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

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KEY POLICY QUESTIONS

EAC pursuing two-pronged regional integration strategy

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

- Monetary integration

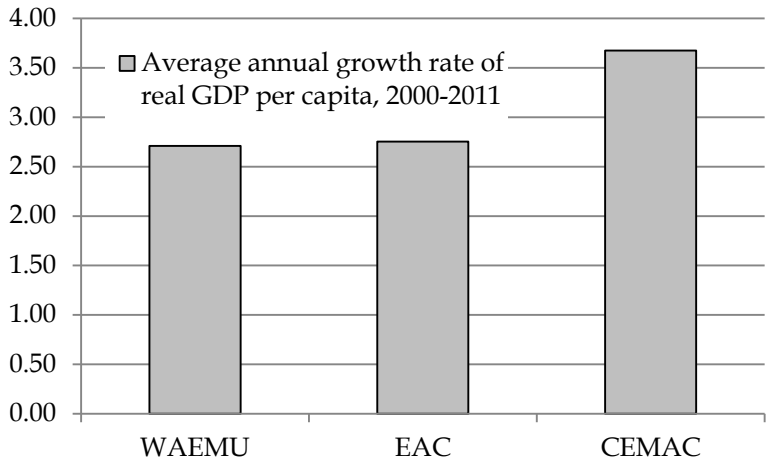
Before embarking into monetary integration, we need to understand

i. How exporters adapt to exchange-rate fluctuations (exchange-rate pass-through)
ii. What is the real cost of exchange-rate volatility on trade

Our strategy: Use our answer to (i) to infer extent of market power (lack of trade integration) in EAC.

DO MONETARY UNIONS GROW FASTER?

- Monetary unions, like fixed exchange-rate zones, are vulnerable to asymmetric shocks
- Lack of market integration raises the probability of asymmetric shocks, so market integration and monetary integration are linked
- Oil exploitation in some of EAC's member states (Uganda) will be a major asymmetric shock
- There is little prima-facie evidence that Africa's monetary unions have grown faster than other zones



EXCHANGE-RATE POLICY IS KEY TO EXPORT GROWTH

Freund Pierola (2012) on export surges:

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)

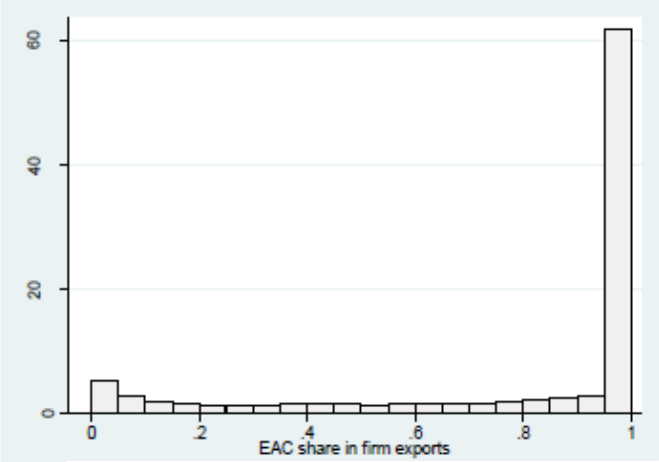
Obstfeld Rogoff (2002) on the exchange-rate disconnect

Our term for the second pricing puzzle is the "the exchange rate disconnect puzzle," a name that alludes broadly to the exceedingly weak relationship (except, perhaps, in the longer run) between the exchange rate and virtually *any* macroeconomic aggregates. It manifests itself in a vari-

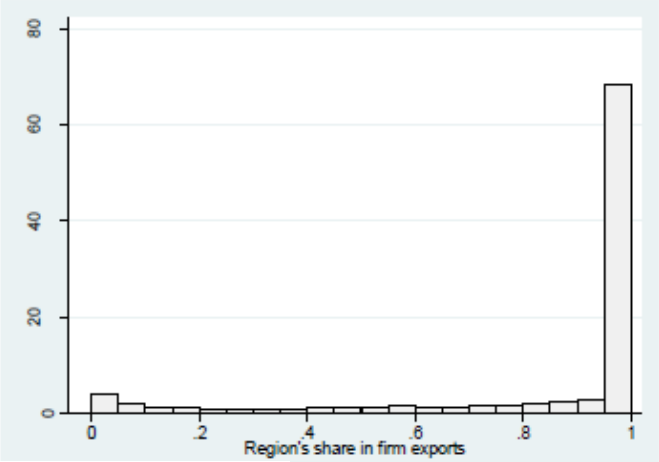
...AND SO IS EAC'S REGIONAL MARKET, WHICH BREEDS A SPECIAL TYPE OF FIRMS—SMALL MANUFACTURERS

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

(a) East African Community (EAC)

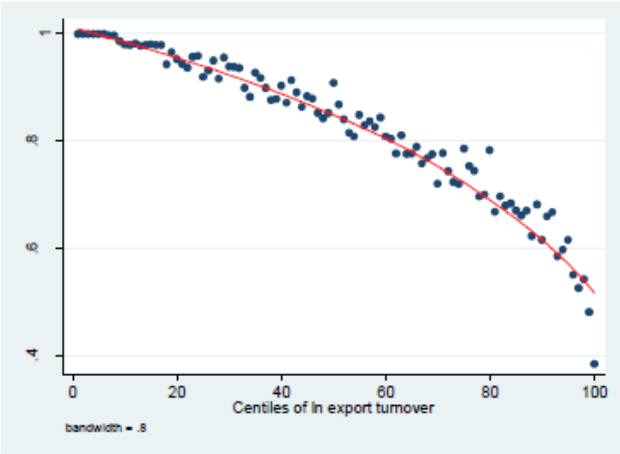


(b) EAC + DRC & South Soudan



Close to 60% of EAC's exporters realize over 95% of their export turnover on regional markets

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



And the most regionally specialized are the smallest

EXCHANGE-RATE PASS-THROUGH: WHAT THEY DO, WHAT WE DO

Typical ERPT equation (Goldberg Knetter 1997)

$$\underbrace{\ln p^{c}_{opdt}}_{\text{cons. price in USD}} = \alpha_0 + \alpha_1 \underbrace{\ln\left(\frac{\tilde{p}_{opdt}}{e_{odt}}\right)}_{\text{export price in USD}} + \underbrace{\gamma}_{\text{ERPT}} \ln e_{odt} + u_{opdt}$$

Our equation

Our dependent variable: Producer price in LCU

$$\ln \tilde{p}_{opdt} = \beta_0 + \underbrace{\beta^{p}}_{PTM} \ln e_{odt} + \delta_{ot} + \delta_{fpd} + u_{opdt}$$

A taxonomy of cases

	γ (ERPT)	$\beta^{p} = 1 + \gamma$ (PTM)	LOP	Markup	Consistent market structure (?)
No pass-through	0	1	Yes	Variable	Perfect competition Homogenous goods
Incomplete pass-through	-0.6	0.4		Variable	Imperfect competition
Full pass-through	-1	0	No	Constant	Monopolistic competition

WHAT THE LITERATURE SAYS… EVIDENCE FROM PTM

Country level estimates

Feenstra (1989): ERPT into U.S. prices around 0.6; i.e. if exchange-rate doubles (from say €0.7/USD to €1.4/USD), U.S. consumer price goes down by only 30% on average across studies

Marston (1990): Even less ERPT (0.1-0.5, PTM 0.5-0.9), variable across sectors

- *Incomplete ERPT—pricing to market—taken as evidence of variable markups (with constant markups, ERPT would be 100%), imperfect competition, market segmentation*

Firm-level estimates

Surprisingly consistent PTM estimates (around 0.1, implying ERPT around -0.9) across countries (Atkeson and Burstein (2008), Berman et al. (2012), Fosse (2012), Chaterjee et al. (2012)

- *More PTM for large firms, more PTM for core products, more PTM for more productive firms*

TESTABLE COMPARATIVE-STATICS PROPERTIES WITH ADDITIVE DISTRIBUTION COSTS

From the theory (standard model as in Berman et al. 2012, Chatterjee et al. 2012) :

Prices:

1- More productive firms price more to market
2- More pricing to market in destinations with higher distribution costs
3- Less pricing to market in faraway destinations
4- Less pricing to market in destinations where competition is tougher

Volumes:

5- More productive firms have lower volume elasticity
6- Lower volume elasticity in destinations with higher distribution costs
7- Higher volume elasticity for faraway destinations
8- Higher volume elasticity in destinations where competition is tougher

NOTATION

Subscripts

- o is origin country,
- d is destination country,
- f is firm,
- p is product,
- t is year.

Explanatory variables: 4 vectors $\mathbf{x}^k$, $k = 1,\ldots,4$, two sets of FE, and the regressor of interest

- $\mathbf{x}^1_{od} = [\tau_{od}]$ (bilateral distance),
- $\mathbf{x}^2_{dt} = [Y_{dt}, y_{dt}, \text{EAC}_{dt}]$ (destination GDP, approximating σ; destination GDP/capita, approximating η; and whether the destination belongs to the EAC customs union, to identify trade-policy effects);
- $\mathbf{x}^3_{ft} = [\ln(n_{ft})]$ (firm f's number of products, approximating φ),
- $\mathbf{x}^4_{p} = [m_p]$ (a dummy variable marking manufactured products).
- δ_{ot} and δ_{fpd} be origin-year and firm-product-destination fixed effects respectively.
- e_{odt} is the real exchange rate between the origin and destination countries in year t,

Dependent variable

p_{fpdt} firm f's producer price for product p in d at t in country o's currency ($\tilde{p}$)

IDENTIFICATION STRATEGY

PTM coefficient θ^p

Baseline estimation equation

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

Estimation issues

1. Exchange-rate exogenous to pricing—no endogeneity bias here
2. Firm size approximated by number of products endogenous to exchange rate—we've got a problem here

   Instrumentation & excuses
   - Lag number of products—not terribly powerful
   - Define number of products at firm level, not firm-product-definition

DATA: THE FIRST MULTI-COUNTRY FIRM-LEVEL DATASET

Export transaction data from customs administrations of 6 developing countries

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.

- 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

PTM: BASELINE RESULTS

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

VOLUME ELASTICITIES

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

PTM, EAC EXPORTERS

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

SUMMING UP RESULTS

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—when doing the algebra, assuming 20% transportation (τ) cost and 100% retail margin (η), estimates imply elasticity of substitution (σ) 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

EFFECT OF EXCHANGE-RATE VOLATILITY ON ENTRY AND EXIT

Dependent var.:	Entry		Exit	
Sample	EAC bilateral	All Sample	EAC bilateral	All Sample
Estimator: RE Probit	(1)	(2)	(3)	(4)
RER volatility a/	4.088***	5.199***	-0.619	-0.511**
	(1.320)	(0.536)	(0.522)	(0.211)
Financial dependence b/	-0.186*	-0.191***	-0.0482	0.0240
	(0.0984)	(0.0551)	(0.0370)	(0.0195)
Volatility × Financial dependence	-1.710	1.618*	1.096	-0.543
	(1.831)	(0.858)	(0.813)	(0.372)
ln (distance)	-2.147***	-0.436***	-0.0784**	0.0981***
	(0.174)	(0.0215)	(0.0357)	(0.00493)
ln (dest. GDP/cap)	0.194	-0.360***	0.201*	0.0402***
	(0.469)	(0.0198)	(0.112)	(0.00472)
ln (dest. GDP)	0.289***	0.301***	-0.0316*	-0.0185***
	(0.0784)	(0.0131)	(0.0179)	(0.00295)
Firm scope c/	-0.530***	-0.401***	-0.00408	0.00231
	(0.0215)	(0.0117)	(0.00377)	(0.00218)
Fixed effects				
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

CONCLUSIONS

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
- Exit rates not higher for credit-constrained firms

Policy implications

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

Thank you!

VOLUME ELASTICITY TO THE EXCHANGE RATE

In partial equilibrium (*P* and *Y* constant), log-differentiating $x(\varphi)$ w.r.t. e gives

$$\beta^q = \frac{d\ln x}{d\ln e} = -\sigma\left[\left.\frac{\partial \ln p^c}{\partial \ln e}\right|_{\tilde{p}\ \text{const.}} + \beta\left.\frac{\partial \ln p^c}{\partial \ln \tilde{p}}\right|_{e\ \text{const.}}\right]$$

$$= -\sigma\left[\frac{-\tau\tilde{p}}{e(\tau p+\eta)} + \beta\frac{\tau p}{\tau p+\eta}\right] \qquad (13)$$

$$= \frac{\sigma\tau p(1-\beta)}{\tau p+\eta}$$

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

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

whereas with full pricing to market,

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

THE FUNDAMENTAL PRICING TO MARKET EQUATION

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

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

Consumer price elasticity to prod. price: $\varepsilon^p = \dfrac{\tau p}{\tau p + \eta}$ (10)

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

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

THE FUNDAMENTAL PRICING TO MARKET EQUATION

PTM elasticity

$$\beta^p = \frac{d\ln \tilde{p}}{d\ln e} = \frac{2\varphi\left(\gamma a + \bar{p}^c\right)}{\varphi\left(\gamma a + \bar{p}^c\right) + \tau\left(1+\gamma\right)} \tag{30}$$

KEY DEFINITIONS

- Exchange-Rate Pass-Through (ERPT): $\frac{d \ln p^c}{d \ln e}$
- Pricing to market (PTM): $\beta^p = \frac{d \ln \tilde{p}}{d \ln e}$
- Mill pricing: $\tilde{p}_i = \tilde{p}_j$ for all destinations i, j.

Relationship between PTM and ERPT

$$\tilde{p} = ep = ep^c / \tau \quad \Rightarrow \quad \ln \tilde{p} = \ln e + \ln p^c - \ln \tau$$

PTM

So $\beta^p \equiv \frac{d \ln \tilde{p}}{d \ln e} = 1 + \frac{d \ln p^c}{d \ln e}$ or $\frac{d \ln p^c}{d \ln e} = \underbrace{\beta^p}_{0.1} \underbrace{- 1}_{-0.9}$

ERPT

That is, with a 10% PTM coefficient ($\beta^p = 0.1$), a 100% exchange-rate increase (from 2'000 shillings per dollar to 4'000) translates into a 10% *rise* in the shilling producer price and a 90% *drop* in the dollar consumer price.