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International Prices and Exchange Rates

Gita Gopinath*

Milton Friedman advocated flexible exchange rates on the premise that they would allow the relative prices of domestic and foreign goods to adjust in a world with nominal rigidities. The strength of his argument, and its implications for monetary and exchange rate policy, depend crucially on the specifics of nominal rigidity: How rigid are prices? Are prices fixed in the producer's currency or in the local currency? When prices adjust, how much do they respond to exchange rate shocks?

The validity of several of the benchmark models and the main hypothesis in international macroeconomics — such as the Mundell-Fleming models of the 1960s, Dornbusch's overshooting exchange rate hypothesis, and the more recent New Open Economy Macroeconomics literature — also depend on the answers to these questions. In a series of papers, my co-authors and I shed light on these questions by providing evidence for actual traded goods prices. Using micro-data on U.S. import and export prices at-the-dock for the period 1994 to 2009, we develop theoretical models that provide a better fit for the empirical evidence than earlier theoretical environments.

Nominal and Real Rigidities in Traded Goods Prices

Significant nominal and real rigidities¹ in the pricing of traded goods

are shown in my work with Roberto Rigobon.² The median price duration in the currency of pricing is long at 10.6 (12.8) months for U.S. imports (exports). Also, 90 percent (97 percent) of imports (exports) are priced in dollars. In international macro models it is typically assumed that prices are either all rigid in the local currency (importer's currency) or in the producer's currency (exporter's currency), and this assumption is symmetric across countries. In the case of the United States, contrary to this assumption, we find local-currency pricing for imports and producer-currency pricing for exports. This suggests an asymmetry in terms of which country bears the costs/benefits of exchange rate movements. Given the long durations between price adjustment and with most goods prices sticky in dollars, the pass-through of exchange rate shocks into import prices is low in the short run. Interestingly though, even conditioning on a price change, bilateral exchange rate pass-through into U.S. import prices is low, at 22 percent. We further document that differentiated goods manufacturers exhibited marked stability in their trade prices during the Great Trade Collapse of 2008–9, despite the large decline in their trade volumes.³

The fact that the vast majority of import prices into the United States are rigid in dollars for a significant duration and that, even conditional on a price change, the response of dollar prices to exchange rate shocks is limited, implies that exchange rate movements produce between zero and small relative price effects over short- and medium-run horizons. This seriously limits the quantitative importance of the Friedman mechanism for the United States.

Currency of Pricing and Pass-Through

The broader question of optimality of a floating-versus-a-pegged exchange rate has been researched extensively in open economy macroeconomics. The presence of nominal rigidities in price setting generates trade-offs between the two exchange rate regimes. In a large class of models used to evaluate optimal policy, the currency of pricing is assumed to be *exogenously* chosen. In the short run when prices are rigid, there is a 100 percent pass-through into import prices of goods priced in the producer's currency and a zero percent pass-through for goods priced in the local currency. When prices adjust, there is no difference in pass-through. Exogenous currency choice results in stark outcomes, like the optimality of floating exchange rates under producer-currency pricing which ensures expenditure switching, and pegging under local-currency pricing which preserves the law of one price. A fundamental question then follows: is pass-through unrelated to the currency of pricing when prices adjust?

Oleg Itskhoki, Rigobon, and I address this question both empirically and theoretically in a paper that uses novel data on currency and prices for U.S. imports.⁴ We show that even conditional on a price change, there is a large difference in the pass-through of the average good priced in dollars (25 percent) versus non-dollars (95 percent), both across countries and within disaggregated sectors. We also show that sectors that would be classified as producing more homogenous goods, like mineral products, are dollar priced sectors while differentiated sec-

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tors, like machinery, have a greater share of non-dollar pricers. Further, non-dollar pricers adjust prices less frequently than dollar pricers. These findings are inconsistent with the assumption, in an important class of models, that the currency of pricing is exogenous. We then present a model of endogenous currency choice and show that the predictions of the model are strongly supported by the data. We depart from existing literature by considering a multi-period dynamic pricing environment and provide conditions under which a sufficient statistic for currency choice can be empirically estimated using observable prices.

These findings require revisiting the debate on optimal exchange rate policy. The stark trade-off between floating and pegged exchange rates arises because firms are forced to price in one or the other currency. Once firms are allowed to choose currency optimally, they will choose it to fit their desired pass-through patterns, enhancing the effective amount of price flexibility and reducing the welfare gap between floating exchange rates and pegs. Further, exchange rate volatility affects currency choice which in turn affects exchange rate volatility, generating the possibility for multiple equilibria. A country that follows more stable monetary policies will experience greater price stability because more of the exporters to that country set prices in its currency. These effects can be first-order relative to the standard trade-offs emphasized in the literature.

Frequency of Price Adjustment and Pass-Through

The importance of studying micro data is ultimately being able to comprehend key aggregate phenomena, such as the sluggish response of prices to shocks, and to discern which models of price setting best fit the data in order to deduce the impact of micro price stickiness on output and welfare. Itskhoki and I advance this literature by developing a new comparison of exchange rate pass-through and frequency of price adjustment across goods.⁵ We document that goods displaying a high frequency of price adjustment have

a long-run pass-through that is at least twice as high as low-frequency adjusters in the data. Next, we prove theoretically that in an environment with variable mark-ups there should be a positive relation between frequency and long-run pass-through, as in the data. Moreover, we show that standard models with constant elasticity of demand and Calvo or state-dependent pricing fail to match the data. When we deviate from this standard framework and calibrate a dynamic menu-cost model with variable mark-ups, we show that it has substantial success in matching the features of the data. The empirical findings highlight a new selection effect that has important implications for the welfare consequences of measured price rigidity.

Bridging Closed and Open Economy Research on Real Rigidities

The closed and open economy literatures work on estimating real rigidities, but in parallel.⁶ Itskhoki and I survey both literatures and highlight areas of agreement and disagreement. One surprisingly consistent result across several studies, surprising since these studies use different methodologies and data sets, is that strategic complementarities, for example operating through variable markups, play little role for retail prices and appear to be quite important for wholesale prices. We then estimate the extent of real rigidities using empirical procedures employed in the closed- and open-economy literatures and with a common international price dataset. We show that, consistent with the presence of real rigidities, the response of reset-price inflation⁷ to exchange rate shocks depicts significant persistence. Individual import prices, conditional on changing, respond to exchange rate shocks prior to the last price change. At the same time aggregate reset-price inflation for imports, like that for consumer prices, shows little persistence. In general, across closed- and open-economy literatures, the response to a specific shock suggests a more important role for real rigidities

than the point estimate of the autocorrelation of reset prices. When we quantitatively evaluate sticky price models (Calvo and menu cost) with variable markups at the wholesale level, we find that they generate sluggishness in price adjustment and increase the size of the contract multiplier, but their effects are modest.

Failure of the Law of One Price

Relative cross-border retail prices, in a common currency, co-move closely with the nominal exchange rate. This well-known fact has spurred a long literature that attempts to determine the sources of this co-movement. Three co-authors and I use a new dataset with product-level retail prices and wholesale costs for a large grocery chain operating in the United States and Canada and decompose this variation into relative wholesale costs and relative markup components.⁸ We find that the correlation of the nominal exchange rate with the real exchange rate is driven mainly by changes in relative wholesale costs, arguably the most tradable component of a retailer's costs. This new finding suggests that the empirical evidence is inconsistent with the traditionally assumed pricing-to-market at the retail level, but is consistent with pricing-to-market at the wholesale level. We then measure the extent to which national borders impose additional costs (over domestic costs) that segment markets across countries. We show that retail prices respond to changes in wholesale costs in neighboring stores within the same country but not to changes in wholesale costs in a neighboring store located across the border. Using a regression discontinuity design, we find a median discontinuous change in retail and wholesale prices of 24 percent at the international border. By contrast, the median discontinuity is zero for state and provincial boundaries, consistent with important "border effects".

Summary

International prices of traded goods, as represented by U.S. imports and exports, demonstrate about one year of

nominal rigidity even in the face of volatile exchange rates. And even when prices adjust, they respond only partially (22 percent) to bilateral exchange rate shocks in the first adjustment. After further price adjustments, the cumulative pass-through is around 34 percent into U.S. import prices. However, there is a sharp difference in dollar pass-through, conditional on first and long-run adjustment, between prices that are rigid in dollars versus a foreign currency. Basically, prices in whichever currency they are set respond partially to exchange rate shocks at most empirically estimated horizons. This fact is consistent with low aggregate pass-through of exchange rate shocks into U.S. prices because most U.S. imports are priced in dollars. On the other hand, for most developing countries, pass-through into local currency prices is high because most of their imports are priced in a foreign currency, dollars.

These findings, along with, the positive correlation between the frequency of price adjustment and pass-through, suggest an important selection effect that drives currency choice and the frequency of adjustment. The variables that define the choice depend on the desired (flexible price) exchange rate pass-through of goods, which in turn depends on

the degree of strategic complementarity in pricing across goods and the sensitivity of costs to exchange rate shocks. Given this selection effect, the profit/losses associated with sub-optimal prices during periods of non-adjustment can be small and the gains to exchange rate flexibility can be limited.

¹ The term “real rigidities” is used to capture reasons why firms do not want to move their price relative to the industry price level by much, even when they can adjust prices. For an early discussion, see L. Ball and D. Romer, “Real Rigidities and the Non-Neutrality of Money,” NBER Working Paper No. 2476 (Also Reprint No. r1437), July 1990, and *The Review of Economic Studies*, 57(2) (April 1990) pp. 183–203.

² G. Gopinath and R. Rigobon, “Sticky Borders,” NBER Working Paper No. 12095, March 2006, and *Quarterly Journal of Economics*, 123(2) (May 2008) pp. 531–75.

³ G. Gopinath, O. Itskhoki, and B. Neiman, “Trade Prices and the Global Trade Collapse of 2008–09,” NBER Working Paper No. 17594, November 2011.

⁴ G. Gopinath, O. Itskhoki, and R.

Rigobon, “Currency Choice and Exchange Rate Pass-through,” NBER Working Paper No. 13432, September 2007, and *American Economic Review*, 100(1) (March 2010) pp. 304–36.

⁵ G. Gopinath and O. Itskhoki, “Frequency of Price Adjustment and Pass-through,” NBER Working Paper No. 14200, July 2008, and *Quarterly Journal of Economics*, 125(2) (May 2010) pp. 675–727.

⁶ G. Gopinath and O. Itskhoki, “In Search of Real Rigidities,” NBER Working Paper No. 16065, June 2010, and in *NBER Macroeconomics Annual 2010, Volume 25*, D. Acemoglu and M. Woodford, eds. (Chicago: University of Chicago Press Journals, 2011), pp. 261–309.

⁷ “Reset price inflation” is inflation that is calculated from the sample of prices that have changed.

⁸ G. Gopinath, P-O. Gourinchas, C-T. Hsieh, and N. Li, “Estimating the Border Effect: Some New Evidence,” NBER Working Paper No. 14938, April 2009, and as G. Gopinath, P-O. Gourinchas, C-T. Hsieh, and N. Li, “International Prices, Costs and Markup Differences,” *American Economic Review*, 101(6) (October 2011) pp. 2450–86.

Time Use

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Until 2000, economists paid scant attention to distinctions in how people used their time other than between working for pay and not working. In part,

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that neglect stemmed from the realization that this simple distinction was of central importance for economic growth, unemployment, and tax policy. There was also the belief that changes in the mix of non-market activities would not affect market outcomes; and finally, there was a paucity of data on time use outside the labor market. Yet not all time away from work is the same: most people would rather watch television than wash dishes, for example.

We are now rapidly going beyond the simple work/non-work distinction, spurred partly by the burgeoning in many countries of large random samples describing people’s time use. These “time diaries” record the previous day’s activities, either in specific categories or with free descriptions that are then categorized by a statistical agency. The United States, which had been a laggard in developing these data, is now a leader: