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How Do Exporters Adjust to Exchange-Rate Fluctuations?

New Evidence from the East African Community

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Abstract

We use a large sample of export transactions from customs files across six developing countries and several years to explore the extent of pricing to market and volume responses to exchange-rate variations in the East African Community (EAC), a customs union, and a control group of exporters from developing countries outside the region. We find that, relative to the control group, EAC exporters seem to have a stronger ability to price to market on the CU market, suggesting the existence of market power. This market power does not seem to relate to usual proxies for firm size, but is more marked for manufactured products. We also find that the supply (volume) response to exchange-rate variations is more subdued for EAC exporters than for the control group, suggesting the existence of supply constraints.

JEL classification numbers: F41

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1 Introduction

In a recent paper, Freund and Pierola (2012) identified 92 "surges" (seven-year growth accelerations) of aggregate manufactured exports and uncovered three striking empirical regularities:

> First, surges are more likely in open economies or economies that are liberalizing. Second, surges are preceded by a large depreciation of the real exchange rate and lower exchange rate volatility. In fact, in developing countries, the real depreciation is large enough so as to leave the exchange rate undervalued by 20% on average. And third, the extensive margin – the discovery of new products and new markets – is an important component of export surges in developing countries, accounting for over 40% of total manufacturing export growth during the surge. (p. 389)

The role of the exchange rate, which echoes previous work on macro growth accelerations (Hausmann, Pritchett, and Rodrik, 2005; or Rodrik, 2008), has important policy implications for developing-country governments. Many still try to "engineer" export surges with export-processing zones and tax incentives, although experience suggests that tax incentives are costly and rarely effective. If a "competitive" exchange rate was, as suggested by the recent literature, such a central driver of export growth across countries, there would be a strong argument to shift policy attention to exchange-rate management away from industrial policy.

However, micro evidence on the link between exchange rates on one hand and export prices and volumes on the other is ambiguous, although it would be a key step to show that the macro correlations were not spurious. For one thing, most of the literature on exchange-rate pass through (ERPT) has attempted to identify short-run correlations rather than the long-run one uncovered by Freund and Pierola, and this paper will be no exception to that. But the ambiguity goes beyond short-run vs. long run.

A large number of papers, including e.g. Goldberg and Knetter (1997), Campa and Goldberg (2005) and Gopinath and Rigobon (2008), found low elasticities of import prices to exchange-rate movements, a phenomenon called the "exchange-rate disconnect".[1] Low price pass-through can be related to a number of features of the destination market. First, there can be what Engel (2003) called "local currency pricing", i.e. short-run nominal rigidities in the destination market. Second, there can be "pricing to market" (PTM), i.e. optimal markup determination by firms with market power, leading to a dampening of exchange-rate pass-through (we will formally explore this channel in Section 2 below). Atkeson and Burstein (2008) and Berman, Martin and Mayer (2012), among others, provide theoretical and empirical explorations of the PTM channel. Third, fixed local distribution costs can contribute to reduce the reaction of consumer prices to exchange-rate fluctuations (see Burstein, Neves and Rebelo 2003, or Goldberg and Campa 2010).

A key argument in the PTM literature is that if large, more productive firms have more market power, they will be the least susceptible of passing through exchange-rate movements, preventing the transmission of exporter-currency devaluations into added demand and growth. This can be shown in a model with CES preferences and additive distribution costs as in Berman, Martin and Mayer (2012) or in a model with quasi-linear preferences and variable markups as in Mayer and Ottaviano (2011). As large firms account for a large fraction of aggregate exports (see Freund and Pierola 2012), aggregate export prices and volumes will largely reflect the behavior of those firms.

[1] The term goes back to Obstfeld and Rogoff (2001).

Under that argument, the lack of reaction of export prices and volumes to exchange-rate fluctuations is attributable to market power. However, pass-through in a heterogeneous-firms model depends on the interplay of firm and destination-market characteristics whose net effect is an empirical question. Moreover, in developing countries, large firms are not necessarily those with more market power as they may be commodity exporters; whereas smaller firms serving regional markets protected by tariffs, NTBs or high transportation costs may have more market power.

Freund and Pierola's third empirical regularity—the relative importance of the extensive margin in export surges—is also surprising, as recent decompositions of export growth at the product level all suggested that it was dominated instead by the intensive margin (see e.g. Evenett and Keller 2002, Besedes and Prusa 2007, Brenton and Newfarmer 2007, or Amurgo-Pacheco and Pierola 2007). However, micro evidence can help reconcile the conflicting evidence. Chaterjee, Dix-Carneiro and Vichyanond (2012) showed in a product-ladder model that an exchange-rate rise (a devaluation of the exporter's currency) leads firms to broaden their product portfolio, as infra-marginal products become profitable at the new exchange-rate. Thus, the missing micro linkage here may be the relationship between exchange-rates and product-portfolio decisions at the firm level.

This paper explores the conjectures above (pricing-to-market and extensive-margin behavior) on the basis of a large, multi-country firm-level dataset with several million transactions obtained from customs administrations in six developing countries. The ability to pool together firm-level data from several countries is a first and lends itself to a systematic exploration of the drivers of pricing to market. The particular nature of the dataset, which includes four countries from the same customs union—the East African Community—makes it possible to explore PTM in a relatively large, integrated Southern regional market.

Results for this sample of countries suggest that there is less pricing to market than observed on industrial-country datasets, and in particular the French dataset used by Berman, Martin and Mayer. Over the whole sample, the PTM coefficient (the elasticity of exporter-currency exporter prices to the exchange rate) is insignificant.

However, the PTM coefficient is high (around 0.34-0.52, against around 0.1 on industrial-country samples) and highly significant on bilateral EAC trade, suggesting the existence of substantial market power. The volume elasticity is very high—between 2.3 and 3.6 (implying an elasticity of substitution between 4 and 7 for plausible values of the parameters, a value itself within the conventional range). Thus, currency fluctuations seem to have strong effects on both export prices and volumes in the EAC market. We also find that product-ladder effects, although quantitatively small, are present; that is, there is more pricing to market for core products, in which firms may have more market power.

The paper is organized as follows. Section 2 gives the analytics behind the pricing-to-market coefficient. Section 3 provides some background descriptive statistics on EAC exporters. Section 4 discusses estimation issues and Section 5 the results. Finally, Section 6 concludes.

2. Background

In order to highlight the assumptions that need to be embodied in a standard heterogeneous-firms model to generate incomplete exchange-rate pass-through—and generate some predictive comparative-statics properties—we present here a stripped-down pricing equation to which we add ingredients one by one, highlighting how the changes introduced affect the relationship between exchange rates, prices and volumes.

The functional form for demand assumed in the literature is typically one of two alternatives: Dixit-Stiglitz, which generates a constant-elasticity demand, or linear-quadratic (see e.g. Ottaviano, Tabuchi and Thisse 2002; Ottaviano and Melitz 2008, or Mayer and Ottaviano 2011), which generates a linear demand with variable elasticity. Consider the first case, which dominates the literature. Assume a continuum of differentiated varieties, each produced by a firm with productivity φ, with an elasticity of substitution σ. Letting $x(\varphi)$ be the demand for variety φ in a "generic" destination, preferences are CES with

$$U = \left[\int_X x(\varphi)^\rho \, d\varphi \right]^{1/\rho} \tag{1}$$

where $\rho = 1 - 1/\sigma$. As is well known, this functional form generates a constant-elasticity demand function of the form

$$x(\varphi) = Y \, P^{1-\sigma} p^c(\varphi)^{-\sigma} \tag{2}$$

where Y is the destination country's income, P its aggregate price index and $p^c(\varphi)$ the consumer price of variety φ. This formulation implies a constant markup over marginal cost which itself implies "mill pricing"—a formula whereby the firm applies the same producer price to all of its export markets. In that case, there is full exchange-rate pass through (ERPT). To see this, let e be the exporter's exchange rate,[2] $\tilde{p} = ep$ the producer price in the exporter's currency, and observe that marginal revenue is

$$\frac{d\left[\tilde{p}(\varphi)x(\varphi)\right]}{dx(\varphi)} = \tilde{p}(\varphi)\left(1 - \frac{1}{\sigma\varepsilon^p}\right) \tag{3}$$

where $\varepsilon^p = d\ln p^c / d\ln p$ is the elasticity of the consumer price to the producer price in the importer currency.

Assume that costs are the sum of a fixed, destination-specific cost $f(\varphi, e)$ and a variable cost x/φ:

$$c(x, \varphi, e) = f(\varphi, e) + \frac{x}{\varphi} \tag{4}$$

At the firm's optimum,

$$\tilde{p}(\varphi) = \left(\frac{\sigma\varepsilon^p}{\sigma\varepsilon^p - 1}\right)\frac{1}{\varphi} \tag{5}$$

where the term in parentheses is the firm's markup over marginal cost.

Prices

[2] Throughout, we will define the exchange rate in the conventional manner as the number of units of the exporter's currency per unit of the importer's one, so a raise in e will be a depreciation of the exporter's currency.

The degree of ERPT on prices depends on ε^p, i.e. on the assumptions made about transportation and distribution costs. With a simple iceberg transportation cost τ,

$$p^c = \tau p \tag{6}$$

so $\varepsilon^p = 1$ and (5) reduces to

$$\tilde{p}(\varphi) = \left(\frac{\sigma}{\sigma - 1}\right)\frac{1}{\varphi}, \tag{7}$$

so

$$\beta^p = \frac{d \ln \tilde{p}}{d \ln e} = 0 \tag{8}$$

and mill pricing applies, which means that there is full ERPT. Thus, under Dixit-Stiglitz preferences, heterogeneity of firms is not enough in itself to destroy the constant-markup/mill-pricing property of monopolistic-competition models.

Suppose, however, that there is an additive distribution cost in the importing country, as in Berman, Martin and Mayer (2012) or Chatterjee, Dix-Carneiro and Vichyanond (2012), so

$$p^c = \tau p + \eta \tag{9}$$

where τ is an iceberg transportation cost and η is a distribution cost incurred in the importing country and expressed in that country's currency.[3] Then, after some manipulation,

$$\varepsilon^p = \frac{\tau p}{\tau p + \eta}, \tag{10}$$

$$\tilde{p}(\varphi) = \left(\frac{\sigma}{\sigma - 1}\right)\left(1 + \frac{\varphi \eta e}{\sigma \tau}\right)\frac{1}{\varphi} \tag{11}$$

and the exchange-rate elasticity of the producer price, in the *exporter*'s currency, is

$$\beta^p = \frac{d \ln \tilde{p}}{d \ln e} = \frac{\varphi \eta e}{\sigma \tau + \varphi \eta e}. \tag{12}$$

In that case, mill pricing ($\beta = 0$) does not apply anymore, as β is strictly between zero and one. Instead, the degree of pricing to market (how close β is to one, as β =1 implies full pricing to market) depends on the parameters, with four testable comparative-statics properties:

[3] There is a surprising disconnect between reality and common practice in trade theory in this formulation. First, freight rates charged by shipping companies are not ad-valorem but by weight. For instance, two quote requests from Maersk for a 20' container to be shipped from Singapore to Rotterdam, one with fertilizers (low unit value) as the declared merchandise and the other with collectors' antiques (high unit value) returned an exactly identical offer of $2'422.83, of which base freight was $1'235. Second, wholesalers and retailers typically charge proportional (ad-valorem) commissions, as the authors verified from business intermediaries. Thus, in (9) the additive component η should be the transportation cost and the multiplicative component τ should be the distribution cost. We will leave this issue for further research and stick to the conventional formulation here.

1. $\dfrac{\partial \beta^p}{\partial \varphi} > 0$: More productive firms price more to market,
2. $\dfrac{\partial \beta^p}{\partial \eta} > 0$: More pricing to market in destinations with higher distribution costs,
3. $\dfrac{\partial \beta^p}{\partial \tau} < 0$: Less pricing to market in faraway destinations,
4. $\dfrac{\partial \beta^p}{\partial \sigma} < 0$: Less pricing to market in destinations where competition is tougher.

In addition, multi-product firms with independent product lines and varying levels of efficiency across products will apply different pricing rules across their portfolio of products. If firms are more efficient in their "core" products (those having a high share in their export sales) they will behave, for those products, like large firms, i.e. price more to market (Chatterjee et al. 2012). This gives a fifth testable property, namely that if a firm produces (and exports) n products ranked from the largest to the smallest, $\varphi_1 > \varphi_2 > ... > \varphi_n$ whence $\beta_1^p > \beta_2^p > ... > \beta_n^p$. That is, there is more pricing to market for "core" products.

Volumes

The effect of exchange-rate variations on volumes can be calculated in a similar fashion. Log-differentiating (2) with respect to e,

$$\begin{aligned}\beta^q = \frac{d\ln x}{d\ln e} &= -\sigma\left[\left.\frac{\partial \ln p^c}{\partial \ln e}\right|_{\tilde{p}\text{ const.}} + \beta\left.\frac{\partial \ln p^c}{\partial \ln \tilde{p}}\right|_{e\text{ const.}}\right]\\ &= -\sigma\left[\frac{-\tau\tilde{p}}{e(\tau p+\eta)} + \beta\frac{\tau p}{\tau p+\eta}\right]\\ &= \frac{\sigma\tau p(1-\beta)}{\tau p+\eta}\end{aligned} \tag{13}$$

As β^p is strictly between zero and one, β^q is strictly positive. Specifically, with full ERPT on prices,

$$\lim_{\beta^p \to 0} \beta^q = \frac{\sigma\tau p}{\tau p+\eta} \tag{14}$$

whereas with full pricing to market,

$$\lim_{\beta^p \to 1} \beta^q = 0\,. \tag{15}$$

In the baseline case with no distribution costs (η = 0), mill pricing implies a volume elasticity of exports to the exchange rate just equal to the elasticity of substitution ($\beta^q = \sigma$). With distribution costs, the exchange-rate elasticity of volumes can be smaller or larger than one, depending on the relative magnitudes of σ and η.

Comparative-statics properties have the same sign as ERPT (but opposite to β^p): The more pass-through on prices, the larger the induced volume change.[4]

$\frac{\partial \beta^q}{\partial \varphi} < 0$: More productive firms have lower volume elasticity,

$\frac{\partial \beta^q}{\partial \eta} < 0$: Lower volume elasticity in destinations with higher distribution costs,

$\frac{\partial \beta^q}{\partial \tau} > 0$: Higher volume elasticity for more faraway destinations,

$\frac{\partial \beta^q}{\partial \sigma} > 0$: Higher volume elasticity in destinations where competition is tougher.

Although comparative statics signs are opposite for prices and volumes, the co-movement between the two is complex. As an illustration, consider a stripped-down example with a developing country exporting to two sharply (and somewhat artificially) differentiated destinations: a Northern one characterized by long distance, tough competition, and high distribution costs, and a Southern one with short distance, low competition, and low distribution costs. Specifically, assume that in the Northern market, $\sigma^N = 5$, $\tau^N = 1.6$, and $\eta^N = 1$; that is, transportation costs add 60% to FOB value and distribution costs add 100% to CIF value (at the baseline price, since they are not ad-valorem). With $\varphi = 1$, $p = 1$, $e = 1$, $\beta^{pN} = 0.11$ and $\beta^{qN} = 2.73$. Assume now that in the neighboring Southern market, $\sigma^S = 2$, $\tau^S = 1.3$, and $\eta^N = 0.2$; that is, transportation cost is 30% of FOB price and distribution cost is 20%. Then $\beta^{pS} = 0.071$ and $q^{qS} = 1.61$. In this case, pricing to market is stronger on the Northern market (*less* ERPT), but so is the reaction of volumes to a change in the exchange rate; the combination of parameter values induces positive co-movement in price and destination elasticities across destinations.

We now turn to an empirical exploration of these effects in a multi-country dataset with exporters from developing countries.

2 Data

We use a new multi-country, firm-level dataset obtained from the Customs administrations of eight countries : Bangladesh, Kenya, Morocco, Rwanda, Tanzania, and Uganda. The data were forwarded to us in the form of ASYCUDA spreadsheets and include all export transactions over a number of years (see Table 1) with, for each transaction, a firm identifier, a date (indicating month and year), the transaction's destination country, the product's HS code (typically at country-specific HS8-equivalent levels), the transaction value in local currency, and a host of other variables of lesser interest for this paper.

[4] This is under the assumption of constant marginal costs (although not equal across firms), where all volume changes are along the demand curve.

Table 1 gives basic sample-size and sample-period information by origin country. The overall sample is dominated by its three large origins, Bangladesh, Kenya and Morocco, in terms of transactions (both total and yearly) and number of firms. All origin countries have diversified destination portfolios, and the total number of HS6 products exported in one year or another ranges between 1'415 (Rwanda) and 4'660 (Kenya), out of a notional total of about 5'000 HS6 lines.

Table 1
Cross-country data summary

	Number of years	Number of transactions	Transactions per year	Number of firms	Number of destinations	Number of products a/
Bangladesh	7 (2005-2011)	412'000	58'857	13'503	197	2'784
Kenya	7 (2005-2011)	255'314	36'473	9'373	185	4'660
Morocco	9 (2002-2010)	463'386	51'487	17'470	179	4'391
Tanzania	7 (2005-2010)	44'408	6'344	4'517	178	3'267
Uganda	8 (2004-2011)	36'919	4'615	2'874	164	2'940
Rwanda	7 (2005-2011)	8'186	1'169	1'991	135	1'415

Notes
a/ Products have been aggregated to the common HS6 classification.

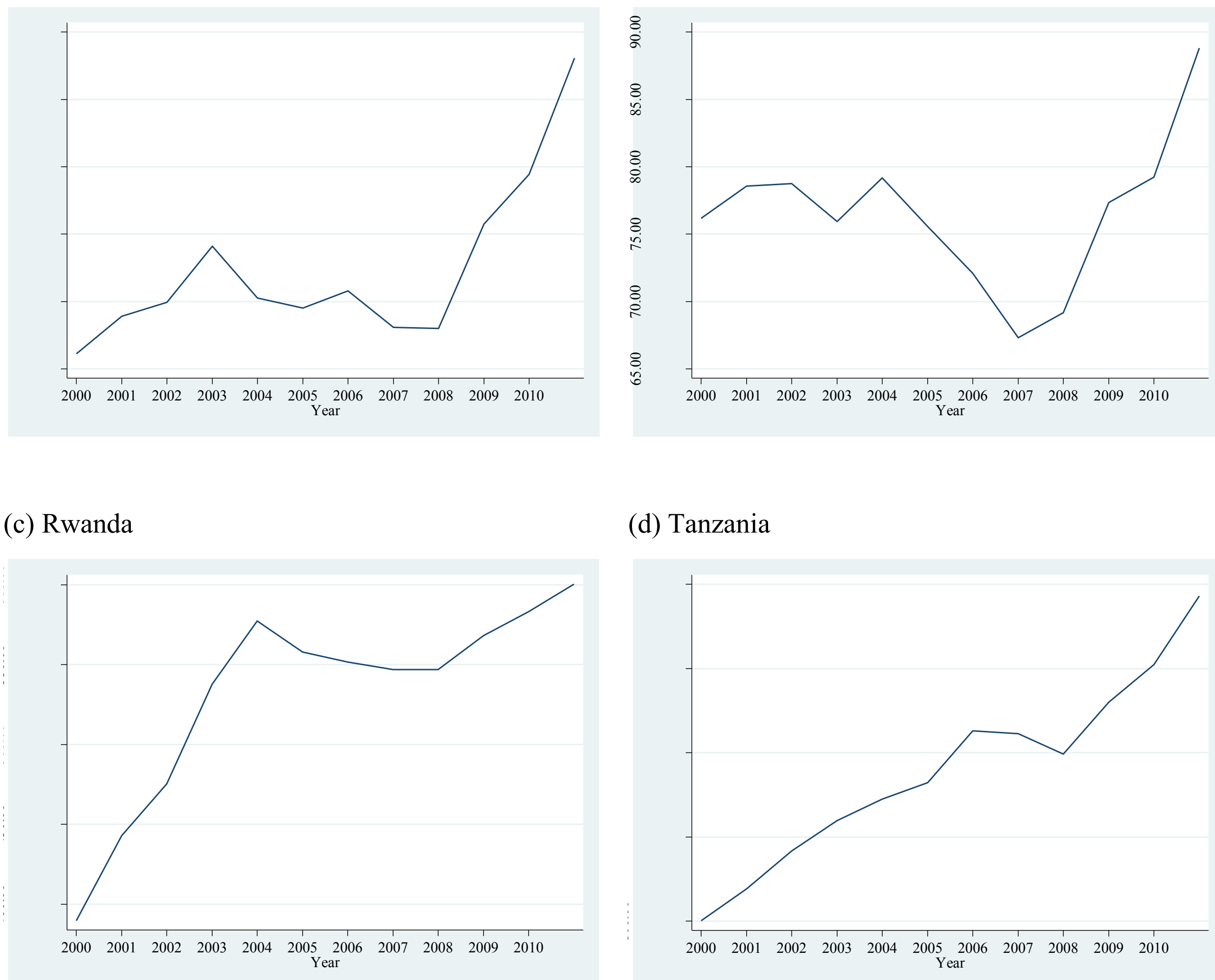
Exchange rates vis-à-vis the U.S. dollar are from the IMF's International Financial Statistics (IFS) and are deflated by consumer price indices to obtain real exchange rates (RER). They are all expressed in local currency units (LCU) per dollar in the IFS. Let e_o and e_d be respectively the origin and destination countries' exchange rates in LCU per dollar, and p_o and p_d their consumer price indices. Our bilateral exchange-rate variable, in logs, is thus

$$\ln\left(e_{od}\right) = \ln\left(\frac{e_o / p_o}{e_d / p_d}\right) = \ln\left(\frac{e_o}{e_d}\right) + \ln\left(\frac{p_d}{p_o}\right). \tag{16}$$

There was substantial volatility in exchange rates for EAC countries in our sample period. Figure 1 shows bilateral nominal exchange rates vis-à-vis the dollar, in local currency units per dollar. Both volatility and lack of co-movement over the sample period are apparent.

Figure 1
Bilateral dollar exchange rates, EAC countries

(a) Uganda (b) Kenya



In some of the regressions below, we will decompose RER effects into nominal exchange-rate effects and price effects in order to explore asymmetries in the price response of exporters to nominal vs. real changes. Table 2 shows descriptive statistics for the variables used in the regressions.

Table 2
Descriptive statistics

Variable	Obs	Mean	Std.Dev.	Min	Max
Volume (Weight in kg)	1'168'627	133'449	4'062'686	100	1.74E+09
ln(Volume)	1'168'627	8.24	2.25	4.61	21.28
Unit Value	1'168'627	11'669	2'299'331	0.00	2.02E+09
ln(Unit Value)	1'168'627	5.50	2.51	-6.84	21.43
Real Exchange Rate (RER)	1'128'862	191	727	0	6'982
ln(RER)	1'128'862	2.19	3.10	-11.49	8.85
Nominal Exchange Rate (RER)	1'160'246	173	621	0	9'126
CPIratio	1'129'090	0.97	0.21	0.01	11.59
Distance to Capital	1'168'627	4'530	3'821	50	18'884
ln(Dist. To Cap.)	1'168'627	7.99	1.00	3.92	9.85
GDP constant (2000)	1'156'661	1.29E+12	2.69e+12	1.55E+07	1.17E+13
ln(GDP)	1'156'661	26.06	2.34	16.56	30.09
GDPpc PPP (Const 2005)	1'156'005	23'179	16'191	249	77'987
ln (GDPpc PPP)	1'156'005	9.46	1.41	5.52	11.26
Number of Products (HS6)	1'168'627	30	68	1	735
ln(Number of Products (HS6)	1'168'627	2.57	1.19	0.69	6.60

3 Stylized facts

As our dataset is the first firm-level trade dataset to cover four EAC countries, we summarize in this section a few stylized facts of interest about East African exporters as they emerge from our data.

3.1 East Africa's exporters : What do we know ?

It has been observed that the distribution of export sales across firms is heavily skewed (see e.g. Freund and Pierola 2012) with the bulk of export values being accounted for by a few large firms. Skewness is apparent in our sample as the mean value of annual firm-level export turnover is thirty to sixty times the median. There is much less skewness in terms of number of destinations and products (Table 3), suggesting that large firms differ more from small ones at the intensive margin than at the extensive one.

Table 3
Exporter characteristics

	Total export turnover a/		Destinations		Product	
	Mean	Median	Mean	Median	Mean	Median
Uganda	2'405'939	37'895	7	4	10	5
Kenya	1'042'485	34'665	4	1	25	10
Tanzania	2'667'656	46'667	6	3	8	4
Rwanda	584'311	17'329	5	3	4	2

Relatedly, the diversification of EAC exporters in terms of products follows a non-monotone path. Table 4 shows panel regression results for the firm-level Herfindahl index of product concentration on the log of export turnover in U.S. dollars. Both between and within firms, the relationship is non-monotone, with firms first diversifying and then re-concentrating.[5]

The turning point, calculated as $\tilde{x} = \exp\left(-\alpha_1 / 2\alpha_2\right)$ where α_1 and α_2 are the regression coefficients on the linear and quadratic terms respectively, is between \$600'000 and \$700'000 depending on the estimation method (\$442'000 for manufactured products), leaving, on average, about 16% of exporter-year observations to the right; that is, about 16% of all exporter-year observations in our cross-country sample are in the re-concentration phase. A plausible explanation is a process of experimentation whereby firms try a number of products on export markets and then concentrate on the most profitable,[6] implying that productivity improvements appearing as "learning by exporting" might in fact be within-firm, between-products composition effects.

[5] This pattern was observed at the country level in terms of production (Imbs and Wacziarg 2002) and in terms of exports (Cadot, Carrère and Strauss-Kahn 2011). To our knowledge, it has not been observed on firms. Whereas Table 4 refers to EAC exporters, the same pattern holds for the whole sample, including Morocco and Bangladesh.

[6] Whether firms "learn from exporting" has been a long-standing debate in the literature. At the firm level, the early ("pre-Melitz") empirical literature on the productivity-export linkage was predicated on the idea that firms learn by exporting (see e.g. Haddad 1993, Aw and Hwang 1995, or Tybout and Westbrook 1995). However, Clerides, Lach and Tybout (1998) argued theoretically that the productivity differential between exporting and non-exporting firms was a selection effect, not a learning one, and found support for this interpretation using plant-level data in Columbia, Mexico and Morocco. Subsequent studies (Bernard and Jensen 1999; Eaton et al. 2004, 2011; Helpman et al. 2004) confirmed the importance of selection effects at the firm level. More recently, however, papers focusing on micro-level data have found some evidence of "learning-by-exporting" (e.g., Girma, Greenaway and Kneller 2004, van Biesebroeck 2005; De Loecker 2007; Aw, Roberts and Winston 2007 or Crespi et al. 2008).

Table 4
Product concentration at the firm level, EAC exporters

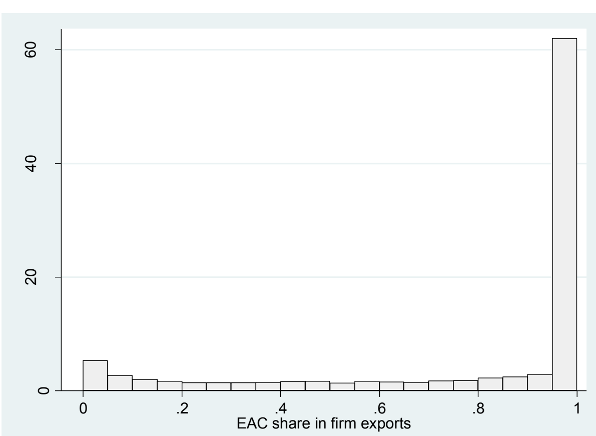
Estimator	OLS	FE	FE
Dep. Var.	Herfindahl concent. index, by product		
	(1)	(2)	(3)
Log export turnover	-0.241	-0.269	-0.312
	(55.68)***	(36.11)***	(29.61)***
Log export turnover, squared	0.009	0.010	0.012
	(46.20)***	(29.36)***	(23.66)***
Constant	2.371	2.513	2.723
	(84.42)***	(55.43)***	(44.06)***
Firm fixed effects	No	Yes	Yes
Time effects	Yes	Yes	Yes
Turning point (USD)	652'710	693'842	442'413
Observations	36'349	36'349	24'416
R-squared	0.14	0.15	0.18
Number of firms		15'142	10'812

Note : Robust t statistics in parentheses, * significant at 10%; ** significant at 5%; *** significant at 1%; turnover in U.S. dollars for all firms.

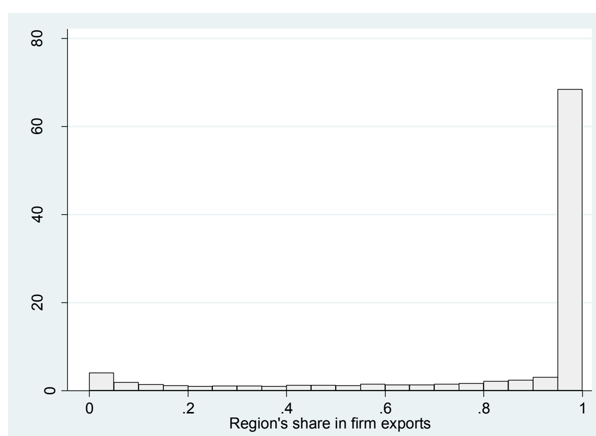
There is strong spatial specialization, as the majority (slightly more than 60%) of the sample's EAC exporters realize over 95% of their export sales on EAC or regional (EAC plus DRC and South Sudan) markets (panels (a) and (b) of Figure 2 respectively).

Figure 2
Share of regional sales in total export turnover, by firm

(a) East African Community (EAC)

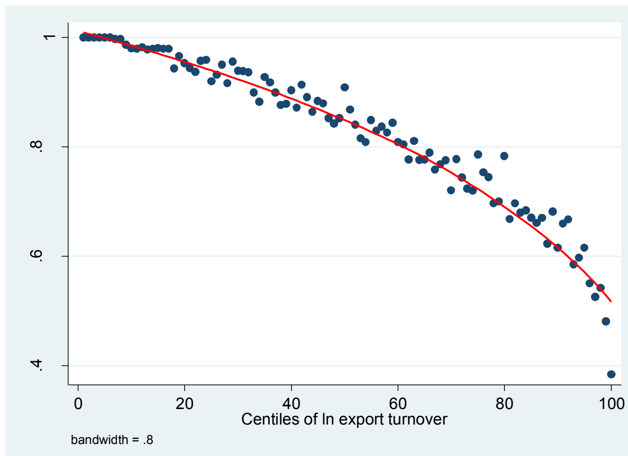


(b) EAC + DRC & South Soudan



However, the share of export sales going to EAC markets is much smaller, as EAC exporters tend to be smaller in terms of overall export turnover than non-EAC exporters. This is shown in Figure 3 which plots a "smoother" (non-parametric) regression of the ratio of regional over total exports at the firm-year level against centiles of the distribution of export turnover, ordered from smallest to largest. The relationship is strongly decreasing, with the largest centile (which accounts for most of the country-level export value) exporting less than 40% to regional markets.

Figure 3
Share of regional sales in export across export-turnover distribution



The heterogeneity of the population of exporters in terms of destination markets highlights the need to identify effects within firms in order to eliminate confounding influences due to selection into destination markets.

4 Estimation

The database is very large, but relatively poor in covariates as it contains no firm characteristics (countries in the sample either do not carry out firm surveys are regular dates or, like Morocco, do not communicate them to researchers).[7] Thus, identification of the key comparative-statics property on firm productivity/size (φ) will have to rely on proxies. In the literature, product scope is the firm-level observable that correlates most closely, across firms, with productivity. However, within firms, both the theoretical literature (Bernard et al. 2011, Eckel and Neary 2010) and the empirical one (Chatterjee, Dix-Carneiro and Vichyanon 2012) suggest that product scope is endogenous to the firm's environment. For instance, Bernard et al. (2011) Eckel and Neary (2010) show that firms optimally reduce product scope (focus on their core competencies) after a trade liberalization as a result of pro-competitive effects. The same pro-competitive effects can be expected from an exchange-rate depreciation (an appreciation of the exporter's currency), as shown by Chatterjee, Dix-Carneiro and Vichyanon (2012). This creates an obvious identification problem. For now, this will be treated in two ways: First, using product scope at the firm level rather than at the firm-destination level, as endogeneity to the bilateral exchange rate would be at the firm-origin-

[7] Uganda has a firm survey, but the combined data is not sufficiently balanced to be usable for this paper.

destination rather than the firm level; second (additionally), using lagged values of product scope as a regressor. We will report results from both approaches.

In a robustness section, we report results using the (lagged) number of destinations and total export value, both at the firm level, as alternative proxies for firm size.

Transportation costs will be approximated by bilateral distance, the degree of competition by the size of the destination economy (GDP), and distribution costs by its income level (GDP per capita).

Let us define the following indices: o is origin country, d is destination country, f is firm, p is product, and t is year. Let e_{odt} be the real exchange rate between the origin and destination countries in year t, as in (16) and p_{fpdt} the producer price of product p exported by firm f to destination d at t, in country o's currency (what was called $\tilde{p}$ in the algebra of section 2).[8]

Let also $\mathbf{x}^k_{\cdot}$, $k = 1,\ldots,4$, be four vectors of explanatory variables. Specifically, $\mathbf{x}^1_{odt} = \left[\tau_{odt}\right]$ (bilateral distance), $\mathbf{x}^2_{dt} = \left[Y_{dt}, y_{dt}, \mathrm{EAC}_{dt}\right]$ (destination GDP, approximating σ, destination GDP/capita, approximating η, and whether the destination belongs to the EAC customs union, to identify trade-policy effects); $\mathbf{x}^3_{ft} = \left[\ln\left(n_{ft}\right)\right]$ (firm f's number of products, approximating φ), and $\mathbf{x}^4_p = \left[m_p\right]$ (a dummy variable marking manufactured products). Finally, let δ_{od} and δ_{fpd} be origin-destination and firm-product-destination fixed effects respectively. The baseline estimation equation is

$$\begin{aligned}\ln\left(p_{fpdt}\right) = {} & \alpha_0 \ln\left(e_{odt}\right) + \alpha_1 \mathbf{x}^1_{odt} + \alpha_3 \mathbf{x}^2_{dt} + \alpha_4 \mathbf{x}^3_{ft} \\ & + \alpha_5 \mathbf{x}^4_p + \sum_k \beta_k \left[\ln\left(e_{odt}\right) \times \mathbf{x}^k_{\cdot}\right] \\ & + \delta_{ot} + \delta_{fpd} + u_{fpdt}\end{aligned} \tag{17}$$

Equation (17) is estimated by FE-OLS with robust standard errors.

4 Results

This section presents baseline results on the pricing-to-market (PTM) coefficient in terms of unit values and volumes, for both the whole sample and EAC countries, as well as preliminary results on product-ladder effects and the effect of exchange-rate volatility on export volumes. As results tables are bulky, they are relegated to the end of the paper.

4.1 Baseline

In order to benchmark results for EAC exporters, Table 5 presents baseline regression results for the whole sample including non-EAC exporters. The dependent variable is the log of export unit values, and all regressions are estimated by OLS with fixed effects by firm-product-destination and by origin-year. The pricing-to-market coefficient—the equivalent of β^p in (12)—is the coefficient on the log of the real bilateral exchange rate. As highlighted in Section 2, we expect it to be between zero and one and to be higher (closer to one) for larger firms and markets with larger distribution costs (presumably higher-income countries), while being lower for more faraway

[8] Origin subscripts can be omitted in the presence of firm subscripts given that firms in the sample are treated as if all country-level subsidiaries were independent entities.

destinations and destinations characterized by tougher competition. As high-income destinations are likely to be characterized by both tough competition and high distribution costs, the effect of destination income is, a priori, ambiguous. These properties are explored through interaction terms between the bilateral RER and various proxies including distance, destination GDP per capita, and the number of products exported by the firm (a proxy for its productivity). We also explore asymmetries between appreciations and depreciations of the exporter's currency.

Table 5
Baseline price regression results, all sample

By and large, the results reported in Table 5 suggest that, compared to the literature, we observe little pricing to market on our sample of developing-country firms, which accords with the intuition that those firms may have less market power than firms located in industrial countries. The coefficient on the log of the bilateral RER, which is the equivalent of β^p in section 2, is significant and close to the usual estimate in industrial countries (0.108) when included alone in the regression, but once other regressors are included, it becomes unstable and insignificant. In other words, when the exporter's currency depreciates, the typical exporter in our sample keeps his export price constant and lets the buyer capture the rent. Unit values correlate positively with the destination country's income level, in accordance with the classic findings of Schott (2004). They correlate negatively with the destination country's GDP, suggesting tougher competition on larger markets. None of the interaction terms of these explanatory variables turns out significant, so there is at this stage no identification of our comparative-statics properties. However, a key interaction term, between the log of the lagged number of products and the real exchange rate, is positive and highly significant, implying more pricing to market for firms with a broader scope. If broader scope is taken as a proxy for firm productivity (a higher φ), the sign of this interaction term is in accordance with the basic prediction of the CES model with additive distribution costs or with that of the QL model. However, quantitatively, this effect is very small.

Table 6
Baseline volume regression results, all sample

Table 6 reports the estimated elasticity of volumes to the exchange rate, the equivalent of β^q in section 2. Here the results are stable and suggest a strong elasticity. Note that unlike β^p, β^q is not constrained by the model's logic to lie between zero and one. Assuming $\beta^p = 0$ (as the estimates in Table 5 are not significant), if transportation costs added on average 20% to the FOB price of goods and distribution costs added 100% to the CIF price, the estimates in Table 6 would imply, by inversion of (14), values of σ, the elasticity of substitution, between 4.26 and 6.6, a plausible range.

Table 7 presents estimates restricted to the sample of EAC exporters. As for the whole sample, the PTM coefficient is not significant. However, for specification (9) where the number of products (as a proxy for firm size) is not lagged, the PTM coefficient interacted with a dummy for manufactured products becomes significant, suggesting there is less pass-through for manufactured products. More importantly, the PTM coefficient is very large and significant for EAC bilateral trade. This means that the limited competitiveness of EAC markets provides market power not only to foreign firms selling there, but also to EAC firms. PTM coefficients between 0.725 (column 10) and 0.888 (column 12) means pass-through of at most a quarter of exchange-rate variations to FOB export prices, a very high degree of pricing to market. Interestingly, the ability to price to market does not seem to relate to firm size in the EAC, confirming our conjecture that in poor countries, firm size is not a good proxy for market power (as larger firms tend to be commodity traders with little or no market power).

Table 7
Baseline price regression results, EAC exporters

Table 8 reports estimates for the volume coefficient (β^q) for EAC exporters. Here the effect is either not significant or barely so (and with the wrong sign in column 12), a very notable difference with the result for the whole sample where it was significant in columns 10-12 with very high point estimates (Table 6). Interacted with a dummy variable for manufactured products, it becomes significant with point estimates between 1.003 in column 10 and 1.160 in column 12. Thus, there is a supply response to exchange-rate variations for EAC exporters selling manufactured products, however, the striking difference with Table 6 is that the coefficient is now substantially (three times) smaller, suggesting a much weaker supply response. This is suggestive of constraints and rigidities—possibly of lack of excess capacity as well—in EAC countries compared to the "control group" of Bangladeshi and Moroccan exporters. Lack of excess capacity is consistent with the ability to price to market.

Table 8
Baseline volume regression results, EAC exporters

In sum, the comparison between the adjustment pattern of EAC exporters to exchange-rate variations with that of a control group of out-of-region exporters suggests substantially more market power and less ability to respond in terms of quantities to price signals.

5.2 Extensions

We noted in Section 2 that if firms are more productive in their core products, the pricing-to-market coefficient would be higher. We test this conjecture, due to Chatterjee et al. (2012), by including in our baseline regression additional interaction terms at the firm-product-destination level between the log of the real exchange rate and the rank of the product in the firm's export sales. We use several proxies for product *p*'s rank in firm *f*'s sales in destination *d* at time *t*: Bottom_{fpdt} is a dummy variable equal to one when product *p* is the smallest in firm *f*'s portfolio; not core_{fpdt} is equal to one when product *p* is not firm *f*'s top product; second_{fpdt} is equal to one when product *p* is firm *f*'s second-largest; finally, $\ln(\text{ranking})_{fpdt}$ is simply product *p*'s rank.

Results are shown in Table 9. All product-ladder variables except second_{fpdt} have negative and significant coefficient; however, the magnitudes are very small. To see this, note that, as before, the pricing-to-market coefficient is insignificant for the whole sample, but large and highly significant for EAC bilateral trade. When product p is firm f's bottom product, its PTM coefficient is reduced from 0.458 to 0.446, an effect which is very small even if it is identified with precision.

Table 9

Regression results, product ladder

In Baldwin and Gu (2009) and Nocke and Yeaple (2006), trade liberalization causes multi-product firms to concentrate on their most profitable products, which raises firm-level productivity through a selection effect at the product level. In Mayer et al. (2010), firms concentrate on their highest-performing products when they export to markets where competition is intense, which, again, translates into higher productivity at the firm level.

In Table 10, we take a first pass at the effect of short-run exchange-rate volatility on export volumes. We construct a new regressor equal to the absolute value of the jump in the exchange rate in the previous period. We find that exchange-rate volatility has a positive effect on trade volumes for the whole sample, but not for EAC exporters. These results, however, are very preliminary.

Table 10
Effect of exchange-rate volatility on export volumes

6 Concluding remarks

Our large cross-country dataset has made it possible to explore the effect of exchange-rate variations on the behavior of EAC exporters at the price and volume margins in comparison to a treatment group of out-of-region exporters. Our results are very preliminary and should be treated with the utmost caution, but they are, as they stand, suggestive of a number of distinctive features of EAC markets and the fabric of exporters in member countries.

We find that the ability to "price to market", a proxy for market power, appears substantial for EAC exporters when the sell in EAC markets. It also does not seem to related to firm size—although the nature of our data obliges us to use crude proxies for firm size and productivity, the key parameters in a heterogenous-firms model—suggesting that market power is not about size on EAC markets. This accords with intuition, as medium-sized firms in manufactured-product sectors protected by high tariffs (the 25% band of EAC's CET) and non-tariff barriers are likely to have more market power than larger firms selling commodities on highly competitive international markets.

We also find that the volume response to exchange-rate variations, while significant and reasonably large (a unit elasticity) is substantially more subdued for EAC exporters than for the control group (for which we find an elasticity around three), suggesting the existence of supply constraints for EAC exporters. These constraints may include capacity constraints, explaining the ability of EAC exporters to capture the rents of currency devaluations (i.e. their ability to price to market noted above).

Finally, we find little evidence that short-term volatility per se penalizes EAC exporters in terms of volume exported, although our results here require further research. In terms of policy implications, our preliminary results suggest that exchange-rate policy may not be enough, in itself, to trigger "export surges" in the presence of other binding constraints to export growth.

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Table 5
Baseline regression results, unit values, all sample

Dependent var.: ln (Unit Value) Estimator: OLS	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)
Log bilateral RER	0.108***	0.0853**	1.622***	-0.0812	-0.0908	-0.197***	0.0873***	0.137***	0.0695**	0.0692	-0.559	-0.0225
	(0.0316)	(0.0332)	(0.369)	(0.127)	(0.212)	(0.0692)	(0.0317)	(0.0303)	(0.0309)	(0.390)	(0.370)	(0.352)
Interaction terms												
ln (RER) × deval. a/		-0.00217								0.000232	0.000670	0.000608
		(0.00143)								(0.00136)	(0.00136)	(0.00136)
ln (RER) × ln (dist.)			-0.182***							-0.0612	0.0490	-0.0385
			(0.0439)							(0.0430)	(0.0434)	(0.0397)
ln (RER) × ln (dest. GDP/cap)				0.0223*						-0.0141	-0.000750	-0.00824
				(0.0128)						(0.0252)	(0.0238)	(0.0237)
ln (RER) × ln (dest. GDP)					0.00987					0.0167	0.0145	0.0249*
					(0.00779)					(0.0144)	(0.0133)	(0.0131)
ln (RER) × manuf. Prod.						0.396***				0.301***	-0.122**	-0.106*
						(0.0777)				(0.0707)	(0.0572)	(0.0568)
ln (RER) × ln (1+number prod.) b/							0.00848***			0.00588***		
							(0.00211)			(0.00203)		
ln (RER) × ln (lag number prod.) b								0.00570***			0.00413**	0.00449**
								(0.00194)			(0.00192)	(0.00192)
ln (RER) × EAC bilateral trade c/									0.692***	0.341**	0.525***	
									(0.153)	(0.164)	(0.179)	
Devaluation (Real)		0.0155***								0.0104**	0.00671	0.00691
		(0.00495)								(0.00491)	(0.00477)	(0.00477)
ln (dest. GDP/cap)				-0.190***						0.546***	0.476***	0.515***
				(0.0480)						(0.0999)	(0.104)	(0.103)
ln (dest. GDP)					-0.323***					-0.648***	-0.505***	-0.539***
					(0.0476)					(0.0897)	(0.0921)	(0.0912)
ln (1+number prod.)							0.00230			0.00749		
							(0.00677)			(0.00672)		
ln (lag number prod.)								-0.0103			-0.00688	-0.00746
								(0.00646)			(0.00644)	(0.00644)
Observations	568,275	568,275	568,275	567,172	567,114	568,240	568,275	431,635	568,275	566,990	430,556	430,556
R-squared	0.967	0.967	0.967	0.967	0.967	0.967	0.967	0.969	0.967	0.967	0.969	0.969
Firm-product-destination FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Origin--year FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes

Table 6
Baseline regression results, volumes, all sample

Dependent var.: ln (Volume) Estimator: OLS	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)
Log bilateral RER	0.403***	0.514***	0.380	2.220***	3.094***	-0.0612	0.402***	0.469***	0.438***	3.629***	3.035***	2.324***
	(0.0655)	(0.0710)	(0.589)	(0.276)	(0.441)	(0.123)	(0.0658)	(0.0749)	(0.0666)	(0.811)	(0.866)	(0.789)
Interaction terms												
ln (RER) × deval. a/		-0.00247								-0.00286	0.000885	0.000966
		(0.00282)								(0.00285)	(0.00294)	(0.00294)
ln (RER) × ln (dist.)			0.00270							-0.193**	-0.0344	0.0816
			(0.0699)							(0.0917)	(0.102)	(0.0840)
ln (RER) × ln (dest. GDP/cap)				-0.202***						0.0192	0.0317	0.0416
				(0.0274)						(0.0530)	(0.0550)	(0.0549)
ln (RER) × ln (dest. GDP)					-0.109***					-0.0897***	-0.122***	-0.136***
					(0.0163)					(0.0316)	(0.0327)	(0.0320)
ln (RER) × manuf. Prod.						0.601***				0.682***	0.674***	0.652***
						(0.133)				(0.134)	(0.142)	(0.141)
ln (RER) × ln (1+number prod.) b/							0.00142			0.00415		
							(0.00385)			(0.00383)		
ln (RER) × ln (lag number prod.) b								-0.0120***			-0.00529	-0.00578
								(0.00359)			(0.00362)	(0.00361)
ln (RER) × EAC bilateral trade c/									-0.633***	-0.813***	-0.696*	
									(0.227)	(0.291)	(0.360)	
Devaluation (Real)		-0.0470***								-0.0514***	-0.0540***	-0.0543***
		(0.0106)								(0.0107)	(0.0108)	(0.0108)
ln (dest. GDP/cap)				1.015***						-0.615***	-0.644**	-0.697***
				(0.113)						(0.230)	(0.250)	(0.250)
ln (dest. GDP)					1.024***					1.544***	1.687***	1.733***
					(0.100)					(0.199)	(0.216)	(0.215)
ln (1+number prod.)							0.250***			0.244***		
							(0.0129)			(0.0128)		
ln (lag number prod.)								0.0587***			0.0427***	0.0435***
								(0.0122)			(0.0122)	(0.0122)
Observations	568,278	568,278	568,278	567,175	567,117	568,243	568,278	431,637	568,278	566,993	430,558	430,558
R-squared	0.931	0.931	0.931	0.931	0.931	0.932	0.932	0.934	0.931	0.932	0.934	0.934
Firm-product-destination FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Origin--year FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes

Table 9
Baseline regression results, unit values, EAC countries

Dependent var.: ln (Unit Value) Estimator: OLS	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)
Log bilateral RER	-0.103	-0.127	2.865***	0.134	0.662	-0.568***	-0.131	0.125	-0.314***	-0.749	-1.534	0.0102
	(0.106)	(0.110)	(0.670)	(0.334)	(0.596)	(0.142)	(0.107)	(0.0926)	(0.115)	(1.340)	(1.087)	(0.929)
Interaction terms												
ln (RER) × deval. a/		-0.00571*								-0.000875	-0.000164	-0.00106
		(0.00327)								(0.00323)	(0.00322)	(0.00320)
ln (RER) × ln (dist.)			-0.378***							0.197	0.281**	-0.0155
			(0.0851)							(0.161)	(0.140)	(0.0910)
ln (RER) × ln (dest. GDP/cap)				-0.01000						0.0412	0.105	0.102
				(0.0358)						(0.0815)	(0.0676)	(0.0676)
ln (RER) × ln (dest. GDP)					-0.0205					-0.0624	-0.0621	-0.0242
					(0.0227)					(0.0505)	(0.0420)	(0.0401)
ln (RER) × manuf. Prod.						0.925***				0.645***	0.124	0.0743
						(0.178)				(0.177)	(0.162)	(0.161)
ln (RER) × ln (1+number prod.) b/							0.0114**			0.00531		
							(0.00466)			(0.00443)		
ln (RER) × ln (lag number prod.) b								0.00532			0.00287	0.00263
								(0.00361)			(0.00364)	(0.00365)
ln (RER) × EAC bilateral trade c/									0.862***	0.725**	0.888***	
									(0.188)	(0.327)	(0.312)	
Devaluation (Real)		0.0170								0.00322	-0.000842	-0.000687
		(0.0127)								(0.0127)	(0.0121)	(0.0121)
ln (dest. GDP/cap)				-0.705***						0.624*	0.0328	0.0517
				(0.166)						(0.361)	(0.290)	(0.290)
ln (dest. GDP)					-0.874***					-1.116***	-0.574**	-0.589**
					(0.148)					(0.295)	(0.248)	(0.248)
ln (1+number prod.)							0.0181			0.0223		
							(0.0161)			(0.0161)		
ln (lag number prod.)								-0.0134			-0.0103	-0.0106
								(0.0132)			(0.0133)	(0.0133)
Observations	145,181	145,181	145,181	144,872	144,873	145,181	145,181	112,501	145,181	144,801	112,189	112,189
R-squared	0.957	0.957	0.957	0.957	0.957	0.957	0.957	0.962	0.957	0.957	0.962	0.962
Firm-product-destination FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Origin--year FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes

Table 8
Baseline regression results, volumes, EAC countries

Dependent var.: ln (Volume) Estimator: OLS	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)
Log bilateral RER	-0.268	0.0264	-0.240	2.270***	3.214***	-0.724***	-0.218	-0.200	-0.178	-1.167	-2.716	-2.753*
	(0.177)	(0.183)	(0.937)	(0.564)	(0.993)	(0.225)	(0.178)	(0.177)	(0.188)	(1.949)	(1.850)	(1.594)
Interaction terms												
ln (RER) × deval. a/		-0.0286***								-0.0284***	-0.0242***	-0.0242***
		(0.00522)								(0.00541)	(0.00561)	(0.00558)
ln (RER) × ln (dist.)			-0.00350							0.238	0.687***	0.694***
			(0.118)							(0.250)	(0.246)	(0.157)
ln (RER) × ln (dest. GDP/cap)				-0.279***						-0.275**	-0.0607	-0.0606
				(0.0601)						(0.127)	(0.120)	(0.120)
ln (RER) × ln (dest. GDP)					-0.134***					0.0604	-0.101	-0.102
					(0.0377)					(0.0802)	(0.0756)	(0.0714)
ln (RER) × manuf. Prod.						0.905***				1.003***	1.159***	1.160***
						(0.257)				(0.280)	(0.291)	(0.290)
ln (RER) × ln (1+number prod.) b/							-0.00878			-0.00922		
							(0.00711)			(0.00704)		
ln (RER) × ln (lag number prod.) b								-0.00675			-0.00398	-0.00397
								(0.00586)			(0.00601)	(0.00601)
ln (RER) × EAC bilateral trade c/									-0.365	-0.626	-0.0212	
									(0.276)	(0.540)	(0.581)	
Devaluation (Real)		-0.144***								-0.149***	-0.154***	-0.154***
		(0.0225)								(0.0226)	(0.0226)	(0.0226)
ln (dest. GDP/cap)				0.807***						0.925	0.379	0.379
				(0.301)						(0.655)	(0.651)	(0.650)
ln (dest. GDP)					0.407*					-0.433	-0.277	-0.277
					(0.243)					(0.540)	(0.538)	(0.538)
ln (1+number prod.)							0.168***			0.169***		
							(0.0258)			(0.0258)		
ln (lag number prod.)								0.0377*			0.0200	0.0200
								(0.0216)			(0.0219)	(0.0219)
Observations	145,181	145,181	145,181	144,872	144,873	145,181	145,181	112,501	145,181	144,801	112,189	112,189
R-squared	0.951	0.951	0.951	0.951	0.951	0.951	0.951	0.954	0.951	0.951	0.954	0.954
Firm-product-destination FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Origin-year FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes

Table 9
Regression results, product-ladder effects

Log bilateral RER	0.0594	0.0661	-0.0980	0.101
	(0.429)	(0.429)	(0.455)	(0.429)
Interaction terms				
ln (RER) × Bottom_{fpdt}	-0.0124***			
	(0.00155)			
ln (RER) × Not Core_{fpdt}		-0.00449***		
		(0.00154)		
ln (RER) × Second_{fpdt}			-0.00207	
			(0.00171)	
ln (RER) × $\ln(\text{Ranking})_{fpdt}$				-0.0120***
				(0.00141)
ln (RER) × manuf. prod.	-0.152***	-0.148**	-0.173***	-0.148**
	(0.0583)	(0.0583)	(0.0625)	(0.0582)
ln (RER) × ln (lag number dest.)	0.00849*	0.00845*	0.00668	0.00847*
	(0.00470)	(0.00469)	(0.00481)	(0.00470)
ln (RER) × EAC bilateral trade	0.458**	0.450**	0.633***	0.444**
	(0.188)	(0.188)	(0.231)	(0.188)
ln (RER) × ln(xrate volatility)	-0.00103*	-0.00103*	-9.00e-05	-0.00100*
	(0.000575)	(0.000574)	(0.000615)	(0.000575)
ln (dest. GDP/cap)	1.089***	1.096***	0.960***	1.100***
	(0.170)	(0.170)	(0.185)	(0.170)
ln (dest. GDP)	-1.001***	-1.007***	-0.915***	-1.010***
	(0.151)	(0.151)	(0.169)	(0.151)
Exchange-rate volatility	2.14e-05	-1.76e-05	0.00389**	-0.000113
	(0.00177)	(0.00177)	(0.00181)	(0.00177)
Observations	391,011	391,011	205,763	391,011
R-squared	0.969	0.969	0.982	0.969
Firm-product-destination FE	Yes	Yes	Yes	Yes
Origin--year FE	Yes	Yes	Yes	Yes

Robust standard errors in parentheses; *** p<0.01, ** p<0.05, * p<0.1; other regressors omitted.

Table 10
Effect of exchange-rate volatility on export volumes

	All sample (1)	EAC bilateral trade (2)
$\ln(GDP_{ot})$	2.718***	10.52
	(0.342)	(8.897)
$\ln(pcGDP_{ot})$	-1.247***	-8.645
	(0.405)	(9.026)
ln(nb products)	0.218***	0.151***
	(0.0137)	(0.0484)
$\ln(volatility)_{t-1}$	-0.226*	0.407
	(0.118)	(0.674)
Observations	161,629	5,841
R-squared	0.915	0.918
Origin destination year FE	Yes	Yes
Firm-Product-Destination FE	Yes	Yes

Robust standard errors in parentheses; *** p<0.01, ** p<0.05, * p<0.1; other regressors omitted.

Appendix

Pricing to market with quasi-linear preferences

Consider a QL utility function à la Melitz-Ottaviano (2008), i.e. of the form

$$U = x_0 + a\int_{\Omega} x(\varphi)\,d\varphi - \frac{\gamma}{2}\int_{\Omega} x(\varphi)^2 - \frac{X^2}{2} \tag{18}$$

where

$$X = \int_{\Omega} x(\varphi)\,d\varphi$$

The corresponding demand function is

$$x = \frac{1}{\gamma}\left(a - X - p^c\right) \tag{19}$$

Integrating (19) and letting N be the measure of varieties,

$$\begin{aligned} X &= \int_{\Omega} x(\varphi)\,d\varphi = \frac{N(a-X)}{\gamma} - \frac{1}{\gamma}\int_{\Omega} p^c(\varphi)\,d\varphi \\ &= \frac{N(a-X)}{\gamma} - \frac{1}{\gamma}\overline{p}^c \end{aligned} \tag{20}$$

where $\overline{p}^c$ is the average consumer price over all firms. Solving this for X gives

$$X = \frac{Na}{\gamma+N} - \left(\frac{N}{\gamma+N}\right)\overline{p}^c \tag{21}$$

Combining (21) with (19),

$$\begin{aligned} x &= \frac{a}{\gamma} - \frac{1}{\gamma}\left[\frac{Na}{\gamma+N} - \left(\frac{N}{\gamma+N}\right)\overline{p}^c\right] - \frac{p^c}{\gamma} \\ &= \frac{a}{\gamma} - \frac{1}{\gamma}\left(\frac{Na}{\gamma+N}\right) + \frac{1}{\gamma}\left(\frac{N}{\gamma+N}\right)\overline{p}^c - \frac{1}{\gamma}p^c \end{aligned} \tag{22}$$

which is their equation (3). Normalizing the measure of varieties at unity ($N = 1$),

$$x = \frac{a}{1+\gamma} + \frac{1}{\gamma(1+\gamma)}\overline{p}^c - \frac{1}{\gamma}p^c \tag{23}$$

where γ is a measure of the substitutability of varieties. This is a linear demand curve where the elasticity goes up with the price. Thus, efficient (high-φ) firms which charge lower prices face a lower elasticity of demand and hence have more market power.

To determine optimal prices and quantities, let

$$A = \frac{a}{1+\gamma} + \frac{1}{\gamma(1+\gamma)} \bar{p}^c = \frac{\gamma a + \bar{p}^c}{\gamma(1+\gamma)}$$

and

$$b = -\frac{1}{\gamma}$$

The “choke price” p_0^c at which demand is zero is

$$p_0^c = \frac{A}{b} = \gamma A = \frac{\gamma a + \bar{p}^c}{1+\gamma} \tag{24}$$

Let p be the producer price in the importer’s currency, with, as before, $\tilde{p} = ep$ in the exporter’s own currency. For a firm with marginal cost $c = 1/\varphi$, profit, in the *exporter*’s currency, is

$$\begin{aligned} \tilde{\pi} &= \left(ep - \frac{1}{\varphi} \right) x \\ &= \left(ep - \frac{1}{\varphi} \right) \left(A - bp^c \right) \end{aligned} \tag{25}$$

and the FOC is

$$eb\left(p^c + p\frac{dp^c}{dp} \right) = eA + \frac{b}{\varphi}\frac{dp^c}{dp}. \tag{26}$$

Suppose that $p^c = \tau p$. Substituting in the FOC and rearranging gives the producer price in the exporter’s currency :

$$\begin{aligned} \tilde{p} = ep &= \frac{eA}{2b\tau} + \frac{\tau b}{2\tau\varphi b} \\ &= \frac{1}{2}\left(\frac{ep_0^c}{\tau} + \frac{1}{\varphi} \right) \end{aligned} \tag{27}$$

or, after substituting for p_0^c and then for A,

$$\tilde{p} = \frac{1}{2}\left[\frac{e\left(\gamma a + \bar{p}^c\right)}{\tau(1+\gamma)} + \frac{1}{\varphi} \right] \tag{28}$$

and the consumer price in the importer’s currency is

$$p^c = \frac{\tau\tilde{p}}{e} = \frac{1}{2}\left(p_0^c + \frac{\tau}{\varphi e} \right) \tag{29}$$

which is equivalent to their equation (7). Using (28), the pricing-to-market elasticity is

$$
\begin{aligned}
\beta &= \frac{d\ln\tilde{p}}{d\ln e} = \frac{e}{\tilde{p}}\frac{d\tilde{p}}{de} = \frac{e}{\tilde{p}}\frac{p_0^c}{\tau} = \frac{\tilde{p}_0}{\tilde{p}} \\
&= \frac{\tilde{p}_0}{\frac{1}{2}\left(\tilde{p}_0 + \frac{1}{\varphi}\right)} = \frac{2\tilde{p}_0}{\tilde{p}_0 + \frac{1}{\varphi}} = \frac{2\varphi\gamma A}{\varphi\gamma A + \tau} \\
&= \frac{2\varphi\left(\gamma a + \overline{p}^c\right)}{\varphi\left(\gamma a + \overline{p}^c\right) + \tau\left(1+\gamma\right)}.
\end{aligned}
\tag{30}
$$

It is easily verified that the comparative-statics properties with respect to φ, τ and γ have the same signs as in the CES case with a positive distribution cost. Thus, QL preferences eliminate the mill-pricing/constant markup property of monopolistic-competition models without the need to include an additive distribution cost.

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