

# WHY DO CONSUMER PRICES REACT LESS THAN IMPORT PRICES TO EXCHANGE RATES?

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**Philippe Bacchetta**

Study Center Gerzensee,  
University of Lausanne,  
Center for Economic Policy Research

**Eric van Wincoop**

University of Virginia,  
National Bureau of Economic  
Research

## **Abstract**

It is well known that the extent of pass-through of exchange rate changes to consumer prices is much lower than to import prices. One explanation is local distribution costs. Here we consider an alternative, complementary explanation based on the optimal pricing strategies of firms. We consider a model where foreign exporting firms sell intermediate goods to domestic firms. Domestic firms assemble the imported intermediate goods and sell final goods to consumers. When domestic firms face significant competition from other domestic final goods producing sectors (e.g., the nontraded goods sector) we show that they prefer to price in domestic currency, while exporting firms tend to price in the exporter's currency. In that case the pass-through to import prices is complete, while the pass-through to consumer prices is zero. (JEL: F31, F41)

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## **1. Introduction**

The pass-through of exchange rate changes to domestic prices is a key factor in the transmission of shocks and the adequate policy response in open economies. Traditional open-economy macroeconomic models have paid little attention to this. For example, most flexible price monetary models assume full pass-through by assuming purchasing power parity.

Since recent theoretical developments in open-economy macroeconomics are based on microfoundations, they enable a deeper analysis of this issue. In particular, in the literature that follows Obstfeld and Rogoff (1995), and where monopolistic producers preset their prices, a special role is given to the degree of pass-through. In effect, exporters can decide to set their price either in their own currency or in the consumers' currency. These have been referred to as respectively PCP (producer currency pricing) and LCP (local currency pricing).

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E-mail addresses: Bacchetta: [phbacchetta@sgerzensee.ch](mailto:phbacchetta@sgerzensee.ch); van Wincoop: [vanwincoop@virginia.edu](mailto:vanwincoop@virginia.edu)

In the last few years numerous researchers have examined the different implications of the pricing strategies for the impact of shocks, optimal exchange rate and monetary policy, trade, capital flows, and welfare.<sup>1</sup>

Some investigators, such as Betts and Devereux (1996) and ourselves (Bacchetta and van Wincoop 2000), have used evidence of limited pass-through to consumer prices and the resulting close relationship between nominal and real exchange rates, as a justification for models with consumer currency pricing. Others, such as Obstfeld and Rogoff (2000), have argued that the relationship between the terms of trade and exchange rates is consistent with models of producer currency pricing, and inconsistent with models of consumer currency pricing. However, neither the LCP nor the PCP assumption is consistent with both pieces of evidence. The heart of the issue is that the degree of pass-through of exchange rates to consumer prices is much lower than the pass-through to import prices. The former is close to zero [e.g., see McCarthy (1999)], while the median estimate of the latter is about 50 percent.<sup>2</sup> Most models do not make a distinction between the extent of pass-through to import prices and consumer prices.

The recent literature has adopted two, possibly complementary, modeling approaches to account for the lower degree of pass-through to consumer than import prices.<sup>3</sup> In the first approach, imported goods have to go through a distribution sector to reach consumers. If “tradable” goods sold to consumers incorporate a significant share of local value added, consumer prices will not be so sensitive to exchange rate changes. Burstein, Neves, and Rebelo (2002) and Burstein, Eichenbaum, and Rebelo (2002) show that the role of local inputs in the distribution sector is quantitatively important. However, they also show that it cannot fully explain the difference in pass-through.<sup>4</sup>

In the second approach imports are intermediate goods, often mixed with domestically produced goods to produce a final good sold to consumers. In that case pricing decisions are made at two different levels, intermediate goods producers and final goods producers. Obstfeld (2001) presents a framework where there is purchasing power parity, and therefore full pass-through, at the level of intermediate goods producers, but zero pass-through to consumer prices by final goods producers.<sup>5</sup> Final goods producers, who combine domestic and

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1. See Lane (2001) for a survey of New Open Economy Macroeconomics models and Engel (2002) for a survey of the literature on exchange rates and prices.

2. See Goldberg and Knetter (1997) for a review of the literature and Campa and Goldberg (2002) for the most recent evidence.

3. See Engel (2002) for further discussion.

4. Corsetti and Dedola (2002) also consider a model in which the pass-through to consumer prices is lower than to import prices as a result of local distribution costs. In their setup the pass-through to import prices is incomplete as monopolistically competitive exporters take into account that the demand from importers is affected by the presence of local distribution costs.

5. See also McCallum and Nelson (1999).

foreign intermediate goods, are assumed exogenously to set prices in the local currency.<sup>6</sup>

In this paper we propose an explanation for the difference in pass-through based on the firms' optimal pricing strategy. We adopt the second approach, where imported goods are intermediate goods. Although we have no doubt that local distribution costs are an important part of the explanation for the lower degree of pass-through to consumer prices, here we will abstract from that explanation by assuming that imported intermediate goods are not mixed with local value added to produce consumption goods. We follow an approach developed in Bacchetta and van Wincoop (2002), henceforth BW, where firms optimally decide in which currency to preset prices.<sup>7</sup> In our previous work firms sell directly to consumers, so that there is no difference between import and consumer prices. The basic result is that the currency in which prices are set depends on competitive pressure in an industry. When firms face less competition, they are more likely to set prices in their own currency.

We present a highly stylized model in order to better crystallize the point we are making. Monopolistically competitive exporters sell intermediate goods to monopolistically competitive final good producers. In order to sharpen our results we assume that final goods producers only use foreign intermediate goods. We argue that final goods producers are more likely to set their price in the local currency than intermediate goods exporters.<sup>8</sup> Final goods producers need to compete with all the goods purchased by consumers, including non-traded goods. On the other hand, intermediate goods producers only compete with other intermediate goods producers. In this context we show that if the nontradable sector is large enough, a likely equilibrium is that exporters set prices in the exporter's currency and final goods producers set prices in domestic currency, implying full pass-through to import prices and no pass-through to consumer prices. Even though the importing final goods producers face exchange-rate risk on their cost side, they prefer to set the price in domestic currency to avoid large price fluctuations relative to other consumer goods.

Nontradable goods play a crucial role for our results. However, the reason they matter is different from the existing literature, where nontradables are used to produce consumer goods. In our context, nontradables matter by affecting consumer's demand. The model is described in Section 2. Section 3 presents the main results and Section 4 concludes. The full analysis is found in a technical appendix available upon request.

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6. The objective of Obstfeld (2001) is to show that a zero pass-through to consumer prices does not imply that an economy is insulated from exchange rate changes.

7. Other papers that look at the endogenous currency decision include Devereux, Engel, and Storgaard (2002) and Corsetti and Pesenti (2002).

8. The alternative where final goods producers set prices in the exporter's currency may seem rather odd, but it can be thought of as an ex-ante choice of full pass-through. This is along the lines of Corsetti and Pesenti (2001), where firms preset a pass-through function rather than the price itself.

## 2. An Auto-Parts Model

The model is an extension of BW, assuming that exports are not sold directly to consumers, but are intermediate goods, as in Obstfeld (2001). Consider an industry with a continuum of foreign intermediate goods producers of mass one. They sell to a continuum of domestic final goods producers. The final goods producers only use imported intermediate goods as inputs. One can think of an auto-parts model, where imported parts are assembled to produce the final product and no local input is required in this process. There is another final good sector producing a nontradable good involving only domestic inputs. We will refer to the sector that assembles the imported intermediate goods as the final goods sector and the other domestic sector as the nontradables sector, even though they both produce final consumer goods.

### 2.1 Consumers

Domestic consumers derive utility from both a nontradable good and final goods:

$$U = (nc_N^{(\mu-1)/\mu} + (1-n)c_F^{(\mu-1)/\mu})^{\mu/(\mu-1)} \quad (1)$$

where  $0 < n < 1$  measures the size of the nontradable sector in consumption;  $c_N$  is a nontraded consumption good and  $c_F$  is an index of final goods:

$$c_F = \left( \int_0^1 c_i^{(\mu_F-1)/\mu_F} di \right)^{\mu_F/(\mu_F-1)} \quad (2)$$

The elasticity of substitution between final and nontradable goods is given by  $\mu$ , while the elasticity among final goods is given by  $\mu_F$ . If we normalize aggregate demand to one, the optimal demand for final good  $i$  is then given by:

$$c_i = \frac{1-n}{n} \left( \frac{p_i}{p_F} \right)^{-\mu_F} \left( \frac{p_F}{P} \right)^{-\mu} \quad (3)$$

where  $p_i$  is the price of good  $i$ ,  $p_F$  is the price index of final goods, and  $P$  is CPI. We assume that the price of the nontradable good is given (for example because the nontradable sector is competitive and faces a fixed wage).

### 2.2 Final Goods Producers

The output of final good producer  $i$ ,  $Y_i$ , is given by the CES “assembling” function:

$$Y_i = \left( \int_0^1 I_{ij}^{(\mu_I-1)/\mu_I} dj \right)^{\mu_I/(\mu_I-1)(1/\eta_F)} \quad (4)$$

where  $I_{ij}$  are imported intermediate goods from exporter  $j$ ,  $\mu_I > 1$  is the elasticity of substitution among the various intermediate goods, and  $\eta_F \geq 1$  is a convexity parameter in the production function.

Final good producers face demand given by (3). They maximize their expected utility  $EU(\Pi)$ , where  $U(\cdot)$  is concave and profits  $\Pi$  are equal to the value of sales minus the cost of intermediate goods. Final goods producers choose in which currency to preset their price (due to menu costs), at what level to set that price, and how much to purchase from intermediate goods producers. The total demand for imported good  $j$  is given by:

$$I_j = \left( \frac{q_j}{q} \right)^{-\mu_I} Y^{\eta_F} \quad (5)$$

where  $q_j$  is the price of exporter  $j$  expressed in domestic currency,  $q$  is the import price index, and  $Y^{\eta_F} = \int_0^1 Y_i^{\eta_F} di$ .

### 2.3 Exporters

Exporters face the demand given by (5) and have a cost function given by  $w^* I_j^{\eta_I}$ , where  $w^*$  is a constant wage rate in foreign currency and  $\eta_I \geq 1$  is a convexity parameter.

## 3. Optimal Pricing Strategies

We assume that the nominal exchange rate  $S$  (units of domestic currency per unit of foreign currency) is the only random variable and is given exogenously.<sup>9</sup> Since firms set prices before the exchange rate is known, it matters whether the price is set in domestic or foreign currency. A difference in pass-through between import and consumer prices then occurs when exporters are more likely to price in their own currency and final goods producers prefer pricing in domestic currency.<sup>10</sup>

In this section we examine the equilibria where firms choose optimally the currency in which they set their price. Our basic strategy is to assume some currency pricing for both exporters and final goods producers and determine

9. In BW, we consider a general equilibrium model and show that results are similar to a partial equilibrium model if nominal wages are rigid. In this short paper, we only consider partial equilibrium.

10. Formally, we only consider the extreme cases of full or zero pass-through. In an economy with several sectors, the pass-through would be the average across sectors.

under what condition a marginal firm (either foreign or domestic) would deviate from this equilibrium. When a marginal firm has no incentive to deviate, we have a Nash equilibrium.<sup>11</sup>

### 3.1 Exporters

Intermediate goods exporting firms can either set their price in their own currency,  $q_j^*$ , or in the importers' currency,  $q_j$ . Let  $\tilde{\Pi}_j^E(\tilde{\Pi}_j^I)$  denote profits of a marginal firm  $j$  when the price is set in the exporter's (importer's) currency. The profits expressed in foreign currency are:

$$\tilde{\Pi}_j^E = q_j^* I_j^E - w^* \cdot (I_j^E)^{\eta} \tag{6}$$

$$\tilde{\Pi}_j^I = \frac{q_j}{S} I_j^I - w^* \cdot (I_j^I)^{\eta} \tag{7}$$

where  $I_j^E$  and  $I_j^I$  are equal to demand in (5). The demand faced by exporters differs when the price is set in domestic or in foreign currency. Consider (5) and assume that  $q$  and  $Y^{\eta_F}$  are given. Then,  $I_j^E$  depends on  $S$ , as  $q_j = S q_j^*$ , but  $I_j^I$  is constant. In this case, the marginal exporter faces a trade-off between price uncertainty (with importer's currency pricing) and quantity uncertainty (with exporter's currency pricing). As shown in BW (Proposition 2), the preferred strategy in this case depends in particular on the demand price elasticity,  $\mu_I$ , as it determines the degree of quantity uncertainty.

However, in general  $q$  and  $Y^{\eta_F}$  are not constant and are conditional on other firms' pricing. Overall, there are four possible cases, since each sector (intermediate and final goods) can price either in domestic or in foreign currency. Thus, we need to find the optimal pricing strategy for a marginal exporting firm in the four cases.

### 3.2 Final Goods Producers

Domestic producers can set their price either in domestic currency,  $p_i$ , or in foreign currency,  $p_i^*$ . Profits expressed in domestic currency are:

$$\Pi_i^E = S p_i^* c_i^E - q \cdot (c_i^E)^{\eta_F} \tag{8}$$

$$\Pi_i^I = p_i c_i^I - q \cdot (c_i^I)^{\eta_F} \tag{9}$$

where  $c_i^E$  and  $c_i^I$  are given in (3). Here again, demand faced by a marginal firm depends on its pricing strategy. When  $q$  and  $p_F$  are given, a marginal firm prefers

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11. We focus on symmetric and pure equilibria. Equilibria in mixed strategies exist in some cases, but can be shown to be unstable.

pricing in domestic currency as it faces both price and quantity uncertainty when pricing in the exporter's currency. However, when exporters price in their own currency,  $q = Sq^*$ , so that there is also cost uncertainty for domestic goods producers. In this case final goods firms may prefer pricing in the foreign currency to hedge cost risk.

In general, there are again four cases to analyze depending on the pricing strategy of other exporters and final good producers.

### 3.3 Equilibrium

By analyzing the optimal strategy of a marginal firm, we can determine under what conditions the four cases mentioned above are equilibria. We do this for small levels of risk and use the same procedure as in BW (using Lemma 1). The full derivation is tedious and can be found in a technical appendix available upon request. To get clearer insights, we focus on a subset of the cases in the following two propositions.

**PROPOSITION 1:** *Assume that final goods producers set their price in the domestic currency. Then pricing in the exporter's currency is always an equilibrium for the intermediate goods exporting firms. It is the unique equilibrium when  $(\eta_I - 1)\mu_I < 1$  and the Pareto-superior equilibrium otherwise.<sup>12</sup>*

When  $\mu_I$  is large enough, there are two (pure strategy) equilibria as pricing in the importer's currency is also an equilibrium for exporters. However, if exporters can coordinate on the currency in which they set their price, they choose to set the price in their own currency. In that case they will face neither price risk, nor demand risk. There is no demand risk since all competitors set the price in the same currency.

**PROPOSITION 2:** *Assume that exporters set their price in the exporting currency. Then an equilibrium in the final goods sector is given by:*

- Pricing in domestic currency when  $(\eta_F - 1)\mu_F > 1$
- Pricing in the exporter's currency when  $(\eta_F - 1)(\mu_F - 2n\mu) > -1$

The optimal pricing strategy in the final goods sector depends on the size of nontradable goods sector  $n$ . When  $n$  is small, pricing in the exporter's currency is always an equilibrium and we get two equilibria when  $\mu_F$  is large. However, when  $n$  is large the second condition in Proposition 2 does not necessarily hold

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12. Proposition 1 is similar to Proposition 2 in BW when the market share of the exporting country is large. In the current model, the market share is one since final goods producers only use imported intermediate goods.

and the only equilibrium may be pricing in domestic currency. In this case final good producers prefer not to pass through their variation in cost because of the large price fluctuations relative to the nontraded goods sector that it would imply. This scenario becomes more likely the higher the elasticity of substitution  $\mu$  between final goods and nontraded goods and therefore the competition that final goods producers face in the domestic market. This is the extreme case where there is no pass-through to consumer prices and full pass-through to import prices (combined with Proposition 1, we know that this is an equilibrium). Even though Propositions 1 and 2 do not fully characterize all equilibria, they represent the most interesting cases.<sup>13</sup>

#### 4. Conclusions

We have presented a framework where domestic firms import goods priced in foreign currency and sell them in domestic currency. Even though they are subject to exchange rate risk on their cost side, they prefer pricing in local currency due to competitive pressure in the domestic market. Our explanation is complementary to the distribution cost explanation offered in the literature: if the final good also needs domestic inputs in its production, it is even more likely that final goods producers price in domestic currency.

The analysis can be extended in several directions. First, we could consider an alternative industrial structure where exporters and importers engage in bilateral bargaining (e.g., Bilson 1983) instead of monopolistic competition. Second, there might be other reasons for price stickiness than menu costs at the level of producers. Finally, another obvious extension is to introduce the above analysis in a general equilibrium framework.

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13. For example, from the technical Appendix, we see that if exporters decide to price in the importer's currency, the final goods producers will also find it optimal to use their own currency since their cost no longer varies with the exchange rate.



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