i>c, s</i>	1; 3
X Electr. equip.	0.13	<i>c, tr, s</i>	1	Commodity prices			
XI Motor veh.	-0.07	<i>c, tr, s</i>	1	Food	-1.97	<i>c, tr</i>	1; 8
Foreign prices				Spun yarn	-3.12	<i>c, tr, s</i>	1
Foreign deflator				Cellulose	-3.37	<i>c, tr, s</i>	1
of total sales	-2.83	<i>c, tr</i>	1; 3	Crude oil	-0.88	<i>c, tr, s</i>	1; 5
Foreign unit				Iron ore	2.53	<i>c, tr, s</i>	0
labour costs	-3.82	<i>c, tr</i>	2				
US producer prices							
computer	-1.52	<i>c, tr, s</i>	1; 4				

⁶²The MacKinnon critical values generated by Eviews across the sample 1976 Q1-2008 Q2 are -3.48*** / -2.88** / -2.58* for the model with a constant and -4.03*** / -3.44** / -3.15* taking into account a constant and a trend at the 1% (***) / 5% (**) / 10% (*) levels of significance.

⁶³Here, *c* denotes a constant, *tr* a trend and *s* seasonal dummies.

Tests for cointegration

To test the long-run relationship between the time series used in equation (5) and (6) for cointegration, the Johansen procedure is conducted on the VECMs for the 11 product categories across both the west German sample and the pan-German period. The system variables included in the individual VECMs are identical with the specification in Table 5. If necessary, centered seasonal dummies are factored in. It is shown that the null hypothesis that the system's rank is zero is rejected in each model at a significance level of 5%.⁶⁴

Table 12: Tests for cointegration

Group	Sample	Number of system variables	Number of lags (first differences)	Trace test statistic (rank = 0)
I Food	WG	4	0	85.52
	G	4	0	55.98
II Textiles	WG	4	0	134.82
	G	4	0	62.00
III Paper products	WG	4	0	111.55
	G	4	1	55.61
IV Petroleum products	WG	3	0	39.34
	G	3	0	53.57
V Chemicals	WG	4	0	96.80
	G	4	0	111.73
VI Plastic products	WG	5	0	130.61
	G	5	0	135.31
VII Metals	WG	4	0	120.99
	G	4	0	76.91
VIII Machinery	WG	4	0	84.13
	G	4	0	78.13
IX Computers	WG	4	0	49.34
	G	4	0	109.66
X Electrical equipment	WG	4	0	107.70
	G	4	0	95.54
XI Motor vehicles	WG	4	0	94.54
	G	4	0	97.40

⁶⁴The critical values for rank = 0 generated by Eviews are 29.80/47.86/69.82 for the model with 3/4/5 system variables.

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