

## How Do Exporters Adjust to Exchange-Rate Fluctuations? New Evidence from the East African Community

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EAC pursuing two-pronged regional integration strategy

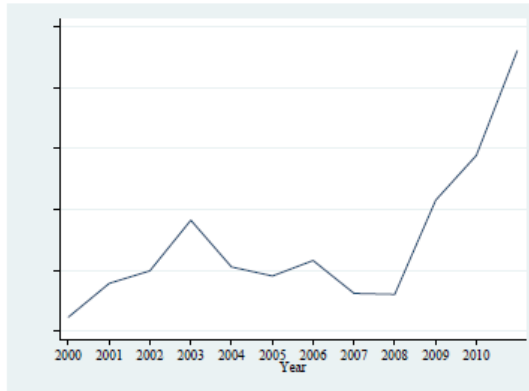
- Trade integration
  - Customs union
  - Attempts at cooperating on building a common market through reduction in NTBs
  - MRAs for some types of services
- Monetary integration

Experience suggests that successful monetary integration requires (inter alia)

- Not too many asymmetric shocks
- Macro convergence
- Integrated regional markets

Figure 1  
Bilateral dollar exchange rates, EAC countries

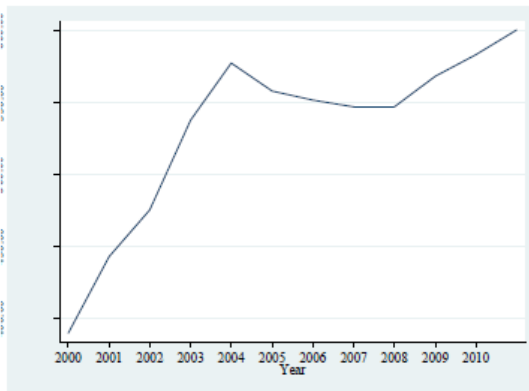
(a) Uganda



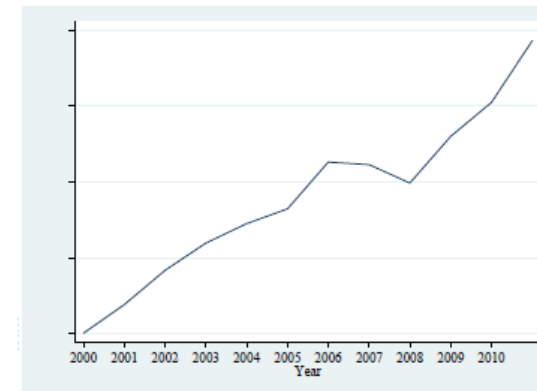
(b) Kenya



(c) Rwanda

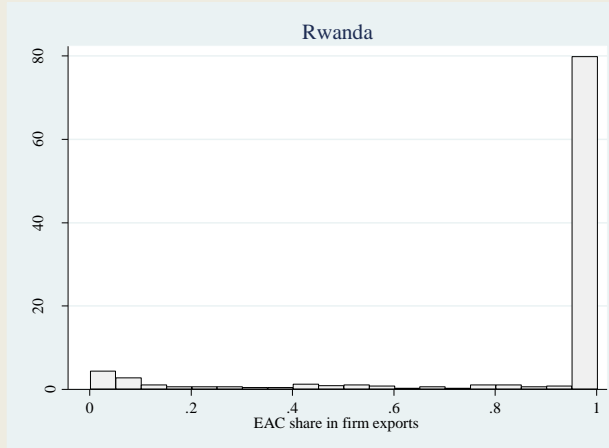


(d) Tanzania

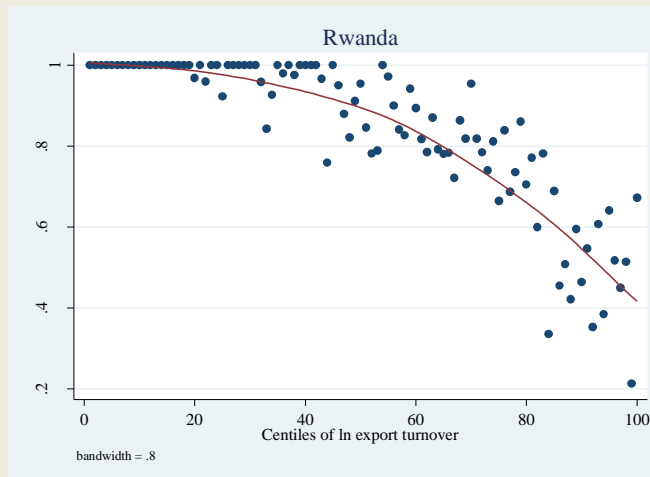
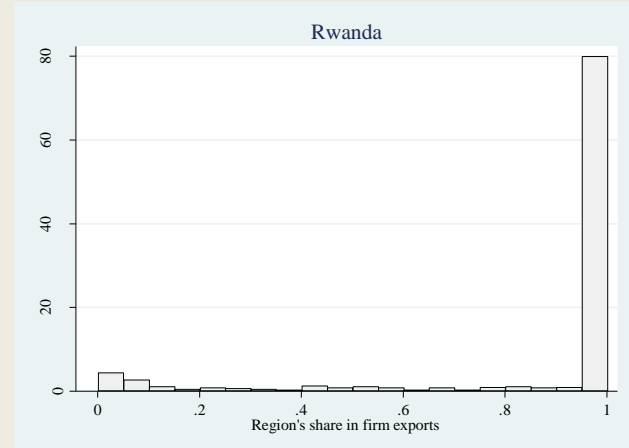


Close to 80% of Rwanda's exporters realize over 95% of their export turnover on regional markets

(a) EAC share in firm exports



(b) Region share (including S-Sudan & DRC)



And the most regionally specialized exporters are the smallest

**Our objective:** Assess EAC market integration through firm pricing behaviour, using exchange-rate variations as a “laboratory”

In the pass-through literature (see e.g. Feenstra 1989; Marston 1990; Gagnon Knetter 1995, and many others), incomplete ERPT, i.e. pricing to market (PTM) is taken as evidence of

- Variable markups (with constant markups, ERPT would be 100%)
- Market segmentation

**Our strategy:** use PTM at the firm level from a large, multi-contry dataset to infer how competitive EAC markets are: **PTM  $\Rightarrow$  market power.**

At the **firm level**, PTM estimates are surprisingly consistent (around **0.1**, implying ERPT around -0.9) across countries (Atkeson and Burstein 2008, Berman Martin Mayer 2012, Tang Zhang 2012, Fosse 2012, Chaterjee, Dix-Carneiro and Vichyanond 2012); but

- More PTM for large firms
- More PTM for core products

Heterogeneous-firms model with distribution costs implies that PTM coefficient decreases with toughness of competition (as measured by  $\sigma$ , the elasticity of substitution):

Additive distribution cost in the importing country, as in Berman, |  
Martin and Mayer (2012) or Chatterjee, Dix-Carneiro and Vichyanond (2012):

$$p^c = \tau p + \eta$$

Consumer price elasticity to prod. price:  $\varepsilon^p = \frac{\tau p}{\tau p + \eta}$

$$\tilde{p}(\varphi) = \underbrace{\left( \frac{\sigma}{\sigma - 1} \right)}_{\text{New markup}} \left( 1 + \frac{\varphi \eta e}{\sigma \tau} \right) \frac{1}{\varphi}$$

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

This property not a particular model's artifact: it appears in a different model

Quasi-linear utility function à la Melitz-Ottaviano (2008):

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

Demand:

$$x = \frac{a}{1+\sigma} + \frac{1}{\sigma(1+\sigma)} \bar{p}^c - \frac{1}{\sigma} p^c$$

Suppose that  $p^c = \tau p$  (iceberg transportation cost, no additive distribution cost)

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

PTM elasticity

$$\beta^p = \frac{d \ln \tilde{p}}{d \ln e} = \frac{2\varphi(\sigma a + \bar{p}^c)}{\varphi(\sigma a + \bar{p}^c) + \tau(1+\sigma)}$$

Export transaction data from customs administrations of 6 countries

Table 1  
Cross-country data summary

|            | Number of<br>years | Number of<br>transactions | Transactions<br>per year | Number of<br>firms | Number of<br>destinations | Number of<br>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.

- The good: Large sample
- The bad: No firm-level covariates except constructed from the database
- The ugly: very, very noisy data, especially when it comes to unit values



### Baseline estimation equation

$$\ln(p_{fpdt}) = \underbrace{\alpha_0}_{\text{pricing to market}} \ln(e_{odt}) + \underbrace{\alpha_1 \mathbf{x}_{odt}^1 + \alpha_3 \mathbf{x}_{dt}^2 + \alpha_4 \mathbf{x}_{ft}^3 + \alpha_5 \mathbf{x}_p^4}_{\text{control variables}}$$

PTM coefficient  $\beta^p$

Cross-firm heterogeneity in PTM  $\longrightarrow$

$$+ \underbrace{\sum_k \beta_k [\ln(e_{odt}) \times \mathbf{x}^k]}_{\text{interaction with firm characteristics}}$$

$$+ \underbrace{\delta_{ot} + \delta_{fpd}}_{\text{fixed effects}} + u_{fpdt}$$

### Estimation issues

1. Endogeneity (omitted variable) from macro shocks controlled with origin-year and firm-product-destination fixed effects
2. Firm size approximated by number of export products

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

Dependent var.: ln (Unit Value)

Estimator: OLS

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

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

## Whole sample

- **PTM coefficient** around 0.1 without all the interaction terms
  - Like in the rest of the literature – no difference between industrial and developing countries?
  - More ERPT at the firm level (0.9) than aggregate/sector-level ERPT (0.3 on average)
- **Volume elasticities** very high for the whole sample, although plausible – when doing the algebra, assuming 20% transportation ( $\tau$ ) cost and 100% retail margin ( $\eta$ ), estimates imply elasticity of substitution ( $\sigma$ ) between 4 and 8

## EAC exporters

- In general, no PTM for EAC exporters, implying no market power
- But **very strong PTM** ( $0.7 < \beta^p < 0.9$ ) **on EAC markets** (bilateral trade), suggesting substantial **market power**
- Weak supply response, suggesting binding **capacity constraints**

| Dependent var.:                          | Entry                 |                       | Exit                  |                         |
|--|-----------------------|-----------------------|-----------------------|-------------------------|
|  | EAC bilateral<br>(1)  | All Sample<br>(2)     | EAC bilateral<br>(3)  | All Sample<br>(4)       |
| Sample                                   |                       |                       |                       |                         |
| Estimator: RE Probit                     |                       |                       |                       |                         |
| RER volatility a/                        | 4.088***<br>(1.320)   | 5.199***<br>(0.536)   | -0.619<br>(0.522)     | -0.511**<br>(0.211)     |
| Financial dependence b/                  | -0.186*<br>(0.0984)   | -0.191***<br>(0.0551) | -0.0482<br>(0.0370)   | 0.0240<br>(0.0195)      |
| Volatility × Financial dependence        | -1.710<br>(1.831)     | 1.618*<br>(0.858)     | 1.096<br>(0.813)      | -0.543<br>(0.372)       |
| ln (distance)                            | -2.147***<br>(0.174)  | -0.436***<br>(0.0215) | -0.0784**<br>(0.0357) | 0.0981***<br>(0.00493)  |
| ln (dest. GDP/cap)                       | 0.194<br>(0.469)      | -0.360***<br>(0.0198) | 0.201*<br>(0.112)     | 0.0402***<br>(0.00472)  |
| ln (dest. GDP)                           | 0.289***<br>(0.0784)  | 0.301***<br>(0.0131)  | -0.0316*<br>(0.0179)  | -0.0185***<br>(0.00295) |
| Firm scope c/                            | -0.530***<br>(0.0215) | -0.401***<br>(0.0117) | -0.00408<br>(0.00377) | 0.00231<br>(0.00218)    |
| <u>Fixed effects</u>                     |                       |                       |                       |                         |
| Firm-product-destination                 | Yes                   | Yes                   | Yes                   | Yes                     |
| Origin-year                              | Yes                   | Yes                   | Yes                   | Yes                     |
| Observations                             | 42,751                | 122,735               | 89,217                | 243,155                 |
| Number of Firm-Destination-Product cells | 29,072                | 81,699                | 47,101                | 138,453                 |

Pricing to market behavior of exporters suggests strong evidence of market power on EAC markets:

- Markets still segmented, protected by tariffs (25% band), NTBs
- Difficult arbitrage between infant-industry protection and need to discipline abuses of market power

Entry and exit behaviour does not provide strong evidence of damage from exchange-rate volatility:

- Exit rates go *down* with exchange rate volatility
- Not higher for credit-constrained firms

### **Policy implications**

- Focus on pursuing regional trade integration (good compromise between infant-industry protection and liberalization)
- Still looking for a compelling case to launch process of monetary integration (given tremendous costs in terms of macro constraints)