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SUMMARY

Incomplete pass-through arises when exchange-rate changes are not fully transmitted into prices, so that trade prices (in a first step) and the general price level (in a second step) exhibit low reaction to exchange-rate changes. In the literature, this phenomenon is explained by the micro-economic behavior of firms facing imperfect competition, that can have an incentive to price-to-market in order to maintain their price in local currency when exchange rates vary. While this phenomenon is often empirically investigated using aggregate data, it is obviously caught more properly by product-level analysis.

In this paper, the BACI database is used to investigate incomplete pass-through at the product level, for a large number of countries. This database, which is built at CEPII using COMTRADE data, provides harmonized trade data for more than 5,000 products (at the hs6 level), covering 130 countries for the period 1989-2003. Here, data are pooled at the hs4 level so that we obtain consistent estimates of both exchange-rate pass-through (ERPT, when focusing on imports prices) and pricing-to-market (PTM, when focusing on the pricing decisions of exporting firms) coefficients for more than 1,000 products, at the country-level.

The empirical analysis suggests that long-run pass-through in import prices is quite high, since almost 100% of exchange rate changes are passed through into import prices (the average pass-through in the whole sample is close to one). This result however hides an important heterogeneity at the product level: looking at the pricing decisions of exporting firms, it turns out that a number of estimated PTM coefficients (30 to 40%) are non-significant, which is interpreted as complete pass-through. On the other hand, strong PTM behaviors are identified in various sectors like chemistry, food, optical goods, electronic machinery, etc. This result is consistent with the dichotomic representation of macro-economic models[2], suggesting that exporters set their price either in their own currency, in which case the pass-through is complete, or in the importer's currency in which case the pass-through is null in the short run and incomplete in the middle run, if prices are sticky.

The BACI database allows to estimate importer-specific pass-through coefficients and exporter-specific PTM coefficients, for each product of the $hs4$ level. We show that pass-through tends to be all the higher that the importer is small, a result that mainly stems from a composition effect. On the export side, we find evidence of pricing-to-market, which tends to be more pronounced for smaller countries, and turns out to be especially small for Germany. Comparing the country-and-product specific pass-through estimates to the product-specific estimates, we show that most of the observed "aggregate" differences between countries result from composition effects rather than systematic behavioral asymmetries.

In macro-economic models, differences in pass-through across importers are explained by the impact of their macro-economic environment on the pricing decision of exporting firms. We investigate the impact of such "macroeconomic" features on import pass-through by importer, and show that the pass-through coefficient tends to be higher in volatile environments, in poorer countries and in less integrated markets.

[1] The authors wish to thank Agnès Bénassy-Quéré and Jean-Olivier Hairault for carefully commenting on previous versions of this paper. Thierry Mayer kindly provided data for the computation of real integration measure.

[2] See for instance Betts & Devereux (1996)

ABSTRACT

This paper uses a detailed database to investigate exchange-rate pass-through at the product level, for a large number of countries. Since the database provides harmonized trade flows, pass-through in both export and import prices can be investigated consistently. The empirical analysis suggests that pricing behaviors are dichotomic: while pass-through is complete in 30 to 40% of sectors, there is significant pricing-to-market in the remaining ones. The average long-run pass-through coefficient is nevertheless quite high, close to 80% on average. This result however hides a strong heterogeneity of pass-through behaviors across sectors and exporting countries, and to a lesser extent across importers. Trying to disentangle composition effects from structural factors, the analysis suggests that a large part of cross-country differences is attributable to composition effects. Still, the pass-through is on average higher i) in volatile environments, ii) in less developed countries, iii) in little integrated markets.

JEL Classification: F12, F31, F41.
Keywords: pass-through, pricing-to-market, product-level analysis, macroeconomic determinants.

RÉACTION DES PRIX AUX VARIATIONS DE CHANGE : UNE ANALYSE SUR DONNÉES DÉSAGRÉGÉES

RÉSUMÉ

Les phénomènes de *pass-through* incomplet se produisent lorsque les variations de change ne sont pas intégralement transmises dans les prix, de telle sorte que les prix du commerce (dans un premier temps) et le niveau général des prix (dans un second temps) réagissent peu aux variations de change. Ce phénomène est généralement expliqué par le comportement micro-économique des firmes dans un environnement imparfaitement concurrentiel, qui peuvent être amenées à adopter des stratégies de tarification au marché pour maintenir leurs prix en monnaie locale quand le taux de change se modifie. Une telle interprétation suggère d'étudier le phénomène sur des données fines, de préférence au niveau du produit. Néanmoins, il est généralement abordé à partir de données agrégées.

Dans cet article, nous utilisons la base de données BACI, construite au CEPII, pour étudier le *pass-through* incomplet au niveau du produit, pour un nombre important de pays. BACI est construite à partir de la base COMTRADE, et fournit des données harmonisées de commerce pour plus de 5000 produits (au niveau sh6) et 130 pays sur la période 1989-2003. Ici, les données sont empilées au niveau sh4, ce qui nous permet d'estimer des coefficients de *pass-through* à l'import et de tarification au marché ou *pricing-to-market* à l'export pour plus de 1000 produits.

L'analyse empirique suggère que le *pass-through* (de long terme) dans le prix des importation est élevé (proche de 1 sur l'ensemble de l'échantillon). Ce résultat cache cependant de fortes disparités entre produits. En effet, un nombre conséquent de coefficients de *pricing-to-market* (entre 30 et 40%) ne sont pas significatifs, ce que l'on peut interpréter comme le signe que les variations de change sont intégralement transmises dans les prix. A l'inverse, nous identifions des comportements marqués de *pricing-to-market* dans des secteurs variés tels que la chimie, le secteur alimentaire, l'industrie optique, les machines électroniques, etc. Ce résultat est cohérent avec la représentation dichotomique du phénomène dans les modèles macro-économiques[3] dans lesquels les exportateurs fixent leurs prix soit dans leur propre monnaie, auquel cas le *pass-through* est complet, soit dans la monnaie de l'importateur, auquel cas le *pass-through* est nul à court terme et incomplet à moyen terme, si les prix sont rigides.

La base de données BACI permet d'estimer des coefficients de *pass-through* par importateur, ainsi que des coefficient de *pricing-to-market* par exportateur, et ce pour chacun des produits disponible au niveau $sh4$. On montre que le *pass-through* tend à être plus élevé en direction d'importateur à faible PIB par tête, un phénomène qui résulte principalement d'un effet de composition. Pour ce qui concerne les exportations, on montre que la tarification au marché est une stratégie utilisée principalement par les exportateurs des petits pays tandis que les exportateurs allemands sont particulièrement peu enclins à adopter ce type de stratégies. Ici aussi cependant, la comparaison des coefficients estimés au niveau du pays et du produit, avec les coefficients estimés au seul niveau du produit, suggère que la plupart des différences agrégées résulte d'effets de composition plutôt que d'écarts systématiques de comportements.

Les modèles macro-économiques expliquent les différences de *pass-through* dans le prix des importations par la spécificité des environnements macro-économiques auxquels sont confrontées les firmes exportatrices sur leurs différents marchés étrangers. Ceci justifie une étude de l'influence des caractéristiques de type macro-économiques sur les décisions de pass-through. Notre analyse empirique suggère que le *pass-through* est en moyenne plus élevé lorsque l'environnement est volatile, en direction des pays moins riches et vers des marchés peu intégrés.

[3]Par exemple, Betts & Devereux (1996).

RÉSUMÉ COURT

Cet article utilise une base de données détaillée pour analyser les comportements de pass-through au niveau du produit pour un grand nombre de pays. Les flux de commerce étant harmonisés, il est possible d'estimer de manière cohérente la sensibilité au change du prix des exportations comme des importations. L'analyse empirique suggère que les comportements de prix sont dichotomiques : alors que les variations de change sont intégralement transmises dans les prix en monnaie de l'importateur de 30 à 40% des produits considérés, on identifie des phénomènes de tarification au marché dans les autres secteurs. Le coefficient de pass-trough moyen à long terme est néanmoins élevé, proche de 80%. Ce résultat masque cependant une forte hétérogénéité des comportements de pass-through entre secteurs et entre pays exportateurs, les différences entre importateurs étant moins marquées. On montre qu'une part importante des différences observées entre pays est due à des effets de composition. Cependant, le pass-through est en moyenne plus élevé i) dans des environnements volatiles, ii) dans les pays moins développés, iii) sur des marchés peu intégrés.

Classification *JEL* : F12, F31, F41
Mots-clé : pass-through, pricing-to-market, données désagrégées, déterminants macro-économiques.

EXCHANGE-RATE PASS-THROUGH AT THE PRODUCT LEVEL

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1 Introduction

The pricing-to-market literature, launched by Krugman (1989) and popularized in open macroeconomics by Betts & Devereux (1996), has opened a new field of research by highlighting the importance of incomplete pass-through. The weak sensitivity of import prices to exchange-rate movements is now well documented, and it contradicts the standard view of a complete pass-through of currency shocks onto consumer prices. The incomplete pass-through bears important macro-economic consequences, which explains the wide interest it meets in both the empirical and theoretical literature. Indeed, when nominal exchange-rate changes are not transmitted into prices, currency changes become inefficient tools in absorbing real shocks, and nominal exchange rates therefore exhibit higher volatility. Moreover, as long as the size of the pass-through is not uniform across countries, this phenomenon generates asymmetries in the transmission of currency changes.

A large part of the related empirical literature is devoted to estimating exchange-rate pass-through (ERPT hereafter) coefficients using macro (i.e. aggregate) data.[7] From this literature, it arises that the pass-through is incomplete in the short run, with a short-run ERPT coefficient around .5 or .6, meaning that a 10% appreciation of the exporter's currency will translate into a 5 to 6 % rise in its foreign prices (in the currency of the importer). In the long run, the pass-through tends to be higher, and close to 1, although heterogeneity still persists across countries and sectors.[8]

Relying on aggregate price indices implies that the heterogeneity of the ERPT across exporters and products is not taken into account, and that the relative contribution of macroeconomic and industry-specific features to pass-through cannot be properly identified. This

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[7]For instance, Anderton (2003) or Warmedinger (2004), explore the exchange-rate pass-through of euro variations into EMU import prices. Mihailov (2005) also uses aggregate-level trade data to investigate exchange-rate pass-through into the import and export prices of 3 major economies (Germany, Japan and the US), Choudhri, Faruqee & Hakura (2002) work on non-US G7 countries, Bailliu & Fujii (2004) on 11 developed countries, but there also exist studies on developing countries (see for instance Anaya (2000) working on 13 Latin American countries, or Barhoumi (2005) on 24 developing countries).

[8]It is estimated to be .81 on average in Campa & Minguez (2004), .75 in Campa & Goldberg (2004), close to 1 in Parsley (2002). As far as country and sector heterogeneity is concerned, Anderton (2003) finds ERPT in EMU imports to be around .8 for imports from non-EU countries, and .5 for imports from EU countries. Campa & Minguez (2004) and Campa & Goldberg (2004) point heterogeneity across (widely defined) industries, while Gil-Pareja (2003) finds heterogeneity at the car model level. In Campa & Minguez (2004), heterogeneity is shown to affect mostly short-run pass-through coefficients, as long-run coefficients are insignificantly different from unity.

calls for an investigation of the macroeconomic determinants of pass-through, based on product-level estimates. However, in existing studies where the sectoral dimension is combined to time-series analysis, either the disaggregation level or the sectoral coverage is rather limited, which leads to results that cannot easily be generalized.[9]

In this paper, we investigate the incomplete pass-through phenomenon at the product level, using a new database providing bilateral, highly disaggregated trade flow data with an extensive country coverage. It is therefore possible to estimate pricing-to-market (PTM hereafter) coefficients for more than 100 countries and 1,000 categories of products at the 4-digit level, from 1989 to 2003. The very large coverage of the database allows to investigate into details whether different exchange-rate pass-through coefficients in different countries stem from (potentially macro-economic) country-specific effects, or from product-specific effects that determine the ability of firms to undertake pricing-to-market.

When product-level data are pooled together at the product level, and homogeneity is assumed across countries, we find that pass-through is complete for 30 to 40% of products, whereas it is quite high (reaching almost 80%) for the remaining ones. There is however strong heterogeneity across products and countries: on the one hand, pass-through tends to be higher in small importing countries; on the other hand, large exporters (especially Germany) tend to pass currency changes into local prices more easily. Comparing country-specific behaviors at the most detailed industry level, we however show that these country-specific features are not systematic across products. In particular, ERPT differences across importing countries seem to be mainly attributable to sectoral composition effects. On the export side, cross-country heterogeneity in pricing behavior (PTM) persists when sectoral composition effects are controlled for. However, this does not mean that all products behave identically in terms of PTM: even in Germany, where PTM is found to be especially low, some exporters in specific sectors still adjust their price to currency changes. This means that PTM is highly influenced by product-specific factors.

In micro-founded macro models, asymmetric ERPT across importers is explained by the specific macroeconomic environment encountered by exporters in their target markets. We perform an empirical analysis of the influence of macroeconomic factors on the import pass-through, based on our product-level ERPT estimates. We show that ERPT tends to be higher in more volatile environments (probably because of the higher risk attached to PTM strategies); it is less pronounced towards wealthier destinations (where the larger demand potential can justify specific pricing strategies) and in less integrated markets (where market pressure is stronger).

The rest of the paper is organized as follows. Section 2 displays the theoretical framework under which the exchange-rate pass-through is investigated. The database and empirical strategy are presented in Section 3. In Section 4, the geographical dimension of the phenomenon is investigated, first focusing on importer-specific pass-through estimates, then on exporter-specific PTM coefficients. In section 5, we try to explain the cross-country differences evidenced in Section 4. Last, section 6 concludes.

[9] For instance, Campa & Minguez (2004) work on monthly data, but with a maximum disaggregation level of 2-digits, Campa & Goldberg (2004) on quarterly data for 5 product categories, and Pollard & Coughlin (2003) on a 3-digit ISIC disaggregation level. The level of disaggregation can be further increased, but at the expense of a narrowing in the number of countries for which data are available. Among the numerous papers are those by Gagnon & Knetter (1992), Gagnon & Knetter (1995) at the 7-digit level within the automobile industry, by Gil-Pareja (2003) (30 car models, with a sample restricted to the USA, Japan and Germany) or by Frankel, Parsley & Wei (2005), who work on 8 narrowly defined goods.

2 Theoretical framework

Assuming complete pass-through of exchange-rate movements into import prices implies that export prices (in the exporter's currency) do not react to currency changes. However, import prices empirically exhibit low sensitivity to exchange rate changes - at least in the short run, and even in small countries - a feature that has lead economists to consider the possibility of exporters adjusting their price to exchange-rate fluctuations in order to stabilize their competitiveness in the destination market.

Such a behavior, labeled pricing-to-market (PTM) by Krugman (1987), is obviously impossible in a perfect competitive framework, since it requires export prices to be initially set above the marginal cost to produce. However, whenever the exporter's margin is strictly positive, incomplete pass-through may become a sustainable pricing strategy from the exporter's point-of-view. The size of the pass-through will thus depend on micro-based features, and above all on the ability of exporters to absorb exchange-rate shocks within their profit margins.

Knetter (1989) shows how strategies of incomplete pass-through can be rationalized within a simple monopolistic competition framework in which bilateral export prices are the product of the marginal cost to produce and a mark-up determined by the elasticity of foreign demand to the price in local currency. Log-linearizing them yields the following price equation:[10]

$$p_t^{ijk} = (1 - \beta^{ijk}) mc_t^{ik} + (1 - \beta^{ijk}) \ln \left(\frac{\eta^{ijk}}{\eta^{ijk} - 1} \right) + \beta^{ijk} s_t^{ijk} + \delta^{ijk} z_t^{jk} \tag{1}$$

where i, j and k respectively refer to the exporting country, the destination market and the considered product. p_t^{ijk} is the price of good k, in the exporter's currency, while mc_t^{ik} is the marginal cost (which is supposed to be the same across importers); both variables are expressed in logs. η^{ijk} is the elasticity of demand to prices in the consumer's currency and z_t^{jk} is a set of other importer-specific demand characteristics, that affect the price elasticity of demand. Finally, s_t^{ij} is the logarithm of the nominal bilateral exchange rate in i's currency per unit of j's.[11]

In this expression, β^{ijk} is the pricing-to-market (PTM) coefficient, measuring the sensitivity of prices (in the producer's currency) to exchange-rate changes. When β^{ijk} is zero, exchange-rate changes have no impact on the exporter's prices: they are fully passed into import prices. As detailed in Knetter (1989), a sufficient condition for complete pass-through to hold in a monopolistic competition framework is that the elasticity of demand with respect to the price in the destination market be constant. Under the alternative situation, when the elasticity of demand is not constant with respect to local currency prices, the pass-through is incomplete and $\beta^{ijk} \neq 0$. The coefficient is then positive if mark-up adjustments are used to offset exchange-rate changes and then their *ex-post* impact on exported volumes. In that case, an appreciation of i's currency ($\Delta s_t^{ij} < 0$) leads the firm to reduce its mark-up so that the price in local currency ($p_t^{ijk} - s_t^{ij}$) reacts less than proportionally and the competitiveness loss is mitigated.

Using more specific theoretical frameworks, several papers have underlined various other structural as well as macroeconomic determinants that are likely to explain PTM strategies. Leaving aside the theoretical features of available models, we give the intuitions provided by some of these papers in the following.

[10] See Appendix A.1. for details.

[11] Note that with this definition of exchange rates, a drop in s_t^{ij} implies an appreciation of i's currency which penalizes its competitiveness in foreign markets.

First, in an oligopolistic model, PTM is fundamentally related to the firm's ability to influence the market price, due either to its large market share - as confirmed in general equilibrium by Bachetta & Van Wincoop (2005) -, or to the presence of impediments to market entrance - such as sunk costs as in Baldwin & Krugman (1989). The underlying intuition is that the firms' incentive to adopt PTM strategies is less pronounced as long as their market power partially protects them from competitive pressures.
The optimal PTM can also be influenced by the relationship between the exporter and her client, as in Froot & Klemperer (1989)'s dynamic model with switching costs, or in Corsetti & Dedola (2002) (in this case, the analysis focuses on the effect of distribution costs). Indeed, firms are more likely to stabilize local prices through PTM when the risk of demand is high.
Notwithstanding the micro-based arguments, pricing-to-market strategies are also often argued to depend on global variables, in particular the macroeconomic volatility in the destination market. This is for instance the case in Taylor (2000), Corsetti & Pesenti (2005), in a context of optimal monetary rules, and Devereux, Engel & Storgaard (2004), in a non-optimizing model. These general equilibrium models suggest that PTM should be less pronounced towards volatile countries (as reflected in their inflation rate or the bilateral exchange-rate volatility). Indeed, pricing-to-market is more costly when the environment in the destination market is uncertain. In Froot & Klemperer (1989) however, the direction of this link is reversed and PTM is more pronounced when the nominal exchange-rate is highly volatile and exporters try to maintain their market share.
Last, pricing-to-market can also depend on the financial development level, that determines the capacity of firms to limit their exposure to exchange rate fluctuations through hedging strategies.[12]

Existing models therefore highlight a number of potential explanatory variables for incomplete pass-through. The only point reached by consensus is that complete pass-through, which is often assumed in macroeconomic models, is likely to be the exception rather than the general case. In the following, we estimate pricing-to-market elasticities at the product level and investigate whether they point to complete pass-through ($\beta^{ijk} = 0$) or pricing-to-market. In this latter case, we also analyze the direction of the price adjustment. Indeed, even though models generally focus on PTM aiming at stabilizing prices in local currency (i.e. $\beta^{ijk} > 0$), one cannot rule out the possibility of "exchange-rate amplification" (see Knetter, 1989), in what case β^{ijk} is negative. The original database and the empirical strategy are described in the following.

3 Data and empirical strategy

3.1 From the theoretical model to the empirical specification

According to the discussion in Section 2, the first-difference specification of the PTM equation should be the following:[13]

$$d\ln P_t^{ijk} = \alpha^{ijk} d\ln MC_t^{ik} + \beta^{ijk} d\ln S_t^{ij} + \delta^{ijk} d\ln Z_t^{jk} \qquad (2)$$

where MC_t^{ik} is the exporter- and product-specific marginal cost, Z_t^{jk} is a set of importer-specific features of demand, which also bear a product dimension, and S_t^{ij} is the bilateral

[12] See Friberg (1998).

[13] In the following, we estimate PTM coefficients using equations in first differences in order to limit the risk of spurious regression linked to the use of potentially non-stationary time series (as exchange-rate series).

exchange rate in the exporter's currency (a fall in S_t^{ij} denotes an appreciation of i's currency against j's). In this equation, β^{ijk} measures the elasticity of export prices to currency changes (the PTM coefficient in the following) and is inversely related to the pass-through ($\gamma^{ijk} = 1-\beta^{ijk}$).[14] In the general form, the PTM coefficient is specific to the exporter (i), the country of destination (j) and the product (k), it is null when the pass-through is complete and positive as long as exporters partly absorb currency changes in their mark-ups in order to keep their local currency price stable.

Both marginal costs and importer's demand characteristics are highly difficult to measure, and even more at the product level. However, within a sample that bears a bilateral, sectoral and time dimension - as our data -, the use of fixed effects allows to overcome this problem. The general form of our estimation is then:

$$d\ln P_t^{ijk} = \alpha_t^{ik} fix_t^{ik} + \delta^{jk} fix^{jk} + \beta^{ijk} d\ln S_t^{ij} + \epsilon_t^{ijk} \tag{3}$$

where fix_t^{ik} and fix^{jk} are fixed effects. fix_t^{ik} encompasses, for each product, all developments affecting country i at time t, notably the evolution of marginal costs, the extent of competition among the firms located in i, etc.[15] As far as the importing country is considered, the fixed effect (fix^{jk}) cannot bear a time dimension, because of data constraints: country-specific features are therefore identified by a linear trend and an error term (ϵ_t^{ijk}).

As explained in the following paragraph, the time dimension of the panel is short (at most 13 yearly growth rates). Therefore, estimations cannot be robustly run on the ijk dimension. Product-level data are thus pooled at the $hs4$ level, assuming that PTM coefficients are homogeneous enough across all $hs6$ sectors of a given $hs4$ category ($\beta^{ijk} = \beta^{ijc}, \forall k \in c$ with c a $hs4$ category). This allows us to keep the product-level dimension of our data and increase the degrees of freedom, as we estimate PTM coefficients for around 1,000 $hs4$ categories instead of 5,000 $hs6$ sectors. An $hs6$-specific fixed effect is then added to the estimated equation, that controls for $hs6$-level determinants of price adjustments.

In the following section, we present three distinct sets of estimates, based on the following three equations :

$$d\ln P_t^{ijk} = \alpha_t^{ic} fix_t^{ic} + \delta^{jc} fix^{jc} + \sigma^{kc} fix^{kc} + \beta^{c} d\ln S_t^{ij} + \epsilon_t^{ijk} \tag{4}$$

$$d\ln P_t^{ijk} = \alpha_t^{ic} fix_t^{ic} + \delta^{ijc} fix^{jc} + \sigma^{ikc} fix^{kc} + \beta^{ic} d\ln S_t^{ij} + \epsilon_t^{ijk} \tag{5}$$

$$d\ln P_t^{ijk} = \alpha_t^{ic} fix_t^{ic} + \delta^{jc} fix^{jc} + \sigma^{kc} fix^{kc} + \beta^{jc} d\ln S_t^{ij} + \epsilon_t^{ijk} \tag{6}$$

Estimating (4) provides us with a set of $hs4$-specific PTM coefficients, that ignore the geographical dimension of the phenomenon and reflect the "mean" PTM in each sector. The corresponding results are presented in section 4.1. Next, estimations run on the jt dimension, obtained from (5), allow us to focus on cross-exporter differences in PTM. These estimates

[14] In the following, we call pass-through the absolute value of the elasticity of import prices (in local currency) to exchange-rate movements. With our definition of exchange rates, this elasticity is negative : when the exchange rate appreciates ($d\ln S_t^{ij} < 0$), import prices increase, through less than proportionally under incomplete pass-through. Since the pass-through is defined as the share of currency changes that is passed into import prices, it corresponds to minus the elasticity of import prices to exchange-rates :

$$\gamma^{ijk} = -\frac{\partial(P_t^{ijk}/S_t^{ij})}{\partial S_t^{ij}} \frac{S_t^{ij}}{P_t^{ijk}/S_t^{ij}} = 1 - \beta^{ijk}$$

[15] The it fixed effect notably covers the impact of exchange-rate changes on marginal costs, thus cleaning up the estimation of the exchange-rate pass-through. In our estimates then, PTM refers to the adjustment of *mark-ups* to exchange rates.

however ignore the potential heterogeneity of PTM across different importers (as we assume $\beta^{ijc} = \beta^{ic}, \forall j$). This last dimension of the phenomenon is thus studied in the last set of estimations, based on (6), that ignores behavioral asymmetries across exporters but allows PTM coefficients to vary across importers ($\beta^{ijc} = \beta^{jc}, \forall i$). As we want our results to be comparable with existing "macro" ERPT estimates, the presentation of results obtained from (6) in Section 4.3 however yields on pass-through rather than PTM coefficients ($\gamma^{jc} = 1 - \beta^{jc}$).

All these equations are estimated using weighted OLS, assuming fixed rather than random effects because the country coverage is exhaustive. The weighting scheme is based on the value of each bilateral flow, with two-period weights as in the computation of Tornqvist price indices.[16]

Estimating PTM coefficients at the $hs4$ level still leaves us with more than 1,000 coefficients for each importing and exporting country. A systematic strategy is therefore needed when interpreting results. In the following, coefficients that are not significantly different from zero (at the 10% level) will be interpreted in terms of complete pass-through as they reflect the insensitivity of export prices to currency changes. When computing summary statistics from the whole distribution of product-level results, it will thus sometimes be relevant to drop these complete pass-through coefficients to focus on incomplete pass-through products. Moreover, summary statistics will be used to describe the whole distribution of product-level estimates. These computed moments can be either unweighted, for results not to be affected by composition effects, or weighted[17], in what case they can be compared to "macro" estimates.[18]

Before results are displayed and commented on, the database is first briefly described. This allows to highlight its specificities, which are used to estimate highly disaggregated PTM elasticities.

3.2 Data

ERPT estimates in the literature are usually confronted with the trade-off that has to be made between the sectoral disaggregation level and the country coverage. Basically, estimates using aggregate prices allow for a larger country coverage and higher frequency of data. However, prices are not much reliable in this case. As pointed out by Lavoie & Liu (2004), the use of aggregate prices might biase the PTM estimates, as it is then impossible to disentangle between PTM reflecting price discrimination and PTM reflecting product differentiation.

Working on product-level prices offers an alternative, since it minimizes the aggregation bias. However, this choice has a cost in terms of data frequency, since highly disaggregated data are mostly available on an annual basis, even when the incomplete pass-through is a short-

[16]Denoting w_t^{ijk} the weighting variable :

$$w_t^{ijk} = 0.5 * \left[\frac{V_{t-1}^{ijk}}{V_{t-1}} + \frac{V_t^{ijk}}{V_t} \right]$$

where i, j, k and t refer respectively to the exporting country, its partner, the product and time, and V_t^{ijk} is the dollar value of the trade flow. $V_t = \sum_{i,j,k} V_t^{ijk}$ is world trade at time t.

[17]In that case, the weighting scheme relies on the trade value in each sector throughout the period and no longer on Tornqvist weights as in the estimation. Indeed, Tornqvist weights bear a time dimension, which is not the case for the estimated coefficients.

[18]Indeed, aggregate ERPT estimates use as dependent variable import price indices, that reflect the price of import baskets, taking into account the weight of each good in the total value of imports.

run phenomenon.[19] Moreover, in most existing studies, this has also a cost in terms of the country coverage, as product-level reliable data are essentially available for a small number of developed countries.[20]
In this paper, we use a new trade database, that has the advantage of combining a large country coverage and a strong disaggregation level. The BACI database, developed by CEPII, provides harmonized trade data drawing on the most detailed available level of disaggregation, on the basis of the United Nations COMTRADE database. Data are harmonized in order to allow for a reconciliation of import and export declarations, and trade flows are reported both in value and quantity. The whole database therefore provides data for more than 130 countries, 5,000 $hs6$ products[21] and 1,000 $hs4$ categories, for the period 1989-2003 with an annual frequency.[22]

Prices (P_t^{ijk}) are proxied by product-level unit values computed using harmonized FOB trade values and quantities, in current US dollars. Notice that the empirical specification includes an it fixed effect (fix_t^{ic}) that ensures that the nominal exchange rate of country i against the USD is controlled for and makes conversion of prices into the exporter's currency unnecessary. Unit values may suffer from measurement errors at such a disaggregated level, leading to an ill estimation of pass-through coefficients at the product level. A number of precautionary measures are implemented to circumscribe the impact of such data problems. First, the use of fixed effects allows to control for unobserved, systematic errors. Therefore, exporter-and-time-specific as well as importer-specific measurement errors should be controlled for.[23] Moreover, *ex-post*, we only use the coefficients estimated with a degree of freedom higher than 100. Indeed, a high degree of freedom assures that the dataset is a "true" panel with a large enough number of individuals (countries) so that country-specific measurement errors do not infect the whole sectoral dataset.

The exchange-rate variable of equations (4), (5) and (6) is the bilateral real exchange-rate (deflated using consumer price indices), where a rise signals a real depreciation in i's currency. In order to insure the best possible quality, episodes of very high (nominal) exchange-rate volatility are excluded by constraining annual exchange rate changes to be less than 50%. While theory would suggest to measure PTM coefficients using nominal exchange rates, most of the empirical literature relies on another definition of the exchange rate. For instance, Gagnon & Knetter (1992), Knetter (1989) or Knetter (1993) deflate the nominal exchange rate with the wholesale price index of the destination (the justification being that the foreign demand curve should depend on the real rather than the nominal price). Similar

[19]For instance, Campa & Goldberg (2004) estimate a dynamic pass-through equation using quarterly data. In this paper, they call "short-run coefficient" the share of of currency changes that is passed into prices after one quarter and "long-run coefficient" the pass-through after one year.

[20]Thus, Knetter (1989, 1993) only studies exports from the USA, Japan, Germany and the UK whereas Gil-Pareja (2002, 2003) and Gross & Schmitt (2000) focus on the European Union. Pollard & Coughlin (2003) and Yang (1997) work on US import data. Takagi & Yoshida (2001)'s study is more original as it focuses on Asian economies (Japan, Indonesia, Malaysia, Philippines, Singapore, Thailand) that they compare with Germany and the USA.

[21]The $hs6$ level is the highest possible level of disaggregation with an exhaustive geographical coverage. For more details on the content and building of the BACI database: http://www.cepii.fr/anglaisgraph/bdd/baci/baci.pdf

[22]As a consequence of this low frequency, our results should be compared with "long-run" rather than "short-run" pass-through coefficients obtained in previous estimations.

[23]In particular, the importer-specific effect should control for trends in the evolution of the demand for quality. Indeed, country growth is often accompanied by an improvement in the quality of imports that is assimilated to a price increase when using unit values as a proxy for prices.

definitions are used in Takagi & Yoshida (2001), Gil-Pareja (2002), Gil-Pareja (2003), Parsley (2002) and Athukorala & Menon (1994). Using real rather than nominal exchange rates aims at identifying pure exchange-rate shocks, as opposed to exchange-rate variations that respond to general inflation differentials. Moreover, this specification has the advantage of allowing for an analysis of euro-zone countries, despite the fixity of their bilateral nominal exchange-rates since 1999.[24]

4 The geographical dimension of pass-through estimates

In this section, the magnitude of PTM coefficients is first investigated on pooled data using (4), i.e. ignoring the geographical dimension of the phenomenon. The heterogeneity of pass-through estimates across countries is however a well-identified - still little explained - phenomenon. Therefore, differences in the estimated pass-through across importing countries and across exporters is also successively investigated through estimates based on (5) and (6).

4.1 Pass-through at the product level

As a first step, PTM coefficients are estimated assuming homogeneous pass-through across exporters and importers ($\beta^{ijc} = \beta^{c}, \ \forall i, \ j$): one PTM coefficient is estimated for each $hs4$ category, over the pooled partners, according to (4).
Results, displayed in Table 1, are somewhat different when using weighted or unweighted statistics. The unweighted statistics are in general higher than the weighted ones: this suggests that PTM is lower in large sectors, which pushes downwards the weighted-mean PTM coefficient. On average, the implicit ERPT estimate turns out to be quite high: the unweighted mean PTM coefficient of .18 corresponds to an average pass-through rate of 82% after one year. This is consistent with the common result that the pass-through is near complete in the long run.

Table 1: Pricing-to-market at the product level, summary statistics

	Mean		Lower quartile		Median		Upper quartile	
	Unweigh.	Weigh.*	Unweigh.	Weigh.*	Unweigh.	Weigh.*	Unweigh.	Weigh.*
$\hat{\beta}^c$	0.179	0.133	0.046	0.026	0.181	0.149	0.327	0.308
(Stud.)	(2.818)	(4.712)	(0.458)	(0.721)	(2.201)	(3.042)	(4.649)	(7.786)
Nb.Obs.	1126							

Note: The weighting scheme is based on the value of exports. See footnote 13. Ex-ante restriction: exchange-rate changes ranging between -50% and +50%. Ex-post restriction : degree of freedom higher than 100. *Source : Authors' calculations.*

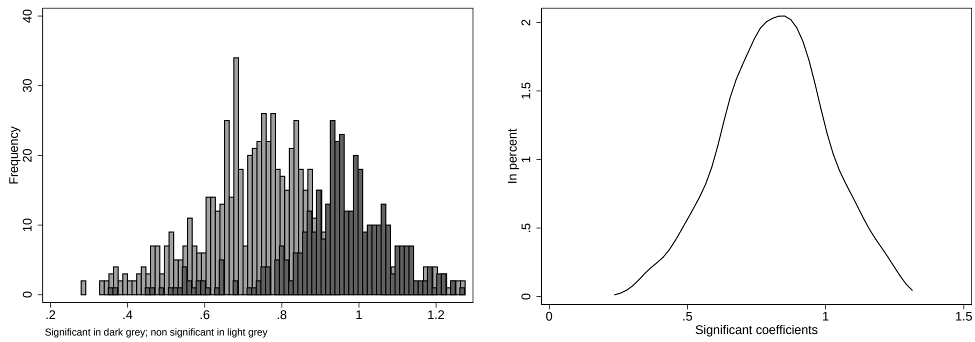
These results require some qualification however, given the large number of non-significant (i.e. complete pass-through) coefficients (more than 40% when the significance threshold is set at 5% and 36% at the 10% level[25], see the first graph of Figure 1). Once non-significant

[24] To check the robustness of this assumption, estimations have also been run in equations that separate nominal exchange rates and consumer-price indices. Results are available upon request but the general picture is the same with regard to PTM coefficients.

[25] In the remaining of the paper, coefficients that pass the Student test at the 10% level will be said significant.

coefficients are dropped, the distribution is clearly oriented towards positive values, which reflects the fact that firms tend to smooth the effect of exchange-rate movements on local prices. Now, the weighted median (significant) PTM coefficient is higher, above 20%. This suggests that, for more than half of products, firms choose incomplete pass-through and absorb, on average, 20% of currency changes, whereas the other ones let exchange rate movements being passed onto local currency prices. Such a behavioral dichotomy is consistent with the macro-economic modelization of the PTM: in Betts & Devereux (1996)'s seminal paper, exporters choose either to set their price in their own currency, in which case the pass-through is complete, or to set them in the importer's currency, in which case the pass-through is null in the short run (and incomplete in the middle run under sticky prices).

Figure 1: Share of significant and non-significant estimated coefficients (at the 10% significance level) and distribution of significant estimated coefficients (from the 5th to the 95th percentile)



Source: Authors' calculations.

This general picture highlights a strong heterogeneity in PTM coefficients across products: even within sectors where incomplete pass-through can be identified, the inter-quartile range of estimates ([0.16;0.39] in the unweighted distribution pictured in Figure 1/[0.11;0.34] in the weighted one) reveals that the range of PTM can be wide.

Table A.3. provides a sample of estimated coefficients at the $hs4$ level that are significantly different from zero, between 0.6 and 1. This provides some insights about the kind of sectors where significant and strong pricing-to-market is identified. As evidenced from this table, PTM is not concentrated in a particular part of the economy, but rather concerns various activities as food, manufactured articles obtained from crude products like leather or ceramic, clothing, firearms, chemicals, optical goods, etc.

This heterogeneity calls for the investigation of PTM at the most detailed level. In the following, the geographical dimension of the phenomenon is further investigated, first considering pricing to market by exporting countries, and then focusing on pass-through coefficients for importing countries.

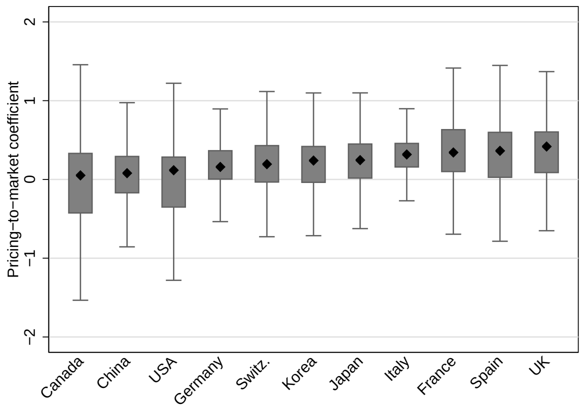
4.2 Pricing-to-market by exporting countries

In this section, we investigate exchange-rate pass-through into export prices. Since this should reflect the ability of exporters to price-to-market, the analysis focuses on the value of the pricing-to-market coefficients estimated with (5) for each $hs4$ category in each exporting country.

Figure 2 displays the summary statistics for PTM coefficients, which are detailed in Table 2.

Figure 2: Country and sector-specific PTM estimated coefficients

(black diamond: weighted median, grey box: weighted interquartile range, $-$: extreme values)



Source: Authors' calculation.

In almost all the countries of the sample, PTM coefficients are consistent with the standard theoretical case: most of them lie between 0 and 1.[26]

[26]They are also consistent with the overall high pass-through estimated with equation (6) displayed *infra*.

Table 2: Median pricing-to-market coefficients and share of significant coefficients, by exporting country.

Exporter	**Weigh. median** $\hat{\beta}^{jc}$	**Share of signif. Coef.(in %)***	**Weigh.median signif.** $\hat{\beta}^{jc}$ **	**Constrained mean** $\hat{\beta}^{jc}$ ***
Canada	0.052	29.5	0.316	0.111
China	0.080	37.6	0.239	-0.142
Others OECD	0.089	33.4	0.395	-0.155
Brazil, Russia, India	0.112	32.6	0.344	0.111
United States	0.117	48.6	0.198	-0.061
Rest of the World	0.140	35.2	0.386	0.109
Germany	0.159	38.3	0.330	0.157
Switzerland	0.194	35.8	0.332	0.166
Korea	0.239	38.4	0.411	-0.001
Japan	0.245	36.1	0.344	0.128
New EU members	0.300	37.5	0.536	0.257
Italy	0.317	47.1	0.402	0.282
Medium EU15	0.322	38.2	0.485	0.210
France	0.342	45.4	0.462	0.257
Small EU15	0.345	39.8	0.559	0.348
Spain	0.363	44.7	0.598	0.320
United Kingdom	0.418	41.2	0.528	0.300
Coef. of variation	0.499		0.269	1.066

Note: Except for the shares of significant coefficients, statistics are weighted by trade flows. *Share of PTM estimates that are significantly different from 0 at the 10% level. **Median PTM coefficient, ignoring non-significant estimates. ***Mean PTM coefficient when non-significant PTM coefficients are set to 0.*Source : Authors' calculations.*

The results point to the strong heterogeneity of PTM coefficients across exporting countries, a feature which is consistent with other existing studies. On average, pricing-to-market coefficients are lower for larger countries: US, Germany and China.[27]

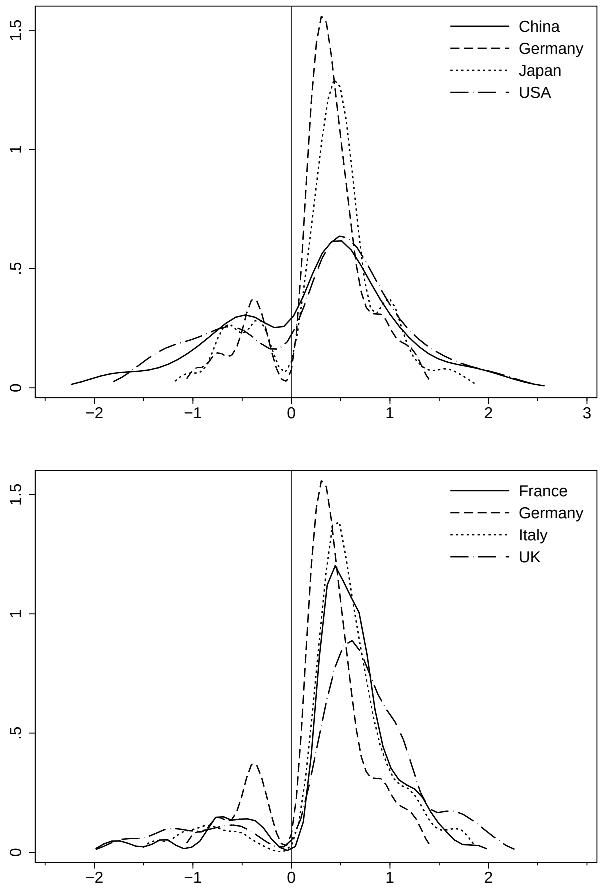
When only significant estimates are considered, the distribution of PTM coefficients is less ambiguously oriented towards positive (and lower than one) values, as shown in Graph 3, except for the United States and China. In all remaining countries, dropping non-significant estimates provides some evidence that PTM is positive and somewhat higher (close to .4 or .5). Cross-country heterogeneity remains and is more pronounced than with importer-specific coefficients (see Figure 5). In particular, the fact that German exporters tend to price less to market is confirmed. Indeed, the corresponding distribution is more concentrated towards low PTM estimates than the other ones. On the other hand, the distribution obtained for the United Kingdom is shifted to the right, thus revealing strong PTM for a significant number of products.

The comparison of our results with previous studies is quite tricky. Indeed, existing analyses of PTM generally focus on a small number of industries. For instance, Gil-Pareja (2002) provides a comparison of PTM across European exporters, however based on only 28 8-digit industries. Unlike us, he finds little evidence of PTM in British data and much more in German ones but his results are close to ours for Spain, France and Belgium. The fact that US exporters tend to price less to market has already been observed by Knetter (1989, 1992, 1993), comparing PTM of US, German, Japanese and British exporters. Actually, there are a number of coefficients displaying extreme negative values in the US distribution, as already noted by Méjean (2004) who finds little significant PTM coefficients in the US, and almost 50% of negative coefficients.

Here too, results are consistent with the dichotomic interpretation of Betts & Devereux

[27] Results for Canada might be taken cautiously. See Footnote 32.

Figure 3: Estimated distributions of PTM coefficients, by exporting country
Only significant coefficients (at the 10% level) are kept. 5% at each distribution tail deleted.



Source: Authors' calculations.

(1996). According to this interpretation, our results suggest that more than 50% of exporters choose a strategy of complete pass-through, however with some differences between exporters (the share being higher in Canada, Brazil, Russia or India, but lower in France, Italy and, surprisingly, the United States). On the other hand, when products display incomplete pass-through, the mean rate of pass-through probably varies, which would explain the variance in median significant PTM coefficients. Thus, Figure 3 suggests that, in comparison with other countries, Germany absorbs a relatively small share of currency changes (or, alternatively, adjusts its prices quicker than other countries). Pricing-to-market behaviors are the more prevailing in the United Kingdom.

Comparing PTM across exporting countries is therefore instructive. It suggests that PTM differences across exporting countries could reflect product-specific rather than global features. Implicitly however, this analysis relies on the assumption that exporters have the same PTM strategy across all their impot markets. In the following section, we go back on this assumption and investigate pass-through differences across importing countries.

4.3 Pass-through into import prices

This section investigates pass-through coefficients on import prices, taking into account the potential heterogeneity of pass-through across destination markets. Indeed, as displayed in Table 3, the existing literature on macro data highlights the cross-country heterogeneity in pass-through coefficients, even in the long run. For instance, the United States is often shown to display low pass-through as an importer - this latter feature being attributed either to the very large size of the country, which might induce firms to price-to-market, or to the fact that the US dollar is a dominant invoicing currency. Looking at disaggregated data allows to investigate whether cross-country differences in PT are the result of composition effects or do reflect macroeconomic features.

Table 3: Selected country-level pass-through estimates (on import prices) in the literature

	EU	France	Germany	Italy	Spain	US	Japan
Anderton (2003)	(.58,.81)	..	..	..	..	..	..
Faruqee (2004)	.80	..	..	..	..	.18	.57
Campa and Goldberg (2004)	..	1.21	.79	.67	..	.41	1.26
Campa and Minguez (2004)	..	.80	.77	.96	1.20	..	..
Warmedinger (2004)	..	.85	.56	.74	.82	..	..
Marazzi et al. (2005)	..	..	..	..	..	(.6, .3)	..

To this aim, pricing-to-market elasticities are first estimated for each importing country j and $hs4$ sector c, using (6), then transformed into pass-through coefficients ($\hat{\gamma}^{jk} = 1 - \hat{\beta}^{jk}$ with $\hat{\beta}^{jc}$ the estimated PTM coefficient), to keep interpretation in line with usual analysis.
Results concerning the main importers are illustrated in Figure 4[28] and detailed in Table 4.[29]

[28]In Figure 4, summary statistics are weighted by the value of flows, but ignoring the weighting scheme does not change the picture (the correlation between weighted and unweighted summary statistics is higher than .8 for the series of median and lower quartile estimates and .55 for the series of upper quartiles).

[29]The whole sample counts 74 countries once the constraint on the number of flows is imposed. In order to make table readings easier, the smaller countries are pooled together. The composition of groups is displayed in the Appendix A.2.

Table 4: Median pass-through coefficients and share of incomplete pass-through coefficients, by importing country.

Importer	**Weigh. median** $\hat{\gamma}^{jc}$	**Share of incomplete PT Coef.(in %)***	**Weigh. median incomplete PT****	**Constrained mean** $\hat{\gamma}^{jc}$ ***
Canada	0.640	42.6	0.459	0.701
United States	0.693	56.4	0.546	0.733
Switzerland	0.693	22.7	0.537	0.847
Spain	0.721	33.4	0.419	0.756
Japan	0.753	43.0	0.539	0.710
Germany	0.778	45.4	0.512	0.818
United Kingdom	0.809	40.0	0.527	0.936
Italy	0.819	32.1	0.548	0.870
France	0.830	33.5	0.576	0.876
Medium EU15	0.835	39.9	0.707	0.931
Others OECD	0.836	53.0	0.775	1.007
Small EU15	0.845	27.5	0.664	0.920
Korea	0.854	31.8	0.657	0.888
China	0.865	34.4	0.771	0.910
New EU Members	0.896	15.9	0.709	0.966
Rest of the World	0.914	47.5	0.839	0.944
Brazil, Russia, India	0.937	26.2	0.775	0.983
Coef. of variation	0.100		0.177	0.107

Note: Except for the shares of significant coefficients, statistics are weighted by trade flows.
* Share of incomplete pass-through coefficients (PTM estimates significantly different from 0 at the 10% level).
** Median PT coefficient, ignoring non-significant PTM estimates.
*** Mean PT coefficients when complete pass-through coefficients (i.e. non-significant PTM coef) are set to 1. *Source : Authors' calculations.*

On average, the rate of ERPT is rather high, since the median pass-through coefficient generally lies between .7 and .9. However, the high share of non-significant PTM estimates raises the issue of how they should be treated. When complete ERPT coefficients[30] are ignored, the median pass-through coefficient is of course lowered for all countries, as shown in the third column of Table 4. Simultaneously, the dispersion of ERPT estimates increases. On the opposite, when constraining complete ERPT coefficients to unity, the mean pass-through increases. Whatever the way non-significant coefficients are treated, the global picture is however the same : the correlation between those three series is always higher than .75.

In any case, median results seem consistent with macro-based estimates that suggest a link between pricing behaviors and the market size of the destination country. Indeed, average ERPT coefficients are very high in such economically small countries as the new EU member states, Brazil, Russia or India.[31] On the other hand, the pass-through is lower (around 80%) in intermediate countries and even lower for "large" countries like the USA.[32]

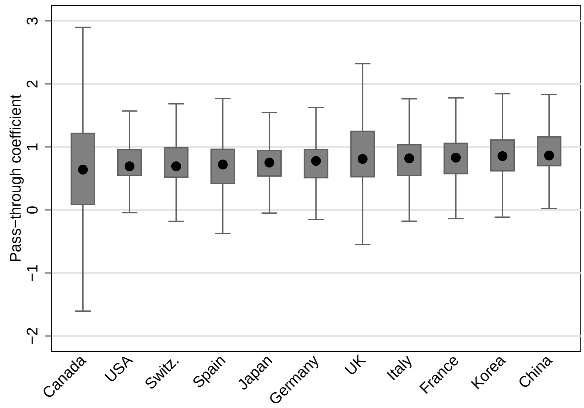
The aggregate results displayed above however again hide a strong heterogeneity across $hs4$

[30] In the following, we call complete ERPT coefficient a coefficient γ^{jc} which is not significantly different from 1, meaning that β^{jk} is not significantly different from zero.

[31] Here, we consider that countries are small when their participation in international trade is limited.

[32] The Canadian case is somewhat surprising as summary statistics suggest that, on average, this country benefits from the smallest pass-through of our sample, even smaller than in the United States. These statistics however hide a strong heterogeneity across products (see Figure 4), probably attributable to the presence of badly estimated coefficients. Indeed, as we use a weighted OLS method and Canada buys a large share of its imports from the United States (85% in 2003 according to the CEPII-CHELEM database), the variability in the individual dimension of the Canadian dataset is probably too small for

Figure 4: Country and sector-specific estimated pass-through coefficients
(black circle: weighted median, gray box: weighted interquartile range, − : extreme values)



Source: Authors' calculations.

products. First, a large number of coefficients reflects complete pass-through (see the second column in Table 4). Consistent with previous results, the share of these complete ERPT coefficients is minimum in the United States and maximum for new EU members. Moreover, even among incomplete pass-through coefficients, there is a strong cross-product heterogeneity, illustrated in Figure 5, which plots the distribution of significant PTM coefficients for selected countries.

Once non-significant coefficients are ignored, cross-country differences are less pronounced. The Chinese distribution is less concentrated than the other ones. However, this probably reflects more a statistical rather than an economic feature. In particular, the higher number of very large, theoretically inconsistent, coefficients suggests that, for this country, the underlying model is not well-fitted. A possible explanation is that a large part of Chinese imports is intra-firm trade and is not priced according to "normal" (i.e. market) rules (see Rangan & Lawrence (1993), analyzing the impact of intra-firm trade on the measured pass-through). Another feature of this figure is that the Japanese distribution is more concentrated towards high pass-through coefficients than the other ones. This suggests that, once complete pass-through coefficients are dropped out and when neglecting sectoral composition effects[33], the pass-through tends to be higher in Japanese import prices.

Still, the distributions are very similar. This means that cross-product differences are quite similar across importing countries.[34] Actually, the main difference across importers lies in the share of significant PTM coefficients, which lies between 32 and 56% of estimated coefficients for the countries considered in Figure 5. These figures can be interpreted as a measure of the mean propensity of exporters around the world to price to market in each importing country: they suggest that incentives to PTM are less pronounced when selling goods in

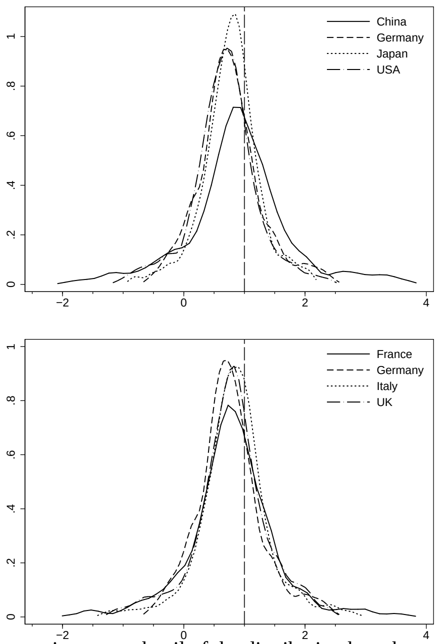
coefficients to be identified with accuracy in our panel model.

[33]Indeed, these distributions are unweighted, meaning that the same weight is given to each product of a given importer-specific distribution.

[34]Note however that this does not imply that PTM coefficients are the same for each product in the different importing countries, since we do not know the position of products in the distributions of Figure 5.

Italy than in the United States. On the other hand, when only significant coefficients are considered, the similarity in the distribution of ERPT coefficients suggests that, on average, exporters do not adopt very different PTM strategies in different target markets, once they have decided to PTM.

Figure 5: Distribution of PT estimates at the product level for selected importing countries



5% of observations at each tail of the distribution have been dropped,
for the distribution plot not to be polluted by extreme values.

Source: Authors' calculations.

5 Sectoral specificity, or macro-economic effects?

5.1 Are observed asymmetries country- or sector- specific ?

The distributions of country-specific PTM and ERPT estimates are not identical. For instance, large exporting countries (especially Germany) tend to display less pricing-to-market than smaller exporters. Moreover, the pass-through of currency changes into import prices is lower for large importers. In this subsection, we go back on this point to investigate whether such asymmetries reflect composition effects or country-specific features that would be attributable to the specific macroeconomic environment in which goods are produced and bought.

To this aim, PTM and PT estimates are first regressed on a complete set of product- and country-specific fixed effects. The following estimations are run:

$$\hat{\beta}^{ic} = fix^c + fix^i + \varepsilon^{ic} \tag{7}$$

$$\hat{\gamma}^{jc} = fix^c + fix^j + \varepsilon^{jc} \tag{8}$$

This provides us with some insight about the kind of determinants (product- or country-specific) that can explain the observed variability in estimated country- and product-specific estimates. Moreover, as we chose a weighted estimation method where weights are the share of each industry in the world value of exports/imports throughout the period, the estimated fix^i/fix^j can be interpreted as the true country-specific component in the estimated series of PTM/PT coefficients, i.e. the country-specific PTM/PT once sectoral composition effects are controlled for.
However, this method is not free of drawbacks. In particular, as we chose to keep all the estimates, results could be biased by a few outliers[35], which will be given a higher weight in this second-step estimation if they correspond to highly traded products. We thus propose an alternative way of investigating the origin of cross-country PTM differences: working at the product level, we compare each country-specific estimated coefficient with the sectoral mean estimate. This amounts to investigating whether country features observed at the aggregate level can also be found systematically at the most detailed level. In that case, they will be interpreted as structural features. To this aim, we compute the distributions of sectoral PTM and PT gaps, defined as follows:

$$Sectoral\ PTM\ gap^{ic} = \hat{\beta}^{ic} - \hat{\beta}^{c}\ where\ \hat{\beta}^{c} = N_c^{-1}\sum_i \hat{\beta}^{ic} \quad (9)$$

$$Sectoral\ PT\ gap^{jc} = \hat{\gamma}^{jc} - \hat{\gamma}^{c} = \hat{\beta}^{c} - \hat{\beta}^{jc}\ where\ \hat{\beta}^{c} = N_c^{-1}\sum_j \hat{\beta}^{jc} \quad (10)$$

In both cases, N_c is the number of (significant) product-level and country-specific estimates. Hence, $\hat{\beta}^c$ is the mean product-level estimated coefficient. The interpretation of these gaps is straightforward. In the case of PTM gaps for instance, any positive (negative) gap means that, in the considered sector, exporter i has a higher (lower) than the mean propensity to price-to-market. If positive (negative) PTM gaps dominate for country i, one can say that this exporting country structurally has a higher (lower) propensity to PTM. This comparison is run using only those coefficients that are significantly different from zero at the 10% level and estimated with a degree of freedom higher than 100, for results no to be affected by badly estimated coefficients.

Combining the results of both analyses described *supra* allows to clean up the results from sectoral composition effects, and to investigate the "structural" dimension of the observed behavioral cross-country differences commented in the previous section. In the following, we first focus on "structural" differences in PTM across exporters (section 5.1.1), next on the pass-through (section 5.1.2).

5.1.1 PTM gaps

We first investigate differences in pricing-to-market across exporters. Therefore, estimated PTM coefficients are regressed on a complete set of product- and country-specific effects, according to (7). As far as country-specific effects are concerned, it is actually possible to underline country-specific asymmetries in PTM behaviors, as evidenced in Table 5, where country-fixed effects are displayed.

[35]This risk is especially high for Canada, the United States and China for which we obtained a significant number of negative PTM elasticities, which are difficult to rationalize in the context of our model.

Table 5: "Pure" exporter-specific PTM coefficients

Exporter	**Estimated fixed effect**	**Standard Error**
Others OECD	-0.249	(0.034)
Canada	-0.093	(0.033)
China	-0.071	(0.031)
USA	-0.051	(0.018)
BRI[a]	0.038	(0.053)
Germany	0.138	(0.016)
Korea	0.172	(0.035)
RoW[b]	0.175	(0.020)
Switzerland	0.192	(0.046)
Medium EU15	0.203	(0.023)
Japan	0.220	(0.019)
France	0.274	(0.026)
Italy	0.278	(0.029)
Spain	0.282	(0.040)
New EU members	0.286	(0.052)
United Kingdom	0.309	(0.030)
Small EU15	0.310	(0.028)

[a] Brazil, Russia and India
[b] Rest of the world
Source: Authors' calculation.

Actually, Table 5 confirms that European exporters display higher propensity to price to market (German ones being an exception). Since these coefficients are not affected by sectoral composition effects, this results can be interpreted in terms of market power, thus suggesting that competitive pressures faced by European exporters are strong enough for them to be forced to absorb currency shocks into their mark-ups. On the other hand, negative country-specific coefficients obtained for the group of "Other OECD countries" as well as for Canada, China and the United States confirm the weak capacity of the model to explain pricing strategies of exporters from these countries.
It should be noted however that country-specific fixed effects account for a very limited share of the variance explained by this simple model (5.3% compared to 94.7% for product-specific fixed effects).

Part of the cross-country differences in PTM estimates could however be due to the presence of outliers in the distributions of estimates. To further investigate this issue, exporter-specific PTM coefficients are compared at the most detailed level to the corresponding product-level means. These "PTM gaps" are summarized in Figure 6 that displays, for each exporting country, the weighted median, lower and upper quartiles and extreme values of the distribution of $(\hat{\beta}^{ic} - \hat{\beta}^{c})$.[36]

[36]As PTM gaps are summarized by the weighted moments of each distribution, results again reflect composition effects and are thus difficult to compare with fixed effects in Table 5. However, it seems to us preferable to weight these moments, to capture something of the "aggregate" reality. A more detailed picture of the results is provided in Appendix A.4 where the unweighted distribution of PTM gaps, for

Figure 6: Distribution of PTM gaps, by exporting country

(black circle: weighted median, grey box: weighted interquartile range, – : extreme values)

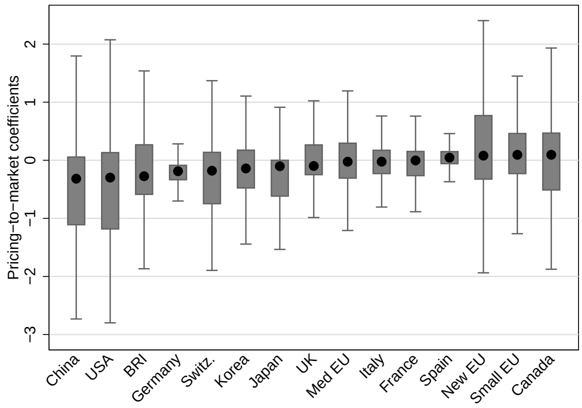


Figure 6 shows that most of the considered exporting countries do not systematically display a different pricing-to-market behavior, compared to the others: except in Germany and Japan, where more than 75% of exports involve negative PTM gaps (thus reflecting a lower propensity to price-to-market in the corresponding sectors), each distribution contains a significant number of positive (negative) values, reflecting a relatively strong (low) propensity to price-to-market in the corresponding industries.[37] This product-level evidence suggests that the observed cross-country PTM differences observed at the global level reflect more composition effects than structural country-specific factors - a conclusion which is consistent with the fact that the share of variance in PTM coefficients that is explained by country-specific fixed-effects remains limited.

each exporting country, is displayed.

[37]The Chinese and US estimates are often below the average also. However, this result should be considered cautiously, since it is mostly due to the high share of negative coefficients in the corresponding estimated distributions of PTM elasticities. This feature reflects the already noticed mitigated capacity of the theoretical model to explain these countries' pricing strategies rather than a true lower propensity to price-to-market.

5.1.2 Pass-through gaps

In this section, we apply the same methodology to product-specific pass-through coefficients to investigate whether some importers structurally display lower/higher ERPT than others. Importer- and product-specific pass-through coefficients are first regressed according to (8). Once again, the variance explained by this model is mainly attributable to industry-specific fixed effects (97.6% compared to 2.4% for country-specific effects). Moreover, estimated importer-specific fixed effects displayed in Table 6 suggest something different than the descriptive statistics in Table 4 (that reflect composition effects as well as structural features). Once estimates are cleaned from sectoral composition effects, the "country-specific" pass-through increases for the groups of "Other OECD countries" and "Medium EU15 members" as well as for the UK, Switzerland and Canada, whereas it is reduced in Japan and Korea. This suggests that, apart from composition effects, the pass-through is especially low in Spain, the United States, Canada and, above all, Japan. In brief, there are significant differences in pass-through coefficients across importing countries, but these are of limited magnitude compared to differences across industries.

Table 6: "Pure" country-specific PT coefficients

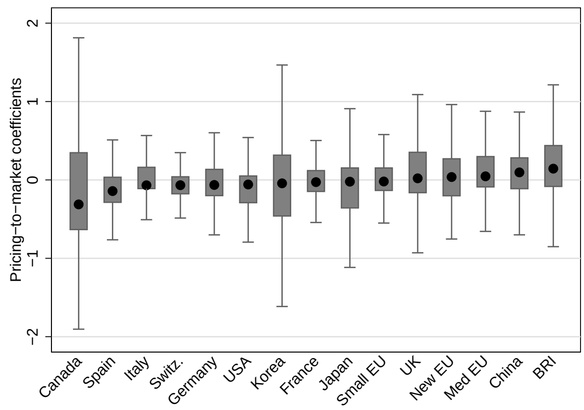
Importer	Estimated fixed effect	Standard error
Japan	0.707	(0.019)
Canada	0.731	(0.025)
USA	0.740	(0.011)
Spain	0.747	(0.025)
Switzerland	0.802	(0.031)
Germany	0.808	(0.013)
Korea	0.837	(0.029)
China	0.868	(0.029)
Italy	0.868	(0.023)
France	0.884	(0.019)
RoW[a]	0.890	(0.011)
Small EU15	0.902	(0.019)
New EU Members	0.930	(0.031)
Medium EU15	0.941	(0.016)
United Kingdom	0.957	(0.019)
BRI[b]	0.984	(0.036)
Others OECD	0.996	(0.021)

[b] Rest of the world
[a] Brazil, Russia and India
Source: Authors' calculation.

Going further into details, Figure 7 hereafter illustrates the comparison of importer-specific PT estimates with the product-specific means (the sectoral "PT gaps"), summarized by the median, lower and upper quartiles and extreme values of the importer-specific weighted distributions of ($\hat{\gamma}^{jc} - \hat{\gamma}^{c}$). These statistics are supplemented in appendix A.5 with the kernel estimates of each distribution. Here, no country seems to exhibit lower or higher pass-through in a systematic way, even though Spain, Switzerland and the United States tend to display lower pass-through rates whereas China and the medium European countries must bear a higher share of currency changes.

On the whole, these exercises suggest that using the whole distribution of estimated coefficients does not allow to draw a strong general conclusion about country-specific features in terms of pass-through or pricing-to-market. Indeed, aggregate results reflect both composition effects and structural features, and disentangling them is difficult. In order to deepen the analysis of the determinants of pricing strategies, we follow the suggestion by Goldberg & Tille (2005), and look for the role of macroeconomic variables in explaining incomplete pass-through coefficient at the most detailed industry-level (i.e. $hs4$). This avoids composition effects to affect the analysis. In the following, we apply this strategy and formally test the influence of macroeconomic variables on the import pass-through, using the sectoral dimension of our estimates.

Figure 7: Distribution of PT gaps, by importing country



5.2 Macroeconomic Determinants

The theoretical literature suggests that various macroeconomic factors could influence pass-through at the microeconomic level. One of the main advantages of our approach is that it allows us to investigate such arguments using product-level ERPT/PTM coefficients, that also take into account the structural dimension of the phenomenon. In the following, we focus on three potential determinants featuring the destination market, that have often been argued to influence the extend of pass-through: the macroeconomic volatility, the extent of market integration and the size of the destination market.

5.2.1 Theoretical intuitions

A number of theoretical papers relate the size of the pass-through to the volatility of its nominal exchange rate. The direction of this influence is however not clear. For instance, Froot & Klemperer (1989) suggest that PTM may be stronger when the nominal exchange rate is highly volatile and exporters try to hold their market share. On the contrary, Engel (2005) argues that a firm chooses a strategy of local-currency price stability (implying zero pass-through in the short run) if the variance of the exchange rate is low enough. In concrete terms, this ambiguity can be explained as reflecting the trade-off between marginal profit and exported quantity that an exporter faces when determining its price strategy. If the exporter mainly cares about its marginal income, pricing-to-market is costly as it increases the volatility of its marginal profit and this cost is all the higher that the exchange-rate volatility is high. On the other hand, if the exporter is concerned by the quantity it exports (or its market share in the destination market), the PTM benefit is to stabilize the volume of sales and this benefit is larger if the avoided fluctuations of demand are large, as would be the case with a volatile exchange rate.

Another potential determinant of PTM is linked to the degree of market integration. Indeed, as argued by Taylor (2000), the incentive to price-to-market is more pronounced when markets are highly integrated. The suggested mechanism relies on the strong competitive pressures perceived by exporting firms engaged in globalized markets, that force them to be in line with their competitors' prices. Such a mechanism can be tested using the natural experiences of regional integration. For instance, Anderton (2003) compares the pass-through into UE members' imports prices, distinguishing imports from other countries of the European Union and imports from the rest of the world. Consistent with Taylor's argument, he finds that the long-run pass-through tends to be higher for imports from non-UE countries. Here also however, the impact of market integration on the pass-through is likely to be product-specific. Indeed, liberalizing trade is likely to have differentiated effects depending on the specific market structures featuring each industry. For instance, if products are highly differentiated, the entry of new competitors following the market integration is likely to have less effect on firms' pricing decisions than for homogeneous goods.

Last, aggregate estimate[38] often underlines the apparent link between the pass-through into import prices and the "size" of the country: wealthier countries tend to display lower pass-through than developing countries. A structural interpretation of this empirical regularity lies in the impact of the market potential of the destination country on pricing decisions. Indeed, the risk of demand that fully passed-through exchange-rate fluctuations engender is higher, the larger is the market from the exporter's point-of-view. As a consequence, the incentive to PTM should be higher towards countries that are large in terms of their market potential.

These intuitions are formally tested in the following, where estimated product-and-importer-specific PT coefficients are explained by macroeconomic variables.

5.2.2 Econometric analysis

In this paragraph, we formally test the influence of the three aforementioned macroeconomic variables on the size of the pass-through. To this aim, we regress the estimated importer- and product-specific pass-through coefficients ($\hat{\gamma}^{jc}$) on:[39]

- a complete set of $hs4$-specific fixed effects, that controls for the product-specific dimension of the phenomenon,

[38] See for instance, Campa & Goldberg (2004).

[39] Where $\hat{\gamma}^{jc} = 1 - \hat{\beta}^{jc}$, and $\hat{\beta}^{jc}$ is estimated from equation (6).

- the nominal volatility of j's currency towards the US dollar ($ERVol^j$ in %),
- j's mean GDP per capita during the estimation period ($LCGDP^j$, logarithm of the GDP per capita in PPP),
- an indicator of what Baldwin, Forslid, Martin, Ottaviano & Robert-Nicoud (2005) call the "phi-ness" of trade which ultimately reflects j's global integration in world markets.

All details concerning the source of these data are provided in Appendix. As for the measure of "phi-ness", we use Head & Mayer's (2004), originally computed at the sector level for each pair of partners (ϕ^{ijk}) by using the intensity of observed bilateral trade flows as an indicator of the freeness of trade between i and j in industry k. As our pass-through estimates only have a j dimension however, we use the weighted median of the ϕ^{ijk} across exporters as an indicator of j's mean integration on the world market for product k. Moreover, as the matching between our hs nomenclature and Head & Mayer's (2004) $ISIC$ one is highly imperfect, we chose to drop the sectoral dimension of this measure and aggregate the previous ϕ^{jk} across sectors through a weighted median calculation. This provides us with a measure of "phi-ness" which only has a j dimension (ϕ^j).
The general form of the equation is the following:

$$\hat{\gamma}^{jc} = MACRO^j + fix^c + \varepsilon^{jc} \tag{11}$$

where $MACRO^j$ is a matrix containing the j-specific macro determinants to be tested and fix^c is the vector of sector-specific fixed effects. The estimation is run using a weighted OLS method, where weights are the inverse of estimated standard errors.[40] The results are summarized in Table 7.

[40]This weighting scheme has been chosen in order for badly estimated coefficients to be given a smaller weight in the regression.

Table 7: Macro determinants of product-specific pass-through coefficients

Model	**1**	**2**	**3**	**4**	**5**	**6**	**7**
Intercept	0.71^{***}	1.49^{***}	0.80^{***}	1.41^{***}	0.75^{***}	1.31^{***}	1.37^{***}
	(.249)	(.273)	(.233)	(.260)	(.233)	(.253)	(.260)
$ERVol^j$	1.99^{***}			-0.10	1.08^{***}		-0.25
	(.280)			(.253)	(.191)		(.259)
$LCGDP^j$		-0.08^{***}		-0.07^{***}		-0.06^{***}	-0.06^{***}
		(.007)		(.008)		(.006)	(.008)
ϕ^j			-1.07^{***}		-0.67^{***}	-0.34^{**}	-0.37^{***}
			(.111)		(.131)	(.134)	(.137)
Fixed effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Nb Obs	18793	17680	18793	17680	18793	17680	17680
Adjusted R^2	14.0%	14.0%	17.7%	18.1%	17.9%	18.1%	18.1%

**,*** means significance at the 5 and 1% level respectively.
Source: Authors' calculations.

These estimations provide us with interesting results, though we only explain a limited share of ERPT discrepancies. Table 7 suggests that the pass-through is higher:

- in highly volatile environments, consistently with Engel (2005),
- in poorer countries, because of a lower risk of demand,
- and in less integrated markets, probably because market integration enhances competitive pressures thus forcing firms to align their price on their competitors'.

These results are robust to the simultaneous introduction of macroeconomic variables in a single estimation, although nominal volatility becomes non-significant when combined with GDP per capita. This probably reflects a problem of multi-collinearity between nominal exchange-rate volatility and GDP per capita as the correlation between these series (-0.4) is significantly negative.[41]

6 Conclusion

The incomplete pass-through phenomenon is rooted in the micro-economic behavior of firms facing imperfect competition. While this phenomenon is often empirically investigated using aggregate data, it is obviously caught more properly by product-level analysis.

In this paper, we use the BACI database to investigate incomplete pass-through at the product level, for a large number of countries. This database, which is built using COMTRADE data, provides harmonized trade data at the $hs6$ level, which allows for consistent analysis of both import pass-through and pricing-to-market in export prices.

The empirical analysis suggests that the long-run pass-through in import prices is quite high, close to one on average in the whole sample. This however hides a strong cross-sector heterogeneity. Indeed, when all countries are pooled together, a high share of PTM coefficients (between 30 and 40%) are not significant, which can be interpreted as reflecting complete

[41] Alternatively, this could also be the sign of a spurious estimation due to a reverse causality from pass-through to exchange-rate volatility. Indeed, in NOEM models, PTM is introduced to explain the volatility of real exchange rates and their unexplained correlation with the nominal exchange rate. As a consequence, the exchange-rate volatility could be argued to be endogenous, though it is quite unlikely as we explain *product-level* pass-through coefficients by the *aggregate* exchange-rate volatility with respect to the dollar.

pass-through of exchange-rate changes into import prices. When PTM coefficients are significant, we still find evidence of exchange-rate pass-through, but the magnitude of the phenomenon strongly varies across products. For instance, we find evidence of strong PTM in sectors such as chemistry, food, optical good, electronic machinery, etc.
On the export side, we find PTM differences to be quite pronounced, even when controlling for sectoral composition effects. For instance, Germany is shown to price little to market, unlike other European countries. On the import side, when allowing the pass-through to vary across importers of a given product, pass-through is shown to be on average all the higher that the importer is small. Further investigating this point however reveals that these differences are mainly attributable to sectoral composition effects.
Last, investigating the link between the pass-through and several macroeconomic determinants, we find that pricing-to-market tends to be more pronounced where

i) the exchange rate is little volatile, meaning that exporters are less reluctant to adjust their margins to currency changes when these fluctuations are limited,

ii) the market potential is large enough, leading exporters to PTM in order to preserve their market share,

iii) markets are integrated, in what case competitive pressures force exporters to be in line with the destination market price.

In comparison with product-specific determinants, these macroeconomic influences are however shown to have a small power in explaining estimated pass-through coefficients. Actually, almost all the variance in estimated PTM coefficients can be explained by product-specific effects. This calls for a further work on the microeconomic determinants of the incomplete pass-through phenomenon.

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A.1. Theoretical framework

Pricing-to-market in a monopolistic competition framework

Suppose country i produces good k within a monopolistic framework. The good is sold to different segmented markets j, where producers are therefore able to differentiate export prices according to the destination. At time t, the optimal destination-specific export-price , in the producer's currency, can be written as:

$$P_t^{ijk} = MC_t^{ik}\mu_t^{ijk}$$

with

- MC_t^{ik} the marginal production cost, which is supposed to be identical across destinations ($MC_t^{ijk} = MC_t^{ik}, \forall\, j$)
- μ_t^{ijk} the producer mark-up, which depends on the elasticity of demand to the price in local currency :

$$\mu_t^{ijk} = \frac{\eta_t^{ijk}(P_t^{ijk}/S_t^{ij}, Z_t^{jk})}{\eta_t^{ijk}(P_t^{ijk}/S_t^{ij}, Z_t^{jk}) - 1}$$

  where η_t^{ijk} is the price-elasticity of demand, which depends on the price in domestic currency (P_t^{ijk}/S_t^{ij} with S_t^{ij} the bilateral exchange rate in i's currency per unit of j's), and possibly on demand-specific variables (summarized by the vector Z_t^{jk}).

First-differentiating with respect to the different variables leads to the following expression, explaining the exporter's price for sales in market j by the marginal cost to produce, the price-elasticity of demand at the steady point, the demand-specific determinants of price-elasticity and the nominal exchange-rate[42]:

$$p_t^{ijk} = (1-\beta_{MC}^{ijk})mc_t^{ik} + (1-\beta_{MC}^{ijk})\ln\left(\frac{\eta^{ijk}}{\eta^{ijk}-1}\right) + \beta_{MC}^{ijk}s_t^{ij} - \gamma_{MC}^{ijk}z_t^{jk}$$

where $\beta_{MC}^{ijk} = \frac{\xi^{\eta^{ijk}}_{P_t^{ijk}/S_t^{ij}}}{\eta_t^{ijk}-1+\xi^{\eta^{ijk}}_{P_t^{ijk}/S_t^{ij}}}$ with $\xi^{\eta^{ijk}}_{P_t^{ijk}/S_t^{ij}} = \frac{\partial \ln \eta_t^{ijk}}{\partial \ln P_t^{ijk}/S_t^{ij}}$

and $\gamma_{MC}^{ijk} = \frac{\xi^{\eta^{ijk}}_{Z_t^{jk}}}{\eta_t^{ijk}-1+\xi^{\eta^{ijk}}_{P_t^{ijk}/S_t^{ij}}}$ with $\xi^{\eta^{ijk}}_{Z_t^{jk}} = \frac{\partial \ln \eta_t^{ijk}}{\partial \ln Z_t^{jk}}$

In his equation, $\beta_{MC}^{ijk} = \frac{\partial p_t^{ijk}}{\partial s_t^{ij}}$ measures the sensitivity of export prices to exchange-rate changes (therefore, it is the pricing-to-market or PTM coefficient) which is inversely related to the magnitude of the pass-through : it is null when the pass-through is complete and unitary when currency changes are fully absorbed into margins, leaving the local currency price unchanged. As detailed in Knetter (1989), this coefficient depends on the firms' perception of how demand elasticities change with respect to the local currency price. A sufficient condition for the pass-through to be complete is that of a constant behavior of the elasticity of demand, with respect to the price in the destination market ($\xi^{\eta^{ijk}}_{P_t^{ijk}/S_t^{ij}} = 0$). Under the alternative hypothesis, the mark-up depends on the price level, in local currency, and the optimal

[42] Lowercase letters refer to the natural logarithm of the corresponding variables.

pass-through is incomplete. In particular, mark-up adjustments partially offset exchange-rate changes when the PTM coefficient is positive. Since, from the second-order condition[43], $\xi^{\eta^{ijk}}_{P^{ijk}_t/S^{ij}_t}$ is positive when the price-elasticity is positive, one can expect this to occur when the elasticity of demand with respect to the local currency price is strong enough (namely when $\eta^{ijk}_t > 1 - \xi^{\eta^{ijk}}_{P^{ijk}_t/S^{ij}_t}$). On the other hand, even if less likely, one cannot rule out the possibility of a negative pass-through coefficient, leading to an over-reaction of export prices to exchange rate movements, which is optimal with an increasing but weak elasticity of demand ($\eta^{ijk}_t < 1 - \xi^{\eta^{ijk}}_{P^{ijk}_t/S^{ij}_t}$).

Thus, in a monopolistic framework, the optimal pass-through depends on the perceived elasticity of demand: in most cases, it is positive when the price-elasticity is increasing in the local price.

However, as shown *infra*, generalizing the theoretical framework leads to a richer explanation of pass-through strategies, that does not entirely rely on the perceived elasticity of demand but also on market structures. Such an explanation could help to explain part of the cross-country heterogeneity in pass-through strategies observed on narrowly defined prices.

Oligopolistic competition

The monopolistic competition framework is only a special case of oligopolistic competition. Further generalizing the theoretical framework, by taking oligopolistic competition into account, is therefore of interest. Moreover, the oligopolistic framework is better suited to the available data. Because data availability forces to identify each exporting country to a representative firm, the number of producers for a given product is de facto constrained, and the market is therefore better described by an oligopolistic competition hypothesis.

In an oligopolistic framework under Cournot competition, the optimal margin depends on the price elasticity of demand as well as on the market share of i's representative firm in the destination market j:

$$\mu^{ijk}_t = \frac{\eta^{ijk}_t}{\eta^{ijk}_t - \omega^{ijk}_t}$$

with $\omega^{ijk}_t = \frac{Q^{ijk}_t}{\sum_i Q^{ijk}_t}$ i's market share in j and Q^{ijk}_t the demand addressed by j to the producer i.

Using the same method and notations as previously, the destination-specific export price equation is the following :

$$p^{ijk}_t = (1-\beta^{ijk}_{OC})mc^{ik}_t + (1-\beta^{ijk}_{OC})\ln\left(\frac{\eta^{ijk}}{\eta^{ijk} - \omega^{ijk}}\right) + \beta^{ijk}_{OC}s^{ij}_t - \frac{\xi^{\eta^{ijk}}_{Z^{jk}} - \xi^{\omega^{ijk}}_{Z^{jk}}}{\xi^{\eta^{ijk}}_{P^{ijk}/S^{ij}} - \xi^{\omega^{ijk}}_{P^{ijk}/S^{ij}}}\beta^{ijk}_{OC}z^{jk}_t$$

Where $\beta^{ijk}_{OC} = \frac{\partial p^{ijk}_t}{\partial s^{ij}_t} = \frac{\omega^{ijk}_t(\xi^{\eta^{ijk}}_{P^{ijk}/S^{ij}} - \xi^{\omega^{ijk}}_{P^{ijk}/S^{ij}})}{\eta^{ijk}_t - \omega^{ijk}_t + \omega^{ijk}_t(\xi^{\eta^{ijk}}_{P^{ijk}/S^{ij}} - \xi^{\omega^{ijk}}_{P^{ijk}/S^{ij}})}$ is the theoretical PTM coefficient and $\xi^{\omega^{ijk}}_{P^{ijk}/S^{ij}} = \frac{\partial \ln \omega^{ijk}_t}{\partial \ln(P^{ijk}_t/S^{ij}_t)}$ the sensitivity of the market share to the local price, which is a priori negative.

[43] The second-order condition of the profit maximization can be written as : $2\eta^{ijk}_t \leq \xi^{\eta^{ijk}}_{P^{ijk}_t/S^{ij}_t}$

In an oligopolistic framework, $\xi^{\eta^{ijk}}_{P^{ijk}/S^{ij}} = 0$ is no more a sufficient condition for complete pass-through. $\beta^{ijk}_{OC} = 0$ requires the price sensitivity of the demand elasticity to equal the elasticity of the exporter's market share to price changes, which is unlikely. On the contrary, β^{ijk}_{OC} should be positive if the demand is elastic enough.[44]

In such a setting, the optimal pass-through still depends on the perceived elasticity of demand but also on the exporter's market share in the foreign market. The direction of this relation is however ambiguous, as

$$sign\left(\frac{\partial \beta^{ijk}}{\partial \omega^{ijk}}\right) = sign\left(\eta^{ijk}_t(\xi^{\eta^{ijk}}_{P^{ijk}/S^{ij}} - \xi^{\omega^{ijk}}_{P^{ijk}/S^{ij}}) - \omega^{ijk}_t \frac{\partial \xi^{\omega^{ijk}}_{P^{ijk}/S^{ij}}}{\partial \omega^{ijk}}(\eta^{ijk}_t - \omega^{ijk}_t)\right)$$

In the general case, the sign of this derivative is positive, i.e. the exchange-rate pass-through decreases when the market share of the exporter grows. This relation is due to the fact that the exporter's mark-up increases with her market share, which gives her a wider room for maneuver to absorb exchange-rate shocks. However, if the price-elasticity of the market share is increasing in the market share ($\frac{\partial \xi^{\omega^{ijk}}_{P^{ijk}/S^{ij}}}{\partial \omega^{ijk}} > 0$) and the price-elasticity of demand is low enough, compared to the market share, the sign of this derivative can reverse. One could then possibly observe a negative relation between β^{ijk}_{OC} and ω^{ijk}_t, in a framework of quasi-monopoly and low demand elasticity (for instance, in high-grade sectors). In that case, the producer need not adjust her prices to exchange-rate changes, since the demand risk is low. Under weak assumptions on the functional form of demand, Feenstra, Gagnon & Knetter (1996) show that the pass-through elasticity *"might initially decline as market share rises, but will increase towards unity as market shares approaches 100 percent"* and find some evidence of such a bell shape relation in the automobile industry.

A.2. Data appendix

Composition of the country groupings

The BACI database provides data for 130 countries. Because constraints are imposed to the quality of the estimates, results are available for a more limited set of countries (around 70). For simplicity, a number of small countries are pooled together when the results are displayed. The composition of the groupings is the following :

- Small EU15 : Denmark, Finland, Greece, Irland, Luxembourg, Portugal and Austria,
- Medium EU15 : Netherlands, Sweden, Belgium,
- New EU Members : Cyprus, Czech Republic, Estonia, Hungary, Latvia, Lithuania, Malta, Poland, Slovak Republic, Slovania,
- Other OECD : Australia, Island, Mexico, New Zealand, Norway, Turkey.

Macroeconomic Variables

The **Nominal Exchange-Rate Volatility** has been computed using IMF's data of nominal bilateral exchange-rates with respect to the dollar, provided in a monthly frequency in the

[44] $\beta^{ijk}_{OC} > 0$ as long as $\eta^{ijk}_t > \omega^{ijk}_t - \xi^{\eta^{ijk}}_{P^{ijk}/S^{ij}} + \xi^{\omega^{ijk}}_{P^{ijk}/S^{ij}}$.

International Financial Statistics. From those monthly series, the annual standard deviations of monthly bilateral exchange-rate changes are computed for each country and each year:

$$NERVol_t^{i\$} = SE_t(d \ln S_{mt}^{i\$})$$

with $S_m^{i\$}$ the bilateral exchange-rate between country i and the United States during the month m of year t and d the one-month difference operator. In paragraph 5.2.2., as the regression has no time dimension, we averaged the nominal exchange-rate volatility with respect to the dollar across years.

The **GDP per capita** series have been obtained from the Penn World Tables (Bettina Aten & Summers (2002)) and correspond to the Real Gross Domestic Product per Capita in PPP. These series are averaged across periods before being used in regressions of paragraph 5.2.2. The indicator of **"phi-ness"** were kindly provided by Thierry Mayer. A detailed description of its construction can be found in Head & Mayer (2004). To measure this indicator, Keith Head and Thierry Mayer used World Bank and OECD data on observed bilateral trade flows between country pairs at the sector level:

$$\phi^{ijk} = \sqrt{\frac{m_{ijk} m_{jik}}{m_{iik} m_{jjk}}}$$

where i and j are the considered countries, k is a sector, m_{ijk} is the value of imports of goods k by country i from country j and m_{iik} is the value of i's "imports" from itself. Theoretically, ϕ^{ijk} lies between 0 and 1 and increases when i and j's markets of good k become more integrated. The authors use the 3-digits ISIC classification. Combining this nomenclature with ours ($hs4$) would imply ignoring a large share of the estimated β^{jc} coefficients because some $hs4$ categories cannot be matched with ISIC sectors. To avoid this, the coefficients were aggregated across sectors. Moreover, as the coefficients we regressed in paragraph 5.2.3. only had a j dimension, we also aggregated them across exporters in a given market. To deal with extreme values, we chose the weighted median as an aggregation method. Our indicator of "phi-ness" is then:

$$\phi^j = WMedian_{i,k}(\phi^{ijk})$$

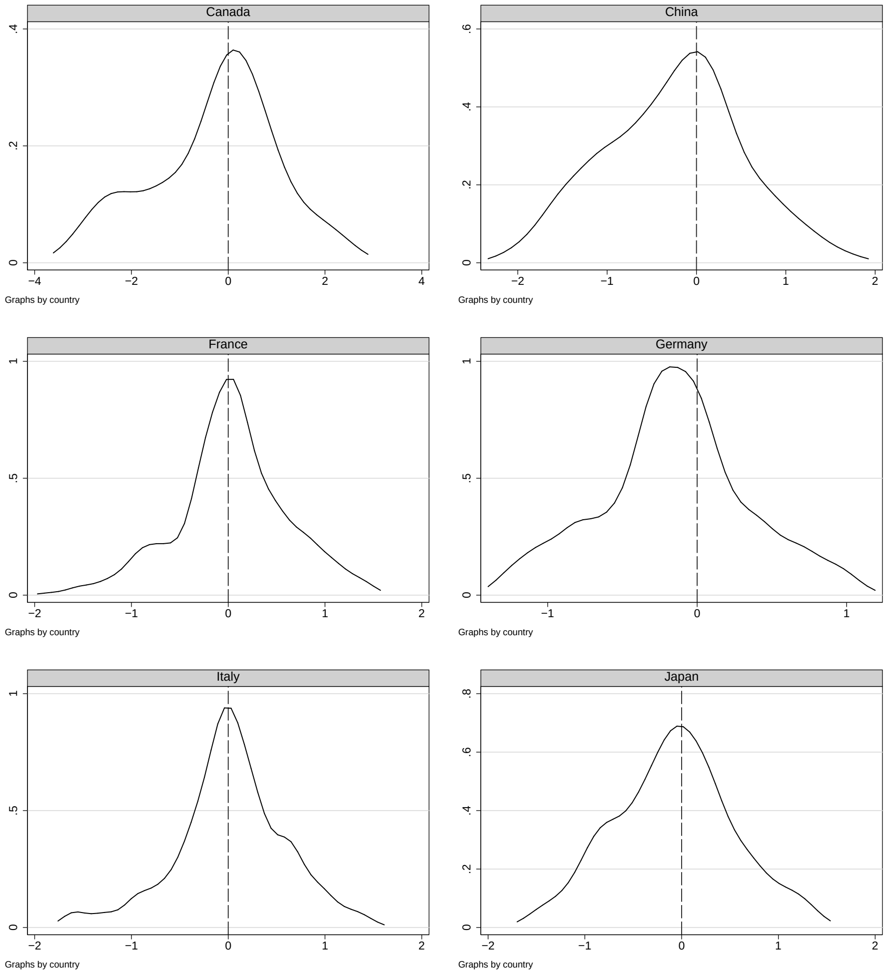
A.3. Sectoral estimates

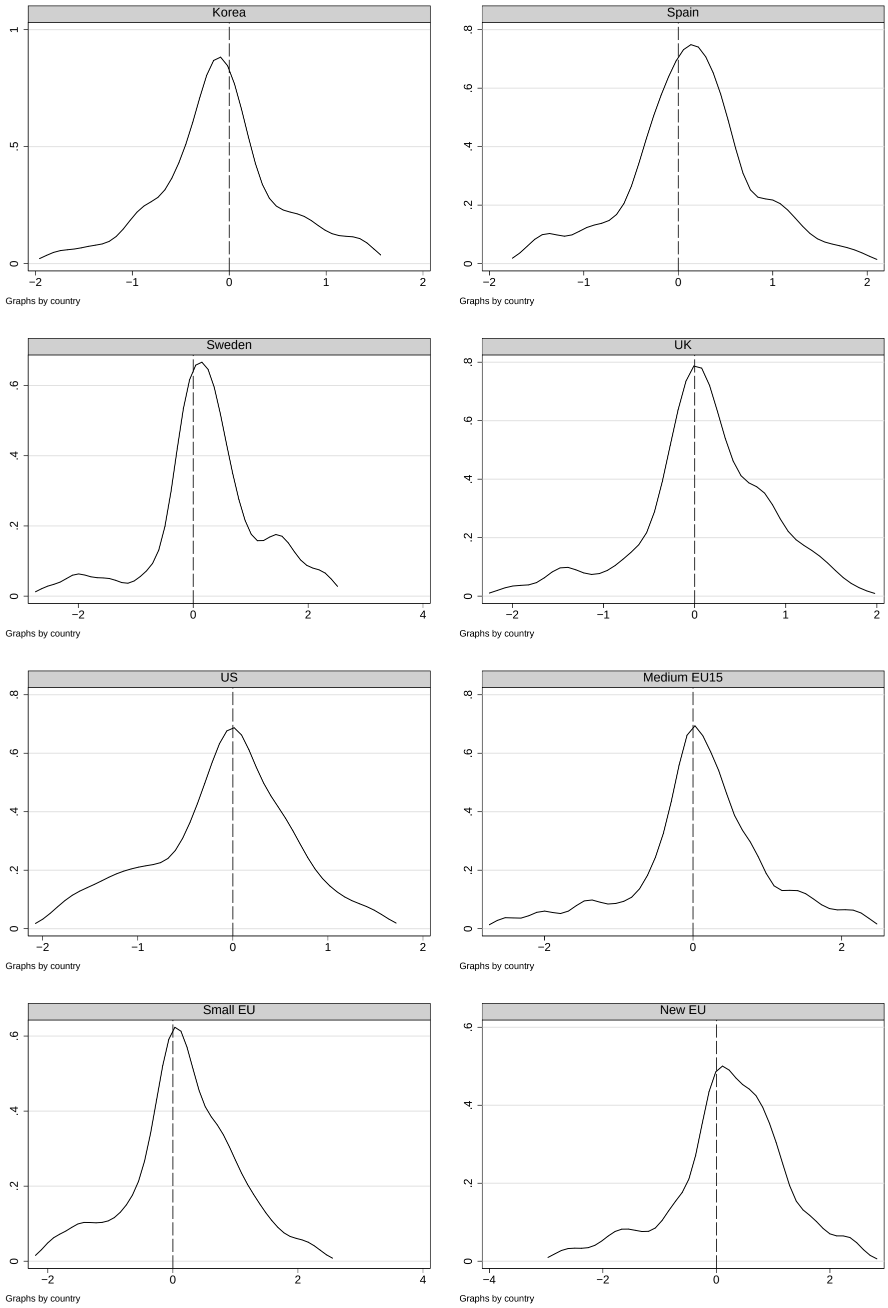
The following table provides a sample of $hs4$ estimated PTM coefficients. These coefficients are significantly different from zero, higher than 0.6 but lower than 1; thus they correspond to theoretically consistent, strong, incomplete pass-through coefficients.

Code	Sector	$\hat{\beta}^c$
1104	Cereal grn o/w workd (ex hulld...)exc rice hd no1006.germ of cereal	0.960
4205	Articles of leather or composition leather, nes	0.954
6212	Brassieres,girdles,corsets,braces,suspenders etc	0.937
3705	Photographic plates & film, exp & developed o/t cinematograph film	0.922
3006	Crust w/n in shell,live,fr....crust in shell ckd in water,w/n chilld..	0.914
5406	Man-made filament yarn (o/t sewing thread), put up for retail sale	0.914
9303	Other firearm & sim dev operating by the firg of an explosive charge	0.902
2932	Heterocyclic compounds with oxygen hetero-atom(s) only	0.867
6808	Panel,board etc of veg fibre,straw etc,agglomeratd w cement etc,binder	0.845
7313	Wire,barbed,twisted hoop,single flat/twisted double of i/s,for fencing	0.840
2938	Glycosides & their salts, ethers, esters & other derivatives	0.839
2810	Oxides of boron. boric acids	0.835
9005	Binoculars, monoculars. astronomical instruments & mountings thereof	0.827
8112	Beryllium,chromium,germanium,etc, & art of these metal,incl waste & scrap	0.823
8520	Magnetc tape recordr & sound rec app,w/n incorp a sound reprdc device	0.820
2941	Antibiotics	0.809
4903	Children‘s picture, drawing or colouring books	0.798
4105	Sheep/lamb skin leather,without wool on,o/t leather of hd no4108/4109	0.795
3606	Ferro-cerium & o pyrophoric alloy.article of combustible mat a in Note 2	0.792
6810	Articles of cement, concrete or arti stone, w/n reinforced	0.791
2816	Hydroxid & peroxid of magnesium.oxid,hydroxid&peroxid strontium&barium	0.785
4907	Unusd postage,revenue stamps.cheque form,banknote,bond certificate,etc	0.774
4302	Tanned or dressed furskins & pieces, unassembled or assembled	0.773
3706	Cinematograph film, exposed and developed w/o incorp sound track	0.767
2201	Waters, incl nat/arti min/aerated waters not sweet/flav. ice&snow	0.765
2202	Waters,min/aeratd,sweet/flav,nonalc bev exc fruit & veg juice of 20.09	0.764
2933	Halogenated derivatives of hydrocarbons	0.748
5609	Articles of yarn, strip, twine, cordage, rope and cables, nes	0.740
4303	Articles of apparel, clothing access and other articles of furskin	0.738
1213	Cereal straw&husks, unprepared, w/n chopped, ground/pressed/pelleted	0.729
5504	Artificial staple fibres,not carded,combed/o/w processed for spinning	0.721
8539	Electric fi/dschg lamps,incl sealed beams&ultra-violet lamps.arc-lamps	0.709
9612	Typewriter/sim ribbons, inked/o/w prepr for giving impress, ink pads	0.666
6909	Ceram ware for lab,chem/o tech use.ceram trough... for agr.ceram pot..	0.663
2826	Fluorides.fluorosilicate,fluoraluminates&other complex fluorine salt	0.653
1510	Oils&their fract ne,obt from olive,w/n ref‘d nt chem mod,incl blend	0.651
1007	Grain sorghum	0.645
206	Edible offal of bovine animals,swine,sheep,goats,horses etc,fr,chd/frz	0.639
5108	Yarn of fine animal hair, not put up for retail sale	0.638
1904	Prepard food obt by swelling/roastg of cereal....cereal o/t corn grain	0.631
8007	Tin articles, nes	0.629
1003	Barley	0.628
9618	Tailors‘ dummies/lay figures.automata&other animatd display for window	0.625
7215	Bars & rods of iron or non-alloy steel nes	0.620
5206	Cotton yarn (o/t sewing thread) cntg < 85% by wt of cotton, not put up	0.616

A.4. Exporter-specific distributions of PTM gaps

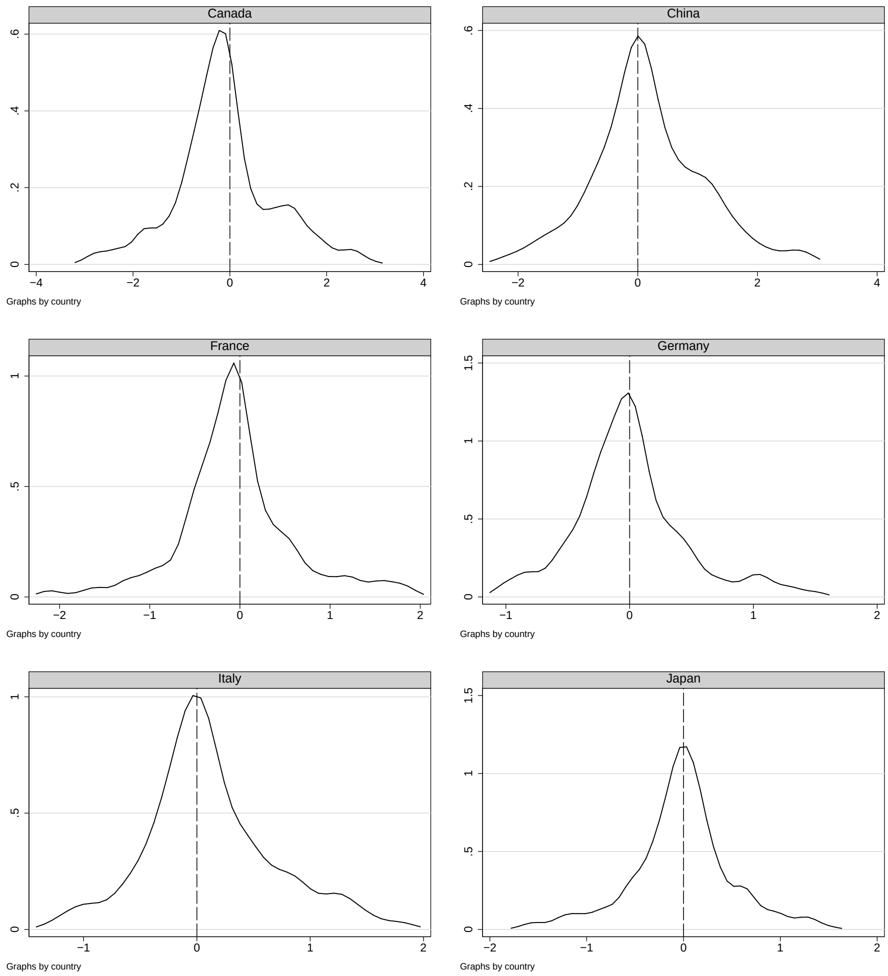
Figure 8: Exporter-specific distributions of PTM gaps

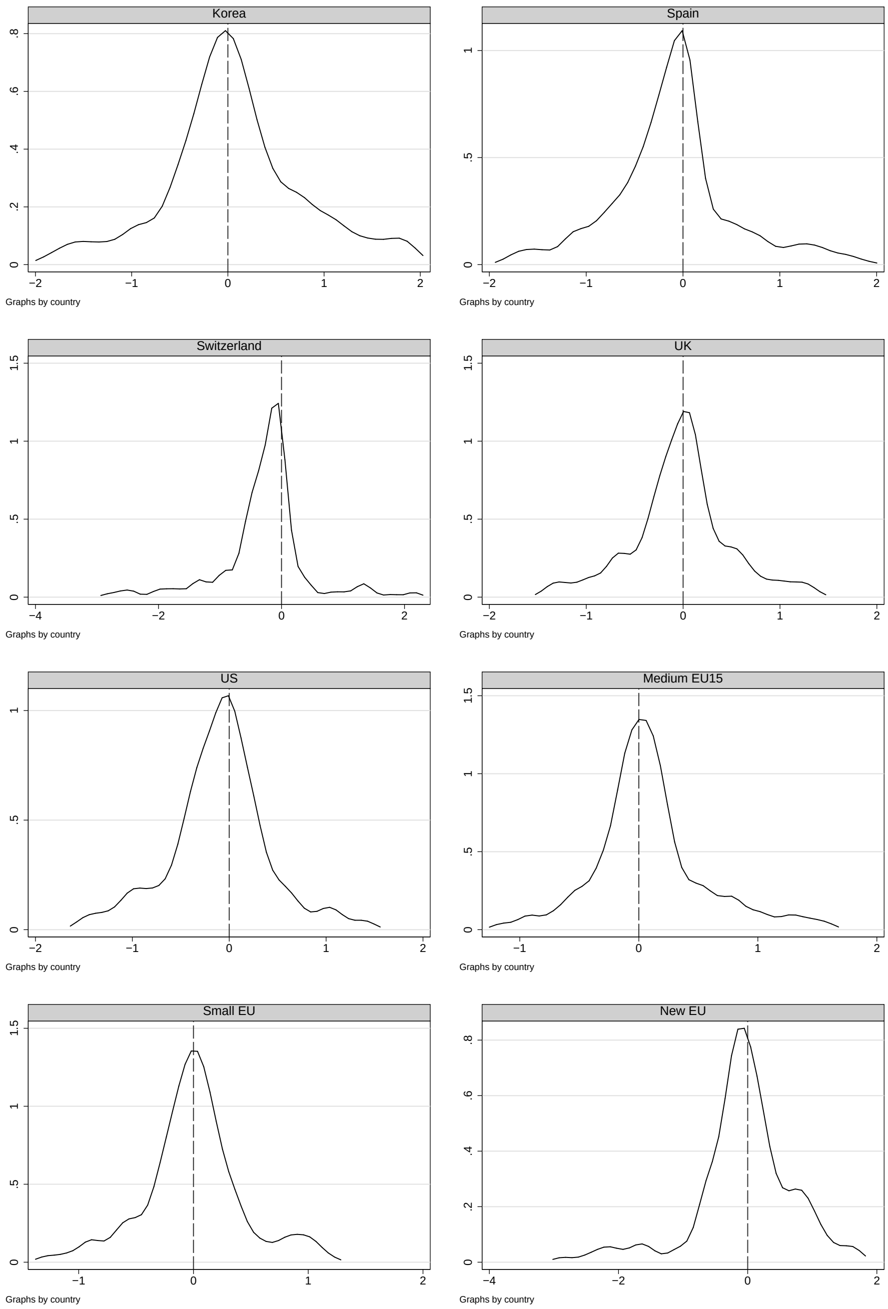



Korea
Spain
Graphs by country
Sweden
UK
Graphs by country
US
Medium EU15
Graphs by country
Small EU
New EU
Graphs by country

A.5. Importer-specific distributions of PT gaps

Figure 9: Importer-specific distributions of PT gaps




Korea
Spain
Switzerland
UK
US
Medium EU15
Small EU
New EU
Graphs by country

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