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RESEARCH ARTICLE

Slow Pass-through Around the World: A New Import for Developing Countries?

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Abstract Developing countries traditionally experience pass-through of exchange rate changes that is greater and more rapid than high-income countries experience. This is true equally of the determination of prices of imported goods, prices of local competitors' products, and the general CPI. But developing countries in the 1990s experienced a rapid downward trend in the degree of pass-through and speed of adjustment, more so than did high-income countries. As a consequence, slow and incomplete pass-through is no longer exclusively a luxury of industrial countries. Using a new data set—prices of eight narrowly defined brand commodities, observed in 76 countries—we find empirical support for some of the factors that have been hypothesized in the literature, but not for others. Significant determinants of the pass-through coefficient include per capita incomes, bilateral distance, tariffs, country size, wages, long-term inflation, and long-term exchange rate variability. Some of these factors changed during the 1990s. Part (and only part) of the downward trend in pass-through to imported goods prices, and in turn to competitors' prices and the CPI, can be explained by changes in the monetary environment—including a fall in long-term inflation. Real wages work to reduce pass-through to competitors' prices and the CPI, confirming the hypothesized role of distribution and retail costs in pricing to market. Rising distribution costs, due perhaps to the Balassa-Samuelson-Baumol effect, could contribute to the decline in the pass-through coefficient in some developing countries.

Keywords Exchange rate · Import · Law of one price · Pass-through · Price · Pricing to market · Purchasing power parity

JEL Classification F4

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1 Introduction

The phenomenon of slow or incomplete pass-through, which has long been a phenomenon of the market in the United States and other rich countries, increasingly characterizes small developing countries as well. In that sense, slow pass-through was "imported" by lower-income countries in the 1990s. In the aftermath of large devaluations in East Asia, Latin America, and other emerging market countries between December 1994 (Mexico) and December 2001 (Argentina), most observers feared correspondingly large increases in local currency prices. That such price increases did not materialize was a welcome surprise, but was a surprise nonetheless: the conventional wisdom had long been that pass-through is relatively rapid and complete in countries that are small, or less developed, or both. This is why the "small open economy" model has in the past been thought more applicable to them than to rich countries.

The apparent decline in the pass-through coefficient in developing countries in the 1990s has been much discussed informally. Yet it has not been extensively documented, let alone explained. Most of the many econometric studies of pass-through, even those that examine a recent decline in the pass-through coefficient, have focused on prices of imports into industrialized countries, rather than into developing countries. For example, Otani et al. (2003) find a decline in pass-through for imports into Japan, which they attribute to increased penetration by intra-firm imports and to a decline in global inflation.[1] Campa and Goldberg (2002) find a decline in the pass-through coefficient in the 1990s, which they attribute to changing commodity composition more than to a less inflationary environment; but their data set again consists solely of industrialized countries.

A few studies include lower-income countries. Choudhri and Hakura (2001) extend to a sample of 71, including developing countries, the Taylor (2000) and Gagnon and Ihrig (2004) findings that a low-inflation environment reduced pass-through to the CPI in the 1990s. Borensztein and De Gregorio (1999) and Goldfajn and Werlang (2000) study the low pass-through of recent large devaluations in developing countries.[2] Saiki (2004) includes two developing countries in her study of whether a switch in monetary regime to inflation-targeting is associated with a fall in the pass-through coefficient. Devereux and Yetman (2002) have 122 countries in their sample. But these are all studies of influences on aggregate price measures, the CPI in particular, not on import prices. Few studies concentrate on imports of specific goods into developing countries.[3] *A primary goal of this paper is to extend the literature to a broad sample that includes developing countries, where the question is particularly salient in light of recent experience, and to examine the reported decline in their pass-through coefficients and possible explanations for it.*

[1] Taylor (2000) proposed that a decline in pass-through of exchange rate changes into the CPI in the 1990s was due to a lower inflationary environment, and looked at US data. Gagnon and Ihrig (2004) extended this claim to a sample of 11 industrialized countries, finding that the standard deviation of inflation explains the coefficient better than does the average inflation rate.

[2] The BIS (2002, p. 92) is among those attributing the low pass-through to the CPI of recent large devaluations in developing countries to a decline in long-run inflation. But Burstein et al. (2002) attribute the low observed pass-through in general price indices to the disappearance from consumption of newly expensive import goods, and their replacement in the indices by inferior local substitutes.

[3] Aw (1993) examines exports from Taiwan to four countries of footwear, but they are heavily affected by quotas. Also, like Maloney's (1994) study of Chile, the data are for an earlier period. Parsley (2002) examines exports from Hong Kong, and finds little pricing to market.

It is important to be explicit about the degree of disaggregation. "Passed through" to what? We must distinguish between pass-through, on the one hand, in the narrow sense of the determination of prices of goods that are physically imported—or at least are physically identical with goods that are imported—versus, on the other hand, the broader sense of the determination of the general price level. There is also an intermediate question: the determination of prices of goods that may be relatively close substitutes for the imported goods but that are produced at home. Gradual pass-through to the general price level has been extensively documented, even for developing countries. The decline in pass-through to the general price level in the 1990s has also been documented. It is primarily to the question of pass-through to narrowly defined import prices that the present paper seeks to contribute. But we will also trace through effects on the prices of domestically produced substitutes and to the general price level, thus facilitating a connection between our findings on pass-through narrowly defined and others' findings on pass-through defined more broadly.

We use data on imports into 76 countries, for eight narrowly defined goods. They are (given with their country of origin): Marlboro Cigarettes (US), Coca-cola (US), Cognac (France), Gilbey's gin (US), Time magazine (US), Kodak Color Film (US), Cointreau Liqueur (France), and Martini & Rossi Vermouth (Italy). Our data pertain to literally the identical product across different countries. The period is 1990–2001. Further details are given below.

2 Hypotheses to be Tested

Any theory of incomplete pass-through must posit some barrier to arbitrage between the import good in the country of origin and the same good in the country of purchase. Among the candidate explanations for the barrier to arbitrage are: trade distortions, transportation costs, and the local value added that enters into the distribution process between the dock and the point of retail.[4] Beyond the question of the arbitrage barriers, some theories model the "pricing to market" phenomenon as a case of optimal price discrimination by firms.[5] Others, perhaps motivated by the notion that the barriers to arbitrage are smaller in the long run than in the short run, model prices as completely sticky in the local currency at a moment in time, but adjusting gradually over time.[6]

[4] Among those who emphasize the importance in incomplete pass-through of local distribution costs consisting of nontraded inputs are Burstein et al. (2002), Burstein et al. (2003b), Campa and Goldberg (2004), Corsetti and Dedola (2002), Frankel (1984), and many others. Parsley and Wei (2003) offer some detailed evidence that the law of one price holds much better for traded inputs than for the product sold to consumers. They seek to reaffirm the conventional wisdom that the failure of PPP can be partly explained by non-traded goods and services, by refuting the Engel (1999) challenge, that the explanation lies solely in failures of the law of one price among traded goods. Burstein et al. (2003a) is another challenge to Engel, this time for four large-devaluation episodes.

[5] In addition to Dornbusch (1987) and Krugman (1987), the price discrimination theory is featured in Marston (1990), Gagnon and Knetter (1995), Yang (1997), Corsetti and Dedola (2002), among many others.

[6] Kasa (1992) shows how adjustment costs can generate incomplete pass-through in the short-run. Ghosh and Wolf (1995) study changes in the local price of the *Economist* magazine in various countries in response to exchange rate changes, and argue that the timing supports the sticky price view, arising from menu costs, better than the pricing to market view, arising from price discrimination. Devereux and Yetman (2002) apply a menu-cost model to the endogenous determination of pass-through. Burstein et al. (2003a) includes another sticky-price model.

Given the diversity of models that have been proposed, it would be good to be able to choose among them empirically or, if it turns out that all posit factors that are important determinants of pass-through, then to get an idea of their relative importance. *A second important goal of this paper is to try to see which of the factors that are invoked in the theoretical literature are in practice important and which are not, using a panel of data that extends across a broad set of countries*.

There are important connections between the recent experience of developing countries and the various competing models in the theoretical literature. Three testable hypotheses apply (after eliminating the compositional effects that affect aggregate price measures). (1) A priori, if pass-through coefficients are higher in small countries, one could attribute that to a paucity of local substitutes in small countries, as in some models of price discrimination.[7] (2) If pass-through coefficients are higher (for retail prices) in poor countries, one could attribute that to lower costs for labor and commercial real estate, which are the non-traded inputs into the distribution and retail process. (3) If pass-through coefficients have declined over time, one could attribute that (a) to a less inflationary environment, or (b) to costs of labor and rent that rise over time, as in the Balassa-Samuelson effect (internationally) or Baumol effect (domestically).

The question whether pass-through is indeed lower for developing countries is important for a number of reasons. It matters for the determination of the trade balance, and for whether the small open economy model is appropriate. It also matters for a country's choice of exchange rate regime. It has been observed that developing countries generally are more reluctant to see their exchange rates fluctuate than rich industrial countries are, a phenomenon sometimes labeled "fear of floating." Even among those that have adopted inflation targeting as a monetary framework, it is more common to see them intervene heavily and frequently in the foreign exchange market than developed economies. Several explanations have been proposed for this phenomenon. For the purpose of this paper, we note that a relatively high degree of pass-through for developing countries has been cited as a rationale for the developing countries' stance on exchange rates (e.g., Ho and McCauley 2003).

One further motivation for this research arises in the recent emphasis that the PPP literature has given to the issue that heterogeneity in parameters can create bias in the estimates from aggregate data.[8] Allowing parameters to vary by means of fixed effects, across goods or across countries, is one way to address the problem. But a better way is to model the variables on which the parameters depend. To the extent that variation in pass-through behavior across countries is an issue (especially rich vs. poor countries), and to the extent that such variation is related to differences in income, size, and so forth, our approach may be able to shed more light on the true parameters.

[7] In the Cournot oligopoly model of Dornbusch (1987), for example, the extent of pass-through is determined by the proportion of foreign firms present in the domestic marketplace, relative to domestic firms.

[8] Imbs et al. (2002) claim that problems of aggregation are the source of estimates of apparently slow convergence to PPP. Chen and Engel (2004) reject their argument.

3 A Brief Further Review of the Models in the Literature, and Their Predictions

A major empirical discovery of recent years is that goods markets are less integrated than previously thought. The Law of One Price fails by surprisingly large margins, even when tests are applied to goods that are narrowly defined into homogeneous categories. An important subset of this research looks at slow or incomplete pass-through of exchange rate changes into import prices: when the exchange rate changes, the price of an imported good does not seem to change by the full amount, at least in the short run.

We have learned steadily about the phenomenon of slow or incomplete pass-through. The subject gets a boost every time there are large increases in a country's exchange rate followed by surprisingly small increases in import prices. For example, some of the early contributions date from the dollar devaluations of the early 1970s.[9] Next, the large swing in the dollar in the 1980s, unaccompanied by matching swings in import prices, produced a large literature, both theoretical and empirical, on slow or incomplete pass-through.[10] Krugman (1987) gave it the name Pricing to Market, to indicate that firms were deliberately setting prices in different countries with an eye to their competitors in the local markets. Theoretical models showed how firms should price-discriminate optimally, as a function of demand elasticities—for example, Knetter (1989, 1993) and Dornbusch (1987). If local demand is highly elastic, foreign firms are forced to absorb exchange rate fluctuations in their profit margins rather than passing them fully through in local markets. More recently, the case of Local Currency Pricing (the price of the importable is unchanged in domestic currency) has been successfully incorporated into modern macroeconomic theory, as a starkly different case from the traditional assumption of Producer Currency Pricing (the change in the exchange rate is fully passed through to the import price).[11] There is also an extensive empirical literature.[12]

As already noted, any theory of incomplete pass-through must begin with a reason why the law of one price fails, that is, with a barrier to arbitrage. To whatever extent we are talking about goods that are not identical to the foreign good, or perhaps not even close substitutes for it, no further explanation is required. But when we are talking about the identical good, the obvious candidates for barriers to arbitrage fall into two categories: (1) the transport costs, tariffs, and other trade barriers that intervene between the port in the country of export and the port in the country of import, and (2) the costs of distribution and retail that intervene between the dock in the country of import and the customer at the store counter. Many modelers have focused on just one category of barrier or the other, but both

[9] Kreinen (1977) and Magee (1973).

[10] There are also other reasons why the literature on incomplete pass-through took off in the late 1980s: it provided an application for some tools of game theory that had then been newly imported into international trade theory from industrial organization; it provided an application for new mathematical techniques of option-pricing with continuous-time stochastic processes (e.g., Dixit, Krugman, Baldwin); the micro price data needed for empirical work became available (e.g., Knetter 1989, 1993); the partial equilibrium exercise of taking exchange rate movements as given became more interesting when models to explain the exchange rate had clearly failed; and slow pass-through into the US market—particularly in the case of automobiles and other exports from long-horizon Japanese producers (e.g., Marston 1990; Froot and Klemperer 1989; Feenstra 1989; Parsley 1993; Gagnon and Knetter 1995; Ohno 1989)—seemed to help explain the slow reaction of the US trade balance to the 1985–97 depreciation of the dollar (Mann 1986).

[11] The models of Devereux and Engel (2002) and Devereux et al. (2002) show how the absence of pass-through reduces the real effects of exchange rate variation.

[12] See Goldberg and Knetter (1997) for a survey.

are potentially important. We will proxy transport costs with bilateral distance between exporting country and importing country, and will measure trade barriers with data on commodity-specific tariffs. We might expect the effect of distance to be the same for rich and poor importers alike, but poor countries are more likely to have higher trade barriers. We will proxy the costs of distribution and retail by the country's wage rate. These are nontraded services, and so the Baumol and Balassa-Samuelson effects lead us to expect that they may play a smaller role in developing countries than in rich countries. Indeed, the low real cost of retail services in poor countries, as a fraction of the value of the product, should constitute one of the possible explanations for the traditional proposition that pass-through is higher in developing countries.

Whatever their choice for an explanation for the failure of arbitrage, modelers can also be distinguished according to their view of price-setting behavior. Here we distinguish three categories of models: (1) prices are sticky in local currency in the short-run, (2) firms follow rule-of-thumb markup pricing, so that an increase in the exchange rate will be fully passed through to local prices (but in some cases there may be a lag, until previous shipments are sold),[13] and (3) firms engage in price-discrimination, optimally "pricing to market" so as to take into account the relevant demand elasticities. Price stickiness should show up as slow adjustment, leaving aside the degree of pass-through that holds in the long run. Markup pricing predicts substantial pass-through, but perhaps with a short lag. It seems less straightforward to get at the hypothesis of price discrimination than the other influences. One piece of evidence that might support price discrimination is that small economies tend to experience higher long-run pass-through than large countries, even after conditioning for other determinants like income per capita or wages. The rationale is the Dornbusch (1987) finding from a Cournot oligopoly model: under optimal price discrimination, the pass-through coefficient will be determined by the share of foreign firms in the domestic marketplace, relative to domestic firms (times the degree of competition, defined as the reciprocal of price as a markup over marginal cost). The more heavily foreign firms outnumber domestic firms, the higher the degree of pass-through. In the limit, a very small country under perfect competition experiences complete pass-through. Admittedly there may be an important difference between the size of the presence of foreign versus domestic firms in the domestic market for a particular commodity, and the size of the foreign presence in the economy in the aggregate.

Another piece of evidence in favor of the price discrimination hypothesis would be if pass-through to local prices of imported goods tended to behave similarly to prices of local substitutes.[14] Under the mark-up pricing hypothesis, by contrast, a devaluation should soon open up a discrete wedge between the import price and the prices of local competitors. Under the sticky price hypothesis the devaluation should also have that effect, but only gradually over time.

One instance of the size hypothesis is that pass-through is particularly low into the world's largest market, the United States, a proposition that goes back at least to

[13] With full mark-up pricing, pass-through may be complete even though the Law of One Price fails. The two criteria differ. Failure of complete pass-through will invalidate even *relative* Purchasing Power Parity, while failure of the Law of One Price need invalidate only Absolute PPP.

[14] We would expect pass-through to prices of *other* local goods to be lower, however. In an optimal-pricing model where imports are intermediate products, Bacchetta and Van Wincoop (2002) show pass-through to consumer goods prices to be low if there is local competition.

Kreinen (1977). Knetter (1993) and Campa and Goldberg (2002), however, found this to be an artifact of composition, that such apparent differences in pass-through across countries tend to disappear for given industries. So the US dummy is another proposition to be tested.

Another composition hypothesis is the claim of Burstein, Eichenbaum, and Rebelo (2002) that recent estimates of low pass-through of devaluations to the CPI are due in part to substitution away from high-end varieties of imports to lower-quality substitutes. If this phenomenon were to constitute the entire explanation for incomplete pass-through, then we would expect that the pass-through would be close to complete and instantaneous for the completely disaggregated import goods in our sample. The ability to discriminate among such hypotheses is one benefit of working with products that are so narrowly defined as to be literally identical in the exporting and importing countries—a pack of Marlboro cigarettes, etc.

We also test two hypotheses regarding a country's longer-term monetary environment. Chronic high rates of inflation affect a country's economic structure, including such institutions as indexation of wages and automatic pass-through of exchange rate changes, as a number of models have shown. We measure the average inflation rate over the preceding five years, to see if it affects the extent of concurrent pass-through and the speed of subsequent adjustment. If so, the lower-inflation environment of the 1990s, relative to the 1970s and 1980s, would clearly be a leading candidate to explain any decline in the pass-through coefficient.

We also test the effect of exchange rate volatility, measured as the standard deviation of monthly exchange rate changes over the preceding five years. At first glance, one might expect exchange rate variability to have the same positive effect on the pass-through coefficient as the long run inflation rate.[15] The logic here, however, is quite different; it is almost the opposite. Krugman (1989), Froot and Klemperer (1989) and Taylor (2000) hypothesized that a given exchange rate change is less likely to be passed through to import prices in an environment where such fluctuations are common and transitory. Firms fear losing market share, and will wait to see whether the exchange rate change looks permanent before modifying local prices. Thus we expect variability (around the trend) to have a negative effect on the pass-through coefficient, not a positive effect.

There is some empirical documentation in the literature for the familiar claim that exchange rate pass-through tends to be higher in developing economies than in rich countries. For example, Choudhri and Hakura (2001) reported that for a sample of 12 emerging market economies during 1979–2000, their average one-year pass-through is 26% (with some individual pass-through degrees as high as 40%). This is much higher than the average one-year pass-through for a group of non-G3 industrial countries (12%) or G3 (only 7%).[16] But few have offered explicit explanations for the differential. It may be that low-income countries are on average smaller and more inflation-prone than rich countries. Or it may be that due to lower real wages and rents, distribution and retail costs tend to be less important for them. Think of a street vendor in a poor country, as compared to an expensive retail operation in a rich country. (Tariffs and transport costs on the other hand are likely to be more important for developing countries, on average.)

[15] Indeed, in the thoery of Devereux and Yetman (2002), exchange rate variability, like price instability, should raise the pass-through coefficient. But they sometimes find the opposite, empirically.
[16] Ho and McCauley (2003).

It would be useful to know if the difference in pass-through behavior that has been observed historically is a result of these other factors, or pertains to the difference in income per se. Answering this question is another goal of this paper.

4 Our Approach

4.1 Description of the Data

The individual goods prices used in this study were compiled by the *Economist Intelligence Unit (EIU)*. The *EIU* data are collected as part of the *Worldwide Cost of Living Survey*, and are designed for use by human resource managers in the design of compensation policies. The *EIU* description is at http://eiu.e-numerate.com/asp/wcol_HelpWhatIsWCOL.asp. The data set contains more than two hundred local currency retail prices of (mostly generic) goods and services collected from 120 cities around the world (some goods are priced at two locations and both prices appear in the data set). The data have been collected annually, during the first week of September since 1990.

We focus on one city (the capital) per country (76 countries), and on well defined, specific products. The *EIU* product descriptions include the brand name, physical attributes, e.g., size, volume, and in some cases, the type of retail establishment where the price was observed, e.g., supermarket versus mid-priced outlet. Where multiple prices are available for the same product, we selected the supermarket price. Alcoholic beverages are heavily represented in the list: French VSOP Cognac, Gilbey's Gin, Cointreau, and Martini and Rossi Vermouth. This reflects our selection criterion: that the survey must specify the brand that has been priced, rather than anything about the types of products the *EIU* thinks important for its survey. Most product specifications in the survey are too generic for our criterion, e.g., "facial tissues, box of 100." [17]

An additional restriction we imposed on the sample was that the goods be associated with a particular country of origin. We recognize that some of our products might have significant local value added, e.g., Time magazine may be printed locally, Coca-Cola may be locally bottled, and Philip Morris may have Marlboro production facilities outside the United States. Our assumption, however, is that even for these cases the primary content (news articles, Coca-Cola syrup, Burley tobacco, and/or the recipe) is exported from the U.S. Applying these restrictions yields a sample of 76 cities and eight well-defined goods for the years 1990 to 2001.

We also collected the prices of local competitor products from the *EIU* data set. For comparison, Table 1 lists the imported products, their country of origin, and the domestic substitute good that we use in our analysis. The choice of domestic substitute prices is dictated by the data set and is clearly more precisely matched for some products, e.g., Marlboro cigarettes than others. However, our results are surprisingly robust across products.

A complete listing of the countries is presented in Table 2. For these same countries and years, we use also the nominal exchange rates and hourly labor costs that are included in the EIU data base.

[17] French VSOP Cognac is an exception to this stringent brand-specific rule; however after checking with the *EIU* we were told that the Cognac brands were, in fact, specified as Remy Martin, or Courvoisier; however another brand would be surveyed if these were not available, as long as it was VSOP, and not VS, XO, or 3-star. Moreover, our empirical findings also apply to this more general category.

Table 1 Goods included

Goods (from Supermarket)	Exporting Country	Competing Prices from EIU
1. Marlboro Cigarettes (pack of 20)	United States	Local brand cigarettes
2. Coca-cola (1 liter)	United States	Mineral water
3. Cognac, French VSOP (700 ml)	France	Local brand beer
4. Gilbey's Gin, or equivalent (700 ml)	United States	Local brand beer
5. Time magazine	United States	Daily local newspaper
6. Kodak Color Film (36 exposures)	United States	Compact disk album
7. Cointreau Liqueur (700 ml)	France	Local brand beer
8. Martini & Rossi Vermouth (1 liter)	Italy	Local brand beer

All of the price series were checked for coding errors. First, price observations (in common currency) that differed from the cross-sectional mean by more than a factor of three were set to missing. Next, price series missing one year's observation were interpolated using the average of the previous and next year's values. Next, we attempted to catch potential coding errors by focusing on within-product/country price swings. Specifically, price changes within a given city of more than 60%, that were subsequently reversed in the next period, were also replaced by the average of the previous and next year's values. Finally, in our reported regressions, we first ran preliminary regressions to identify the largest residual outliers. The observations associated with the top 1 percent of the residuals in these preliminary regressions were then excluded prior to obtaining the estimates reported in the tables.

Table 2 Countries included

1 Argentina	20 Egypt	39 Libya	58 Saudi Arabia
2 Australia	21 Finland	40 Luxembourg	59 Senegal
3 Austria	22 France	41 Malaysia	60 Singapore
4 Azerbaijan	23 Gabon	42 Mexico	61 South Africa
5 Bahrain	24 Germany	43 Morocco	62 South Korea
6 Bangladesh	25 Greece	44 Netherlands	63 Spain
7 Belgium	26 Guatemala	45 New Zealand	64 Sri Lanka
8 Brazil	27 Hong Kong	46 Nigeria	65 Sweden
9 Cameroon	28 Hungary	47 Norway	66 Switzerland
10 Canada	29 Iceland	48 Pakistan	67 Taiwan
11 Chile	30 India	49 Panama	68 Thailand
12 China	31 Indonesia	50 Papua N. Guinea	69 Tunisia
13 Colombia	32 Iran	51 Paraguay	70 Turkey
14 Costa Rica	33 Ireland	52 Peru	71 U. Arab Emirates
15 Cote d'Ivoire	34 Israel	53 Philippines	72 U. Kingdom
16 Croatia	35 Italy	54 Poland	73 U. States
17 Czech Republic	36 Japan	55 Portugal	74 Uruguay
18 Denmark	37 Jordan	56 Romania	75 Venezuela
19 Ecuador	38 Kenya	57 Russia	76 Vietnam

In addition to the *EIU* data, we obtained aggregate consumer price indices (used to deflate the nominal wage, and to compute long-term five-year rolling averages of inflation), per capita real GDP, monthly bilateral exchange rate, and aggregate real GDP data from the World Economic Outlook data base. We obtained simple average tariff levels from Table 6.6 of the World Bank publication *World Development Indicators 2001*. For each country, the tariff data are available for two years—once in the early 1990s and once for the late 1990s. We use the first reported value in our bilateral tariff rate calculations for the years 1990–95 and the most recent tariff rate for the years 1996–2001. Finally, the distance between importer and exporter cities was calculated by the great circle formula using each city's latitude and longitude data obtained from the UN web site www.un.org/Depts/unsd/demog/ctry.htm.

We also obtained matching unit value data from the United Nations Commodity Trade Statistics Database (Comtrade), and matching product-specific tariff data from the UNCTAD-TRAINS data base. The unit value data were thoroughly checked for errors using the same procedures as for the price data (Table 3).

4.2 The Equations Estimated

We begin by estimating an error correction equation using all of the data, i.e., we pool the eight goods, twelve years, and seventy-six countries. We estimate Eq. 1 below,

$$\Delta p_t^{imp} = \beta_1 \Delta s_t + \beta_2 \Delta p_t^{\exp} + \sum_i \lambda_i \Delta s_t X_i + \gamma\, ecm_{t-1} + \sum_i \alpha_i ecm_{t-1} X_i + \\ + \textit{product and country dummies} + \varepsilon_t. \tag{1}$$

where $\Delta \equiv$ the first-difference operator.

For the base case estimation, the matrix X is empty. The variables initially included in Eq. 1 are defined as:

$$p_t^{imp} = \log \text{ price of import good in local currency}$$

$$s_t = \log \text{bilateral exchange rate (importer's currency per unit of exporter's currency)}$$

$$p_t^{\exp} = \log \text{exporter's price (in the exporting country)}$$

$$ecm_{t-1} = \text{error correction term } (p_{t-1}^{imp} - s_{t-1} - p_{t-1}^{\exp}),$$

Table 3 Unit value series

Goods		SITC Code
1. Cigarettes	Cigarettes (tobacco) (4 digit) under Tobacco, manufactured	1222
2. Coca-cola	Flavored waters, non alcoholic (5 digit) under Beverage non-alcohol nes	11102
3. Cognac	Brandies/marc, etc (5 digit) under Distilled Alcoholic beverages	11242
4. Gin	Gin/Geneva (5 digit) under Distilled alcoholic beverages	11245
5. Time magazine	Newspapers/periodic nes (5 digit) under Newspapers/periodicals	89229
6. Color Film	Photo film roll unexposed (4 digit) under Photographic supplies	8823
7. Cointreau	Brandies/marc, etc (5 digit) under Distilled Alcoholic beverages	11242
8. Vermouth	Vermouth/flavored wine (5 digit) under Wines of fresh grapes	11213

After reporting estimates from this basic equation, we sequentially add variables to the X matrix. This approach allows us to begin with a very simple equation that explains changes in local prices as a function only of changes in the exchange rate and changes in the price of the identical commodity, and an error-correction process. This tells us the contemporaneous or short-term pass-through coefficient and the speed of subsequent adjustment [the negative ECM term]. Next, we look for possible (unconditional) time trends in the degree of short-term pass-through and the speed of adjustment, by interacting a time trend with the exchange rate change and with the ECM term. Finally, we add successive variables (from the list below) that might help explain these two parameters and their trends. We begin with relative income (importer/exporter) because we want to know if pass-through is (unconditionally) stronger for poor countries than rich. Then we proceed to condition on a sequence of further variables, not only to see if they are important determinants in their own right, but also to see if they claim some of the explanatory power of the trend and the income term. Specifically, we sequentially add the following variables to the matrix X in Eq. 1:

$$
\begin{aligned}
trend &= \text{trend}\\
income_t &= \log(\text{import country per capita GDP}/\text{export country per capita GDP})\\
tariff_t &= \log(\text{import country tariff levels})\\
dist &= \log \text{ distance (between importer and exporter)}\\
size_t &= \log(\text{import country GDP}/\text{export country GDP})\\
rwage_t &= \log \text{ real wage (in import country)}\\
infl_t &= \log \text{ inflation (average of previous five year's, in import country)}\\
xrvol &= \text{standard deviation of previous five year's monthly log changes in bilateral exchange rates}\\
\text{US dummy} &= \text{dummy variable (1 if US is importer, 0 otherwise).}
\end{aligned}
$$

5 Results

For the tables below, we report results for the complete set of commodities. However, in separate appendices, we also report results on a good-by-good basis.[18]

5.1 The Determination of Retail Prices of Imported Goods

Table 4 presents the coefficient estimates for the determination of imported goods prices at the retail stage, as specified in Eq. 1. We report standard errors corrected for heteroscedasticity and autocorrelation (Newey-West). There are dummy variables for countries as well as commodities. The advantage of allowing dummy variables is that it takes care of any country-specific or commodity-specific omitted variables, such as whether some markets are more highly competitive than others. The disadvantage, of course, is that it means throwing out a lot of potentially useful variation in the data. It is our hope that our independent variables, such as income,

[18] All Appendix Tables referred to in what follows are available in the working paper version, Harvard Kennedy School Faculty Research Working Paper Series No. 05-016, 2005.

Table 4 Pass-through to imported good prices

		Eqn 1	Eqn2	Eqn3	Eqn 4	Eqn 5	Eqn 6	Eqn 7	Eqn 8	Eqn 9
Δ	exchange rate	0.423***	0.758***	0.690***	1.215	1.350	1.794**	1.076	1.168	1.353
		(0.029)	(0.063)	(0.065)	(0.922)	(0.921)	(0.878)	(0.812)	(0.822)	(0.848)
Δ	exporter's price	0.086***	0.100***	0.103***	0.102***	0.101***	0.066**	0.050*	0.050*	0.060**
		(0.024)	(0.024)	(0.024)	(0.025)	(0.025)	(0.029)	(0.029)	(0.029)	(0.028)
(Δs)*	trend		−0.053***	−0.053***	−0.052***	−0.052***	−0.072***	−0.050***	−0.050***	−0.048***
			(0.008)	(0.008)	(0.008)	(0.008)	(0.010)	(0.010)	(0.010)	(0.010)
(Δs)*	log[per capitaRGDP(importer) / per capitaRGDP(exporter)]			−0.035***	−0.039***	−0.057***	−0.072***	−0.044*	−0.047**	−0.058***
				(0.009)	(0.010)	(0.017)	(0.022)	(0.023)	(0.024)	(0.023)
(Δs)*	tariff levels				−0.085	−0.116	−0.170	−0.066	−0.082	−0.109
					(0.174)	(0.174)	(0.148)	(0.142)	(0.144)	(0.143)
(Δs)*	log distance				−0.014	−0.007	−0.013	−0.013	−0.013	−0.027
					(0.039)	(0.040)	(0.051)	(0.050)	(0.050)	(0.050)
(Δs)*	log[RGDP(importer)/RGDP(exporter)]					0.019	0.038*	0.019	0.024	0.031
						(0.015)	(0.020)	(0.020)	(0.021)	(0.020)
(Δs)*	log real wage ($)						−0.006	−0.005	−0.005	−0.005
							(0.008)	(0.008)	(0.008)	(0.007)
(Δs)*	long term inflation							0.353*	0.358*	0.237***
								(0.202)	(0.202)	(0.067)
(Δs)*	long term exchange rate variability							−1.211	−1.261	
								(1.292)	(1.295)	
(Δs)*	US Importer dummy								−0.365**	−0.441***
									(0.162)	(0.162)
	Error Correction term (ECM)	−0.107***	−0.159***	−0.158***	−0.436***	−0.458***	−0.602***	−0.385***	−0.383***	−0.465***
		(0.007)	(0.016)	(0.015)	(0.105)	(0.105)	(0.116)	(0.116)	(0.116)	(0.118)
ECM*	trend		0.007***	0.007***	0.008***	0.008***	0.006***	0.004*	0.004*	0.004*
			(0.002)	(0.002)	(0.002)	(0.002)	(0.002)	(0.002)	(0.002)	(0.002)

Table 4 (continued)

	Eqn 1	Eqn2	Eqn3	Eqn 4	Eqn 5	Eqn 6	Eqn 7	Eqn 8	Eqn 9
ECM* log[per capitaRGDP(importer) / per capitaRGDP(exporter)]			0.001 (0.002)	0.003 (0.003)	0.006* (0.004)	−0.001 (0.006)	0.000 (0.006)	−0.001 (0.006)	−0.002 (0.006)
ECM* tariff levels				0.021 (0.017)	0.025 (0.018)	0.034 (0.022)	0.006 (0.021)	0.006 (0.021)	0.012 (0.022)
ECM* log distance				0.018** (0.008)	0.018** (0.009)	0.040*** (0.010)	0.029*** (0.011)	0.030*** (0.011)	0.036*** (0.010)
ECM* log[RGDP(importer)/RGDP(exporter)]					−0.003 (0.004)	0.001 (0.006)	0.000 (0.005)	0.001 (0.006)	0.003 (0.006)
ECM* log real wage ($)						0.017** (0.007)	0.001 (0.008)	0.001 (0.008)	0.006 (0.008)
ECM* long term inflation							−0.083* (0.046)	−0.083* (0.046)	−0.092** (0.045)
ECM* long term exchange rate variability							−0.185** (0.072)	−0.183** (0.072)	
ECM* US Importer dummy								−0.057 (0.062)	−0.062 (0.063)
# of Observations	5677	5677	5677	5192	5192	3316	3250	3250	3316
Adjusted R-squared	0.297	0.315	0.321	0.330	0.330	0.316	0.288	0.288	0.330
Country dummies	yes	yes	yes	yes	yes	yes	yes	yes	yes
Product dummies	yes	yes	yes	yes	yes	yes	yes	yes	yes

Full sample: *=10%, **=5%, and ***=1% levels of significance; product specific (ps) tariffs

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size, and so forth, will explicitly capture much of what would otherwise be heterogeneity in the parameters.

In column 1, the specification includes only the change in the exchange rate, the change in exporter's price, and last period's deviation from the Law of One Price (and good and country dummies). According to the estimates in column 1, pass-through is highly significant, but far from complete after one year (0.42). The pass-through of changes in the exporter's price is also highly significant, but much smaller in magnitude, a pattern that will hold throughout. The difference between the two kinds of pass-through is large and significant, and so we will not impose the constraint that they are equal as the Law of One Price would require.[19]

The coefficient on the error correction term captures long-run reversion to absolute price parity. Although highly significant statistically, the estimate of .11 suggests that convergence is quite slow. The half life is 6.1 years (ln(.5)/ln(1-.107)), somewhat above the 'consensus' noted by Rogoff (1996). In the first year, the failure of the Law of One Price is apparently due to slow adjustment far more than to a long-run pass-through coefficient that falls short of one. This suggests that sticky prices play a large role, relative to either optimal price discrimination or rule-of-thumb mark-up pricing. We also note that since our data are (a) sampled at a point in time, and (b) disaggregated by product, recent theoretical arguments suggesting that slow convergence may be due to product-aggregation bias, or temporal-aggregation bias, apparently do not apply to these data.

Column 2 reports highly significant downward time trends in both the magnitude of the pass-through coefficient and the magnitude of the ECM term. Remarkably, the trend is estimated to be strong enough to eliminate more than 2/3 of the pass-through coefficient over a ten-year period (10*.053/.76=.70). Perhaps the linear trend is not the best functional form, however; after all we don't think that the pass-through coefficient should go negative.

In column 3 we add the income term: the log of relative per capita income (the importer relative to the exporter), interacted both with the change in the exchange rate and the ECM term. At this point the interaction variables in X, so far, are: *income*, and a *trend*. The result is a highly significant negative effect on the pass-through coefficient, confirming lower pass-through for rich countries than poor. There is no tendency for the time trend in the pass-through coefficient to lose strength when controlling for income; this indicates that one cannot explain the tendency for the coefficient to decline globally simply to a convergence of income levels. (Indeed, Fig. 1, a graph of the average income per capita, PPP basis, vis-à-vis the US shows no overall tendency toward income convergence among these countries during the 12 years of the sample.) There is no significant implication of income for the ECM term, the speed of adjustment.

In column 4 we control for tariffs and distance. Both coefficients have the hypothesized negative signs, but neither is statistically significant. Distance does, however, have a highly significant effect on the ECM term, suggesting quite sensibly that transport costs slow down the speed of adjustment, as in a sticky price model, or possibly a rule-of-thumb markup pricing model.

[19] It is possible that there is an element of endogeneity to the export prices—that a depreciation of the Moroccan currency against the French franc or euro shows up partly as a decline in the price of the export product in France, not just as an increase in the price in Morocco. But as almost all the exporters are large countries, we guess that this effect may be small.

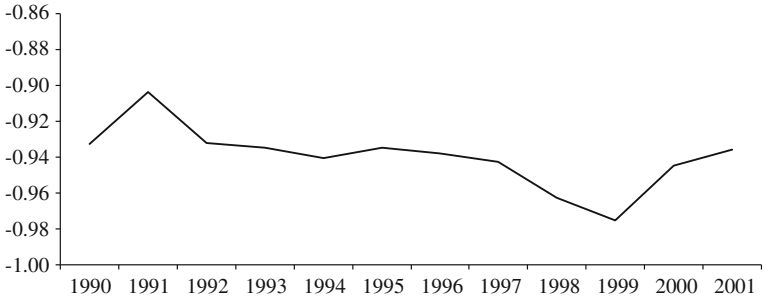

Fig. 1 Average log per capita income relative to the US

Size, introduced in column 5, is not statistically significant. Even if it had been, Fig. 2 shows no sign of convergence in the size of countries' economies within our sample. Thus growth by small countries does not appear to have been the source of declining pass-through in our sample. The coefficient on wages in column 6 again is of the hypothesized sign (for the distribution and retail models) but not statistically significant.

Long-term inflation, in columns 7–8, is significant, especially if we do not control for exchange rate variability at the same time. The trend term falls somewhat when controlling for inflation. Furthermore, long-term inflation is also a significant determinant of the ECM term, signifying that adjustment takes place more quickly in an inflationary environment. And the trend in the ECM term also falls sharply and loses significance when controlling for inflation. Thus we conclude that the inflationary environment is an important determinant of the speed and degree of pass-through, and that the decline in inflation during the 1990s is one reason for the decline in both of these parameters.

To complete the attribution of declining pass-through to a less-inflationary environment, as in Taylor (2000), we should document the extent to which inflation did indeed decline in our sample. Figure 3 depicts what happened to average inflation for the 76 countries considered here during the twelve years of this study. In accord with conventional wisdom, inflation declined everywhere. Both the mean and its cross-country standard deviation declined after 1990.[20] In our sample of countries, average (un-weighted) inflation fell from 22 percent per year in 1990 to 6 percent in 2001. According to the estimates in the table, this magnitude of decline in average inflation (18 percentage points) implies a decline in the average pass-through coefficient of about six percentage points (.06=18*.36). The decline for the median country is smaller, from .07 in the first part of the sample to .03 in 2000 and 2001. Nevertheless, the decline in inflation is apparently one component of the overall observed decline in pass-through. Figure 4 illustrates the contrast between the pass-through coefficient in high-inflation countries and low inflation countries, and between the first half of the sample period and the lower-inflation second half.

Poor countries have historically had higher tariffs and higher inflation rates than rich countries. One might have therefore expected that the estimated effect of the

[20] Indeed, the decline in the average inflation rate in industrial countries has been steady over three decades: from 12% in the second half of the 1970s to 2% in the second half of the 1990s. The average inflation rate among developing countries has moved less monotonically, but also has declined substantially more recently (from 25% in the second half of the 1970s to 13% in the second half of the 1990s). Tytell and Wei (2003).

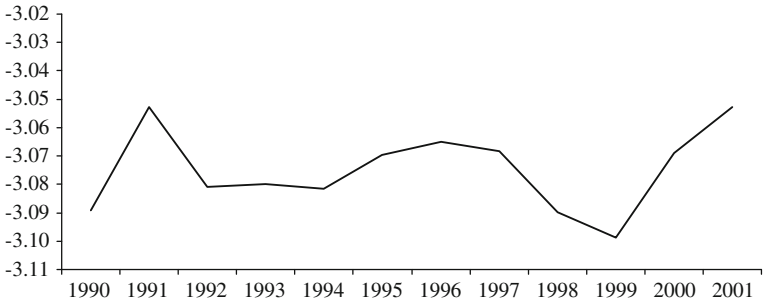

Fig. 2 Average log Real GDP relative to the US

income term would change when controlling for such factors—that it would have been biased upward before controlling for tariffs, and downward before controlling for inflation. But that does not happen in Table 4.

Exchange rate variability is also a significant determinant of the ECM term, but with a sign that indicates a positive effect on the speed of adjustment, the opposite from the Krugman-Froot-Klemperer-Taylor prediction. It may be that this term is capturing changing long run trends in the same way that the inflation term is.

Finally, the dummy representing when the US is an importer is significant. This confirms the consensus that pricing to market is more common in the world's largest national market. Exporters to the United States absorb exchange rate fluctuations in profit margins, rather than passing them through to their customers. Because our data are so narrowly defined, it is not possible that this finding is due to the sort of composition differences to which others have attributed findings of low pass-through to US price indices.[21] (It should be noted, however, that we are talking about only three products; the other goods are US products and so are excluded.)

For robustness, Appendix Table 1 drops some observations where one might have qualms about the data, such as prices of alcoholic beverages in Moslem countries. Most of the results are qualitatively the same as before. Appendix Table 5 reports the same regressions, but without the country dummies.[22] Again, most of the results are qualitatively similar.

The next order of business is to examine other points along the chain of pricing pass-through. The complete chain runs from the country of export to dockside in the country of import, to retail in the country of import, to locally produced competing goods, to the general price level. So far we have looked only at the second pass-through, to the import price at the retail level.

5.2 Determination of Prices of Local Substitutes

Table 5, and Appendix Tables 2 and 6, show the next stage, pass-through to the prices of locally produced goods that are competitive with the specific imported goods in our

[21] Knetter (1993) and Campa and Goldberg (2002). Otani et al. (2003) similarly conclude that composition cannot be the entire explanation for the decline of pass-through, for the case of the Japanese market.
[22] For Appendix Tables 1 and 5, see the webpage in the working paper version, Harvard Kennedy School RWP No. 05-016, 2005.

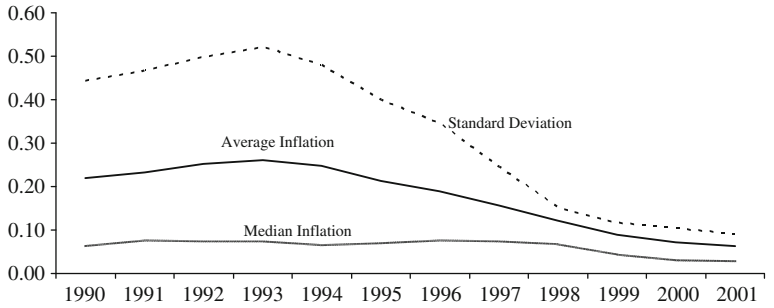

Fig. 3 Inflation decline in sample

sample. For example, we use a local cigarette brand as the relevant substitute for Marlboros, local beer as a substitute for imported alcoholic beverages, a local newspaper as a substitute for Time magazine, and so on. (Table 1 gives the complete list of commodities and substitutes.)

Obviously these goods are not perfect substitutes for the imports. As one would expect, the R^2 is somewhat smaller; and the pass-through of exchange rate changes to the local substitutes is less than the pass-through to imports. But it is still highly significant, and only slightly smaller (.37 as compared to .40, in the complete sample with country dummy variables; or .56 as compared to .58, in the version that includes country dummies).[23] The main difference is in the ECM parameter: adjustment is far slower for the local substitutes than for the imports themselves. Furthermore the downward trend in the pass-through coefficient is even stronger than for imports themselves. (The trend in the ECM coefficient suggests that adjustment has been speeding up in the case of the local substitutes, when estimated with the full sample and dummies.)

As before, the relative income term is statistically significant, suggesting that richer countries have lower pass-through coefficients; but the effect is only half as strong as for the case of import prices. Distance appears significant, but paradoxically appears to have the effect of increasing the pass-through coefficient. Size has a consistent and significant effect on the ECM term: larger countries exhibit slower adjustment, as expected. Real wages have the negative effect on the pass-through coefficient that is hypothesized—higher labor costs create more of a margin insulating prices of local substitutes from import competition—and are often highly significant statistically. Long-term inflation has the hypothesized positive effect on the degree of contemporaneous pass-through, and is highly significant. Exchange rate variability again has the unexpected effect of increasing the speed of subsequent adjustment. As was also the case with import prices, some but not all of the downward trend in pass-through to local prices is explained by long-term inflation.

[23] That the pass-through coefficient is similar suggests higher substitution than one might expect.

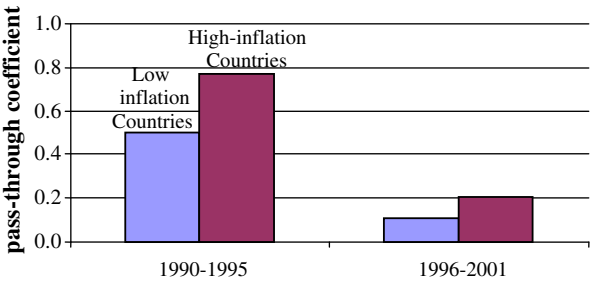

Fig. 4 Pass-through coefficient and Inflation

Some of the differences relative to import prices are noteworthy: distance, size, and wages are now important determinants of the level of short-run pass-through, whereas previously distance and wages mattered only for the speed of adjustment. [24]

5.3 Determination of the CPI

Next we leap to the highest level of aggregation: the determination of the consumer price index, in Table 6 and Appendix Tables 3 and 7. As one would expect, there is a clear fall in the magnitude and significance of pass-through—but the coefficient remains fairly strong (.28–.59) and highly significant. The estimated speed of adjustment falls enough to lose statistical significance. The downward trend in the pass-through coefficient is just as strong as before. But now there is also a significant trend toward a slower speed of adjustment. The speed of adjustment is slower the higher is the country's income, when not conditioning on other variables, as expected. But there is no indication that the pass-through coefficient depends (unconditionally) on income. And when conditioning on wages and the monetary variables, pass-through is actually significantly higher in rich countries. (The speed of adjustment also increases conditionally with income, in Appendix Table 7 which excludes the country dummies.)

Tariffs and distance are both estimated to have negative effects on the pass-through coefficient, as hypothesized. Size is significant, but of the wrong sign: big countries appear to experience more pass-through. The effect of wages is highly significant and of the right sign: labor costs reduce pass-through to the CPI. Both monetary variables are highly significant and of the right sign: long-term inflation

[24] Without country dummies (Appendix Table 6), the unconditional pass-through coefficient is higher (.56), with an equally strong downward trend. Most of the results are as before. Richer countries clearly have a lower pass-through coefficient [but appear to have a faster speed]. Tariffs, wages, size and long-term inflation have strong effects on the level of pass-through. Size works strongly to slow down the speed of adjustment. Exchange rate variability again has the unexpected significant effect of increasing the speed. [Distance has a puzzling positive coefficient. The US dummy appears very significant and of the unexpected sign; but this should probably be discounted because it is estimated from only three non-U.S. export goods—cointreau, cognac and vermouth—all three of which unfortunately have the same domestic competitor good, beer.]

Table 5 Pass-through to local competitor prices

		Eqn 1	Eqn2	Eqn3	Eqn 4	Eqn 5	Eqn 6	Eqn 7	Eqn 8	Eqn 9
Δ	exchange rate	0.396*** (0.027)	0.756*** (0.053)	0.723*** (0.054)	−0.382 (0.550)	−0.017 (0.563)	−0.668 (0.786)	−1.015 (0.791)	−1.117 (0.800)	−1.142 (0.832)
Δ	exporter's price	0.052* (0.027)	0.038 (0.028)	0.040 (0.028)	0.022 (0.030)	0.019 (0.030)	0.014 (0.037)	0.013 (0.035)	0.013 (0.035)	0.009 (0.037)
(Δs)*	trend		−0.057*** (0.007)	−0.057*** (0.007)	−0.057*** (0.007)	−0.058*** (0.007)	−0.082*** (0.009)	−0.050*** (0.010)	−0.050*** (0.010)	−0.063*** (0.011)
(Δs)*	log[per capitaRGDP(importer) / per capitaRGDP(exporter)]			−0.018*** (0.006)	−0.020*** (0.006)	−0.061*** (0.016)	−0.094*** (0.025)	−0.113*** (0.023)	−0.109*** (0.023)	−0.078*** (0.026)
(Δs)*	tariff levels				0.011 (0.093)	−0.075 (0.097)	−0.010 (0.133)	0.126 (0.133)	0.144 (0.135)	0.053 (0.144)
(Δs)*	log distance				0.118*** (0.039)	0.134*** (0.039)	0.193*** (0.054)	0.139*** (0.049)	0.139*** (0.049)	0.186*** (0.055)
(Δs)*	log[RGDP(importer)/ RGDP(exporter)]					0.042*** (0.015)	0.078*** (0.022)	0.099*** (0.021)	0.093*** (0.022)	0.065*** (0.023)
(Δs)*	log real wage ($)						−0.019*** (0.008)	−0.010 (0.007)	−0.010 (0.007)	−0.018*** (0.008)
(Δs)*	long term inflation							0.621** (0.254)	0.615** (0.254)	0.180*** (0.063)
(Δs)*	long term exchange rate variability							−2.222 (1.640)	−2.166 (1.643)	
(Δs)*	US Importer dummy								0.436** (0.182)	0.478*** (0.184)
	Error Correction term (ECM)	−0.018*** (0.006)	0.006 (0.014)	0.005 (0.014)	0.023 (0.084)	0.047 (0.084)	−0.033 (0.113)	−0.038 (0.111)	−0.037 (0.111)	−0.004 (0.113)
ECM*	trend		−0.003** (0.001)	−0.003** (0.001)	−0.003** (0.002)	−0.003** (0.002)	−0.001 (0.002)	−0.002 (0.002)	−0.002 (0.002)	−0.001 (0.002)
ECM*	log[per capitaRGDP(importer) / per capitaRGDP(exporter)]			−0.001 (0.002)	−0.002 (0.002)	−0.008** (0.004)	−0.020*** (0.006)	−0.016*** (0.006)	−0.016*** (0.006)	−0.020*** (0.006)

Table 5 (continued)

		Eqn 1	Eqn2	Eqn3	Eqn 4	Eqn 5	Eqn 6	Eqn 7	Eqn 8	Eqn 9
ECM*	tariff levels				−0.009 (0.012)	−0.012 (0.012)	−0.025 (0.020)	−0.026 (0.019)	−0.026 (0.019)	−0.030 (0.020)
ECM*	log distance				0.003 (0.007)	0.003 (0.007)	0.027*** (0.008)	0.027*** (0.009)	0.027*** (0.009)	0.027*** (0.008)
ECM*	log[RGDP(importer)/ RGDP(exporter)]					0.006* (0.003)	0.015*** (0.005)	0.011** (0.005)	0.011** (0.005)	0.015*** (0.005)
ECM*	log real wage ($)						0.019*** (0.007)	0.013* (0.007)	0.013** (0.007)	0.018** (0.007)
ECM*	long term inflation							0.011 (0.025)	0.011 (0.025)	−0.005 (0.026)
ECM*	long term exchange rate variability							−0.175** (0.077)	−0.176** (0.077)	
ECM*	US Importer dummy								−0.018 (0.053)	−0.041 (0.053)
	# of Observations	5630	5630	5630	5077	5077	3299	3235	3235	3299
	Adjusted R-squared	0.224	0.240	0.242	0.248	0.250	0.241	0.259	0.259	0.246
	Country dummies	yes	yes	yes	yes	yes	yes	yes	yes	yes
	Product dummies	yes	yes	yes	yes	yes	yes	yes	yes	yes

Full sample: *=10%, **=5%, and ***=1% levels of significance; product specific (ps) tariffs

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Table 6 Pass-through to the CPI

		Eqn 1	Eqn2	Eqn3	Eqn 4	Eqn 5	Eqn 6	Eqn 7
Δ	exchange rate	0.279*** (0.052)	0.602*** (0.103)	0.623*** (0.135)	3.254** (1.641)	4.898** (2.061)	5.621*** (1.840)	2.616*** (1.331)
(Δs)*	trend		−0.054*** (0.011)	−0.055*** (0.011)	−0.054*** (0.012)	−0.057*** (0.012)	−0.066*** (0.011)	−0.011 (0.007)
(Δs)*	log[per capitaRGDP(importer) / per capitaRGDP(exporter)]			0.009 (0.040)	−0.037 (0.041)	−0.099* (0.052)	0.777*** (0.195)	0.466*** (0.100)
(Δs)*	tariff levels				−0.509 (0.356)	−0.860** (0.438)	−0.934** (0.446)	−0.287 (0.306)
(Δs)*	log distance				−0.031 (0.055)	−0.001 (0.074)	−0.157 (0.131)	−0.156** (0.069)
(Δs)*	log[RGDP(importer)/RGDP(exporter)]					0.084* (0.043)	0.034 (0.034)	0.055*** (0.020)
(Δs)*	log real wage ($)						−0.540*** (0.077)	−0.334*** (0.050)
(Δs)*	long term inflation							0.907*** (0.139)
(Δs)*	long term exchange rate variability							−4.303*** (0.929)
	Error Correction term (ECM)	−0.014 (0.009)	−0.003 (0.006)	−0.003 (0.006)	−0.417 (0.319)	−0.428 (0.307)	−0.900* (0.477)	0.461** (0.189)
ECM*	trend		0.003*** (0.001)	0.004*** (0.001)	0.008*** (0.002)	0.008*** (0.002)	0.010*** (0.003)	0.006*** (0.002)
ECM*	log[per capitaRGDP(importer) / per capitaRGDP(exporter)]			0.015 (0.011)	0.014* (0.008)	0.010 (0.008)	0.012 (0.055)	−0.056 (0.039)
ECM*	tariff levels				0.089 (0.067)	0.091 (0.065)	0.194* (0.102)	−0.099** (0.040)
ECM*	log distance				−0.006*** (0.002)	−0.004 (0.004)	−0.011* (0.006)	0.002 (0.004)
ECM*	log[RGDP(importer)/RGDP(exporter)]					0.005 (0.007)	0.003 (0.008)	0.003 (0.006)
ECM*	log real wage ($)						−0.003 (0.029)	0.040* (0.021)
ECM*	long term inflation							−0.162*** (0.039)
ECM*	long term exchange rate variability							0.115* (0.065)
	# of Observations	732	732	732	732	732	732	732
	Adjusted R-squared	0.693	0.693	0.693	0.693	0.693	0.693	0.693
	Country dummies	yes	yes	yes	yes	yes	yes	yes

full sample

Average Tariffs

*=10%, **=5%, and ***=1% levels of significance

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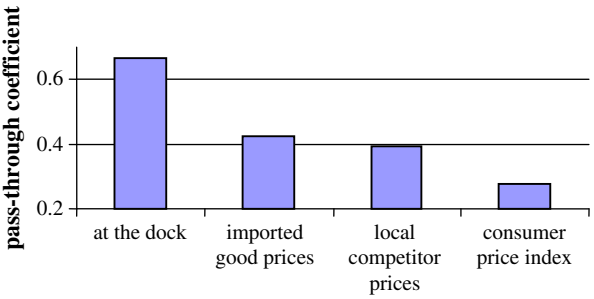

Fig. 5 Exchange rate pass-through to domestic prices

raises the level and speed of pass-through to the CPI, while long-term exchange rate variability lowers the level and speed of pass-through.[25]

5.4 Determination of Import Prices at the Dock

Finally, we go back to the determination of the prices of our narrowly defined import goods when they first arrive in the country, Table 3. These data are disaggregated unit value prices. The prices are observed, figuratively speaking, "at the dock;" in other words, the stage before the retail prices that we began by examining above. Figure 5 shows that the pass-through coefficient is higher for the prices at the dock than for the same imports at retail, higher for retail import prices than for local competitor prices, and higher for local competitor prices than for the aggregate price index. This is precisely what we would expect, but it is nice to see it.

Table 7, and Appendix Tables 4 and 8, seek to explain pass-through to unit value import prices, with the same variables that we used to explain other local price measures. To the extent that price discrimination is the right model of price determination, we might expect that these in-country wholesale prices would exhibit similar pricing to market behavior as do the retail prices of the same goods. But to the extent that retailers follow inertial sticky-price rules, we might expect that pass-through will be more immediate at the wholesale level.

The table shows that pass-through to prices in the port behaves quite differently than to retail. It is not surprising to find a higher overall pass-through coefficient, as noted: .53–.68. But, more strikingly, there is an *upward* trend in the coefficient, at .04 per year, and also in the speed of adjustment. The estimated trend in the pass-through coefficient, in theory, should be strong enough to reach 1.0—complete pass-through—by the end of the sample period. (Extrapolating the estimated trend in the ECM term, by contrast, suggests it would take more than a century to reach instantaneous adjustment.) Moreover, income is highly significant, appearing to suggest that richer countries have *higher* pass-through. Perhaps wholesale markets are more competitive and less regulated in rich countries than poor.

[25] The results are similar when the country dummies are omitted (Appendix Table 7). The most notable difference is that higher wages are now seen to slow down the speed of adjustment significantly.

Table 7 Pass-through to unit values

		Eqn 1	Eqn2	Eqn3	Eqn 4	Eqn 5	Eqn 6	Eqn 7	Eqn 8	Eqn 9
Δ	exchange rate	0.666*** (0.067)	0.423*** (0.144)	0.451*** (0.143)	5.339*** (1.265)	5.169*** (1.367)	1.966 (1.520)	1.663 (1.508)	1.697 (1.537)	2.195 (1.572)
Δ	exporter's price	0.094 (0.063)	0.136** (0.065)	0.138** (0.065)	0.137** (0.068)	0.135** (0.068)	0.263*** (0.072)	0.258*** (0.073)	0.257*** (0.073)	0.271*** (0.072)
(Δs)*	trend		0.037** (0.017)	0.039** (0.017)	0.041** (0.017)	0.042** (0.018)	0.049** (0.021)	0.040* (0.024)	0.040* (0.024)	0.033 (0.024)
(Δs)*	log[per capitaRGDP (importer) / per capitaRGDP(exporter)]			0.028* (0.015)	0.028** (0.014)	0.040 (0.041)	0.105** (0.051)	0.151*** (0.055)	0.149*** (0.055)	0.100* (0.053)
(Δs)*	tariff levels				−0.482** (0.235)	−0.448* (0.255)	−0.066 (0.296)	−0.040 (0.299)	−0.046 (0.304)	−0.084 (0.301)
(Δs)*	log distance				−0.290*** (0.074)	−0.292*** (0.074)	−0.163** (0.083)	−0.141 (0.093)	−0.141 (0.093)	−0.159* (0.082)
(Δs)*	log[RGDP(importer)/ RGDP(exporter)]					−0.013 (0.040)	−0.116** (0.047)	−0.156*** (0.047)	−0.154*** (0.049)	−0.115** (0.049)
(Δs)*	log real wage ($)						−0.002 (0.013)	−0.020 (0.016)	−0.020 (0.016)	−0.005 (0.013)
(Δs)*	long term inflation							−0.553 (0.404)	−0.551 (0.404)	−0.337 (0.223)
(Δs)*	long term exchange rate variability							1.350 (2.202)	1.330 (2.214)	
(Δs)*	US Importer dummy								−0.140 (0.278)	−0.169 (0.269)
	Error Correction term (ECM)	−0.218*** (0.030)	−0.183*** (0.033)	−0.186*** (0.034)	0.064 (0.121)	0.091 (0.135)	0.266* (0.148)	0.388*** (0.148)	0.388*** (0.148)	0.283* (0.149)
ECM*	trend		−0.005** (0.002)	−0.005** (0.002)	−0.005*** (0.002)	−0.005** (0.002)	−0.006* (0.003)	−0.007** (0.003)	−0.007** (0.003)	−0.006** (0.003)
ECM*	log[per capitaRGDP (importer) / per capitaRGDP (exporter)]			−0.002 (0.003)	−0.005 (0.004)	−0.008 (0.005)	−0.007 (0.009)	−0.003 (0.009)	−0.003 (0.009)	−0.007 (0.009)

Table 7 (continued)

		Eqn 1	Eqn2	Eqn3	Eqn 4	Eqn 5	Eqn 6	Eqn 7	Eqn 8	Eqn 9
ECM*	tariff levels				0.015 (0.025)	0.011 (0.029)	0.002 (0.024)	−0.020 (0.021)	−0.020 (0.021)	−0.001 (0.024)
ECM*	log distance				−0.038*** (0.012)	−0.039*** (0.012)	−0.048*** (0.017)	−0.052*** (0.019)	−0.052*** (0.019)	−0.048*** (0.017)
ECM*	log[RGDP(importer)/RGDP (exporter)]					0.003 (0.006)	0.007 (0.007)	0.004 (0.007)	0.004 (0.007)	0.007 (0.007)
ECM*	log real wage ($)						−0.001 (0.015)	−0.015 (0.016)	−0.015 (0.016)	−0.005 (0.016)
ECM*	long term inflation							−0.017 (0.052)	−0.017 (0.052)	−0.030 (0.047)
ECM*	long term exchange rate variability							−0.149 (0.107)	−0.149 (0.106)	
ECM*	US Importer dummy								0.164 (0.115)	0.158 (0.116)
	# of Observations	3774	3774	3774	3548	3548	2625	2561	2561	2625
	Adjusted R-squared	0.151	0.153	0.154	0.162	0.161	0.153	0.155	0.154	0.154
	Country dummies	yes	yes	yes	yes	yes	yes	yes	yes	yes
	Product dummies	yes	yes	yes	yes	yes	yes	yes	yes	yes

Full sample: *=10%, **=5%, and ***=1% levels of significance; product specific (ps) tariffs

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More in line with our a priori reasoning, tariffs, distance and size all work to reduce pass-through significantly. (Distance paradoxically works to increase the speed of adjustment, however). Unlike the retail case, the effect of inflation on the pass-through coefficient is of the wrong sign, and insignificant. Evidently the rising importance of pricing to market, and the role of a less inflationary environment, are entirely retail phenomenon.

Unit value data are traditionally viewed as less reliable than other price data. That is one reason why we have placed these results last. But this suspicion is much less justified for prices of highly disaggregated goods such as we are using, than it would be for aggregate indices of import prices. Furthermore, that we have a strong pass-through estimate and that we are able to identify specific significant determinants of it, suggest that the unit value prices may not be subject to large measurement error.

5.5 Pass-through in Developing Countries

Our last task in this paper is to break out the results for low-income countries, separately from high-income countries. Our motivations for doing so were laid out at the beginning, including the lack of detailed econometric scrutiny that they have received in the past. Moreover, the results in the preceding section have confirmed the traditional wisdom that the pass-through coefficient varies with per capita income. Perhaps the most striking lesson of this paper emerges only in this section: some of the aspects of the determination of local retail prices that we have identified in the preceding sections turn out to be phenomena that apply primarily or even exclusively to developing countries.

In Tables 8, 9, 10 and 11 we report for each coefficient the base-case estimate from the sample of high-income countries, and then the estimate for developing countries (defined as either low-income or middle-income) expressed as a deviation from the base case. Table 8 reports the determination of retail import prices. Equation 1 shows that for developing countries, the level of the (unconditional) pass-through coefficient is almost four times as high as it is for high-income countries. In Table 9, for competitors' prices, and Table 10, for the CPI, the pass-through coefficient in poor countries is an even greater multiple of that in rich countries, on the order of ten times as high. Table 11, for unit values, is the exception. The estimate for the pass-through coefficient shows no significant difference between rich and developing countries.

In Equation 2 of Table 8, the clear downward trend in the pass-through coefficient during the sample period is twice as high for developing countries as for rich countries. But because the initial level of pass-through is high, the trend is not enough to eliminate the poor-rich differential by the end of the period. The downward trend is also substantially stronger for poor countries in the determination of competitors' prices and the CPI. Indeed, in the case of the CPI, the downward trend in the pass-through coefficient for developing countries is strong enough to eliminate all of the difference by the end of the 12-year sample period.

The ECM term in these tables suggests significantly faster adjustment for poor countries than rich in the case of retail imported goods (Equation 1 of Table 8). (The difference is not significant in the case of local competitors' prices or unit values,

Table 8 Determination of pass-through to imported goods prices: developing countries, relative to rich countries

		Equation 1		Equation 2		Equation 3		Equation 4		Equation 5		Equation 6		Equation 7		Equation 8	
		Rich	D Dev.	Rich	D Dev.	Rich	D Dev.	Rich	D Dev.	Rich	D Dev.	Rich	D Dev.	Rich	D Dev.	Rich	D Dev.
Δ	exchange rate	0.133*** (0.031)	0.365*** (0.045)	0.310*** (0.075)	0.496*** (0.101)	0.314*** (0.075)	0.422*** (0.104)	2.840*** (0.852)	−1.424*** (1.409)	2.551** (1.057)	−1.032 (1.533)	2.084* (1.083)	0.009 (1.545)	2.032* (1.083)	−1.155 (1.551)	2.489** (1.144)	−1.607 (1.595)
Δ	exporter's price	0.108*** (0.025)	−0.052 (0.042)	0.108*** (0.025)	−0.023 (0.042)	0.107*** (0.025)	−0.017 (0.042)	0.102*** (0.027)	−0.008 (0.045)	0.101** (0.045)	−0.008 (0.045)	0.080*** (0.027)	−0.046 (0.061)	0.081*** (0.028)	−0.068 (0.062)	0.082*** (0.028)	−0.069 (0.062)
(Δs)*	trend			−0.025*** (0.009)	−0.026** (0.013)	−0.026*** (0.009)	−0.025* (0.013)	−0.024** (0.010)	−0.025* (0.013)	−0.024** (0.010)	−0.026** (0.013)	−0.021** (0.010)	−0.059*** (0.017)	−0.013 (0.012)	−0.047** (0.019)	−0.014 (0.012)	−0.046** (0.019)
(Δs)*	log[per capitaRGDP(importer) / per capitaRGDP(exporter)]					−0.005 (0.010)	−0.026* (0.014)	−0.010 (0.010)	−0.025* (0.015)	0.004 (0.025)	−0.058* (0.033)	0.011 (0.028)	−0.070 (0.043)	−0.004 (0.031)	−0.069 (0.046)	−0.022 (0.034)	−0.050 (0.048)
(Δs)*	tariff levels							−0.433** (0.190)	0.228 (0.314)	−0.368 (0.246)	0.228 (0.314)	−0.275 (0.252)	0.055 (0.301)	−0.318 (0.246)	0.256 (0.298)	−0.431 (0.265)	0.368 (0.314)
(Δs)*	log distance							−0.057 (0.041)	0.054 (0.068)	−0.063 (0.045)	0.054 (0.068)	−0.064 (0.046)	0.059 (0.088)	−0.046 (0.046)	0.066 (0.089)	−0.029 (0.048)	0.049 (0.091)
(Δs)*	log[RGDP(importer)/RGDP (exporter)]									−0.013 (0.020)	0.033 (0.027)	−0.018 (0.024)	0.045 (0.039)	−0.006 (0.025)	0.051 (0.041)	0.016 (0.030)	0.029 (0.044)
(Δs)*	log real wage ($)											−0.014 (0.008)	0.013 (0.012)	−0.018* (0.010)	0.016 (0.013)	−0.019* (0.010)	0.017 (0.013)
(Δs)*	long term inflation													2.016 (1.860)	−1.662 (1.872)	2.135 (1.871)	−1.781 (1.884)
(Δs)*	long term exchange rate variability													−1.620 (4.962)	0.247 (5.141)	−2.262 (4.932)	0.890 (5.112)
(Δs)*	US Importer dummy															−0.442** (0.190)	
	Error Correction term (ECM)	−0.093*** (0.008)	−0.017* (0.010)	−0.091*** (0.016)	−0.105*** (0.025)	−0.092*** (0.016)	−0.101*** (0.026)	−0.124 (0.220)	−0.427 (0.264)	−0.117 (0.248)	−0.446 (0.286)	−0.128 (0.265)	−0.770** (0.340)	−0.146 (0.260)	−0.330 (0.334)	−0.129 (0.264)	−0.347 (0.337)
ECM*	trend			0.000 (0.002)	0.011*** (0.003)	0.000 (0.002)	0.011*** (0.003)	0.001 (0.002)	0.011*** (0.003)	0.001 (0.002)	0.011*** (0.003)	0.001 (0.002)	0.011** (0.004)	0.001 (0.002)	0.006 (0.004)	0.001 (0.002)	0.006 (0.004)
ECM*	log[per capitaRGDP(importer) / per capitaRGDP(exporter)]					−0.005** (0.002)	0.007* (0.004)	−0.003 (0.002)	0.007* (0.004)	−0.004 (0.006)	0.010 (0.008)	−0.004 (0.006)	0.004 (0.015)	−0.004 (0.006)	0.007 (0.015)	−0.005 (0.007)	0.008 (0.015)
ECM*	tariff levels							−0.040 (0.047)	0.078 (0.051)	−0.041 (0.056)	0.081 (0.060)	−0.041 (0.061)	0.088 (0.066)	−0.034 (0.060)	0.046 (0.064)	−0.040 (0.061)	0.052 (0.066)
ECM*	log distance							0.025*** (0.009)	−0.007 (0.016)	0.025** (0.011)	−0.007 (0.017)	0.031*** (0.011)	0.026 (0.022)	0.030*** (0.011)	0.001 (0.023)	0.032*** (0.011)	−0.001 (0.024)

Table 8 (continued)

	Equation 1		Equation 2		Equation 3		Equation 4		Equation 5		Equation 6		Equation 7		Equation 8	
	Rich	D Dev.	Rich	D Dev.	Rich	D Dev.	Rich	D Dev.	Rich	D Dev.	Rich	D Dev.	Rich	D Dev.	Rich	D Dev.
ECM* log[RGDP(importer)/RGDP (exporter)]									0.001 (0.006)	−0.003 (0.007)	0.001 (0.006)	0.001 (0.013)	0.002 (0.006)	−0.003 (0.013)	0.003 (0.006)	−0.005 (0.013)
ECM* log real wage ($)											0.018 (0.016)	−0.007 (0.022)	0.015 (0.015)	−0.020 (0.023)	0.016 (0.015)	−0.020 (0.023)
ECM* long term inflation													−0.086 (0.266)	0.022 (0.270)	−0.083 (0.267)	0.019 (0.271)
ECM* long term exchange rate variability													0.142* (0.085)	−0.424*** (0.133)	0.152* (0.087)	−0.433*** (0.134)
ECM* US Importer dummy															−0.053 (0.061)	
# of Observations	5677		5677		5677		5192		5192		3316		3250		3250	
Adjusted R-squared	0.305		0.324		0.327		0.338		0.338		0.327		0.294		0.294	

*=10%, **=5%, and ***=1% levels of significance; note: Developing country coefficient=values in the "D Dev." column should be added to estimates in column labelled "Rich"

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Rich countries = high income countries

Average Tariffs

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Table 9 Determination of pass-through to local competitor prices: developing countries, relative to rich countries

		Equation 1		Equation2		Equation 3		Equation 4		Equation 5		Equation 6		Equation 7		Equation 8	
		Rich	D Dev.	Rich	D Dev.	Rich	D Dev.	Rich	D Dev.	Rich	D Dev.	Rich	D Dev.	Rich	D Dev.	Rich	D Dev.
Δ	exchange rate	0.035 (0.031)	0.456*** (0.044)	0.158** (0.076)	0.676*** (0.096)	0.168** (0.076)	0.656*** (0.098)	−0.439 (0.576)	0.773 (0.884)	0.839 (0.741)	−0.319 (0.999)	0.957 (0.772)	−1.580 (1.301)	0.523 (0.874)	−1.564 (1.432)	−0.129 (0.938)	−0.912 (1.470)
Δ	exporter's price	0.046 (0.034)	−0.007 (0.051)	0.036 (0.034)	−0.012 (0.051)	0.036 (0.034)	−0.011 (0.052)	0.020 (0.037)	−0.011 (0.056)	0.017 (0.045)	−0.010 (0.055)	0.017 (0.040)	−0.020 (0.076)	0.014 (0.040)	0.000 (0.072)	0.013 (0.040)	0.000 (0.072)
(Δs)*	trend			−0.016* (0.010)	−0.040*** (0.012)	−0.018* (0.010)	−0.039*** (0.012)	−0.019* (0.010)	−0.037*** (0.013)	−0.022** (0.010)	−0.036*** (0.013)	−0.022** (0.011)	−0.073 (0.016)	−0.009 (0.012)	−0.054*** (0.020)	−0.007 (0.012)	−0.056*** (0.020)
(Δs)*	log[per capitaRGDP(importer) / per capitaRGDP(exporter)]					−0.014 (0.009)	0.009 (0.012)	−0.008 (0.009)	−0.002 (0.012)	−0.062*** (0.022)	0.024 (0.029)	−0.077*** (0.026)	0.028 (0.047)	−0.072** (0.030)	−0.049 (0.045)	−0.045 (0.033)	−0.077 (0.047)
(Δs)*	tariff levels							0.068 (0.123)	0.070 (0.196)	−0.204 (0.166)	0.070 (0.196)	−0.244 (0.172)	0.223 (0.226)	−0.218 (0.187)	0.345 (0.243)	−0.056 (0.205)	0.183 (0.257)
(Δs)*	log distance							0.034 (0.042)	0.062 (0.065)	0.051 (0.044)	0.062 (0.065)	0.062 (0.046)	0.148 (0.092)	0.063 (0.050)	0.099 (0.090)	0.037 (0.052)	0.124 (0.091)
(Δs)*	log[RGDP(importer)/RGDP (exporter)]									0.051 (0.019)	−0.022 (0.026)	0.066 (0.024)	−0.027 (0.043)	0.067*** (0.025)	0.044 (0.042)	0.034 (0.029)	0.076* (0.044)
(Δs)*	log real wage ($)											−0.001 (0.008)	−0.014 (0.011)	−0.006 (0.008)	−0.003 (0.011)	−0.004 (0.008)	−0.004 (0.011)
(Δs)*	long term inflation													2.980** (1.501)	−2.376 (1.527)	2.810* (1.506)	−2.206 (1.531)
(Δs)*	long term exchange rate variability													1.980 (4.541)	−4.503 (4.848)	2.941 (4.578)	−5.463 (4.881)
(Δs)*	US Importer dummy															0.669*** (0.215)	
	Error Correction term (ECM)	−0.006 (0.008)	−0.013 (0.010)	0.029* (0.016)	−0.032 (0.025)	0.028* (0.016)	−0.031 (0.025)	−0.046 (0.160)	0.105 (0.198)	0.136 (0.182)	−0.042 (0.217)	0.150 (0.189)	−0.190 (0.265)	0.016 (0.197)	−0.181 (0.275)	0.015 (0.200)	−0.180 (0.276)
ECM*	trend			−0.005*** (0.002)	0.003 (0.003)	−0.004** (0.002)	0.002 (0.003)	−0.005** (0.002)	0.003 (0.003)	−0.005*** (0.002)	0.003 (0.003)	−0.005*** (0.002)	0.008** (0.004)	−0.002 (0.002)	0.005 (0.005)	−0.002 (0.002)	0.005 (0.005)
ECM*	log[per capitaRGDP(importer) / per capitaRGDP(exporter)]					−0.006*** (0.002)	0.005* (0.003)	−0.006* (0.002)	0.004 (0.003)	−0.019*** (0.006)	0.011 (0.007)	−0.019*** (0.007)	−0.008 (0.014)	−0.019*** (0.007)	0.000 (0.013)	−0.018*** (0.007)	0.000 (0.013)
ECM*	tariff levels							−0.007 (0.034)	0.003 (0.037)	−0.052 (0.040)	0.045 (0.043)	−0.053 (0.043)	0.028 (0.050)	−0.031 (0.044)	0.009 (0.050)	−0.030 (0.045)	0.008 (0.051)
ECM*	log distance							0.012 (0.009)	−0.018 (0.014)	0.020** (0.009)	−0.026* (0.014)	0.018 (0.011)	0.016 (0.018)	0.019* (0.012)	0.019 (0.019)	0.018 (0.012)	0.020 (0.019)

Table 9 (continued)

	Equation 1		Equation2		Equation 3		Equation 4		Equation 5		Equation 6		Equation 7		Equation 8	
	Rich	D Dev.	Rich	D Dev.	Rich	D Dev.	Rich	D Dev.	Rich	D Dev.	Rich	D Dev.	Rich	D Dev.	Rich	D Dev.
ECM* log[RGDP(importer)/RGDP (exporter)]									0.013*** (0.005)	−0.008 (0.006)	0.013** (0.006)	0.009 (0.012)	0.014** (0.006)	−0.001 (0.011)	0.013** (0.006)	−0.001 (0.011)
ECM* log real wage ($)											−0.008 (0.015)	0.044** (0.020)	0.002 (0.015)	0.018 (0.020)	0.002 (0.015)	0.018 (0.020)
ECM* long term inflation													0.530* (0.273)	−0.502* (0.275)	0.537* (0.274)	−0.509* (0.275)
ECM* long term exchange rate variability													0.099 (0.065)	−0.323** (0.129)	0.085 (0.065)	−0.309** (0.129)
ECM* US Importer dummy															−0.003 (0.062)	
# of Observations	5630		5630		5630		5077		5077		3299		3235		3235	
Adjusted R-squared	0.236		0.250		0.250		0.255		0.256		0.252		0.264		0.265	

*=10%, **=5%, and ***=1% levels of significance; note: Developing country coefficient=values in the "D Dev." column should be added to estimates in column labelled "Rich"

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Rich countries = high income countries

product specific (ps) tariffs

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Table 10 Determination of pass-through to the cpi: developing countries, relative to rich countries

		Equation 1		Equation 2		Equation 3		Equation 4		Equation 5		Equation 6		Equation 7	
		Rich	D Dev.	Rich	D Dev.	Rich	D Dev.	Rich	D Dev.	Rich	D Dev.	Rich	D Dev.	Rich	D Dev.
Δ	exchange rate	0.017 (0.011)	0.336*** (0.065)	0.001 (0.034)	0.677*** (0.124)	−0.022 (0.033)	1.131*** (0.220)	1.620 (0.851)*	1.017 (2.038)	1.733* (1.031)	2.338 (2.416)	1.858* (1.072)	−2.086 (3.377)	1.915 (1.079)*	−3.681 (2.656)
Δ	exporter's price	−0.021*** (0.007)	−0.073*** (0.028)	−0.024*** (0.008)	0.002 (0.027)	−0.023*** (0.008)	0.013 (0.027)	−0.019** (0.009)	0.022 (0.032)	−0.018 (0.045)	0.031 (0.033)	−0.017 (0.011)	0.049 (0.044)	−0.019* (0.011)	0.021 (0.031)
(Δs)*	trend			0.002 (0.004)	−0.059*** (0.013)	0.002 (0.004)	−0.065*** (0.013)	0.001 (0.004)	−0.063*** (0.014)	0.001 (0.004)	−0.065*** (0.014)	0.001 (0.004)	−0.101*** (0.021)	0.005 (0.006)	0.002 (0.015)
(Δs)*	log[per capitaRGDP(importer) / per capitaRGDP(exporter)]					−0.063 (0.045)	0.251*** (0.085)	−0.040 (0.046)	0.235** (0.098)	−0.036 (0.049)	0.151 (0.090)*	−0.050 (0.088)	1.120*** (0.248)	0.102 (0.102)	0.453*** (0.167)
(Δs)*	tariff levels							−0.336* (0.192)	−0.440 (0.493)	−0.358 (0.227)	−0.440 (0.493)	−0.396* (0.233)	0.153 (0.638)	−0.452** (0.220)	1.072** (0.528)
(Δs)*	log distance							−0.007 (0.024)	0.122 (0.109)	−0.006 (0.024)	0.122 (0.109)	0.000 (0.027)	0.086 (0.290)	0.009 (0.025)	−0.194 (0.165)
(Δs)*	log[RGDP(importer)/RGDP(exporter)]									0.003 (0.009)	0.079* (0.041)	0.007 (0.010)	−0.099* (0.056)	0.003 (0.012)	0.008 (0.048)
(Δs)*	log real wage ($)											−0.002 (0.039)	−0.684*** (0.094)	−0.020 (0.042)	−0.369*** (0.071)
(Δs)*	long term inflation													0.920 (0.938)	0.055 (0.954)
(Δs)*	long term exchange rate variability													2.301** (1.133)	−7.133*** (1.549)
	Error Correction term (ECM)	−0.037*** (0.012)	0.025** (0.014)	−0.037*** (0.012)	0.036*** (0.014)	−0.039*** (0.013)	0.039*** (0.014)	−0.989 (0.704)	0.697 (0.753)	−0.923 (0.700)	0.617 (0.749)	−0.984 (0.719)	0.216 (0.897)	−0.807 (0.684)	1.155 (0.706)
ECM*	trend			0.000 (0.000)	0.003*** (0.001)	0.000 (0.001)	0.006*** (0.002)	0.000 (0.001)	0.008*** (0.002)	0.000 (0.001)	0.008*** (0.002)	−0.002 (0.001)	0.015** (0.006)	0.001 (0.002)	0.010*** (0.004)
ECM*	log[per capitaRGDP(importer)/ per capitaRGDP (exporter)]					−0.008 (0.016)	0.032 (0.021)	−0.018 (0.015)	0.057*** (0.021)	−0.012 (0.017)	0.046** (0.022)	0.023 (0.041)	0.022 (0.108)	0.022 (0.039)	−0.117 (0.088)
ECM*	tariff levels							0.207 (0.149)	−0.144 (0.159)	0.193 (0.148)	−0.127 (0.158)	0.205 (0.152)	−0.038 (0.190)	0.166 (0.144)	−0.241 (0.149)
ECM*	log distance							−0.001 (0.001)	0.001 (0.004)	0.001 (0.002)	0.001 (0.006)	0.001 (0.003)	−0.009 (0.013)	−0.001 (0.004)	0.006 (0.009)
ECM*	log[RGDP(importer)/RGDP (exporter)]									0.005* (0.003)	0.002 (0.008)	0.010*** (0.003)	−0.004 (0.015)	0.008** (0.003)	−0.002 (0.012)

Table 10 (continued)

		Equation 1		Equation 2		Equation 3		Equation 4		Equation 5		Equation 6		Equation 7	
		Rich	D Dev.	Rich	D Dev.	Rich	D Dev.	Rich	D Dev.	Rich	D Dev.	Rich	D Dev.	Rich	D Dev.
ECM*	log real wage ($)											−0.019 (0.016)	0.016 (0.052)	−0.012 (0.015)	0.085* (0.044)
ECM*	long term inflation													0.473 (0.485)	−0.629 (0.487)
ECM*	long term exchange rate variability													−0.007 (0.034)	0.156 (0.097)
	# of Observations	732		710		710		579		579		350		345	
	Adjusted R-squared	0.716		0.747		0.767		0.778		0.786		0.861		0.907	

*=10%, **=5%, and ***=1% levels of significance; note: Developing country coefficient = values in the "D Dev." column should be added to estimates in column labelled "Rich"

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NEED TO SET SMPL 1 1440, REMOVE PRODUCT DUMMIES, AND INCLUDE LINES DEFINING DEP VARIABLE

Table 11 Determination of pass-through to unit values: developing countries, relative to rich countries

		Equation 1		Equation2		Equation 3		Equation 4		Equation 5		Equation 6		Equation 7		Equation 8	
		Rich	D Dev.	Rich	D Dev.	Rich	D Dev.	Rich	D Dev.	Rich	D Dev.	Rich	D Dev.	Rich	D Dev.	Rich	D Dev.
Δ	exchange rate	0.681** (0.112)	−0.022 (0.144)	0.516** (0.262)	−0.139 (0.317)	0.485* (0.265)	−0.062 (0.321)	8.496** (1.781)	−3.408 (2.355)	8.144** (2.557)	−3.142 (3.024)	7.244** (2.404)	−7.188** (3.012)	6.966** (2.459)	−5.754* (3.114)	7.422** (2.647)	−6.213* (3.260)
Δ	exporter's price	0.226** (0.069)	−0.237** (0.116)	0.322** (0.077)	−0.328*** (0.121)	0.322** (0.077)	−0.327*** (0.121)	0.327** (0.081)	−0.336*** (0.126)	0.326** (0.045)	−0.333*** (0.126)	0.307** (0.084)	−0.082 (0.144)	0.311** (0.084)	−0.104 (0.152)	0.309** (0.084)	−0.102 (0.151)
(Δs)*	trend			0.029	0.011	0.033	0.009	0.016	0.032	0.017	0.032	0.024	0.042	−0.039	0.082	−0.039	0.082
				(0.028)	(0.035)	(0.028)	(0.035)	(0.032)	(0.039)	(0.035)	(0.041)	(0.033)	(0.045)	(0.055)	(0.066)	(0.055)	(0.066)
(Δs)*	log[per capitaRGDP(importer) / per capitaRGDP(exporter)]					0.032 (0.020)	−0.003 (0.027)	0.010 (0.020)	0.028 (0.027)	0.018 (0.085)	0.028 (0.097)	0.031 (0.088)	0.142 (0.115)	0.127* (0.067)	0.037 (0.112)	0.108 (0.077)	0.055 (0.118)
(Δs)*	tariff levels							−1.446** (0.420)	0.988 (0.699)	−1.358** (0.632)	0.988 (0.699)	−1.248** (0.598)	1.442 (0.677)	−1.224** (0.611)	1.401** (0.687)	−1.337** (0.678)	1.514** (0.746)
(Δs)*	log distance							−0.111 (0.141)	−0.196 (0.185)	−0.122 (0.156)	−0.196 (0.185)	−0.085** (0.157)	−0.032 (0.192)	0.003 (0.237)	−0.211 (0.263)	0.021 (0.248)	−0.228 (0.272)
(Δs)*	log[RGDP(importer)/RGDP (exporter)]									−0.010 (0.081)	0.001 (0.093)	−0.017 (0.085)	−0.174 (0.109)	−0.133** (0.056)	−0.063 (0.099)	−0.109 (0.070)	−0.086 (0.107)
(Δs)*	log real wage ($)											0.003 (0.023)	−0.007 (0.030)	−0.055 (0.050)	0.059 (0.055)	−0.056 (0.050)	0.059 (0.055)
(Δs)*	long term inflation													−16.703** (8.483)	15.998* (8.487)	−16.205* (8.284)	15.500* (8.288)
(Δs)*	long term exchange rate variability													8.604 (7.164)	−6.531 (7.504)	7.571 (7.342)	−5.498 (7.679)
(Δs)*	US Importer dummy															−0.572 (0.482)	
	Error Correction term (ECM)	−0.210** (0.036)	−0.014 (0.016)	−0.145*** (0.034)	−0.082** (0.035)	−0.146** (0.035)	−0.094** (0.038)	0.094 (0.243)	−0.116 (0.292)	0.090 (0.251)	−0.201 (0.306)	0.190 (0.195)	0.234 (0.268)	0.171 (0.214)	0.429 (0.283)	0.169 (0.214)	0.432 (0.284)
ECM*	trend			−0.010*** (0.003)	0.010** (0.004)	−0.010** (0.003)	0.010** (0.004)	−0.011** (0.003)	0.010** (0.005)	−0.010** (0.003)	0.010** (0.005)	−0.010** (0.003)	0.012** (0.006)	−0.007* (0.004)	0.006 (0.006)	−0.007* (0.004)	0.006 (0.006)
ECM*	log[per capitaRGDP(importer) / per capitaRGDP(exporter)]					−0.002 (0.003)	−0.002 (0.004)	−0.005 (0.004)	−0.001 (0.004)	−0.016* (0.009)	0.015 (0.012)	−0.010 (0.011)	0.000 (0.020)	−0.009 (0.010)	0.008 (0.018)	−0.009 (0.010)	0.008 (0.018)
ECM*	tariff levels							0.022 (0.081)	−0.001 (0.084)	0.018 (0.085)	0.013 (0.088)	0.020 (0.064)	−0.035 (0.070)	0.012 (0.057)	−0.056 (0.063)	0.012 (0.058)	−0.056 (0.064)
ECM*	log distance							−0.041* (0.025)	0.005 (0.027)	−0.037 (0.028)	0.003 (0.030)	−0.050 (0.031)	0.000 (0.032)	−0.047* (0.028)	−0.011 (0.028)	−0.047* (0.028)	−0.011 (0.028)

Table 11 (continued)

	Equation 1		Equation2		Equation 3		Equation 4		Equation 5		Equation 6		Equation 7		Equation 8	
	Rich	D Dev.	Rich	D Dev.	Rich	D Dev.	Rich	D Dev.	Rich	D Dev.	Rich	D Dev.	Rich	D Dev.	Rich	D Dev.
ECM* log[RGDP(importer)/RGDP (exporter)]									0.011 (0.009)	−0.017 (0.012)	0.009 (0.009)	0.004 (0.017)	0.009 (0.008)	−0.003 (0.015)	0.008 (0.008)	−0.003 (0.015)
ECM* log real wage ($)											−0.023 (0.026)	0.046 (0.031)	−0.020 (0.022)	0.027 (0.027)	−0.020 (0.022)	0.027 (0.027)
ECM* long term inflation													0.512 (0.532)	−0.542 (0.537)	0.508 (0.531)	−0.538 (0.535)
ECM* long term exchange rate variability													−0.429* (0.260)	0.491* (0.278)	−0.428* (0.259)	0.490* (0.277)
ECM* US Importer dummy															0.136 (0.104)	
# of Observations	3774		3774		3774		3548		3548		2625		2561		2561	
Adjusted R-squared	0.152		0.155		0.156		0.163		0.163		0.158		0.165		0.165	

*=10%, **=5%, and ***=1% levels of significance; note: Developing country coefficient = values in the "D Dev." column should be added to estimates in column labelled "Rich"

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Rich countries = high income countries

product specific (ps) tariffs

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and is significantly slower in the case of the CPI.) While the ECM term has no trend at all for rich countries, there is a strong downward trend in the speed of adjustment for developing countries, which by the end of the period is again sufficient to outweigh the initial difference in speeds.

Equation 3 of Table 8 suggests that, even within the set of developing countries alone, higher income continues to mean lower pass-through to import prices. The effect whereby higher wages reduce the pass-through coefficient, however, turns out to be only a property of rich countries. The effect whereby greater distance means significantly slower adjustment turns out to apply equally to both sets of countries. The breakdown sheds light on the earlier finding that long-term exchange rate variability increases the speed of adjustment: this turns out to be a property only of developing countries. For rich countries, exchange rate variability delays adjustment, as hypothesized by Froot-Klemperer-Krugman-Taylor. Most likely the result for poor countries is dominated by time variation in trends, even though we are also conditioning on long-term inflation variability, and even though we have removed a (constant) trend from both monetary measures before computing variability.

In the determination of local competitors' prices, Table 9, the difference in trends is enough to eliminate more than half of the difference in pass-through by the end of the sample period. The phenomenon whereby long-term high inflation increases pass-through turns out to be a property of rich countries. Controlling for the effect of lower inflation all but eliminates the downward trend in rich-country pass-through to competitors' prices. But we do not explain the downward trend for developing countries, either with inflation or with any other variables.

Long-term inflation appears to slow down adjustment of competitor prices for rich countries, but only for them. (This puzzle applies also to the CPI in the next table.) Controlling for the change in inflation in turn all but eliminates the apparent trend of acceleration of the ECM parameter. Again, the effect whereby exchange rate variability appears to raise the speed of adjustment turns out to be a phenomenon of the developing countries alone.

In the determination of the CPI, Table 10, as already noted, the downward trend in pass-through for developing countries is strong enough to eliminate the entire differential vis-à-vis rich countries. In this case we can identify the main reason for the downward trend: long-term exchange rate variability has a strong negative effect on pass-through for developing countries (the opposite of the effect for rich). When controlling for exchange rate variability, the downward trend for poor countries all but disappears. This suggests that the trend estimates are capturing low pass-through during the currency crises of the latter half of the sample period. Tariffs and distance both turn out to reduce the pass-through coefficient even more strongly for developing countries than they do for rich countries. But the pattern whereby tariffs and distance slow down the speed of adjustment turns out to apply only to rich countries.

Generalizing across the three different price measures, the pass-through coefficient has traditionally been higher for lower-income countries, but a strong downward trend in the coefficient during the course of the 1990s eliminated much of the gap. A similar story can be told for the speed of adjustment in the case of import

prices. But in the case of the CPI, it is rich countries that have the faster adjustment. Tariffs and distance have highly significant downward effects on pass-through to the CPI. The monetary variables have the hypothesized effect for developing country CPIs, but not necessarily in other cases.

Those results pertain to the various retail prices. The case of pass-through to the prices in the port, reported in Table 11 is a different story. Here there is not much difference in the pass-through coefficient between rich and poor countries (although the speed of adjustment is higher for poor countries than rich). Both have pass-through coefficients in the neighborhood of .7. Tariffs have the hypothesized significant negative effect on pass-through for rich countries (when controlling for other variables like size), but *only* for rich countries. Rich countries are also the only ones to show the unexpected negative effect of long-term inflation on pass-through to unit prices and positive effect of exchange rate variability on the speed of adjustment.

6 Other Extensions

We have pursued a number of extensions in response to comments from readers of earlier drafts.

We tried adding on the right-hand side of the import price equation measures of domestic inflation, particularly changes in prices of competing goods and changes in the cost of domestic inputs (wages). We had omitted them from our basic results, because we had already been using the former as the dependent variable in the local prices regression and the latter as an interactive component of the Balassa-Samuelson variable. But this is not a good enough reason, in that theory requires these variables. The least we can do to respond to concerns that they are missing from the equation—and, worse yet, that such measures of domestic inflation are correlated with exchange rate changes—is to try adding them to the right-hand side. We did try this, and found that the basic conclusions about the coefficient trend did not change.[26]

Three other important extensions are to look for:

(1) asymmetric effects between appreciation and depreciation;
(2) threshhold effects whereby the proportionate effect on prices of large devaluations is proportionately different—presumably, smaller—than for small devaluations; and,
(3) cyclical factors, as an additional determinant on the list.

The salient motivation in all three cases is the emerging market currency crashes of the late 1990s. The observation that inflation rates did not rise nearly to the extent of currency depreciation during the recent crises in Asia and Latin America does not necessarily imply a consensus that the pass-through coefficient has declined structurally. Goldfajn and Werlang (2000) argue that the pass-through measured during these crises may be lower than during a normal, tranquil time. The reason is that recession could act to depress domestic prices, hence generating a spurious appearance that domestic prices do not respond much to exchange rate depreciation.

[26] Charles Engel suggested this line of exploration to us.

Carranza et al. (2004) find evidence of such asymmetries in pass-through of devaluation to the CPI in 15 emerging market countries.

Thus we checked with our data if one still saw a secular decline in the degree of pass-through among developing countries after controlling for the effect of crisis-related recession episodes, via asymmetry and/or a business cycle effect. For comparison with previous tables, we report results for each stage (retail, local competitor, CPI, and unit value) in Appendix Tables 9–12. In Appendix Tables 13–16, we present the results for the rich-poor comparison.

The output gap interacted with exchange rate change appears statistically significant, but the direction is opposite the hypothesized effect (pass-through appears higher in recessions, not lower). The threshold effect, while significant, goes the wrong way: increases in the exchange rate above 25% are found to have proportionately larger pass-through effects, not smaller. We did find strong evidence of asymmetry. In fact we cannot reject the hypothesis that appreciation is not passed through at all, suggesting downward price rigidity. This is an interesting finding. But the significant downward trend in the pass-through coefficient remains nonetheless. In short, the decline in pass-through during this period does not appear to be merely an artifact of the high-profile currency crashes in emerging markets.

7 To Conclude

We have produced a lot of results, but things still remain to do.

7.1 Next Steps

A number of possible extensions remain for future work. It would be nice to ground the estimation in a theoretical model of the pass-through coefficients for prices of imports and local substitutes, simultaneously. The parameters should be modeled as depending, at a minimum, on a parameter representing the magnitude of barriers to arbitrage and another representing the competitiveness of local markets.

We could relax the constraint that pass-through is complete in the long run. The spirit of the models of optimal price discrimination such as Dornbusch (1987), Gagnon and Knetter (1995), and others is that pass-through is incomplete even in the very long run and even for the most disaggregated of products. One possible empirical extension is to apply the TAR (threshold autoregressive) technique, to reflect that arbitrage should in theory work within a band determined by barriers (tariffs, transport, distribution costs, etc.), rather than as a linear autoregressive process.[27]

[27] We could allow for correlation of errors across commodities. In Appendices a1-a8, b1-b8, and c1-c8, we report results we have obtained for individual commodities. They show a lot of variation (which we attribute to garden-variety estimation error). The results reported here were for the eight commodities pooled together, though with commodity-specific dummies.

7.2 Summary of Conclusions

To summarize our findings,

1. As one would expect, pass-through of exchange rate changes is greatest in the determination of prices of imported goods at the dock, is less to prices of the same goods at the retail level, less to prices of local substitutes for such goods, and still less to the CPI.
2. Nevertheless, even for import prices at the dock (and even in developing countries), pass-through is not complete and instantaneous. We would reject the idea that the Burstein, Eichenbaum, and Rebelo hypothesis constitutes the entire explanation for incomplete pass-through to the CPI, though nothing rules out that it could explain part.
3. Transport costs (as proxied by distance) are an important barrier to arbitrage reducing or slowing pass-through at all four stages—dockside imports, retail, competitors' prices, and the CPI.
4. Tariffs are another important barrier.
5. There is clear evidence of stickiness: that is, inertia, followed by slow adjustment, as reflected in an error-correction process;
6. Importers do indeed "price to market" in that pass-through to retail import prices is not just incomplete, but is broadly similar to pass-through to the prices of local substitutes. There is no need to choose between the price discrimination model and the price stickiness model; both are probably important.
7. There is a little evidence of a size effect—pass-through is higher or faster in a small country than in a large one—but much less than one would expect.
8. A particular example, for retail prices, is that pass-through is much smaller into the United States import market than into other countries. This result cannot be attributed to composition effects, because the goods are so disaggregated.
9. Per capita income is perhaps the second most robust determinant of the pass-through coefficient (after distance). It generally does not lose value when conditioning on wages (but it sometimes loses some explanatory power when conditioning on long-term inflation). As implied by the "small open economy model," poor countries have traditionally experienced higher pass-through.
10. The monetary climate is also important: pass-through coefficients are significantly higher in an environment of high inflation. Often they are also influenced by an environment of transitory exchange rate fluctuations.
11. There is some evidence that pass-through to price of imports on the dock has actually gone up (perhaps due to declining transportation costs).
12. Otherwise, pass-through to retail prices (or imports, substitutes, and the CPI) did indeed experience a substantial downward trend during the 1990s—both a decrease in the contemporaneous coefficient and a (small) decrease in the speed of subsequent adjustment.
13. In particular, retail pass-through coefficients have historically been much higher in poor countries than in rich ones, but the coefficient in poor countries declined significantly in the 1990s. The downward trend among rich countries is much less, and for the CPI is not statistically significant.

14. Some of the downward trends in the degree of pass-through and speed of adjustment can be explained by changes in their determinants, but some of the trend remains unexplained.
15. One factor in explaining part of the decline in the pass-through coefficient in the 1990s is a decline in the inflationary environment.
16. The hypothesized monetary variables are particularly relevant in explaining the decline in the pass-through to developing-country CPIs.
17. Higher wages have a strong negative effect on pass-through to the local competitors' prices and the CPI, supporting the hypothesized importance of distribution and retail costs. Controlling for wages reverses the tendency for pass-through to the CPI to decline as income grows (compare equations 5 and 6 in Table 6). A possible interpretation is that the role of distribution costs in pricing to market may become increasingly important as countries achieve higher incomes, due to the Balassa-Samuelson-Baumol effect.

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References

Aw B-Y (1993) Price discrimination and markups in export markets. J Dev Econ 42:315–336
Bacchetta P, van Wincoop E (2002) Why do consumer prices react less than import prices to exchange rates? NBER Working Paper No. 9352, Nov. J Eur Econ Assoc, 2003.
Bank for International Settlements (2002) 72nd Annual Report, Basle.
Borensztein E, De Gregorio J (1999) Devaluation and inflation after currency crises. International Monetary Fund.
Burstein A, Eichenbaum M, Rebelo S (2002) Why are rates of inflation so low after large devaluations? NBER WP No. 8748, January.
Burstein A, Eichenbaum M, Rebelo S (2003a) Large devaluations and the real exchange rate. IMF seminar, September.
Burstein A, Neves J, Rebelo S (2003b) Distribution costs and real exchange rate dynamics during exchange-rate-based-stabilizations. J Monet Econ 50:1189–1214
Campa J, Goldberg L (2002) Exchange rate pass-through into import prices, a macro or micro phenomenon? NBER WP no. 8934.
Campa J, Goldberg L (2004) Do distribution margins solve the exchange rate disconnect puzzle? forthcoming, Federal Reserve Bank of New York.
Carranza L, Galdon-Sanchez JE, Gomez Biscarri J (2004) Exchange rate and inflation dynamics in dollarized economies. FCEE WP no. 10/04,, Universidad de Navarra, Spain, May.
Chen S-S, Engel C (2004) Does 'aggregation bias' explain the PPP puzzle. NBER Working Paper No. 10304.
Choudhri E, Hakura D (2001) Exchange rate pass-through to domestic prices: does the inflationary environment matter? IMF Working Paper WP/01/194.
Corsetti G, Dedola L (2002) Macroeconomics of international price discrimination. June.
Devereux M, Engel C (2002) Exchange rate pass-through, exchange rate volatility and exchange rate disconnect. Carnegie-Rochester Conference (Nov. 2001); March.
Devereux M, Yetman J (2002) Price setting and exchange rate pass-through: theory and evidence. Hong Kong Institute for Monetary Research Working Paper No. 22/2002, December.
Devereux M, Engel C, Storgaard P (2002) Endogenous exchange rate pass-through when nominal prices are set in advance. CEPR Discussion Paper 3608, October.
Dornbusch R (1987) Exchange rates and prices. Am Econ Rev 77:93–106

Engel C (1999) Accounting for US real exchange rate changes. J Polit Econ 107:507–538
Feenstra R (1989) Symmetric pass-through of tariffs and exchange rates under imperfect competition: an empirical test. J Int Econ 27(1):25–45
Frankel J (1984) The theory of trade in middle products: extension. Am Econ Rev (June).
Froot K, Klemperer P (1989) Exchange rate pass-through when market share matters. Am Econ Rev 79 (4):637–654
Gagnon J, Ihrig J (2004) Monetary policy and exchange rate pass-through. Int J Finance Econ 9(4):315–338
Gagnon J, Knetter M (1995) Markup adjustment and exchange rate fluctuations: evidence from panel data on automobile exports. J Int Money Finance 14(2):289–310
Ghosh AR, Wolf H (1995) Pricing in international markets: lessons from the economist (March).
Goldberg P, Knetter M (1997) Goods prices and exchange rates: what have we learned? J Econ Lit XXXV, September, 1243–1272.
Goldfajn I, Werlang S (2000) The pass-through from depreciation to inflation: a panel study. Economics Department, PUC-Rio, Texto Para Discussao No. 424.
Ho C, McCauley R (2003) Living with flexible exchange rates: issues and recent experience in inflation targeting emerging market economies. Bank for International Settlements Working Paper 130, Basel.
Imbs J, Mumtaz H, Ravn MO, Rey H (2002) PPP strikes back: aggregation and the real exchange rate. NBER Working Paper No. 9372, December.
Kasa K (1992) Adjustment costs and pricing-to-market: theory and evidence. J Int Econ 32(1–2), 1–30.
Knetter M (1989) Price discrimination by U.S. and German exporters. Am Econ Rev 79(1):198–210
Knetter M (1993) International comparisons of price-to-market behavior. Am Econ Rev 83(3):473–486
Kreinen M (1977) The effect of exchange rate changes on the prices and volume of foreign trade. Int Monet Fund Staff Pap 24(2):297–329
Krugman P (1987) Pricing to market when the exchange rate changes. In: Arndt S, Richardson JD (eds) Real-financial linkages among open economies. MIT Press, Cambridge, pp 49–70
Krugman P (1989) The delinking of exchange rates from reality. Chapter 2 in Exchange Rate Instability, MIT Press.
Magee S (1973) Currency contracts, pass-through and devaluation. Brookings Papers Econ Activ 1:202–223
Maloney W (1994) Exchange rate uncertainty and the law of one price. CIBER [CIDER?] working paper 94–010, October.
Mann C (1986) Prices, profit margins, and exchange rates. Fed Reserv Bull 72:366–379
Marston R (1990) Pricing to market in Japanese manufacturing. J Int Econ 29:217–236
Ohno K (1989) Export pricing behavior of manufacturing: a US-Japan comparison. Int Monet Fund Staff Pap 36:550–579
Otani A, Shiratsuka S, Shirota T (2003) The decline in the exchange rate pass-through: evidence from Japanese import prices. Monet Econ Stud, Bank of Japan 21(3):53–81
Parsley D (1993) Exchange rate pass-through: evidence from aggregate Japanese exports. Southern Econ J 60(2):454–462
Parsley D (2002) Pricing in international markets: a 'small country' benchmark. Vanderbilt University.
Parsley D, Wei S-J (Nov. 2003) A prism into the PPP puzzles: the micro-foundations of big mac real exchange rates. NBER Working Paper No. 10074.
Rogoff K (1996) The purchasing power parity puzzle. J Econ Lit 34(2):647–668
Saiki A (2004) The change in inflation persistence and exchange rate pass-through for inflation targeting countries. Essay 2 in Ph.D. dissertation, Brandeis University.
Taylor J (2000) Low inflation, pass-through and the pricing power of firms. Eur Econ Rev 44(7):1389–1408
Tytell I, Wei S-J (2003) Does financial globalization induce better macroeconomic policies? forthcoming, NBER working papers.
Yang J (1997) Exchange rate pass-through in us manufacturing industries. Rev Econ Stat 95–104.