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An Empirical Estimation of the Degree of Price Transmission from Border to Consumer Prices in Mozambique

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Chapter 11

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Abstract

This paper aims to quantify empirically the degree of price transmission from border to retail prices in Mozambique. Using a database from the Customs Authority, we link average import unit values at the border with retail prices for the same product and provincial market. Thus, this study provides evidence at the micro or product specific level on the determinants of consumer price changes. The main finding of the paper is that exchange rate pass-through (ERPT) is high and symmetric (similar for appreciation and depreciation episodes). Other transmission elasticity estimates, such as the one associated to changes in *cif* unit values or trade taxes, tend to be small or not statistically significant. This suggests that distribution margins may be used to offset changes in import unit values and trade taxes, while changes in the exchange rate tend to be fully transmitted.

1. Introduction

Mozambique has carried out significant trade liberalization in the last twenty years and is currently engaged in a process of tariff phase down with main trade partners under the SADC agreement. The main objective of this liberalization process is to increase Mozambique's economic integration with its regional partners and with the global economy. But are the potential gains from this trade liberalization process accruing to the Mozambican economy? Is the Mozambican economy becoming more integrated regionally and globally?

Obviously the answer depends on a large number of factors, such as the elimination of non-tariffs barriers, the business and investment climate or the elimination of the significant constraints on domestic supply capacity. In this paper, however, we focus on another, perhaps more simple, but equally important, factor for economic integration: the degree of border price transmission.

The degree of economic integration between countries depends on how well markets function, and how well price signals are transmitted from one country to the other. Thus, two countries are well integrated if price signals are correctly transmitted. This implies that producers and consumers adjust production and consumption decisions responding to existing excess supply/demand conditions in other locations of the integrated area. As a result, integration is potentially welfare improving, since it implies a more efficient allocation of resources and higher consumption possibilities.

Trade reform, multilateral or regional, aims to eliminate restrictions to trade flows. In the absence of good price transmission from the border, price signals after trade reform may be imperfectly transmitted to the economy, jeopardizing the potential benefits in terms of resource allocation and higher consumption possibilities described above. For example, in the case of no border price transmission due to a monopolistic distribution sector, the price of imports may no be significantly reduced and the economy may not experience any significant increase in competition following trade reform.

The aim of this paper is to assess the degree of price transmission from border to consumer prices for a sample of homogenous products in three main urban markets in Mozambique. We do so by exploiting a unique dataset from the Mozambican Customs Authority that registers all import processes by border post in the country. This allows us to estimate the short-run elasticity between these import unit values and consumer prices at the specific market level. Furthermore, it allows decomposing price transmission into three different components: changes in the exchange rate, changes in border taxes and changes in import unit values.

The paper is organized as follows. The following section briefly describes the theory behind price transmission and price equalization. Section 3 describes the methodology employed in the paper. The forth section summarizes the main data used in the estimations. Section 5 describes the main results and the final section concludes. The main finding of the paper suggests a large and robust degree of exchange rate pass-

through (ERPT) to consumer prices, while the degree of transmission of border price and trade tax changes seem to be low.

2. Price Transmission and the Law of One Price

The law of one price (LOP) establishes that in the absence of any barriers to trade, costless trade and perfectly functioning markets, prices of the same good in different countries should be equal when evaluated in the same currency.

Several empirical papers have tried to test different versions of the LOP, and most of the evidence indicates that the LOP tends to be rejected (see Goldberg and Knetter, 1996, for an overview).[1] For some authors this rejection is due to the violation of two main assumptions: costless trade and arbitrage and good homogeneity, especially when using aggregate indices. For others, however, the LOP failure implies the rejection of global monetarism and the existence of important price rigidities and imperfect competition.

Related to the failure of the LOP, the empirical literature has tested whether changes in exchange rates and tariffs are fully transmitted to domestic prices; exchange rate pass-through (ERPT) and tariff pass-through (Feenstra, 1989).[2] Full or complete ERPT happens if there are constant marginal costs or, there is a constant mark-up of price over

[1] Several empirical studies have analyzed the LOP in the context of specific goods, for applications see Haskel and Wolf (2001), Gosh and Wolf (1994) or Goldberg and Verhoven (2001).
[2] The degree of ERPT is of high importance since, for example, the Marshall-Lerner condition, the sensitivity of the trade balance to the exchange rate, depends on the degree of ERPT.

cost. Thus, lack of full ERPT implies some degree of imperfect competition, where firms can adjust margins according to their business strategy.

The evidence suggests that ERPT and tariff pass-through to border prices are far from perfect, indicating evidence of imperfect competitive markets. Estimated ERPT to import prices is around 60% in the US (Campa and Goldberg, 2005), and smaller countries tend to experience larger pass-through (Frankel, Parsley and Wei, 2005). On the other hand, ERPT to consumer prices tend to be even lower than to border prices, between 13% and 30% (Campa and Goldberg, 2006).

Some authors have also tested whether the extent of ERPT is symmetric; this is whether firms respond to appreciations and depreciations in the same way when pricing. Pollard and Coughlin (2004) suggests that ERPT tends to be asymmetric, and firm's pricing policies react differently to appreciations than to depreciations.

A critique to the existing empirical literature comes from papers that use threshold methodologies. These models have tried to test the existence of thresholds to arbitrage, where prices converge only if price differentials are above a certain threshold that makes arbitrage profitable (Obstfeld and Taylor, 1997). Thus, these studies tend to find higher pass-through once accounted for the thresholds or bands of inaction.

The source of incomplete ERPT can lie at the import or the export side. Krugman (1986) suggests as the source of incomplete pass-through the fact that exporting firms in an

oligopolistic setting may use third degree price discrimination when pricing in different markets, pricing to market (PTM).

The most recent literature has focused on the import side and the fact that border prices seem to be more sensitive than consumer or retail prices to exchange rate changes (Goldberg and Campa, 2006, or Frankel, Parsley and Wei, 2005). There are three potential explanations of this result: i) the existence of non-tradable goods in the CPI; ii) the fact that the distribution sector reduces the foreign content value of imports, and; iii) the fact that imperfect competition in the distribution sector implies double marginalization, where distributors adjust profits and margins according to exchange rate fluctuations in order to expand their market share.

Goldberg and Campa (2006) find evidence of three channels that limit pass-through to consumer and retailer prices. First, they find that margins change with exchange rate changes. Second, the use of imported inputs in non-tradable goods is less that for tradable goods, which impacts pass-through. Finally, they find that non-tradables also use imported inputs, so the impact of the distribution sector is also important for non-tradable goods.

Goldberg and Hellerstein (2006) model pass-through in a Bertrand oligopolistic setting with differentiated products, where retailers set prices according to the ones given by wholesalers. In this setting, firms adjust margins in response to exchange rate changes, reducing full pass-trough. Hellerstein (2004) analyzes the market for beer and finds that

the effect of exchange rate changes is dampened by strategic interactions between domestic and foreign firms in the traded and the non-traded sector.

Summing up, the evidence on border price transmission indicates that foreign and domestic prices do not tend to converge in the short run. This is mainly due to imperfect competition, both, on the export side, where firms apply some degree of price discrimination, as well as on the import side, where distribution markups impede perfect price transmission.

The following section describes the methodology used for estimating the degree of price transmission from border prices in Mozambique.

3. Methodology

As suggested above, the LOP stresses that the price of the same good sold in different markets should be the same when evaluated in the same currency. The assumption for the LOP to hold is that trade and arbitrage are costless, and markets efficient. Thus, price differences should be explained by transport, distribution costs, price discrimination and variable margins/markups. As an example, in the case of an imported good, the consumer price should equal to the *fob* price adjusted to insurance and freight, tariffs and other border taxes, transport costs and the commercialization margin.

Mozambique's capacity to affect the *fob* export price is negligible, since it is a small country, where more than 50% of imports are originated in neighboring South Africa.[3] For this reason, this paper focuses on the degree of price transmission from the border to consumer prices. This allows looking at the sources of inefficiency in the domestic market, and has clear implications in terms of domestic competition policy and the potential impact of trade reform.

As shown in equation *(1)*, we can express consumer price P^c_{it} of good *i* in period *t* as a function of the *fob* price converted to domestic currency and adjusted to insurance and freight (a^{cif}), taxes paid at the border (τ_{it}) (mainly import duties t_{it} and vat), internal transport costs (tr_{it}), and the commercialization markup (η_{it}).

$$P^{fob}_{it}\, e_t\, (1 + a^{cif}_{it})\, (1 + \tau_{it})\, (1 + tr_{it})\, (1+\eta_{it}) = P^c_{it} \qquad (1)$$

$$P^{cif}_{it} = P^{fob}_{it}\, (1 + a^{cif}_{it}) \qquad (2)$$

$$T_{it} = (1 + \tau_{it}) = (1+t_{it})(1+vat_{it}) \qquad (3)$$

$$TR_{it} = (1 + tr_{it}) \qquad (4)$$

Using equations *(2)*, *(3)* and *(4)* and applying logarithms, we obtain equation *(5)*. This reduced form equation allows us to decompose and estimate the elasticity of pass-through from changes in the exporter price, the exchange rate, import taxes, transport costs and markups.

[3] We should expect that South African exporters have some degree of market power when fixing prices of exports to Mozambique. This implies that a discrepancy between the factory price of that product in South Africa and the fob price should be expected, introducing a first wedge between the retail price in South Africa and in Mozambique.

$$\ln P_{it}^{c} = \beta \ln P_{it}^{cif} + \lambda \ln e_{t} + \sigma \ln T_{it} + \chi \ln TR_{it} + \gamma \ln M_{it} + \varepsilon_{it} (5)$$

Equation *(5)* assumes a product specific and time variant markup. This constitutes a problem in the estimations since there is a lack of data on distribution margins and markups. Some authors (see Feenstra, 1989), use competitive pressure indicators for the markup. The problem with this approach is that in our case we are interested on distribution margins at the product specific level, and the distribution sector in Mozambique appears to be very concentrated in a few firms. This implies that the same distributors may allocate domestically produced and imported goods for retail with certain degree of monopolistic power. For this reason, and due to lack of any relevant information on these margins, we adopt a strategy that treats the markup as constant and product specific.

Finally, we would like to add the monthly CPI index for each province as a control variable for supply and demand shocks affecting the economy. However, the CPI index is highly correlated with the exchange rate.[4] Furthermore, no major shocks were observed in the three provincial urban markets during the period of study. Our baseline model is summarized by equation *(6)*.

$$\ln P_{it}^{c} = \sum_{i=1}^{i-1} \alpha_{i} M_{i} + \beta \ln P_{it}^{cif} + \lambda \ln e_{t} + \sigma \ln T_{it} + \chi \ln TR_{it} + \varepsilon_{it} (6)$$

[4] This may be interpreted as an indicator of potential high ERPT.

4. Data

The main source of data is TIMS, the primary database use by Customs Authority in order to register import processes. It contains information specific to each separate import process: declared *cif* value, customs valuation, taxes paid, currency priced, source, date and border post of entry. We have this information available from 2000 to 2005

One of the main constraints that we face is lack of data, especially regarding *cif* unit values as compared to complete consumer price series. For this reason, we employ a panel data strategy in order to maximize the number of observations. We use monthly observations across a list of 25 agricultural and light processed products (see Table 1 for a list of the products). The selection of the products is based on the basket of products available in the consumer price indexes of Maputo, Nampula and Beira. The main criteria for product selection are: i) product homogeneity; ii) availability of data in order to compute *cif* unit values.

A simple examination of computed unit values suggests that this measure contains a lot of noise. A first source of variance is the use of different units. We express all the units in kg in order to be comparable with CPI data. Furthermore, two other problems emerge when working with border unit values. First, there is a significant amount of typing errors when imputing the import value, especially related to wrong decimals and other typing mistakes. Second, it is likely that some substantial differences may correspond to quality differences. In order to overcome these problems, we apply Hadi´s (1992) methodology

to eliminate outliers at 99% confidence level, to the de-trended unit values series. This allows us to eliminate extreme values due typing errors or due to large quality differences.

Our panel is unbalanced due to the fact that for most products we do not observe imports every month. In addition, when estimating the province panels, we eliminate products that do not have more than 3 observations in time. As a result, when we pool all the observations for the three markets we have 25 products and 1140 observations; 24 products and 696 observations for Maputo, 18 products and 324 observations for Beira and 8 products and 104 observations for Nampula.

Consumer prices are obtained from the provincial consumer price indexes calculated at the National Institute of Statistics (INE). Concretely, we use the monthly average CPI index for Maputo, Beira and Nampula.

The choice of the relevant reference price at the border is crucial in the analysis. In the case of Maputo, it is clear that the relevant border price is the one observed at the border posts of the Maputo Province, since there is hardly any internal North-South of the country. However, this is less clear for the case of Beira and Nampula, and some products may be transported from the Maputo Province border posts towards the North of the country. For this reason we have considered two different specifications.

The first specification considers as border reference prices the average *cif* import unit value observed in the same province border posts for every product. This implies that for Maputo we use the monthly average of all *cif* unit values of that product observed in border posts at the Maputo province. For the case of Beira, we use those *cif* unit values observed at Beira province and Zimbabwe's border; and for Nampula, those observed at the Nampula province and Malawi's border.[5]

The second specification, considers that the relevant border price is the one in Maputo Province. In this case, we use Maputo's *cif* unit value for the cases of Beira and Nampula, and we adjust the transport costs proxies to reflect for the increase in the relevant distance. For both specifications, we compute *cif* unit values expressed in Rands, which is the most used currency regarding imports of these products. [6]

Regarding transport costs, we build two proxies. The first proxy uses the information regarding the calculation of the *cif* unit values and computes the average distance from the relevant border post to the market. Since import process from different border post may be observed, this proxy calculates the average distance for all these import processes. The second proxy uses information on transport costs for maize in selected routes available at the SIMA database.[7] Data on transport costs is available for some months from 2001 to 2005. We use this information and build a transport cost index for those routes from the border to the three markets. Since there are observations missing

[5] Concretely the border posts with observed unit values for those products are Espungabera and Beira port for Beira; and Cuamba, Nampula and Nacala for Nampula.
[6] We also compute unit values in US dollars and reproduce the estimations using the US dollar as the relevant currency. Nevertheless, as discussed in the following section the results are very similar.
[7] Sistema Integrado de Monitoria Agrícola (SIMA), Ministry of Agriculture.

for some periods, we fit the data available for every route, border to market, with a regression in logarithms with a time trend, and use the predicted values as our transport costs proxy.

Import taxes are calculated according to the information provided in the customs database. Rather than using nominal tax rates existing in the tariff book, we calculate taxes as the ratio between total taxes effectively paid and the *cif* value. This allows us to account for exemptions, since we only include taxes effectively paid at the border.[8] [9]

As the exchange rate we use the Rand/Metical monthly official exchange rate, since most imports are priced in Rands.[10] Finally, as suggested above, we model the markup as product specific dummy.

5. Results

Equation (6) is estimated at the national level, pooling all the observations, and at the provincial level. We start by discussing the results for the pooled specification, and later in the section, we describe the results for each one of the provinces selected.

[8] Exemptions have to be previously granted by the Ministry of Finance and/or customs under the different exemption schemes: inputs for transforming industry, investment law and other ad hoc exemptions. Thus, there is no possibility of duty drawbacks after the import process have crossed the border.
[9] Smuggling may be significant for some products and therefore small changes in taxes may not be very relevant in affecting consumer prices. We do not have however, any registered data on smuggling products that would allow controlling for this effect.
[10] We also estimate some specifications using *cif* prices in dollars and the Dollar/Metical exchange rate for comparison, obtaining similar results.

We consider different specifications at each level. For the national pooled case, we have four specifications, two using different reference prices for Beira and Nampula,[11] and two using different transport costs proxies. At the provincial level, in the case of Beira and Nampula we compute three specifications. In this case, we are forced to drop the specification that uses the transport cost index using Maputo reference border prices due to high the existing high collinearity between the transport cost index and the exchange rate; both with no variation across the products of the panel. [12] In the case of Maputo, we estimate two specifications for each of the transport costs proxy.

Pooled sample

Equation (6) is estimated using all the observations of our sample and controlling for specific province effects using province dummies. The results for the four different specifications are summarized in Table 2.

The first column of each specification reports the result of the Ordinary Least Squares (OLS) estimation without controlling for product specific heterogeneity. The main results show that the border price elasticity transmission is low, around 0.2 on average. That means that a 1% change in the border price is translated in 0.2% increase in the consumer price. Second, the degree of exchange rate pass-through is high, between 50% and 75% depending on the specification. These results imply some kind of adjustment in

[11] One where the reference border price is calculated from neighboring border posts and the other specification using Maputo Province border prices.
[12] In the case where the transport costs index is used for case of neighboring border reference price, we use the average of transport costs index for all the processes from all the border posts observed that month. That gives us enough variation across products to avoid collinearity.

distribution margins when exporters increase their price, or, perhaps, substitution to local sources; while, high transmission of exchange rate changes to retail pricing.

Another interesting result is the high transmission elasticity of border taxes changes with the OLS estimation. Changes in trade taxes seem to be fully transmitted to consumer prices. However, some caution is required when interpreting this result. No major tariff changes have occurred during the period of study, therefore there is little time variance and most of the variation is related to exemptions at the border across products. Thus, this coefficient may be capturing product specific effects.

More puzzling is the negative sign associated to the transport costs proxy. One potential explanation is that transport costs from the border to the three markets studied are not very relevant when pricing, due to the fact that road corridors are in very good conditions and the substantial transport costs from the origin to the border posts are already included in the *cif* price. However, this is unlikely to be the case for Beira and Nampula when using Maputo's border prices, since the large distance to the border should impact the price.

We use province dummies to control for provincial effects. The coefficients indicate a lower intercept for Beira with respect to Maputo for most specifications, and for Nampula changes sign according to the specification. If the intercept is capturing mostly a constant margin, this implies lower margins in Beira.

A problem that arises with the OLS specification is the fact that it does not control for margins heterogeneity. The assumption is that all margins are constant through time and products and captured by the intercept. We apply an F-test to test whether we can eliminate heterogeneity. The result of the test, however, supports the rejection of the restricted OLS model (constant common intercept), indicating as in equation *(6)* the presence of product specific effects.

In order to introduce product specific effects we estimate in columns *(2)* to *(3)*, the specifications for Least Squares Dummy Variables (LSDV) and Random Effects (RE). The Hausman and the Breusch and Pagan Lagrangian multiplier test indicate the significance of product specific effects, and the RE model seems to be preferred to OLS.

The first important result is that product specific effects absorb most of the transmission elasticity of border prices and trade taxes, the last one becoming statistically not significant. This indicates weak elasticity estimates or the importance of product specific effects. Especially relevant is the large drop in the taxes elasticity, indicating, as suggested above, that the coefficient in the OLS specification was capturing product specific effects. Secondly, the coefficient associated to ERPT is still high, suggesting a robust significant large pass-through. The estimated ERPT coefficients drop on the third specification using the maize transport index, but this is likely to be the result of collinearity between this index and the exchange rate.[13]

[13] Due to this problem of collinearity, we have abandoned the specification that uses the maize transport cost index and Maputo reference border price for the Provincial panels.

Summing up, the results for the pooled specifications indicate that once controlled for product heterogeneity, border price and trade taxes transmission elasticity estimates are very low and not statistically significant. On the other hand, ERPT is high and robust across specifications, while product specific margins may be also significant in explaining price transmission. The results are robust using different transport costs proxies and different reference border prices for Beira and Nampula.

Maputo Province

Table 3 shows the results from estimating equation *(6)* for Maputo Province. We consider two specifications using the two different proxies for transport costs. The results are very similar to the ones obtained at the pooled country level above. We perform an F-test for the significance of product specific effects and we reject the null of common intercept. This is also confirmed by the Breusch-Pagan LM test supporting RE as opposed to OLS, and by the FE estimation that rejects the possibility of a common product effect.

The Hausman test cannot be performed due to the fact that model fitted on these data fails to meet the asymptotic assumptions of the test. Nevertheless, coefficient estimates appear to be very similar between models and the estimated correlation between the error term and the regressors for the FE model is very low (0.02). This indicates that the RE model is more efficient than FE.

The results show that the ERPT elasticity remains very high and significant. On the other hand, border price elasticity is low, around 0.15, and once we account for product specific effect, it becomes very low. Trade taxes elasticity is very volatile and not robust across specifications.

The R^2 of the panel estimates is very low. Most of the variance explained corresponds to the "within" R^2, around 0.5. Nevertheless, the model poorly explains "between" variance. This is also reflected in the fact that 99% of the variance is due to product effects. The most likely explanation is the lack of significant data variation cross-section. The panel has large gaps for every cross-section, especially until 2003, where the average number of observations per period is around six.

An important issue that arises when working with price equations is the fact that prices tend to have some inertia and persistence in price formation. This is confirmed by the modified Durbin-Watson test (Bhargava et al., 1982), which indicates the presence of autocorrelation in the error term in our data (Baltagi, 2003). Therefore, we need to deal with time dependence and potential autocorrelation problems, which may bias our estimates if data are not properly corrected.

The third column of each specification (GLS AR1 FE) corrects for panel specific autocorrelation and heteroscedasticity[14] using fixed effects. Once autocorrelation is corrected, some coefficients estimates change significantly, supporting the idea of

[14] Hetereoscedasticity may arise from problems with unit measurements between unit values, price per kg, and market prices, which may represent price per units different from Kg, especially for non-agricultural products.

correlation between the explanatory variables and the error term, and indicating FE as preferred. In addition, the within R^2 for the FE model doubles the RE R^2. The results are very similar to the previous estimates, suggesting very high ERPT and low border price transmission.

Finally, the last specification (PCSE) performs the Prais-Winsten transformation for autocorrelation using OLS estimation (Greene, 2003), also correcting for heteroscedastic panels. We control for product specific effects using product dummies. The results, as expected, are similar to the fixed effects estimation with autocorrelation, where the ERPT elasticity is very high, and border price elasticity very low. Across all specifications, border price transmission appears very low and statistically significant.

Beira Province

The results for Beira province are illustrated in Table 4. They are very similar to the ones found for Maputo above. We cannot reject the presence of product specific effects. Once we control for product effects, most elasticity estimates become not significantly different from zero. The only robust result is the ERPT elasticity and the product dummies. The ERPT elasticity is around 0.5, depending on the specification, but the coefficient is more volatile than for the previous panels. The different specifications explain most of the "within" variance; however, due to lack of data and enough cross-section variation, very little "between" variance is explained by the model.

Nampula Province

For this province we have fewer observations and therefore we find that the results are less robust. Despite the lack of robustness, the estimates are similar to the two previous provinces. Nevertheless, most elasticity estimates are not significantly different from zero, and the model performs badly explaining retail price variance; we obtain a very low R^2 for both, "within" and "between" variances. The ERPT elasticity estimate is lower than in the previous cases, and only statistically significant and positive for a few specifications.

Main Results

Several issues arise from analyzing the previous estimates. First, as equation *(6)* suggests, estimates should be performed controlling for specific products effects. This may reflect specific product margins, but also other product specific characteristics.

Second, ERPT elasticity tends to be quite high and this result is robust across specifications. This indicates that exchange rate changes tend to be fully transmitted to retail prices. On the other hand, the elasticity of transmission from border *cif* import unit values tend to be very small and they are statistically significantly for the pooled and

Maputo regressions. This suggests that retail prices seem to be very responsive to exchange rate changes, but not very responsive to border prices. We may expect this to happen only if retailers adjust retail margins and therefore they have some degree of market power.

Third, trade taxes transmission elasticity tends to be small and not statistically different from zero. This may be explained by the fact that there is very little variation of trade taxes, both "within" and "between" panels. Furthermore, the coefficient associated to the transport costs proxy, tends to be negative, which is somehow puzzling. This may be related to the fact that these proxies may not reflect accurately transport costs for some products. In addition, another potential explanation is that the relevant transport costs for the retailer, transport costs from the exporter to the customs post, are already incorporated in the *cif* import unit value.

These results are consistent across the three provinces studied. They are also consistent with specifications that control for autocorrelation due to time dependence in price formation, and for panel heteroscedasticty, likely to arise due to potential different measurement units across panels.

Equality of Coefficients across Provinces

We test for the equality of the coefficients between the pooled sample and the province specifics regressions. The same specification, based on a normal regression with product

specific dummies, is estimated for the pooled sample and each of the provinces and then we apply an F test.[15] The F statistic rejects the restricted model and the null hypotheses that the coefficients are the same for all the provinces.

ERPT Symmetry

We also look at whether the high ERPT elasticity is symmetric; this is whether appreciations and depreciations are transmitted equally to retail prices. In order to do so, we employ an approach based on Pollard and Coughlin (2004), and replace the exchange rate term in equation (6) by two interactive terms. The first term is the product of a dummy variable A_{it}, with value 1 if the rand/Mt appreciated that month, by the logarithm of the exchange rate. The second term is the product of a dummy variable D_{it}, with value 1 if the rand/Mt depreciated that month, by the logarithm of the exchange rate. Thus, we estimate the following equation:

$$\ln P_{it}^{c} = \sum_{i=1}^{i-1} \alpha_i M_i + \beta \ln P_{it}^{cif} + \lambda_1 (A_{it} \ln e_t) + \lambda_2 (D_{it} \ln e_t) + \sigma \ln T_{it} + \chi \ln TR_{it} + \gamma CPI_t + \varepsilon_{it} \quad (7)$$

Table 6 shows the results for the preferred specifications at the national and provincial levels using distance as transport cost proxy and neighboring border prices.[16] We observe a monthly appreciation of the Metical with respect to the rand in around 33% of the months of our period of analysis. The results clearly indicate that ERPT tends to be

[15] $F_{k+1, N_1+N_2+N_3-3k-3} = \dfrac{(RSS_R - RSS_1 - RSS_2 - RSS_3)(N_1 + N_2 + N_3 - 3K - 3)}{(RSS_1 + RSS_2 + RSS_3) * (K+1)}$

[16] Tests for symmetry using different specifications regarding transport costs and border prices yield similar results.

symmetric. For all the cases, pooled and provincial, coefficient estimates are very close. We perform a Wald test for the equality of the coefficients and we accept the null hypothesis of equal coefficients only for the case of the pooled sample. Nevertheless, we accept the null that the appreciation elasticity is 1.05 times the elasticity of depreciation, which indicates only marginal differences, and more importantly, a symmetric ERPT.

6. Conclusions and Policy Implications

This paper has attempted to address empirically the issue of price transmission from border to retail prices. We use a unique customs dataset that allows us to link average import unit values with retail prices for the same product and the same provincial market. Thus, this study provides evidence at the micro or product specific level, of the determinants of consumer price changes.

The main result of the estimations is that the ERPT elasticity tends to be very high and symmetric. Other transmission elasticity estimates, such as the ones associated to changes *cif* unit values or trade taxes, tend to be small and not significantly different from zero. This suggests that margins are used to offset changes in import unit values and trade taxes, while changes in the exchange rate are fully transmitted to consumer prices.

There are two main policy implications of these results. The first policy implication, related to monetary policy, is the importance of exchange rate stability in order to avoid increases in consumer prices. Large exchange rate volatility, as observed in some recent

periods, is translated into volatile consumer prices, and steady appreciation is associated to significant price changes.

The second policy implication is related to competition policy. Despite the fact that more work is required in order to model markups, the fact that consumer prices seem to be insensitive to changes in border prices and taxes indicate the use of markups for offsetting these changes and departing from the perfect competition framework. Therefore, more work is required to analyze the size of these markups and the degree of competition in the retail sector.

References

Bacchetta, Philippe, and Eric van Wincoop, 2003, "Why do Consumers Prices React Less Than Import Prices to Exchange Rates," *Journal of the European Economics Association* 1, issue 2-3, April/May, pp. 662-670.

Bhargava, A., L. Franzini and W. Narendranathan (1982) "Serial correlation and fixed effects model" *Review of Economic Studies* 49, 533-549

Baltagi, B. (2003) *Econometric Analysis of Panel Data*. Second Edition. John Wiley and Sons, United Kingdom.

Campa, Jose and Linda Goldberg. 2005. "Exchange Rate Pass Through into Import Prices*", Review of Economics and Statistics*, November, 87 (4): 679-690.

Campa, Jose and Linda Goldberg. 2006. "Distribution Margins, Imported Inputs, and the Sensitivity of the CPI to Exchange Rates." *NBER Working Paper* 12121

Feenstra, Robert C. (1989), "Symmetric Pass-Through of Tariffs and Exchange Rates Under Imperfect Competition: An Empirical Test," *Journal of International Economics*, 27(1/2), 25- 45.

Frankel, J.D. Parsley and S. Wei (2005) "Slow Pass-through Around the World: A New Import for Developing Countries?", *NBER Working Paper* 11199.

Ghosh, Atish R. and Wolf, Holger C., "Pricing in International Markets: Lessons from The Economist" (July 1994). *NBER Working Paper* W4806.

Goldberg, Pinelopi and Verboven, Frank, "Market Integration and Convergence to the Law of One Price: Evidence from the European Car Market" (August 2001). *CEPR Discussion Paper* No. 2926

Goldberg, Pinelopi and Frank Verboven. 2001. “The Evolution of Price Dispersion in the European Car Market.” *Review of Economic Studies* vol. 68, pp. 811-48.

Goldberg, Pinelopi and Michael Knetter, 1997, "Goods Prices and Exchange Rates: What Have We Learned?", *Journal of Economic Literature*, vol. 35, 1243-92.

Greene, W.H. (2003) *Econometric Analysis*. Fifth Edition. Prentice hall.

Hadi, A. S. (1992), "A New Measure of Overall Potential Influence in Linear Regression," *Computational Statistics and Data Analysis*, 14, 1- 27.

Haskel, Jonathan and Wolf, Holger (2001) "The Law Of One Price - A Case Study," *Scandinavian Journal of Economics* v103 (4), 545-558.

Hellerstein, Rebecca (2004) “Who Bears the Cost of a Change in the Exchange Rate? The Case of Imported Beer” Staff Reports no. 179 (February), Federal Reserve Bank of New York.

Krugman, Paul R., (1986) "Pricing to Market when the Exchange Rate Changes". *NBER Working Paper* 1926.

Obstfeld, M. and A.M. Taylor (1997) “Non-Linear Aspects of Goods-Market Arbitrage and Adjustment: Heckscher's Commodity Points Revisited” *Journal of the Japanese and International Economies*, Vol. 11, No. 4

Pollard, Patricia S. and Coughlin, Cletus C., (2004) "Size Matters: Asymmetric Exchange Rate Pass-Through at the Industry Level". *University of Nottingham Research Paper* No. 2004/13.

Tables

Table 1: Products selected and number of observations

HS	Product	Observations
2045000	Goat meat	15
2071200	Chicken	62
4051000	Butter	81
4070090	Eggs	64
7019000	Potatoes	42
7020000	Tomatoes	62
7032000	Garlic	54
7051100	Lettuce	89
7061000	Carrots	121
7082000	Butter Beans	40
7089000	Green Beans	6
7122000	Onions	9
8030000	Banana	11
8043000	Pineapple	20
8045000	Mangoes	7
8051000	Oranges	47
8052000	Tangerines	17
8055000	Lemons	41
8072000	Papaya	9
8081000	Apples	66
9012100	Coffee	33
9023000	Tea	60
12022090	Groundnuts	50
25010000	Salt	71
48181000	Toilet Paper	63
	Total	1140

Table 2: Price Transmission Panel Estimates-Pooled Provinces

	Transport Costs: Distance						Transport Costs: Maize Transport Cost Index					
	Neighboring border price			Maputo province border price			Maputo province border price			Neighboring border price		
	OLS	LSDV	RE	OLS	LSDV	RE	OLS	LSDV	RE	OLS	LSDV	RE
P^{cif}	0.1362***	0.0165***	0.0171***	0.2178***	0.0172***	0.0188***	0.2470***	0.0014	0.0025	0.1352***	0.0156***	0.0161***
	[0.0168]	[0.0056]	[0.0057]	[0.0138]	[0.0056]	[0.0057]	[0.0147]	[0.0048]	[0.0048]	[0.0169]	[0.0056]	[0.0057]
ERPT	0.5986***	0.7616***	0.7605***	0.5068***	0.6741***	0.6702***	0.7720***	0.2959***	0.2957***	0.5947***	0.7804***	0.7799***
	[0.1551]	[0.0489]	[0.0491]	[0.1183]	[0.0449]	[0.0454]	[0.2104]	[0.0570]	[0.0576]	[0.1599]	[0.0494]	[0.0496]
Tax	1.5121***	-0.1434	-0.14	1.6343***	-0.1135	-0.11	1.5227***	-0.1462	-0.1447	1.5211***	-0.1705	-0.1678
	[0.3924]	[0.1381]	[0.1385]	[0.3328]	[0.1514]	[0.1528]	[0.3434]	[0.1223]	[0.1235]	[0.3929]	[0.1382]	[0.1386]
T. Cost	-0.0177	-0.0164***	-0.0165***	-0.1656***	0.0079	0.0063	-1.7124	3.774***	3.7529***	-0.0394	-0.0642***	-0.0647***
	[0.0176]	[0.0054]	[0.0054]	[0.0387]	[0.0135]	[0.0136]	[1.1850]	[0.3210]	[0.3246]	[0.0549]	[0.0167]	[0.0168]
Beira	-0.2772***	-0.0529***	-0.0538***	0.4947***	-0.1430**	-0.1366**	-0.2362***	-0.1024***	-0.1027***	-0.2521***	-0.0263	-0.027
	[0.0653]	[0.0203]	[0.0204]	[0.1811]	[0.0630]	[0.0637]	[0.0494]	[0.0133]	[0.0135]	[0.0639]	[0.0202]	[0.0202]
Nampula	0.2664***	-0.1783***	-0.1769***	0.5908***	-0.2121***	-0.2047***	-0.0607	0.007	0.0069	0.2772***	-0.1479***	-0.1463***
	[0.0981]	[0.0307]	[0.0308]	[0.2028]	[0.0706]	[0.0714]	[0.0499]	[0.0135]	[0.0136]	[0.1031]	[0.0322]	[0.0323]
Constant	4.5797***	5.2802***	3.9655***	5.5423***	5.5524***	4.5963***	11.4201**	-9.8077***	-10.84***	4.5706***	5.1017***	3.7964***
	[1.2579]	[0.4043]	[0.4293]	[0.9768]	[0.3803]	[0.3962]	[4.5471]	[1.2572]	[1.2764]	[1.3020]	[0.4107]	[0.4351]
Obs.	1140	1140	1140	1835	1835	1835	1865	1865	1865	1140	1140	1140
R^2	0.11	0.93	0.03 (0.25)	0.18	0.91	0.04(0.20)	0.18	0.94	0.03 (0.35)	0.11	0.93	0.03 (0.26)
Products	25	25	25	25	25	25	25	25	25	25	25	25

Standard errors in brackets, * significant at 10%; ** significant at 5%; *** significant at 1%. The R^2 in ( ) corresponds to the "within" R^2 for the panel estimates

Table 3: Price Transmission Panel Estimates – Maputo Province

	Transport Costs: Distance				Transport Costs: Maize Transport Cost Index			
	OLS	**RE**	**GLS (AR1) FE**	**PCSE**	**OLS**	**RE**	**GLS (AR1) FE**	**PCSE**
P^{cif}	0.1482***	0.0247***	0.0181**	0.0260***	0.1498***	0.0252***	0.0187**	0.0240***
	[0.0217]	[0.0050]	[0.0078]	[0.0052]	[0.0224]	[0.0051]	[0.0079]	[0.0049]
ERPT	1.0206***	0.9147***	1.2824***	1.3825***	0.9019***	0.8791***	1.2763***	1.3765***
	[0.2247]	[0.0488]	[0.0103]	[0.0095]	[0.2295]	[0.0483]	[0.0099]	[0.0091]
Tax	2.3994***	-0.2152	0.156	0.2410*	2.2463***	-0.2538	0.1607	0.2296
	[0.6196]	[0.1620]	[0.1404]	[0.1431]	[0.6244]	[0.1623]	[0.1407]	[0.1425]
T. Cost	-0.2147***	-0.0269***	-0.0210**	-0.0303***	-0.2715***	-0.0215	-0.0112	-0.0386**
	[0.0451]	[0.0095]	[0.0101]	[0.0072]	[0.0823]	[0.0181]	[0.0218]	[0.0185]
Constant	1.3513	2.7848***	-0.2583***		1.8506	3.0188***	-0.2699***	
	[1.8422]	[0.4418]	[0.0099]		[1.9130]	[0.4436]	[0.0100]	
Obs.	696	696	672	696	696	696	672	696
R^2	0.15	0.04 (0.47)	0.04 (0.98)	0.99	0.14	0.04 (0.46)	0.03 (0.98)	0.999
Products	24	24	24	24	24	24	24	24

Standard errors in brackets, * significant at 10%; ** significant at 5%; *** significant at 1%. The R^2 in ( ) corresponds to the "within" R^2 for the panel estimates

Table 4: Price Transmission Panel Estimates – Beira Province

	Transport Costs: Distance						Transport Costs: Maize Transport Cost Index		
	Neighboring border price			Maputo province border price			Neighboring border price		
	OLS	RE	GLS (AR1) FE	OLS	RE	GLS (AR1) FE	OLS	RE	GLS (AR1) FE
P^{cif}	0.1476***	-0.0042	0.002	0.2524***	-0.0012	0.0234**	0.1234***	-0.0046	0.002
	[0.0387]	[0.0109]	[0.0087]	[0.0294]	[0.0078]	[0.0095]	[0.0385]	[0.0109]	[0.0087]
ERPT	0.5590*	0.5064***	1.2076***	0.4015	0.7212***	0.2651**	0.2445	0.4978***	1.2075***
	[0.2935]	[0.0913]	[0.0264]	[0.2496]	[0.0618]	[0.1311]	[0.2968]	[0.0937]	[0.0264]
Tax	1.4095	-3.0835***	0.6326	0.7615	-0.1483	-0.0065	1.332	-3.0984***	0.634
	[0.9339]	[0.6619]	[0.5148]	[0.6052]	[0.1882]	[0.1592]	[0.9245]	[0.6617]	[0.5159]
T. Cost	0.0135	0.0013	-0.004	-3.0597	-0.8173	1.1077***	0.2398**	0.0092	-0.0149
	[0.0249]	[0.0059]	[0.0054]	[2.4287]	[0.6098]	[0.1463]	[0.1018]	[0.0246]	[0.0226]
Constant	4.5928*	7.0065***	-0.0064	27.7598*	9.9885**	-0.0647***	7.1186***	7.0805***	-0.0092
	[2.4588]	[0.9394]	[0.0162]	[16.3322]	[4.1259]	[0.0128]	[2.4793]	[0.9551]	[0.0161]
Obs.	324	324	306	529	529	509	324	324	306
R^2	0.09	0.0001 (0.34)	0.02 (0.98)	0.17	0.01 (0.29)	0.05 (0.99)	0.1	0.0002 (0.34)	0.02 (0.98)
Products	18	18	18	20	20	19	18	18	18

Standard errors in brackets, * significant at 10%; ** significant at 5%; *** significant at 1%. The R^2 in ( ) corresponds to the "within" R^2 for the panel estimates

Table 5: Price Transmission Panel Estimates – Nampula Province

	Transport Costs: Distance						Transport Costs: Maize Transport Cost Index		
	Neighboring border price			Maputo province border price			Neighboring border price		
	OLS	**RE**	**GLS (AR1) FE**	**OLS**	**RE**	**GLS (AR1) FE**	**OLS**	**RE**	**GLS (AR1) FE**
P^{cif}	0.0569	-0.0326*	-0.0024	0.2050***	-0.0051	0.0070*	0.0578	-0.0339*	-0.0015
	[0.0636]	[0.0176]	[0.0044]	[0.0379]	[0.0149]	[0.0040]	[0.0638]	[0.0177]	[0.0048]
ERPT	0.9616*	0.3317*	0.2573**	1.1307***	0.9335***	-0.1599*	0.9684*	0.3505*	0.4033***
	[0.5790]	[0.1837]	[0.1012]	[0.4007]	[0.1502]	[0.0845]	[0.5801]	[0.1862]	[0.1034]
Tax	0.3941	-0.6707**	0.0017	2.2416***	0.2264	-0.0787	0.5787	-0.6962**	-0.0087
	[0.8742]	[0.2958]	[0.0679]	[0.8421]	[0.3516]	[0.0600]	[0.8615]	[0.2967]	[0.0736]
T. Cost	-0.0286	0.0067	0.001	-15.1826**	-15.3971***	1.4290***	0.0115	0.0387	-0.0062
	[0.0452]	[0.0147]	[0.0019]	[6.8713]	[2.5851]	[0.0878]	[0.1527]	[0.0559]	[0.0085]
Constant	2.402	7.5338***	32.6903***	116.3668**	120.6233***	2.5308***	2.1796	7.3829***	25.6366***
	[4.5544]	[1.5020]	[0.0053]	[51.2768]	[19.4039]	[0.0044]	[4.5571]	[1.5237]	[0.0060]
Obs.	104	104	96	249	249	240	104	104	96
R^2	0.07	0.01(0.11)	0.05 (0.09)	0.23	0.09 (0.20)	0.01 (0.93)	0.07	0.01 (0.11)	0.05 (0.16)
Products	8	8	8	9	9	9	8	8	8

Standard errors in brackets, * significant at 10%; ** significant at 5%; *** significant at 1%. The R^2 in ( ) corresponds to the "within" R^2 for the panel estimates

Table 6: ERPT Symmetry Specifications

	Pooled *LSDV*	**Maputo** *PCSE*	**Beira** *GLS (AR1) FE*	**Nampula** *GLS (AR1) FE*
p^{cif}	0.0166***	0.0213***	0.0017	-0.0039
	[0.0056]	[0.0050]	[0.0087]	[0.0043]
e_apr (λ_1)	0.7668***	1.3935***	1.2058***	0.2934***
	[0.0494]	[0.0092]	[0.0262]	[0.1029]
e_dep (λ_2)	0.7651***	1.3862***	1.2016***	0.2912***
	[0.0491]	[0.0091]	[0.0264]	[0.1026]
Tax	-0.1417	0.1958	0.718	0.0028
	[0.1381]	[0.1403]	[0.5129]	[0.0653]
T. Cost	-0.0162***	-0.0255***	-0.005	0.0011
	[0.0054]	[0.0072]	[0.0053]	[0.0019]
Beira	-0.0531***			
	[0.0203]			
Nampula	-0.1783***			
	[0.0307]			
Constant	5.2460***		0.0091	31.1061***
	[0.4066]		[0.0161]	[0.0052]
Test H_0: $\lambda_1=\lambda_2$	Accept	Reject	Reject	Reject
Observations	1140	696	306	96
R^2	0.93			
Products		24	18	8

Standard errors in brackets, * significant at 10%; ** significant at 5%; *** significant at 1%