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Exchange rates and prices

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C. Wyplosz, "Is There a Safe Passage to EMU? Evidence on Capital Controls and a Proposal," in *The Microstructure of Foreign Exchange Markets*, J. A. Frankel, G. Galli, and A. Giovannini, eds. Chicago: University of Chicago Press, 1996; and "Exchange Market Mayhem: The Antecedents and Aftermath of Speculative Attacks," *Economic Policy*, 21 (1995), pp. 249–312.

⁶ That currency crises are more heterogeneous than devaluations and that their timing is difficult to predict is consistent with the conclusions of Rose and Svensson, who found that macroeconomic fundamentals are of relatively little use for explaining the credibility of exchange rate parities. Eichengreen and Wyplosz also found that fundamentals did not obviously predict the timing of the 1992 attack on the EMS. A. Rose and L. Svensson, "European Exchange Rate Credibility Before the Fall," in *European Economic Review*, 38 (1994), pp. 1185–1216; B. Eichengreen and C. Wyplosz, "The Unstable EMS," *Brookings Papers on Economic Activity*, 1 (1993), pp. 51–144.

⁷ One of us has recently reported evidence to this effect: B. Eichengreen and T. Bayoumi, "Exchange Rate Volatility and Intervention: Implications of the Theory of Optimum Currency Areas," *Journal of International Economics*, 45 (1998), pp. 191–209.

⁸ C. Wyplosz, "Capital Controls and Balance of Payments Crises," *Journal of International Money and Finance*, 5 (1986), pp. 167–79.

⁹ B. Eichengreen, A. Rose, and C. Wyplosz,

"Contagious Currency Crises: First Tests," *Scandinavian Journal of Economics*, 98 (1996), pp. 463–84; B. Eichengreen and A. Rose, "Contagious Currency Crises: Channels of Conveyance," in *Changes in Exchange Rates in Rapidly Developing Countries*, T. Ito and A. Krueger, eds. Chicago: University of Chicago Press, 1998; B. Eichengreen, A. Rose, and C. Wyplosz, "Contagious Currency Crises," NBER Working Paper No. 5681, August 1996.

¹⁰ R. Glick and A. Rose, "Contagion and Trade: Why Are Currency Crises Regional?" *Federal Reserve Bank of San Francisco Working Paper*.

¹¹ J. Frankel and A. Rose, "Currency Crashes in Emerging Markets: An Empirical Treatment," *Journal of International Economics*, 41 (November 1996), pp. 351–66.

¹² An important exception is A. Demirgüç-Kunt and E. Detragiache, "The Determinants of Banking Crises: Evidence From Developing and Developed Countries," *IMF Working Paper No. 97/107*, September 1997.

¹³ B. Eichengreen and A. Rose, "Staying Afloat When the Wind Shifts: External Factors and Emerging-Market Banking Crises," NBER Working Paper No. 6370, January 1998.

¹⁴ B. Eichengreen and O. Jeanne, "Currency Crises and Unemployment: Sterling in 1931," NBER Working Paper No. 6563, May 1998.

¹⁵ M. Obstfeld, "Models of Currency Crises With Self-Fulfilling Features," NBER

Working Paper No. 5285, February 1997; also published in *European Economic Review*, 40 (1996), pp. 1037–47. We claim patrimony (in 1994) of the first- and second-generation terminology used to distinguish alternative approaches to modeling currency crises. See B. Eichengreen, A. Rose, and C. Wyplosz, "Speculative Attacks on Pegged Exchange Rates: An Empirical Exploration With Special Reference to the European Monetary System."

¹⁶ International Monetary Fund, "Financial Crises: Characteristics and Indicators of Vulnerability," in *World Economic Outlook*, International Monetary Fund, May 1998; G. Kaminsky, S. Lizondo, and C. Reinhart, "Leading Indicators of Currency Crises," *Policy Research Working Paper No. 1852*, The World Bank, November 1997; D. Hardy and C. Pazarbasioglu, "Leading Indicators of Banking Crises: Was Asia Different?" *IMF Working Paper No. 98/91*, June 1998.

¹⁷ A. Rose and L. Svensson, "European Exchange Rate Credibility Before the Fall."

¹⁸ Another study that makes these points is A. Berg and C. Pattillo, "Are Currency Crises Predictable? A Test," unpublished manuscript, International Monetary Fund, July 1998.

¹⁹ Indeed, suppose that forecasts of a country's vulnerability trigger corrective policy actions that then prevent a crisis. In this case, the model would appear to forecast poorly, as the potential for a crisis would never be followed by an actual crisis.

Exchange Rates and Prices

Charles M. Engel*

In the early 1970s, when the industrialized countries abandoned the fixed exchange rates of the Bretton Woods system, many economists were surprised by the high volatility of exchange rates under the new regime of more flexible rates. Dornbusch provided a new paradigm,

based on the Mundell–Fleming model of the 1960s, but granting a prominent role to expectations in the determination of exchange rates.¹ His model assumed that nominal goods prices adjusted sluggishly, but that exchange rates resembled asset prices more closely. In that model, expectations generated the short-run "overshooting" of exchange rates in response to monetary and other demand shocks.

The Dornbusch model dominated academic discussions of exchange rates for at least a decade, but gradually began to lose favor. There were

two reasons for the decline of the overshooting model. First was evidence that the model was not very useful in forecasting exchange rates. Meese and Rogoff showed that forecasts of the exchange rate based on the Dornbusch model could not beat the simplest forecast of no-change-in-the-exchange-rate.² Still, not all of the empirical evidence on the Dornbusch model was negative. For example, Frankel and I used the Dornbusch model to explain the famous money supply announcements puzzle of the early 1980s.³ The model was successful in explaining the simultane-

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ous jump in short-term interest rates and appreciation of the dollar at the moment the Federal Reserve announced money supply totals that were greater than anticipated by markets. However, many of the movements of exchange rates appeared to be completely unrelated to the economic fundamentals—money supplies and government budgets—stressed by Dornbusch. Even after dozens of variants of the model were introduced, nobody was able to tweak the model to produce consistently successful forecasts of exchange rates.

The second cause for the decline in popularity of the Dornbusch model was the movement in macroeconomics in the 1980s toward models based explicitly on utility maximization. Dornbusch developed a rational expectations version of the Mundell-Fleming model, which was based on descriptive equations for asset markets and goods markets. Although the new Keynesian theory of the 1980s established a formal basis for slow adjustment of prices by optimizing firms, the new international macroeconomics of the 1980s was based primarily on neoclassical models with flexible prices. One assumption that characterized all of these models was the law of one price: that any traded good would sell for the same price (corrected for currency of denomination) in every country.

Law of One Price

The data clearly show that there are large fluctuations in real exchange rates (that is, the price of a consumption basket in one country relative to another). Since the neoclassical models did not allow for the failure of the law of one price, there had to be some other mechanism for explaining these movements in real exchange rates. Probably the most popular type of model assumed that there was a group of goods that were

not traded, so that the law of one price did not need to hold for these goods. Fluctuations in the prices of nontraded goods relative to traded goods explained the movements in real exchange rates. For example, services generally were nontraded. A country experiencing rapid inflation in services relative to traded manufactured goods would experience a greater increase in its price level than a country without inflation in services prices. Another class of models assumed that countries weighted goods differently in their consumption bundles. For example, wine might receive a high weight in the French consumption bundle and beer a high weight in the U.S. consumption bundle. Even though Frenchmen and Americans pay the same prices for each good, an increase in the price of wine relative to beer would drive the overall French price index up relative to the U.S. index.

Both of these neoclassical models assume that there will be large, very visible changes in relative prices within each country. In the first model, prices of services move relative to prices of manufactured goods. In the second model, there will be large changes in the price of wine relative to beer. Any model must make certain assumptions about the world. My 1993 paper⁴ asks whether the general pattern assumed by the neoclassical models—that failures of the law of one price across countries are relatively small, and that there are significant relative price changes within countries—is true in the data. For that paper, I examined two datasets. The first collected price indexes for disaggregated categories of goods—such as energy, food, and rent—for several large OECD (Organization for Economic Cooperation and Development) countries. The second collected price indexes on even more disaggregated goods—such as bananas, televisions, and automobile

tires—for the United States and Canada. For each dataset, I calculated the variance of changes in all relative prices within each country: bananas to televisions, televisions to tires, tires to bananas, and so on. I also calculated the variance of changes in prices of the same goods across countries: bananas in Canada compared to bananas in the United States, televisions in Canada relative to televisions in the United States, and so on.

My results strongly contradict the underlying presumption of the neoclassical models. Failures of the law of one price, as measured by the variance of prices of the same good across countries, tended to be much larger than the variance of prices of different goods within countries. Indeed, the median volatility of prices of similar goods across borders was nearly an order of magnitude larger than the median volatility of prices of goods within each country. The evidence runs exactly counter to the underlying assumption of the neoclassical models of the 1980s. Modeling failures of the law of one price appear to be much more important for our understanding of real exchange rate movements than the channels examined in the neoclassical literature.

One of my recent papers presents a more complete examination of similar issues.⁵ I decompose real exchange rates into two components: the price of traded goods in one country relative to their price in another country, and the relative price of nontraded goods to traded goods. Variation in the first term represents deviations from the law of one price, and variation in the second term comes from movements in the relative price of nontraded goods. I use five different measures of traded goods and nontraded goods for the United States. For some measures, there are data for up to 20 countries, although for others there are data available for only six or seven countries. In each

case, I calculate the variance of changes in each of the two components at every horizon—from one month, in some cases, out to 30 years. Then, I compare the variance of these two components to ask which accounts for most of the variance of real exchange rates at each horizon.

The results are startling: at almost every horizon for almost every measure and every country relative to the United States (generally with the exception of Canada), the failure of the law of one price accounts for over 90 percent of real exchange rate variation. In many cases it accounts for 98 to 99 percent of the variation.

The case of the real U.S.-Japan exchange rate is worth special mention. It is often claimed that the real value of the yen has risen precisely because of the increase in prices of nontraded goods in Japan. However, the evidence does not support this view. There has been a large increase in the relative price of nontraded to traded goods in Japan over the past 30 years, but it has been matched by the size of the relative price increase in the United States. Moreover, the U.S.-Japan real exchange rate has been marked by a high degree of short-run and medium-run volatility, but that sort of volatility is not apparent in the data on the relative price of nontraded to traded goods.

Purchasing Power Parity

I have argued recently that variation in the price of nontraded to traded goods could actually explain very long-run movements in the real exchange rate.⁶ Tests of purchasing power parity (PPP) with very long datasets (100 years and more) appear to rule out permanent changes in relative prices of nontraded to traded goods between the United States and other countries, because their results suggest that PPP holds in the long

run. (Long-run PPP is the proposition that in the long run the real exchange rate converges to a constant mean.) I argue that those tests have a serious size bias; they are too likely to reject the null hypothesis that there are important long-run relative price movements between countries. This paper appears to contradict my earlier work, which downplays the importance of relative price changes, but the arguments are actually closely related. My point in the more recent paper is simply: The relative price movements are very small in the short run compared to movements in real exchange rates arising from failures of the law of one price. In tests of PPP, even with long datasets, the short-run variation from the law of one price dominates the data. The failure of the law of one price is transitory, so it appears that deviations from PPP are transitory. That is, the movements in the first component of my decomposition are so dominant that they swamp the movements in the second component which may be important for the long run.

My paper with Chang-Jin Kim can be read as a resolution of these issues.⁷ We estimate a model for the U.S.-U.K. real exchange rate using more than 100 years of data. With Kalman filter techniques, we decompose the real exchange rate into two components: one that has permanent shocks (and, thus, a unit root), and one in which all shocks are transitory. We note that the volatility of the real exchange rates has changed from time to time over the decades. So we allow the variance of each component to follow a Markov-switching process. It turns out that a single variance is sufficient for the permanent component, but that the transitory component switches among three variance states. The transitory component is generally much more volatile than the permanent component. The switches among states of low, medium, and high volatility all

are associated with monetary events. Generally when nominal exchange rates are floating, the transitory component of the real exchange rate is highly volatile; when the exchange rate is fixed, the transitory component is very quiescent. Other significant monetary events affect the volatility of the transitory component. Based on this evidence, we note that the behavior of the transitory component is consistent with a model of real exchange rates in which consumer prices in each country adjust sluggishly, so that the nominal exchange rate dominates movements in real exchange rates. The permanent component, although not very important in short-run movements of the real exchange rates, appears to be related to fundamentals that drive relative prices as in the neoclassical literature.

Pricing to Market

My research with John H. Rogers⁸ aims to explain why the law of one price fails. We use data on disaggregated price indexes for U.S. and Canadian cities.⁹ We ask what is responsible for variations in prices of similar goods across cities. For example, what leads to variance in the price of men's clothing in New York compared to Los Angeles or Toronto? One hypothesis is that more distant city pairs should witness greater variation, because transportation and other costs effectively segment the markets and keep economic forces from equalizing prices. Another view is that nominal prices are sticky. Under this view, there should not be too much variation of prices between pairs of U.S. cities or pairs of Canadian cities. However, there should be large fluctuations between Canadian-U.S. pairs, because in each country prices are set in their respective currencies and the nominal exchange rate has been highly volatile.

In fact, the evidence in all the

papers lends some support to both views. Distance does play a role in explaining deviations from the law of one price, but the "border" effect is much larger. Interestingly, further investigation¹⁰ finds that sticky nominal prices can explain only a bit more than half of the failure of the law of one price across borders. An alternative way of comparing prices is to take the price of individual goods in each city relative to the overall price index in that city. When that ratio is compared to the similar ratio in another city, no exchange rate is involved. For example, we calculate the price of men's clothing in Toronto relative to overall prices in that city, and compare it to the same ratio in New York. As we are comparing one relative price to another, we do not need to convert any prices using nominal exchange rates. Even using this method, though, there appear to be extremely large failures of the law of one price between Canadian and U.S. cities. This suggests that other types of market segmentation may be important for explaining international price movements. We focus on formal trade barriers, but find that the implementation of the U.S.-Canada Free Trade Agreement had little effect on the price behavior among North American cities. It is more likely that informal trade barriers—marketing, transportation, and distribution services that are organized on a national basis—account for the segmentation that prevents price convergence between U.S. and Canadian cities.

Devereux and I have recently investigated the implications of this empirical evidence for the choice of fixed versus floating exchange rates.¹¹ We follow the approach of the neoclassical literature by modeling optimizing agents with long horizons facing uncertainty about the economic environment. However, we augment that literature by allowing for price stickiness. We pay spe-

cial attention to the source of price stickiness: Do producers set prices in their own currencies or do they set different prices in different national markets? The empirical evidence seems to support the latter view. From a welfare standpoint, if prices are set in the producer's currency, then there is some ambiguity about whether fixed or floating exchange rates are better. Floating exchange rates tend to insulate the economy more from foreign monetary shocks, but the average level of consumption is actually higher under fixed rates. However, if it is true that producers "price to market," then (as we show) floating rates are unambiguously better than fixed exchange rates in terms of maximizing welfare of consumers. If this is the proper description of price setting, then floating exchange rates provide a tremendous advantage over fixed exchange rates in terms of insulation from foreign monetary shocks. (I have investigated some of the same issues in a traditional Mundell-Fleming framework, also providing some new empirical evidence on the significance of failures of the law of one price for real exchange rate movements among European countries.¹²)

Exchange Rates

This line of research certainly undercuts the empirical foundations of the new neoclassical models of exchange rates, but it leaves open this question: Do we have a successful empirical model of nominal exchange rates? I believe the answer to that is still negative, at least for the short-run behavior of exchange rates. Furthermore, I believe it is unlikely that we will develop a model that can identify fundamental economic causes of short-run exchange rate movements, because I believe that many short-run exchange rate movements are driven by herding behavior of speculators.

This is a difficult position to defend, because it is a large leap from the statement that we do not have a model of the fundamental determinants of short-run exchange rate movements to the statement that those movements are not driven by fundamentals. One of the seminal pieces of evidence to support this latter view is from Flood and Rose, who find that there is virtually no difference in the behavior of economic fundamentals between fixed and floating exchange rate periods.¹³ One would think that if fundamentals were driving the exchange rate, they would behave very differently when exchange rates were fixed compared to when they were floating.

My suspicions about speculative herd behavior arise from my study of the uncovered interest parity puzzle. That parity relation says, for example, that when the short-term U.S. interest rate exceeds the short-term German interest rate, investors should expect a depreciation of the dollar. Unless one of the two assets is considered to be a riskier investment, the expected return on the assets would be equalized. Investors must require a higher interest rate in one country to compensate for the expected depreciation of the currency of that country.

The puzzle is that in the data (over an extremely wide variety of time periods and countries¹⁴) the currency of the country with the higher interest rate actually tends to appreciate rather than depreciate! There is a neoclassical literature that attempts to explain the puzzle by attributing it to a time-varying risk premium. But I have argued that those models are not capable of explaining the interest parity puzzle.¹⁵ I have surveyed dozens of studies that attempt to explain the puzzle with various models of rational risk-averse behavior.¹⁶ None of those models come close to explaining the perverse relationship between interest differentials and

exchange-rate changes.

Instead, I think the most convincing explanation comes from Frankel and Froot's model with a group of "chartist" speculators who do not evaluate investment opportunities rationally, but instead chase trends.¹⁷ The idea is quite simple. Suppose that the Federal Reserve Board were to raise short-term interest rates. In the Dornbusch model, the dollar would appreciate, but then would immediately begin to depreciate in a gradual way. So, the higher interest rate would be associated with an instantaneous appreciation, but also with expectations of a depreciation. Frankel and Froot suggest that after that initial appreciation, there is herding behavior by speculators. The speculators see that the dollar has appreciated, and they follow the trend and plunge into dollars. There will be a further appreciation of the dollar, so that the interest rate increase is associated with an expectation of future appreciation of the dollar. Investors' sentiment is swayed by recent trends: when the interest rate rises, investors come to believe that U.S. assets are good investments. They reinforce the interest rate advantage of U.S. assets by bidding up the value of dollars. An analysis by Eichenbaum and Evans¹⁸ lends support for Frankel and Froot's theory of interest rate and exchange rate dynamics. Also, the Markov-switching model estimated in my work with Hamilton fits the Frankel-Froot theory precisely.¹⁹ There are long swings in the value of the dollar. Once the dollar starts appreciating (or depreciating), it continues in that direction for a long period. Furthermore, interest rates do not rationally reflect those long-term exchange rate movements.

From the modern (1990s) perspective, the shortcoming of the Frankel-

Froot model is that it allows irrational herding behavior by economic agents. Additional serious research is needed to understand whether nonfundamental speculation can really drive short-run behavior of exchange rates.

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² R. Meese and K. Rogoff, "Empirical Exchange Rate Models of the Seventies," *Journal of International Economics*, 14 (1993), pp. 3-24.

³ C. Engel and J. Frankel, "Why Interest Rates React to Money Announcements: An Answer From the Foreign Exchange Market," *Journal of Monetary Economics*, 13 (1984), pp. 31-39.

⁴ C. Engel, "Real Exchange Rates and Relative Prices," *Journal of Monetary Economics*, 32 (1993), pp. 35-50.

⁵ —, "Accounting for U.S. Real Exchange Rate Changes," *Journal of Political Economy* (1999, forthcoming).

⁶ —, "Long Run PPP May Not Hold After All," *Journal of International Economics* (1999, forthcoming).

⁷ C. Engel and C.-J. Kim, "The Long-Run U.S./U.K. Real Exchange Rate," *Journal of Money, Credit and Banking* (1999, forthcoming).

⁸ C. Engel and J. H. Rogers, "How Wide Is the Border?," *American Economic Review*, 86 (1996), pp. 1112-1125; "Regional Patterns in the Law of One Price: The Roles of Geography and Currency," in *The Regionalization of the World Economy*, J. A. Frankel, ed. Chicago: University of Chicago Press, 1998; "Relative Price Volatility: What Role Does the Border Play?," Working paper, 1998, available at <http://www.econ.washington.edu>; and C. Engel, M. K. Hendrickson, and J. H. Rogers, "Intranational, Intracontinental, and Intraplanetary PPP," NBER Working Paper No. 6069, June 1997, also published in *Journal of the Japanese and International Economics*, 11 (1997), pp. 480-501.

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¹¹ M. B. Devereux and C. Engel, "Fixed vs. Floating Exchange Rates: How Price Setting Affects the Optimal Choice of Exchange-Rate Regime," Working paper, 1998, available at <http://www.econ.washington.edu>; and "The Optimal Choice of Exchange-Rate Regime: Price-Setting Rules and Internationalized Production," Working paper, 1998, available at <http://www.econ.washington.edu>.

¹² C. Engel, "A Retrial in the Case Against the EMU," Working paper, 1998, available at <http://www.econ.washington.edu>.

¹³ R. Flood and A. Rose, "Fixing Exchange Rates: A Virtual Quest for Fundamentals," *Journal of Monetary Economics*, 36 (1995), pp. 3-37.

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¹⁵ —, "On the Foreign Exchange Risk Premium in a General Equilibrium Model," *Journal of International Economics*, 32 (1992), pp. 305-319; C. Engel, "The Risk Premium and the Liquidity Premium in Foreign Exchange Markets," *International Economic Review*, 33 (1992), pp. 871-879.

¹⁶ —, "The Forward Discount Anomaly and the Risk Premium: A Survey of Recent Evidence," *Journal of Empirical Finance*, 3 (1996), pp. 123-192.

¹⁷ J. Frankel and K. Froot, "Chartists, Fundamentalists and the Demand for Dollars," in *Private Behavior and Government Policy in Interdependent Economies*, A. Courakis and M. Taylor, eds. Oxford: Clarendon Press, 1990.

¹⁸ M. Eichenbaum and C. Evans, "Some Empirical Evidence on the Effects of Shocks to Monetary Policy on Exchange Rates," *Quarterly Journal of Economics*, 110 (1995), pp. 975-1009.

¹⁹ C. Engel and J. D. Hamilton, "Long Swings in the Dollar: Are They in the Data and Do Markets Know It?," *American Economic Review*, 80 (1990), pp. 689-713; C. Engel, "Can the Markov-Switching Model Forecast Exchange Rates?," *Journal of International Economics*, 36 (1994), pp. 151-165.