Export Destinations and Input Prices: Evidence from Portugal*

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Abstract

This paper investigates whether the destination of exports matters for the input prices paid by firms, using detailed customs and firm-product-level panel data from Portugal. We use exchange-rate movements as a source of exogenous variation in export destinations and find that exporting to richer countries leads firms to pay higher prices for inputs, other things equal. These results are consistent with a model of endogenous input and output quality choices by heterogeneous firms, in which firms sell higher-quality goods to richer countries and producing high-quality outputs requires high-quality inputs.

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1 Introduction

There is mounting evidence of effects of exporting on firm behavior. Although findings on the productivity effects of exporting are mixed (Clerides, Lach, and Tybout, 1998; Bernard and Jensen, 1999; Van Biesebroeck, 2005; De Loecker, 2007), a number of recent studies have found causal effects of exporting on a variety of directly observable outcomes. For instance, Bustos (2011) and Lileeva and Trefler (2010) find effects on technology investments by Argentinian and Canadian firms, respectively, and Verhoogen (2008) finds effects on wages and ISO 9000 certification (an international production standard) in Mexico. At the same time, there is continuing interest among policy-makers in export promotion, and the possible salutary effects of exports on economic performance.

An important question in this literature is whether the destination of firm-level exports matters and if so, why. It is common in the literature to model exporting as operating through scale effects: in the presence of fixed costs, for instance of technology purchases, increases in sales volume due to exports may induce firms to incur the fixed costs (Yeaple, 2005; Bustos, 2011). These effects depend on the volume of exports *per se*, and not the characteristics of specific export destinations. But studies using newly available transaction-level datasets have documented robust cross-sectional correlations between export prices and destination-country characteristics. In Portuguese data, Bastos and Silva (2008, 2010) show that, within narrow product categories, in a given year, firms charge higher "free on board" (f.o.b.) prices for varieties sold to richer countries.[1] Recent papers by Manova and Zhang (2012), Martin (2010), and Görg, Halpern, and Muraközy (2010) document similar cross-sectional patterns for China, France and Hungary, respectively.

While this new evidence is suggestive, the question of why destination matters remains less than definitively resolved. Two potential explanations have received particular attention. It may be that firms may charge different mark-ups in different markets (i.e. they may "price to market"), even for homogeneous goods; in particular, they may charge higher mark-ups in richer markets populated by less price-sensitive consumers. Alternatively, richer consumers may have greater willingness to pay for product quality and this may in turn induce firms to sell higher-quality varieties to richer destinations (Verhoogen, 2008).[2]

[1] The f.o.b. prices in principle should not include transport costs, which are likely to be higher in rich countries. Bastos and Silva (2008, 2010) also find a positive correlation between price and distance, consistent with the Alchian-Allen hypothesis that firms "ship the good apples out" (Hummels and Skiba, 2004).

[2] At a more aggregate level, the idea that consumers in richer countries are more willing to pay for higher-quality

In this paper, we use a rich combination of customs and firm-level price data from Portugal to shed light on these potential explanations for the cross-sectional price patterns. A key empirical challenge is that product quality is unobserved in our data, as in almost all other firm-level datasets.[3] In the absence of direct quality measures, the literature on quality and trade has relied on an accumulation of indirect evidence. Several papers have noted that some sectors in some countries are able to sell larger volumes at higher prices than other sectors, suggesting that that they are producing relatively higher-quality goods (Hummels and Klenow, 2005; Hallak and Schott, forthcoming; Khandelwal, 2010). Using detailed price information from the Colombian manufacturing census, Kugler and Verhoogen (2008, 2012) document that a similar cross-sectional pattern holds at the plant level: on average within narrow product categories, larger plants charge more for their outputs. Although this correlation can also be rationalized by models of endogenous mark-ups on homogeneous goods, Kugler and Verhoogen take advantage of information on the prices of material inputs — in particular, the fact that larger plants also pay more for their inputs, on average — to strengthen the argument that quality differences play an important role.[4]

Building on this previous work, in this paper we focus on the effect of export destination on *input* prices in order to distinguish the pricing-to-market and product-quality explanations for the cross-sectional relationship between destination-country income and output prices. Our key contention is that a product-quality effect of destination-market income is likely to show up in input prices but a pure pricing-to-market effect is not. To strengthen the former intuition, we develop a Melitz (2003)-type heterogeneous-firm model with endogenous input and output quality choices (as in Kugler and Verhoogen (2012)) and an asymmetry between countries in their willingness to pay for product quality (as in Hallak (2006) and Verhoogen (2008)). Using real-exchange-rate changes as a source of exogenous variation in the composition of destination markets at the firm level, we show that increases in the average income level of export destinations lead Portuguese firms to pay higher prices on average for material inputs. We interpret the results as supportive of the hypothesis that increased exporting to richer countries leads firms to raise the average quality of goods they produce, which in turn requires purchasing higher-quality inputs.

This paper is related to an existing paper by Brambilla, Lederman, and Porto (2010). Using

imports has a distinguished history, appearing in Linder (1961), Markusen (1986), Flam and Helpman (1987), and Hallak (2006), among other studies.

[3] A small number of studies have access to detailed product attributes or explicit quality ratings (Goldberg and Verboven, 2001; Crozet, Head, and Mayer, 2009), but such information is typically only available for specific, narrow sectors.

[4] Corroborating evidence is provided in the subsequent paper by Manova and Zhang (2012) mentioned above, which shows that Chinese firms that export to richer destinations pay more for their imported inputs.

firm-level trade-transactions data linked to a firm-level panel survey from Argentina, the authors analyze the effect of the Brazilian devaluation of 1999, which led Argentinian firms to reduce exports to Brazil and increase exports to other destinations — principally the U.S. and Europe. They find that increased exports to rich countries led to higher skill composition and higher wages at the firm level, while increased exports *per se* had no such effect. Relative to that study, our paper makes two main contributions. First, we are able to analyze the effect of export destinations on material input prices, not just labor inputs. Material inputs may be less subject to institutional particularities (for instance in collective bargaining practices) in the determination of prices. Second, we are arguably better able to separate the effects of income and distance. In the Argentinian case, there is a strong positive correlation between the income level of the destination and its distance from the home market, which may make it difficult to identify the effects of income and distance separately (especially if both variables are measured with error and/or income or distance effects are non-linear.) In Portugal, the correlation is reversed.[5] In addition to the papers cited above, our paper is also more broadly related to a growing recent literature on the role of product quality and trade, including Schott (2004), Sutton (2007), Hallak and Sivadasan (2009), Johnson (2012), Baldwin and Harrigan (2011), Iacovone and Javorcik (2009), Eckel, Iacovone, Javorcik, and Neary (2010), Kneller and Yu (2008), Mandel (2010) and Gervais (2010).

2 Theory

This section develops a model of endogenous input and output quality choices by heterogeneous firms in countries that differ in their willingness to pay for product quality, building on the Melitz (2003) framework. The goal is to derive comparative-static predictions for how firms' endogenous output and input quality choices respond to exogenous changes in production costs across countries. The model borrows from Verhoogen (2008) and the first variant of the model of Kugler and Verhoogen (2012) the idea that there is a complementarity between firm "capability" and input quality in producing output quality, such that in equilibrium more-capable entrepreneurs are matched with higher-quality inputs in producing higher-quality outputs.[6] The model has in common with Hallak (2006) and Verhoogen (2008) that consumers in richer countries are more

[5]This paper also has the advantage that we observe export prices, and can confirm that exports to richer countries carry higher prices.

[6]Following Sutton (2007), we use the term "capability" to refer to the Melitz productivity draw in order to avoid confusion below, where we allow the parameter to affect both production costs and quality.

willing to pay for product quality, an idea that dates back at least to the work of Linder (1961).[7]

2.1 Set-up

Consider three countries, Home (h), North (n) and South (s), where we think of North as richer than Home and South as poorer than Home in a manner which will be discussed below. Let i index the location of production and j index the location of consumer purchases. In each country, there are three sectors: (1) a homogeneous-good "outside" sector producing for consumption; (2) a differentiated manufacturing sector producing final goods for consumption; (3) a perfectly competitive intermediate-input sector, producing inputs for the final-good manufacturers. Both the final-good manufacturing sector and the intermediate-input sector may have quality differences, as will be discussed below.

As in Helpman, Melitz, and Yeaple (2004), Chaney (2008), and other papers, we assume that the homogeneous-good sector is perfectly competitive, produces under constant returns to scale, and is costlessly traded, and that countries' endowments of effective units of labor, L_i, are sufficiently similar that in equilibrium all countries produce the homogeneous good and sell it at the same price. We take the homogeneous good to be the numeraire. We allow countries' productivities in this sector to differ, such that one unit of effective labor can produce w_i units of the homogeneous good. As a consequence, the wage rate in country i will be pinned down at w_i; this is the main role that the homogeneous sector plays in the model.

In each country, a representative consumer has the following utility function over final goods:

$$U_j = \left\{ \left[\int_{\omega \in \Omega_j} \left(q(\omega)^{\mu_j} x(\omega) \right)^{\frac{\sigma-1}{\sigma}} d\omega \right]^{\frac{\sigma}{\sigma-1}} \right\}^{\beta} Z^{1-\beta} \tag{1}$$

Z is the quantity of the homogeneous good consumed; $\beta > 0$ will be the budget share spent on differentiated goods; ω indexes varieties in the final-good sector; Ω_j is the set of all differentiated

[7] A number of recent papers have developed heterogeneous-firm models in which more-productive firms (under some circumstances) produce higher quality goods: see e.g. Baldwin and Harrigan (2011), Johnson (2012), Hallak and Sivadasan (2009), Crozet, Head, and Mayer (2009), Mandel (2010), Eckel, Iacovone, Javorcik, and Neary (2010), and Gervais (2010). The Melitz (2003) model can also be interpreted in terms of quality-differentiated outputs. This model differs both in the heterogeneity in willingness to pay for quality across countries and in the treatment of inputs; see Kugler and Verhoogen (2012, appendix D) for further discussion. The model can be understood as a general-equilibrium formulation of the model in Verhoogen (2008), which employed a logit-based demand system in a partial-equilibrium setting. The model is also related to papers by Ghironi and Melitz (2005), Arkolakis, Demidova, Klenow, and Rodriguez-Clare (2008) and Hsieh and Ossa (2011), which extend the Melitz (2003) framework to allow for differences in wages and productivity distributions across countries, without explicitly considering quality choices or differences in willingness to pay for quality across countries.

varieties available in country j; σ is the elasticity of substitution between varieties, where we make the standard assumption that $\sigma > 1$; and $x(\omega)$ is the quantity of variety ω consumed. Here $q(\omega)$ represents the quality of variety ω, which we assume is chosen by firms, and μ_j represents the valuation that consumers place on quality, which we take as exogenous.[8] To guarantee an interior solution to the optimization problem below, we assume that $\mu_j > \frac{1}{2}$. We assume that willingness to pay for quality is greater in richer countries, such that $\mu_n > \mu_h > \mu_s > \frac{1}{2}$.[9]

If all units of effective labor are employed at wage w_i, as will be true in equilibrium, then the demand of the representative consumer in country j for each variety will be:

$$x_j(\omega) = \beta w_j L_j P_j^{\sigma-1} q(\omega)^{\mu_j(\sigma-1)} p(\omega)^{-\sigma} \tag{2}$$

where $p(\omega)$ is the price of variety ω, P_j is a quality-adjusted ideal price index,[10] and $w_j L_j$ is total income in country j.

The intermediate sector transforms units of effective labor into intermediate inputs of different qualities, under constant returns to scale. The production function in this sector (the same in all countries) is $F_I(\ell, c) = \frac{\ell}{c}$, where c is the quality of the input produced and ℓ is units of effective labor. The production cost of an intermediate input of quality c in country i is $w_i c$. Note that the intermediate-input sector can be thought of as an education sector, which converts units of effective labor into workers of different skill levels. Given perfect substitutability in this sector, how units of effective labor are bundled into people is of little consequence for the rest of the analysis.

As in Melitz (2003), potential final-good entrepreneurs in each must make an investment of f_e effective labor units in their home country (at cost $w_i f_e$, given the wage rate), to enter the final-good sector and receive a capability draw, λ. We assume that in all countries capability

[8]Here product quality, $q(\omega)$, may reflect consumer perceptions (for instance, due to advertising) rather than inherent quality, but the key point is that $q(\omega)$ is perceived to be the same by all consumers. Consumer heterogeneity in the perception of quality is best thought of as being captured by μ_j. In this model, we assume that μ_j varies only across countries, not within. This is clearly a drastic simplification, but given that in the empirical analysis we observe only which country a good is sold in, not the characteristics of consumers it is sold to, the assumption is convenient for our purposes in this paper.

[9]Ideally, one would be able to derive differences in willingness to pay for quality from income differences, as in the logit specification of Verhoogen (2008). But here in the interests of tractability we follow the literature in simply assuming exogenous differences in preferences for quality across countries in a constant-elasticity-of-substitution (CES) framework.

[10]P_j is defined as:

$$P_j := \left[\int_{\omega\in\Omega_j} \left(\frac{p_O(\omega)}{q(\omega)^{\mu_j}}\right)^{1-\sigma} d\omega\right]^{\frac{1}{1-\sigma}} \tag{3}$$

is drawn from a Pareto distribution with c.d.f. $G(\lambda) = 1 - \left(\frac{\lambda_m}{\lambda}\right)^k$, with $0 < \lambda_m \leq \lambda$. Each period a fraction δ of firms dies for exogenous reasons; we focus on a steady-state in which an equal mass of new entrants replaces the exiters. We assume that there is a fixed cost for a firm located in country i to produce for market j of f_{ij} effective labor units (paid to labor in their home country, at cost $w_i f_{ij}$), that there is an iceberg variable cost of trade of τ_{ij}, and that these costs are symmetric across countries in the sense that $f_{ij} = f_x$ and $\tau_{ij} = \tau > 1$ for $i \neq j$, and $f_{ij} = f$ and $\tau_{ij} = 1$ for $i = j$.

In each country, production of physical units in the final-good sector is given by $F(n) = n\lambda^a$, where n is the number of units of inputs used and $a > 0$ reflects the extent to which capability lowers unit costs. Given this assumption, the the marginal cost of each unit of output is $\frac{p_{Ii}(c)}{\lambda^a}$. Following the first variant of Kugler and Verhoogen (2012), the production of quality in the final-good sector is assumed to be governed by a CES combination of firm capability and input quality:[11]

$$q(\lambda) = \left[\frac{1}{2}\left(\lambda^b\right)^\theta + \frac{1}{2}\left(c^2\right)^\theta\right]^{\frac{1}{\theta}} \tag{4}$$

We assume $\theta < 0$, which guarantees that firm capability, λ, and input quality, c, are complements in generating output quality. The parameter b can be interpreted as capturing the technological scope for improving quality with increased know-how, or what might be termed the scope for quality differentiation. We assume that producing quality does not require fixed investments. We assume that there is no cost of differentiation and that each firm produces a single, distinct variety for each market that it enters. It is convenient to think of firms are producing on up to three separate production lines, corresponding to the three possible destinations, Home, North and South. To ensure that the distribution of revenues has finite variance in all countries, we assume that $k > (\sigma - 1)\left[b\left(\mu_j - \frac{1}{2}\right) + a\right]$.[12]

2.2 Equilibrium

We are now in a position to characterize the steady-state equilibrium. In the perfectly competitive intermediate-input sector, the equilibrium price of inputs produced is simply $p_{Ii}(c) = w_i c$. In the final-good sector, firms choose which markets to enter, input quality and output price (p_O). The

[11] The multiplicative factor $\frac{1}{2}$ and the 2 in the exponent on c are convenient but not crucial. See Kugler and Verhoogen (2012, fn 30).

[12] Helpman, Melitz, and Yeaple (2004) and Chaney (2008) place an analogous lower bound on the shape parameter for the Pareto distribution to ensure finite variance of the distribution of sales.

choice of input quality determines input price and, together with the firm's capability draw, output quality. The optimal output price is a fixed multiplicative mark-up over costs, as is standard in Dixit-Stiglitz-type demand systems. Because there are no fixed costs of quality, the choices of input and output price can be considered separately for each product line, indexed by ij. The first-order conditions for each firm's optimization problem for each production line imply the following:

$$c^*_{ij}(\lambda) = (2\mu_j - 1)^{-\frac{1}{2\theta}} \lambda^{\frac{b}{2}} \tag{5a}$$

$$p^*_{Iij}(\lambda) = w_i(2\mu_j - 1)^{-\frac{1}{2\theta}} \lambda^{\frac{b}{2}} \tag{5b}$$

$$q^*_{ij}(\lambda) = \left(2 - \frac{1}{\mu_j}\right)^{-\frac{1}{\theta}} \lambda^b \tag{5c}$$

$$p^*_{Oij}(\lambda) = \left(\frac{\sigma}{\sigma - 1}\right) w_i \tau_{ij} (2\mu_j - 1)^{-\frac{1}{2\theta}} \lambda^{\frac{b}{2}-a} \tag{5d}$$

$$r^*_{ij}(\lambda) = \beta w_j L_j \Phi_j \left(\frac{P_j}{w_i \tau_{ij}}\right)^{\sigma-1} \lambda^{\zeta_j} \tag{5e}$$

where $\zeta_j := (\sigma - 1)\left[b\left(\mu_j - \frac{1}{2}\right) + a\right] > 0$, and $\Phi_j := \left[\left(\frac{\sigma-1}{\sigma}\right)\mu_j^{\frac{\mu_j}{\theta}}(2\mu_j - 1)^{-\frac{2\mu_j-1}{2\theta}}\right]^{\sigma-1} > 0$. Noting that $\theta < 0$, these conditions imply that on a product line selling to a richer country a given firm will (1) choose a higher level of input quality; (2) pay a higher input price; (3) produce higher output quality; and (4) charge a higher output price.

The cut-offs for entry into each market, given the wage levels, w_i, are pinned down by two sets of conditions, similar to conditions in Melitz (2003). First, in each country firms on the margin of entry into each of the three destination markets earns zero profit from entry into that market:

$$\pi^*_{ij}(\lambda^*_{ij}) = \left[p^*_{Oij}(\lambda^*_{ij}) - \frac{p^*_{Iij}(\lambda^*_{ij})}{\lambda^{*\,a}_{ij}}\right] x^*_{ij}(\lambda^*_{ij}) - w_i f_{ij} = \frac{r^*_{ij}(\lambda^*_{ij})}{\sigma} - w_i f_{ij} = 0, \quad i, j \in h, n, s \tag{6}$$

Second, in each country there is free entry condition and the ex ante expected future profit of paying the investment cost to get a capability draw is zero:

$$\sum_{j \in h,n,s} \left\{ (1 - G(\lambda^*_{ij})) \sum_{t=0}^{\infty} (1 - \delta)^t \left[\frac{E(r^*_{ij}(\lambda))}{\sigma} - w_i f_{ij}\right]\right\} - w_i f_e = 0, \quad i \in h, n, s \tag{7}$$

where the term in square brackets is the expected per-period profit on the ij production line (see also (6)) and $1 - G(\lambda^*_{ij})$ is the ex ante probability that a firm's capability draw is sufficiently high to be worth producing for market j.

Appendix A.1 shows that the zero-profit conditions (6) and the fact (from (5e)) that $\frac{r^*_{ij}(\lambda)}{r^*_{ij}(\lambda^*_{ij})} = \left(\frac{\lambda}{\lambda^*_{ij}}\right)^{\zeta_j}$ imply that, conditional on entering market j, $E(r^*_{ij}(\lambda)) = \frac{\sigma k f_{ij} w_i}{k-\zeta_j}$. These facts, together with the free-entry conditions (7), imply that the three domestic entry cut-offs pinned down by the following three equations:

$$\sum_{j\in h,n,s} \frac{f_{ij}}{R^k_{ij}} \left(\frac{\zeta_j}{k-\zeta_j}\right) \left(\frac{w_j}{w_i}\right)^{\frac{\sigma k}{\zeta_j}} \Lambda_j = \frac{\delta f_e}{\lambda^k_m}, \quad i \in h, n, s \tag{8}$$

where $\Lambda_j := \frac{1}{(\lambda^*_{jj})^k}$ and $R_{ij} = \left[\frac{f_{ij}}{f_{jj}} \left(\frac{\tau_{ij}}{\tau_{jj}}\right)^{\sigma-1}\right]^{\frac{1}{\zeta_j}}$. These equations can be solved explicitly and the cut-off for entry of foreign firms into each destination market can then be inferred from the domestic cut-offs. As in Melitz (2003), the entry cutoffs do not depend on the measure of firms or the total size of the labor in the economies.

Appendix A.2 shows that the measure of firms in each economy and the share of each country's total labor endowment employed in manufacturing are pinned down by the conditions that the labor markets and goods markets clear.

2.3 Response to Exchange-Rate Shocks

In this setting, we can think of changes in real exchange rates as deriving from shocks to productivity in the homogeneous, "outside" sectors, represent by w_i for $i \in h, n, s$. These affect the wage level in each economy, and in turn affect the prices of all goods in manufacturing. In this subsection, we derive comparative-static results for the effect of such shocks on average input prices paid by firms. In the interests of tractability, we make two simplifying assumptions. First, we consider deviations of homogeneous-good-sector productivities from an equilibrium in which the productivities are the same across sectors and normalized to 1: that is, $w_h = w_n = w_s = 1$ initially. This assumption is not quite as restrictive as it may initially appear, since (as discussed above) we can be agnostic about how units of effective labor are bundled into people; individuals in North can be thought of as embodying more units of effective labor (and hence earning higher wages) than individuals in Home or South, even though the wage per unit of effective labor is initially equal across the countries. Second, to derive clean predictions, we assume that the countries are not too different in their willingnesses to pay for product quality; the condition is stated more precisely in Appendix A.3.

Under these restrictions, we can derive unambiguous predictions for how the various entry cutoffs vary with changes in wage levels. Consider an increase in productivity in the homogeneous-good sector in North, which is also an increase in the Northern wage level. This can be thought of as a real-exchange-rate appreciation in North. The comparative-static predictions for changes in the entry cutoffs are the following:

$$\frac{\partial \lambda^*_{nh}}{\partial w_n} > 0 \qquad \frac{\partial \lambda^*_{ns}}{\partial w_n} > 0$$
$$\frac{\partial \lambda^*_{hn}}{\partial w_n} < 0 \qquad \frac{\partial \lambda^*_{sn}}{\partial w_n} < 0 \tag{9a}$$

$$\frac{\partial \lambda^*_{ss}}{\partial w_n} > 0 \qquad \frac{\partial \lambda^*_{hh}}{\partial w_n} > 0$$
$$\frac{\partial \lambda^*_{hs}}{\partial w_n} > 0 \qquad \frac{\partial \lambda^*_{sh}}{\partial w_n} > 0$$
$$\frac{\partial \lambda^*_{nn}}{\partial w_n} < 0 \tag{9b}$$

The intuition for the four results in (9a), is straightforward. Northern exporters are put at a disadvantage by the increase in the Northern wage and the consequent increase in input prices in North, and marginal Northern exporters stop exporting to Home and South. Conversely, Home and Southern exporters benefit from their lower costs relative to Northern producers in the market in North, and firms previously below the cut-off for entering the Northern market can profitably enter. The intuition for the results in (9b) is more subtle. In Home and South, the expansion of profitable export opportunities induces a greater measure of firms to pay the fixed investment cost to get a productivity draw, increasing the measure of firms in the domestic market. This in turn drives down the price index for differentiated goods and induces firms at the domestic cut-off margin to exit, leading the domestic cut-offs to rise. There is an offsetting effect, in that producers in Home and South face less competition in their domestic markets from Northern exporters, but given the assumptions of our model (in particular, the assumptions about the Pareto distribution of capabilities), the former effect always dominates the latter. Similar logic explains the increase in cut-offs for Home exporters to South and Southern exporters to Home. The opposite logic explains the fall in the cut-off in North: because export opportunities are less attractive, fewer firms enter, the price index rises, and firms at the domestic cut-off margin become more profitable.

A convenient feature of this model is that firm-level revenues and output and be expressed as functions of the entry cut-offs, without reference to the variables reflecting the scale of each of the economies. In particular, output on each production line can be expressed as:

$$x^*_{ij}(\lambda) = \frac{r^*_{ij}(\lambda)}{p^*_{Oij}(\lambda)} = \frac{(\sigma-1)f_{ij}}{w_i\tau_{ij}(2\mu_j-1)^{-\frac{1}{2\theta}}}\frac{\lambda^{\zeta_j+a-\frac{b}{2}}}{\lambda^{*\,\zeta_j}_{ij}} \tag{10}$$

Output of each production line varies inversely with the entry cut-offs for each market.

As in other firm-level datasets, in our data it is not possible to observe input prices at the level of product lines. What is observable is an average of input prices across all product lines. In the model, this average input price can be represented as:

$$\overline{p}^*_{Ih}(\lambda) = \sum_{j\in h,n,s}\left[\frac{x^*_{hj}(\lambda)}{x^*_{hh}(\lambda)+x^*_{hn}(\lambda)+x^*_{hs}(\lambda)}\right]p^*_{I_{hj}}(\lambda) \tag{11}$$

An average output price can be defined analogously:

$$\overline{p}^*_{Oh}(\lambda) = \sum_{j\in h,n,s}\left[\frac{x^*_{hj}(\lambda)}{x^*_{hh}(\lambda)+x^*_{hn}(\lambda)+x^*_{hs}(\lambda)}\right]p^*_{O_{hj}}(\lambda) \tag{12}$$

Now consider the effect of an increasing in the Northern wage on average firm-level output and input prices for Home firms. Note that the Northern wage, w_n, does not enter the expressions for output or input prices on a particular production line (refer to (5b) and (5d)). Hence any changes in $\overline{p}^*_O(\lambda)$ or $\overline{p}^*_I(\lambda)$ in response to a change in w_n must arise through changes in the output shares destined to each market. For a Home firm that initially exports to both North and South, it follows from (9a) -(9b) that its output share to North will increase and its output share to Home and South will decrease. Given that output and input prices on the Northern production line are greater than on either of the other lines (refer to (5d) and (5b)), this implies that average output and input prices, $\overline{p}^*_{Oh}(\lambda)$ and $\overline{p}^*_{Ih}(\lambda)$ will both increase. In the case of Home firms that initially do not export to one or both markets, the results go weakly in the same direction. Hence:

$$\frac{\partial\overline{p}^*_{Oh}(\lambda)}{\partial w_n} \geq 0 \tag{13}$$

$$\frac{\partial\overline{p}^*_{Ih}(\lambda)}{\partial w_n} \geq 0 \tag{14}$$

The effect of an increase in the Southern wage on average output and input prices in Home firms can be analyzed similarly. In this case, the comparative-static result (analogous to (9a)-(9b)) are that $\frac{\partial\lambda^*_{hs}}{\partial w_s}<0$, $\frac{\partial\lambda^*_{hh}}{\partial w_s}>0$, and $\frac{\partial\lambda^*_{hn}}{\partial w_s}>0$. These in turn (weakly) imply an increase in the output share sold to South and a decrease in output shares for North and Home. Given that output and input prices are lower on the production line for South, we have:

$$\frac{\partial \overline{p}^{*}_{Oh}(\lambda)}{\partial w_s} \leq 0 \quad (15)$$

$$\frac{\partial \overline{p}^{*}_{Ih}(\lambda)}{\partial w_s} \leq 0 \quad (16)$$

The predictions (13)-(16) are the testable implications that we take to the data in the remainder of the paper.

3 Data

The analysis in this paper draws on two main datasets, both collected by the *Instituto Nacional de Estatística (INE)*, the Portuguese national statistical agency:

1. Customs data on firm-level international trade transactions, which are collected separately for transactions outside of the European Union (*Estatísticas Correntes do Comércio Extracomunitário*, [Current Statistics on Extra-community Trade]) and for transactions within the European Union (*Estatísticas Correntes do Comércio Intracomunitário*, [Current Statistics on Intra-community Trade]).[13]

2. *Inquérito Anual à Produção Industrial (IAPI)* [Annual Survey of Industrial Production], a special survey that solicits information on values and physical quantities of outputs and inputs of firms. We supplemented this survey with information on firms' locations and industry from the *Inquérito Anual às Empresas (IAE)* [Annual Survey of Companies], a yearly firm-level survey, and the *Sistema de Contas Integradas das Empresas (SCIE)* [Enterprise Integrated Accounts System], which provides a census of firms in 2005. The years for which both the IAPI and the IAE are available are 1997-2005, with between 7,000 and 9,000 firms covered during 1997-2001 and a reduced number (2,300-3,500 firms) covered in 2002-2005.[14]

   The product-level information is reported using a 12-digit PRODCOM classification, with

[13] The extra-community trade statistics capture the universe of external trade transactions. The intra-community statistics capture shipments from firms registered in the value-added tax system whose value of annual shipments exceed a cut-off that has changed over time. In 2005, for instance, the cut-off was 85,000 Euros. See Bastos and Silva (2010) for further details.

[14] The IAPI has an unorthodox sampling frame. From 1997-2001 it was intended to included manufacturing firms to cover 90% of total manufacturing sales. Firms were ranked in descending order of sales and included until the 90% threshold was reached, with some minor qualifications: all firms with 20 or more employees were included, all firms in sectors with fewer than 5 firms were included, and once included in the sample firms were followed in subsequent years. In 2002-2005, for budgetary reasons, the set of sectors covered by the survey was reduced.

approximately 5,300 different products and 3,300 different material inputs appearing in the data.

As we discuss in the next section, we use the IAPI data to construct average prices at the firm level and we use the customs data to construct export share variables. Our baseline estimation sample then includes the manufacturing firms for which we are able to construct both sets of variables. The result is an unbalanced panel with 3,000-3,500 firms per year in 1997-2001 and 750-1,350 firms per year in 2002-2005.

Table 1 reports summary statistics on our estimation sample and comparisons to the full set of exporters in the customs data and the full set of firms in the economic census of 2005. The firms that we were able to link between the customs and the IAPI data tend to be larger firms, even relative to the set of exporters. Firms in our estimation sample tend to have greater exports per year, export to more destinations, export in more different product categories, source inputs from more countries and source more different types of inputs than firms in the full customs dataset.

Table 2 presents descriptive statistics on the destination markets for sales and source markets for input purchases of Portuguese firms for 1997, both in the full customs data and in our estimation sample. The leading destinations and sources among richer countries include several countries that joined the Euro during our study period (Germany, Spain, France, Netherlands, Belgium, Italy) but also include the UK and the US.[15]

4 Empirical Methodology

We are interested in examining the effect of the income level of export destinations on input prices at the firm level. A general issue in relating income levels of destination countries to firm-level outcomes is that there may be unobserved differences among firms that affect both the composition of export destinations and the outcomes of interest. In particular, shocks to the supply of different inputs may affect both input prices and firms' choices of which markets to enter. Our strategy for dealing with this concern is to construct instruments for the average income of destinations and the export share of sales, in the form of firm-specific average real-exchange rates for subsets of countries in different income groups, using the initial distribution of a firm's exports across destinations. Similar measures have been constructed at the sector level by Revenga (1992) and

[15]The currencies of the initial set of countries in the Euro zone were fixed in relation to one another on Jan. 1, 1999, and the Euro bills and coins were introduced on Jan. 1, 2002.

Bertrand (2004), and at the firm level by Park, Yang, Shi, and Jiang (forthcoming) and Brambilla, Lederman, and Porto (2010), among others.

We are interested in constructing exchange-rate instruments that are firm-specific, so that we can control flexibly for macro trends using year effects. We construct firm-specific average real exchange rates, relative to a set of partner countries J, as follows:

$$\overline{e}_{Jit} = \sum_{j \in J} \gamma_{ij} e_{jt} \tag{17}$$

where e_{jt} is the log real exchange rate of destination j,[16] and the weights γ_{ij} are given by the share of firm i's export revenues from to destination j in 1997 and 1998:

$$\gamma_{ij} = \frac{r_{ij,1997-98}}{\sum_{j \in J} r_{ij,1997-98}} \tag{18}$$

We construct this measure separately for five income groups, chosen by ranking destinations by GDP per capita and dividing into groups of similar "size", where size is given by Portuguese exports to each group.

To provide a visual sense of the variation underlying the movements in the firm-specific exchange rates, Figures 1 and 2 illustrate the movements in the real exchange rates of Portugal's principal trading partners, for countries richer and poorer than Portugal, respectively. Note that the largest exchange-rate movements are in poorer countries, which tend to fall in the lowest-income of the five groups of destinations.

An additional issue that arises in the estimation is how to measure prices at the firm level. Our preferred approach is a two-step method. We first run the following regression:

$$\ln p_{ikt} = \theta_{it} + \psi_{kt} + u_{ikt} \tag{19}$$

where i indexes firms, k indexes products, t indexes years, θ_{it} is a firm-year fixed effect and ψ_{kt} is a product-year fixed effect. Note that the product-year effects capture all common factors that affect the price of a particular output or input across firms; the firm-year effects, θ_{it}, are thus identified by comparisons with other firms producing the same product in the same year. The

[16] The real exchange rate is calculated as $e_{jt} = (\widetilde{e})\frac{CPI_{portugal}}{CPI_j}$, where $\widetilde{e}$ is the nominal exchange rate (foreign currency/Portuguese escudo). The real exchange rates are calculated in escudo terms even after the introduction of the Euro (using the fixed Euro/escudo exchange rate.)

estimates $\widehat{\theta}_{it}$ reflect average prices at the firm level purged of effects due to the composition of products.

With these measures of firm-level prices in hand, we then run a regression of the following form:

$$\widehat{\theta}_{it} = inc_{it}\beta_1 + share_{it}\beta_2 + a_i + b_t + \varepsilon_{it} \tag{20}$$

where inc_{it} is the average GDP per capita of a firm i's export destinations in year t, weighted by export shares; $share_{it}$ is export share of sales; a_i is a firm fixed effect; and b_t is a year effect. We use the weighted-average exchange rate variables as instruments for inc_{it} and, in some specifications, for $share_{it}$ as well. In some specifications, we also include log total sales as a co-variate.

This two step method is expected to yield results that are similar to a one-step method in which firm-product-level prices are regressed directly on the second-step covariates. (For more on the relationship between such one-step and two-step estimators, see Amemiya (1978) and Donald and Lang (2007).) We show that our baseline results are robust to this alternative method.

5 Results

Before presenting our baseline results, we begin by confirming that the cross-sectional results of Bastos and Silva (2010) can be replicated in our modified sample. Table 3 presents regressions of log export unit values at the firm-product level on indicators of income level in the destination and a set of standard variables from gravity regressions. The data are a cross-section of the customs data from 1997, the first year of our sample. The "richer than Portugal" variable is an indicator for whether the country's GDP per capita is above Portugal's, and "ln gdp per capita" refers to income in the destination country. The results indicate, consistent with Bastos and Silva (2010), that individual firms charge higher prices in richer countries. This pattern is robust to the inclusion of firm-product fixed effects: a given firm charges higher prices in richer markets even for a particular product in a particular year.

Table 4 presents the estimates from the first-stage regressions of various specifications of our instrumental-variables procedure, with average destination income and and export share of sales regressed on the exchange-rate instruments (and firm and year effects). Real depreciations (increases in real exchange rates) in richer partner countries tend to lead to a decline in average destination income, and depreciation in poorer partner countries leads to an increase in average destination income. Except for an anomalous result for the second-lowest income group, increases in real exchange rates lead to declines in the export share, as expected. Overall, the instruments appear to be sufficiently correlated with the exporting variables for us to be able to identify the effect of those variables on our outcomes of interest.

Table 5 presents our baseline results, for a specification in the form of (20), with firm-average input prices as the outcome variable. In the OLS regressions in Columns 1 and 2, there is not a robust relationship between destination income and input prices. As noted above, however, this may be due to omitted variables correlated with both destination income and input prices, for instance, shocks to the supply of inputs that affect firms' choices of which markets to enter. In Columns 3 and 4, however, we see that there are significant relationships between our exchange-rate instruments and average input prices: a real depreciation (increase in the real exchange rate) in the poorest income group leads to higher average input prices, and real depreciations in the richest two income groups lead to lower average input prices, as expected. The two-stage least squares (2sls) results in Columns 5-8 show a significant positive relationship between the average income of export destinations, as predicted by the exchange-rate instruments, and firm-average input prices. This finding is robust to using the exchange-rate variables to instrument for export share of sales as well as average income of destination (Columns 6 and 8) and to including log total sales as a co-variate (Columns 7 and 8). This result supports the hypothesis that firms sell higher-quality goods to richer countries, and this in turn requires purchasing higher-quality inputs.

Note that when the export share of sales is also instrumented, as it arguably should be, in Columns 6 and 8, there is also a significant positive coefficient on the export share of sales. This suggests that exports *per se* also matter; the effects of exporting on input prices appear not to be due solely to income differences across destinations. Our argument in this paper is thus not that exports *per se* have no effect; it is rather that product quality appears to be playing a non-trivial role, since otherwise it is difficult to explain the effect of average destination income on input prices.

We now turn to results for export prices and average output prices (export and domestic). In our theoretical model, export prices and average output prices respond in the same way as input prices to exchange-rate shocks. In reality, it would not be surprising to find that firms change the prices they charge in response to real-exchange-rate movements in other countries. Indeed, a large literature on the pass-through of exchange rates suggests that pass-through is typically incomplete.[17] In our context, incomplete pass-through would lead us to expect Portuguese firms to reduce the home-currency price of their exports to a country that has undergone a real depreciation (an increase in the real exchange rate relative to Portugal.) Rigorous structural estimation of the extent of pass-through is beyond the scope of this paper, but Table 6 presents some simple descriptive regressions of export prices on real exchange rates in destination markets. In Panel A, the dependent variable is average firm-product prices, constructed using a two-step approach as described in Section 4, by recovering the coefficients on firm-destination-year effects in a regression of export prices on firm-destination-year effects, product effects, and year effects. In Panel B the dependent variable is total volume of firm exports to a particular destination. The reported regressions include firm-destination fixed effects; thus the coefficients are identified by variation in prices with firm-destination pairs over time. Column 1 reports results for all destinations together, and Columns 2-6 break out destinations by income group. In Panel A, we see that there is evidence, especially for the richest and poorest income groups, that export prices in home-currency terms fall in response to increases in destination real exchange rates. The results in Panel B indicate that (again except for an anomalous pattern in income group 2) increases in destination real exchange rates lead to decreases in export volumes, as expected. This pattern is particularly strong in the lower income groups, which tend to experience larger real-exchange-rate movements.

Table 7 presents estimates of a specification similar to Table 5, with firm-level average export prices as the outcome. Based solely on the cross-sectional correlation between export price and destination income observed in Table 3, we would expect to find a positive effect of average destination income on export prices. In the 2sls specifications in Columns 5-8, we do see that the point estimates are positive, but they are not statistically significant. The lack of significance appears to be due to the pass-through issue discussed in reference to Table 6. It appears that the tendency of firms to reduce prices in response to real-exchange-rate increases in destination markets appears to be offsetting the increase in export prices that would otherwise be expected in response to, for instance, an increase in the real exchange rate in the poorest income group. Table 8 presents similar specifications, with firm-average output prices (averaging over foreign and domestic sales) as the dependent variable. As for the export-price results, we find that the 2sls point estimates for average destination income in Columns 5-8 are positive, as expected, but are not significant. Given the lack of significance in the export-price results, the lack of significance for

[17] Goldberg and Knetter (1997) provide a review. For more recent developments, see Goldberg and Hellerstein (2008), Hellerstein (2008), and Nakamura and Zerom (2010).

output prices (any effect of destination income on which is dampened by averaging with domestic prices) is perhaps not surprising.

The remaining tables undertake a set of robustness checks of the main results for input prices. Tables 9 and 10 allow for the possibility that the exchange-rate movements affect input price not only through output quality choices but also through direct effects on the prices of inputs. To address this issue, we construct firm-level average real-exchange rates as in (17) but using initial *import* shares as weights, instead of initial export shares. We call these "source-weighted" average exchange rates, to distinguish them from the "destination-weighted" average exchange rates constructed above.[18] Table 9 presents the first stage, with the average source-country income as the dependent variable; it appears that the source-weighted exchange rates have a non-negligible effect on average source-country income. Table 10 presents specifications similar to our baseline specifications in Table 5 but including either the source-weighted instruments or the average source income. In Column 4, the source-weighted instruments are included directly as covariates. In Column 5, they are used as instruments for the share of imports from richer nations. The key point of the table is that the coefficients on average destination income are robust to including either the source-weighted exchange-rate instruments or the instrumented average source income.

Table 11 presents results from the one-step estimation of the effect of the exporting variables on firm-level average input prices. Rather than first regressing average input prices on firm-year and product-year effects and then regressing the estimated firm-year effects on other firm characteristics (e.g. average destination income), we regress input prices at the firm-product-year directly on the firm characteristics and product-year effects. (Refer to the discussion in Section 4 above.) Reassuringly, the results are consistent with the two-step results in Table 5.

6 Conclusion

This paper has examined the effects of export shocks to different destinations on the input prices paid by Portuguese manufacturing firms. We have found that arguably exogenous increases in average destination income, driven by changes in the composition of export destinations due to real-exchange-rate movements, have a robust, positive effect on average input prices paid by Portuguese firms, controlling for the mix of input categories they use. These findings suggest that

[18] Note that these are not collinear with the destination-weighted exchange rates because differences in the composition of source and destination countries in each firm in the initial year.

the effects of exporting derive not solely from scale effects but also from destination characteristics. In particular, they support the hypothesis that exporting to richer countries requires an upgrading of product quality, both of outputs and of inputs. It does not appear that the empirical patterns can be explained entirely by effects of distance or pricing-to-market behavior by firms. The results thus support a recent renewal of attention in the trade literature to the effects of non-homotheticities in demand.

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A Theory Appendix

A.1 Solving for Cut-offs

[To be completed.]

A.2 Solving for Scale of Economies

[To be completed.]

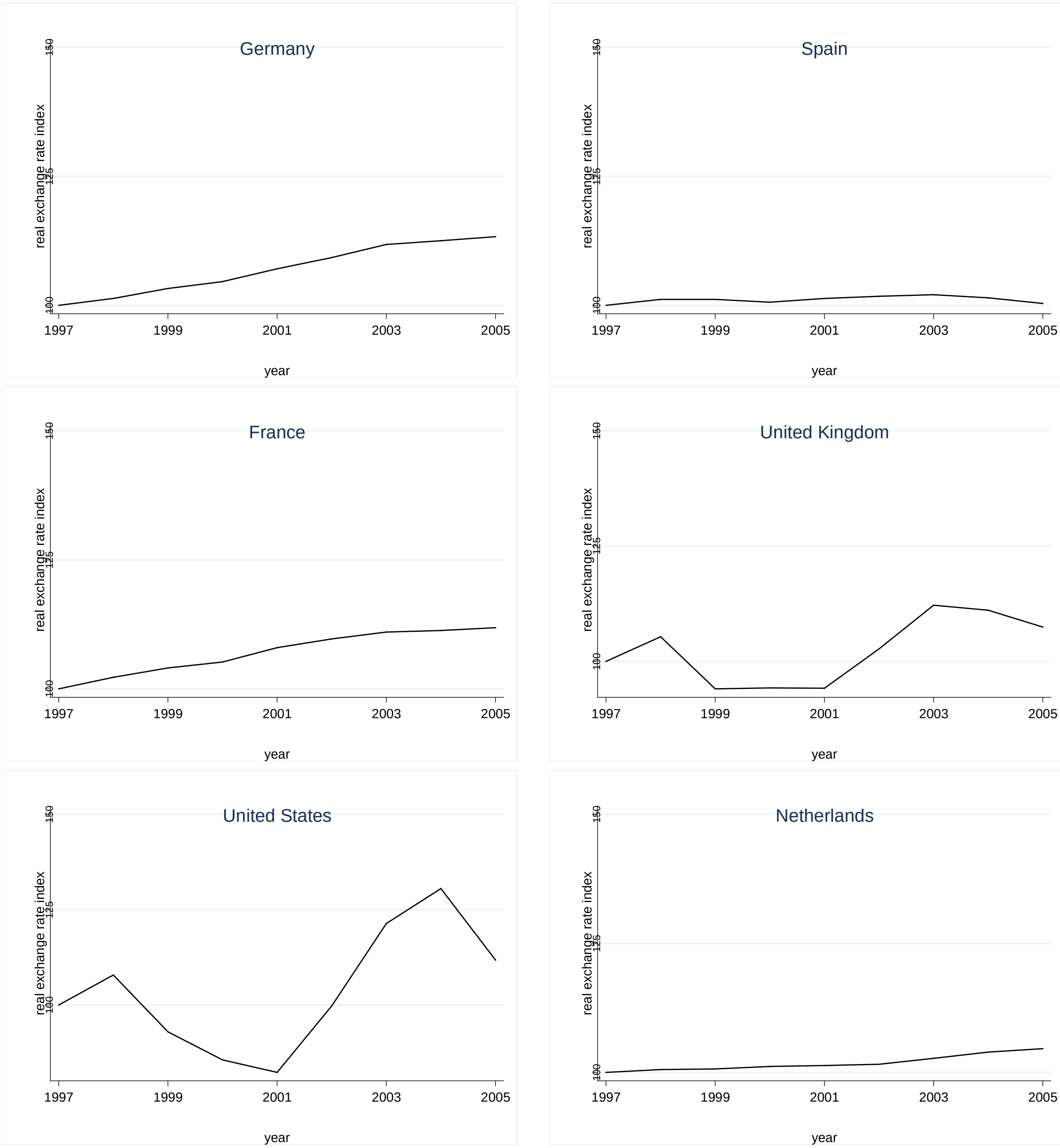
A.3 Deriving Changes in Entry Cut-offs in Response to Exchange-Rate Shock

[To be completed.]

B List of Richer and Poorer Countries

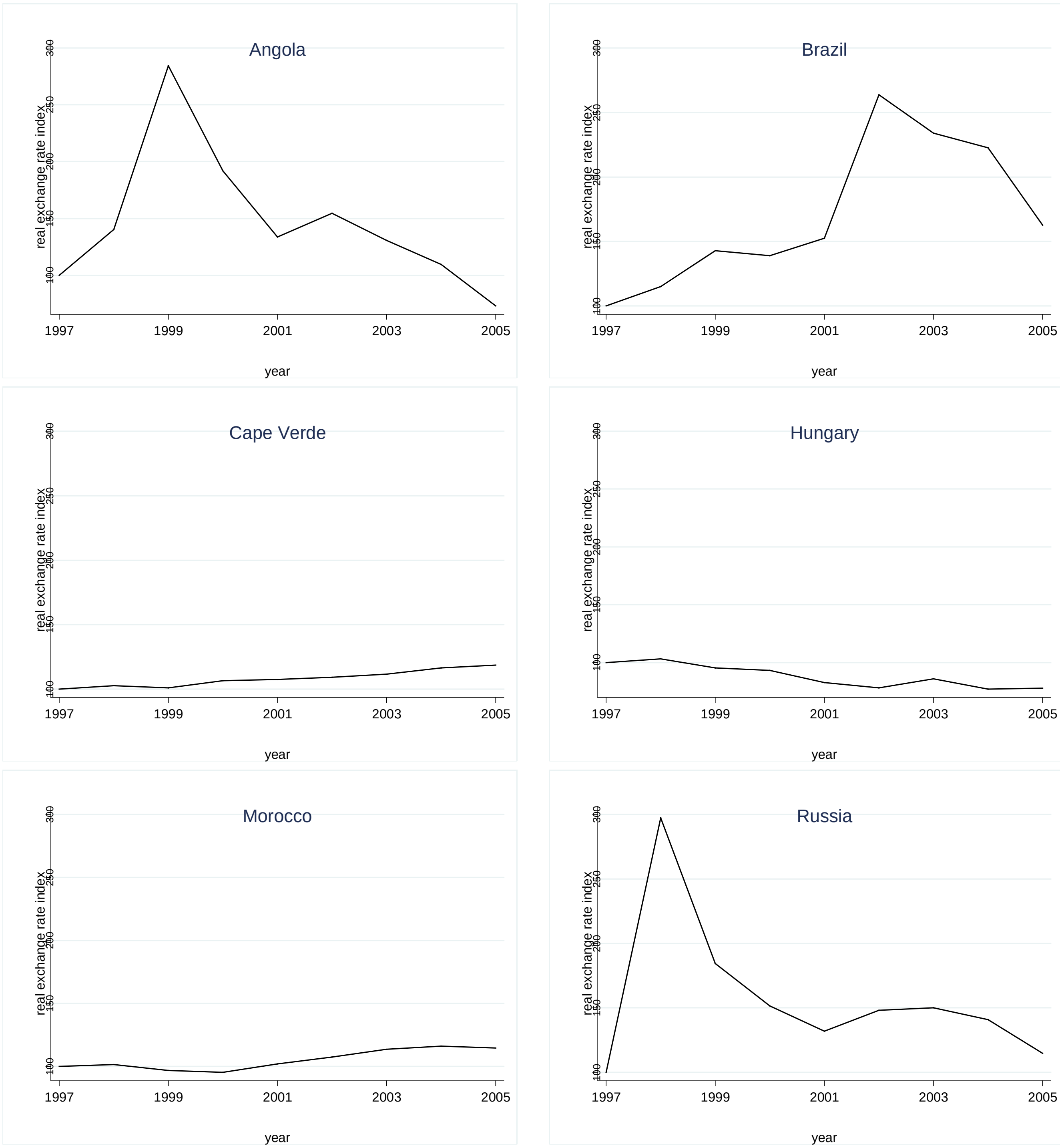
[To be completed.]

Figure 1: Real Exchange Rates, Top Richer Export Destinations



Notes: Real exchange rates calculated as $e * \frac{CPI_{jt}}{CPI_{portugal,t}}$ where e is the nominal exchange rate. 1997 real exchange rate set to 100. Real-exchange-rate movements of countries in Euro zone after 1999 are due solely to different rates of inflation.

Figure 2: Real Exchange Rates, Top Poorer Export Destinations



Notes: Real exchange rates calculated as $e * \frac{CPI_{jt}}{CPI_{portugal,t}}$ where e is the nominal exchange rate. 1997 real exchange rate set to 100. Real-exchange-rate movements of countries in Euro zone after 1999 are due solely to different rates of inflation.

Table 1: Summary statistics, firm-level data, 1997-2005

	est. sample	all exporters	all manufact.
Exports per firm per year	6.33	1.65	
	(42.35)	(18.66)	
Share of exports to richer nations	0.82	0.91	
	(0.33)	(0.23)	
Export share of sales	0.47		
	(0.38)		
Imports per firm per year	5.01	1.96	
	(53.41)	(25.99)	
Share of imports from richer nations	0.89	0.92	
	(0.24)	(0.19)	
Number of input categories	13.87		
	(10.08)		
Number of export destinations, 2005	10.21	3.35	
	(10.75)	(5.29)	
Number of export categories, 2005	15.2	9.85	
	(23.15)	(27.5)	
Number of source countries, 2005	7.38	2.84	
	(6.49)	(4.34)	
Number of import categories, 2005	35.46	14.02	
	(60.54)	(40.08)	
Avg. earnings, 2005	9.44	9.25	5.54
	(4.1)	(28.19)	(22.91)
Employment, 2005	172.89	49.37	17.38
	(468.05)	(242.42)	(62.47)
Sales, 2005	27.49	6.3	1.24
	(200.27)	(70.35)	(31.83)
N (firm-year obs.)	19485	134655	45031
N (distinct firms)	3896	39865	45031

Notes: Standard deviations in parentheses. Sales, exports and imports are annual, measured in millions of 2000 euros. Earnings are annual, measured in thousands of euros. Number of export, import and input categories refers to number of distinct categories in which non-zero revenues or expenditures are reported.

Table 2: Main export destinations and source countries, 1997

Exports	Full data (aggreg.) (1)	Est. sample (aggreg.) (2)	Est. sample (firm-level) (3)	Imports	Full data (aggreg.) (4)	Est. sample (aggreg.) (5)	Est. sample (firm-level) (6)
Richer nations	**0.922**	**0.937**	**0.807**	**Richer nations**	**0.907**	**0.888**	**0.891**
Germany	0.206	0.221	0.109	Spain	0.252	0.21	0.28
Spain	0.148	0.146	0.187	Germany	0.16	0.218	0.112
France	0.145	0.147	0.146	France	0.115	0.112	0.106
UK	0.124	0.122	0.086	Italy	0.086	0.061	0.146
Netherlands	0.051	0.053	0.04	UK	0.073	0.071	0.058
Belgium	0.046	0.051	0.027	Netherlands	0.05	0.036	0.000
US	0.042	0.045	0.051	Belgium	0.034	0.029	0.033
Italy	0.039	0.039	0.023	US	0.032	0.030	0.031
Poorer nations	**0.078**	**0.063**	**0.193**	**Poorer nations**	**0.093**	**0.112**	**0.109**
Angola	0.018	0.006	0.053	Brazil	0.018	0.024	0.024
Brazil	0.01	0.009	0.023	China	0.007	0.004	0.021
Turkey	0.004	0.004	0.002	Russia	0.005	0.007	0.004
Cape Verde	0.004	0.002	0.025	India	0.004	0.006	0.011
Morroco	0.004	0.004	0.005	Thailand	0.004	0.002	0.002
Russia	0.003	0.003	0.006	South Africa	0.004	0.004	0.004
Hungary	0.003	0.003	0.002	Turkey	0.003	0.003	0.004
South Africa	0.003	0.003	0.006	Pakistan	0.003	0.002	0.009

Notes: Columns (2) and (5) report aggregate export and import shares, respectively, for the estimation sample, effectively giving larger firms greater weight. Columns (3) and (6) report simple averages of firm-level export and import share, giving each firm equal weight. Oil exports and imports are excluded.

Table 3: Gravity and export prices, 1997

	dep. var.: firm-product log export price			
	(1)	(2)	(3)	(4)
richer than Portugal	0.09***	0.08***		
	(0.03)	(0.02)		
ln gdp per capita			0.03***	0.03***
			(0.01)	(0.01)
ln gdp	0.01	0.00	0.01	0.00
	(0.00)	(0.01)	(0.00)	(0.01)
European Union	0.07***	0.03	0.07***	0.04*
	(0.02)	(0.02)	(0.02)	(0.02)
landlocked	0.05**	0.03*	0.03	0.02
	(0.02)	(0.02)	(0.02)	(0.02)
ln distance	0.09***	0.07***	0.08***	0.07***
	(0.01)	(0.01)	(0.01)	(0.01)
product effects	Y	N	Y	N
firm-product effects	N	Y	N	Y
R2	0.75	0.93	0.75	0.93
N	71687	71687	71687	71687

Notes: Standard errors clustered by export destination in parentheses. *10% level, **5% level, ***1% level.

Table 4: First stage for baseline regressions

	(1)
A. Dependent variable: av. gdp per capita of export destinations	
dest-weighted log real exchange rate richest income group	-0.13
	(0.09)
dest-weighted log real exchange rate 2nd income group	-0.58**
	(0.25)
dest-weighted log real exchange rate 3rd income group	-0.54***
	(0.19)
dest-weighted log real exchange rate 4th income group	-0.42***
	(0.14)
dest-weighted log real exchange rate poorest income group	0.15***
	(0.03)
firm effects	Y
year effects	Y
R2	0.83
N	19485
B. Dependent variable: export share of sales	
dest-weighted log real exchange rate richest income group	-0.15***
	(0.05)
dest-weighted log real exchange rate 2nd income group	-1.73***
	(0.12)
dest-weighted log real exchange rate 3rd income group	-0.15**
	(0.07)
dest-weighted log real exchange rate 4th income group	0.15**
	(0.06)
dest-weighted log real exchange rate poorest income group	-0.05***
	(0.01)
firm effects	Y
year effects	Y
R2	0.78
N	19485

Notes: Robust standard errors in parenthesis. *10% level, **5% level, ***1% level.

Table 5: Destination income and firm average input price

	dep. var.: firm average log real input prices							
	OLS	OLS	Red. form	Red. form	2SLS	2SLS	2SLS	2SLS
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
av. gdp per capita of export destinations	0.01*	0.01			0.31***	0.25***	0.30***	0.25***
	(0.01)	(0.01)			(0.10)	(0.10)	(0.10)	(0.09)
export share of sales	0.04**	0.03*	0.03*	0.02	0.02	0.24**	0.01	0.24**
	(0.02)	(0.02)	(0.02)	(0.02)	(0.02)	(0.10)	(0.02)	(0.10)
log sales		0.05***		0.05***			0.05***	0.03***
		(0.01)		(0.01)			(0.01)	(0.01)
dest-weighted log real exchange rate richest income group			-0.14**	-0.14**				
			(0.06)	(0.06)				
dest-weighted log real exchange rate 2nd income group			-0.55***	-0.54***				
			(0.18)	(0.18)				
dest-weighted log real exchange rate 3rd income group			-0.01	-0.01				
			(0.12)	(0.12)				
dest-weighted log real exchange rate 4th income group			-0.02	-0.02				
			(0.08)	(0.08)				
dest-weighted log real exchange rate poorest income group			0.04**	0.04**				
			(0.02)	(0.02)				
firm effects	Y	Y	Y	Y	Y	Y	Y	Y
year effects	Y	Y	Y	Y	Y	Y	Y	Y
R2	0.78	0.78	0.78	0.78				
N	19485	19485	19485	19485	19485	19485	19485	19485

Notes: In Columns (5) and (7) the destination-weighted log real exchange rates for each income group are instruments for the average gdp per capita of export destinations. In Columns (6) and (8) they are instruments for both the average gdp per capita of export destinations and log exports. Robust standard errors in parenthesis. *10% level, **5% level, ***1% level.

Table 6: Exchange rates and export prices, firm-destination panel

	Full data	richest inc. group	2nd inc. group	3rd inc. group	4th inc. group	poorest inc. group
	(1)	(2)	(3)	(4)	(5)	(6)
A. Dependent variable: firm-destination average log real export price						
log real exchange rate	-0.07***	-0.19*	1.62	-0.13	-0.07	-0.06**
	(0.03)	(0.11)	(1.62)	(0.17)	(0.06)	(0.02)
firm-destination effects	Y	Y	Y	Y	Y	Y
year effects	Y	Y	Y	Y	Y	Y
R2	0.82	0.80	0.81	0.82	0.84	0.84
N	158361	38050	12356	27897	27750	52308
B. Dependent variable: firm-destination log real export volume						
log real exchange rate	-0.48***	-0.24	2.62	-0.16	-0.59**	-0.45***
	(0.07)	(0.22)	(3.88)	(0.36)	(0.29)	(0.09)
firm-destination effects	Y	Y	Y	Y	Y	Y
year effects	Y	Y	Y	Y	Y	Y
R2	0.82	0.82	0.85	0.83	0.83	0.81
N	158361	38050	12356	27897	27750	52308

Notes: The dependent variable in Panel A, firm-destination-average log real export price, are estimated coefficients on firm-destination dummies in a regression of export price on firm-destination dummies, product dummies and year dummies. Standard errors clustered by destination-year in parenthesis. *10% level, **5% level, ***1% level.

Table 7: Destination income and firm average export prices

	dep. var.: firm average log real export price							
	OLS	OLS	Red. form	Red. form	2SLS	2SLS	2SLS	2SLS
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
av. gdp per capita of export destinations	0.02	0.02			0.15	0.19	0.14	0.19
	(0.01)	(0.01)			(0.15)	(0.15)	(0.15)	(0.15)
export share of sales	0.01	0.01	0.02	0.01	0.01	-0.18	0.00	-0.19
	(0.03)	(0.03)	(0.03)	(0.03)	(0.03)	(0.15)	(0.03)	(0.15)
log sales		0.02		0.02			0.02	0.03*
		(0.02)		(0.02)			(0.02)	(0.02)
dest-weighted log real exchange rate richest income group			-0.26***	-0.26***				
			(0.09)	(0.09)				
dest-weighted log real exchange rate 2nd income group			0.48*	0.49*				
			(0.28)	(0.28)				
dest-weighted log real exchange rate 3rd income group			0.07	0.07				
			(0.20)	(0.20)				
dest-weighted log real exchange rate 4th income group			-0.22	-0.22*				
			(0.12)	(0.12)				
dest-weighted log real exchange rate poorest income group			0.01	0.01				
			(0.03)	(0.03)				
firm effects	Y	Y	Y	Y	Y	Y	Y	Y
year effects	Y	Y	Y	Y	Y	Y	Y	Y
R2	0.72	0.72	0.72	0.72				
N	19485	19485	19485	19485	19485	19485	19485	19485

Notes: In Columns (5) and (7) the destination-weighted log real exchange rates for each income group are instruments for the average gdp per capita of export destinations. In Columns (6) and (8) they are instruments for both the average gdp per capita of export destinations and log exports. Robust standard errors in parenthesis. *10% level, **5% level, ***1% level.

Table 8: Destination income and firm average output prices

	dep. var.: firm average log real output price							
	OLS	OLS	Red. form	Red. form	2SLS	2SLS	2SLS	2SLS
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
av. gdp per capita of export destinations	-0.00	-0.00			0.11	0.09	0.10	0.08
	(0.01)	(0.01)			(0.14)	(0.15)	(0.14)	(0.15)
export share of sales	0.06**	0.05*	0.05*	0.04	0.05*	0.15	0.04	0.14
	(0.03)	(0.03)	(0.03)	(0.03)	(0.03)	(0.16)	(0.03)	(0.16)
log sales		0.06***		0.06***			0.06***	0.05***
		(0.02)		(0.02)			(0.02)	(0.02)
dest-weighted log real exchange rate 1st income group			-0.21**	-0.21**				
			(0.11)	(0.11)				
dest-weighted log real exchange rate 2nd income group			0.41	0.42				
			(0.32)	(0.32)				
dest-weighted log real exchange rate 3rd income group			-0.70***	-0.70***				
			(0.20)	(0.20)				
dest-weighted log real exchange rate 4th income group			-0.06	-0.04				
			(0.13)	(0.13)				
dest-weighted log real exchange rate 5th income group			-0.05	-0.05				
			(0.03)	(0.03)				
firm effects	Y	Y	Y	Y	Y	Y	Y	Y
year effects	Y	Y	Y	Y	Y	Y	Y	Y
R2	0.82	0.82	0.82	0.82				
N	19485	19485	19485	19485	19485	19485	19485	19485

Notes: In Columns (5) and (7) the destination-weighted log real exchange rates for each income group are instruments for the average gdp per capita of export destinations. In Columns (6) and (8) they are instruments for both the average gdp per capita of export destinations and log exports. Robust standard errors in parenthesis. *10% level, **5% level, ***1% level.

Table 9: Import-source regressions, first stage

	dep. var.: av. inc. of source countries		
	(1)	(2)	(3)
source-weighted log real exch. rate richer inc. group	-0.28***		-0.25***
	(0.09)		(0.09)
source-weighted log real exch. rate 2nd inc. group	0.60**		0.63**
	(0.25)		(0.25)
source-weighted log real exch. rate 3rd inc. group	-0.11		-0.09
	(0.23)		(0.23)
source-weighted log real exch. rate 4th inc. group	-0.24		-0.27
	(0.24)		(0.24)
source-weighted log real exch. rate poorest inc. group	0.08*		0.08*
	(0.04)		(0.04)
dest-weighted log real exch. rate richest inc. group		-0.16**	-0.10
		(0.07)	(0.07)
dest-weighted log real exch. rate 2nd inc. group		-0.11	-0.16
		(0.19)	(0.20)
dest-weighted log real exch. rate 3rd inc. group		-0.14	-0.15
		(0.16)	(0.16)
dest-weighted log real exch. rate 4th inc. group		0.12	0.14*
		(0.08)	(0.08)
dest-weighted log real exch. rate poorest inc. group		0.03	0.02
		(0.02)	(0.02)
firm effects	Y	Y	Y
year effects	Y	Y	Y
R2	0.77	0.77	0.77
N	14808	14808	14808

Notes: Robust standard errors in parentheses. *10% level, **5% level, ***1% level.

Table 10: Source-country income and firm average input prices

	dep. var.: firm average log real input price				
	OLS	Red. form	Red. form	2SLS	2SLS
	(1)	(2)	(3)	(4)	(5)
av. gdp per capita of export destination	0.01**			0.45***	0.37***
	(0.01)			(0.15)	(0.13)
av. gdp per capita of source countries	-0.00				0.11
	(0.01)				(0.20)
source-weighted exch. rate, richest			0.07	0.11	
			(0.07)	(0.09)	
source-weighted exch. rate, 2nd			0.04	0.19	
			(0.22)	(0.27)	
source-weighted exch. rate, 3rd			0.17	0.08	
			(0.18)	(0.22)	
source-weighted exch. rate, 4th			-0.54***	-0.20	
			(0.20)	(0.25)	
source-weighted exch. rate, poorest			0.01	-0.01	
			(0.02)	(0.03)	
dest-weighted exch. rate, richest		-0.20***	-0.21***		
		(0.07)	(0.08)		
dest-weighted exch. rate, 2nd		-0.45**	-0.45**		
		(0.20)	(0.20)		
dest-weighted exch. rate, 3rd		-0.06	-0.08		
		(0.13)	(0.13)		
dest-weighted exch. rate, 4th		0.07	0.11		
		(0.09)	(0.09)		
dest-weighted exch. rate, poorest		0.06***	0.06***		
		(0.02)	(0.02)		
firm effects	Y	Y	Y	Y	Y
year effects	Y	Y	Y	Y	Y
R2	0.79	0.79	0.79		
N	14808	14808	14808	14808	14808

Notes: In Column (4) the destination-weighted log real exchange rates for each country income group are instruments for the average gdp per capita of export destinations. In Column (5) the destination-weighted and source-weighted log real exchange rates for each country income group are instruments for the average gdp per capita of export destinations and source countries. Robust standard errors in parenthesis. *10% level, **5% level, ***1% level.

Table 11: Destination income and input prices, one-step method

	dep. var.: firm-product log real input price							
	OLS	OLS	Red. form	Red. form	2SLS	2SLS	2SLS	2SLS
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
av. gdp per capita of export destinations	0.00	0.00			0.25**	0.20**	0.25**	0.20**
	(0.01)	(0.01)			(0.11)	(0.10)	(0.11)	(0.10)
export share of sales	0.02	0.02	0.01	0.01	0.00	0.20*	-0.00	0.19*
	(0.02)	(0.02)	(0.01)	(0.02)	(0.02)	(0.11)	(0.02)	(0.11)
log sales		0.04***		0.04***			0.05***	0.04***
		(0.01)		(0.01)			(0.01)	(0.01)
dest-weighted log real exchange rate richest income group			-0.15**	-0.15**				
			(0.07)	(0.07)				
dest-weighted log real exchange rate 2nd income group			-0.53**	-0.53**				
			(0.24)	(0.24)				
dest-weighted log real exchange rate 3rd income group			0.07	0.07				
			(0.11)	(0.11)				
dest-weighted log real exchange rate 4th income group			-0.01	-0.01				
			(0.07)	(0.07)				
dest-weighted log real exchange rate poorest income group			0.04**	0.04**				
			(0.02)	(0.02)				
firm effects	Y	Y	Y	Y	Y	Y	Y	Y
year effects	Y	Y	Y	Y	Y	Y	Y	Y
R2	0.96	0.96	0.96	0.96				
N	153341	153341	153341	153341	153341	153341	153341	153341

Notes: In Columns (5) and (7) the destination-weighted log real exchange rates for each country income group are instruments for the average gdp per capita of export destinations. In Columns (6) and (8) the destination-weighted log real exchange rates for each income group are instruments for the average gdp per capita of export destinations and the export share of sales. Standard errors clustered by firm in parenthesis. *10% level, **5% level, ***1% level.