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THE RESPONSIVENESS OF CONSUMER PRICES TO EXCHANGE RATES AND THE IMPLICATIONS FOR EXCHANGE-RATE POLICY: A SURVEY OF A FEW RECENT NEW OPEN-ECONOMY MACRO MODELS

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The Responsiveness of Consumer Prices to Exchange Rates And the Implications for Exchange-Rate Policy: A Survey Of a Few Recent New Open-Economy Macro Models
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ABSTRACT

The traditional case for flexibility in nominal exchange rates assumes that there is nominal price stickiness that prevents relative prices from adjusting in response to real shocks. When prices are sticky in producers' currencies, nominal exchange rate changes can achieve the relative price change that is required between home and foreign goods. The nominal exchange rate flexibility provides the desired "expenditure-switching" effect of relative price changes. But if prices are fixed ex ante in consumers' currencies, nominal exchange rate flexibility cannot achieve any relative price adjustment. In fact, nominal exchange rate fluctuations are undesirable because they lead to deviations from the law of one price. So, fixed exchange rates are optimal. The empirical literature appears to support the notion that prices are sticky in consumers' currencies. This paper surveys the approaches taken in the new open economy macroeconomic literature to formalize the role of optimal monetary policy. The survey explores how this literature has dealt with the empirical evidence on pass-through of exchange rate changes to consumer prices.

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1. Introduction

Exchange-rate flexibility, it has been argued, is useful because it facilitates relative price adjustment among countries. Currency depreciation is a quick and painless way to lower domestic prices relative to foreign prices. A burgeoning literature has examined the benefits of exchange-rate stability in emerging economies. That literature has focused on the potential for greater monetary and financial stability from either fixing exchange rates, or taking more extreme measures such as adopting a currency board or dollarizing. But that analysis is not directly applicable to the choice of adopting the euro facing some European countries. These countries uniformly have stable monetary policy (at least as stable as the policy conducted by the European Central Bank) and have deep, well-regulated financial markets. The economic benefit of adopting the euro is the increased efficiency of transactions and the elimination of uninsurable exchange-rate risk. On the other hand, a country adopting the euro cedes its monetary policy to the European Central Bank, and no longer has the option of using monetary policy to respond to local conditions. Furthermore, adopting the euro eliminates one possible avenue for adjustment between countries – the relative price changes induced by exchange rate movements. It is this latter effect that is the focus of this survey. Specifically, I shall examine how the recent theoretical literature in open-economy macroeconomics has addressed empirical evidence on the effects of exchange rates on prices, and its implications for the choice of exchange-rate regime.

Much recent evidence has found that consumer prices are not much affected by nominal exchange rate changes.[1] This finding may imply that nominal exchange rate changes do not play much of a role in changing relative prices of goods. If consumer prices are not responsive to exchange rates, then a depreciation of the home currency, for example, may not increase much

[1] I have been the perpetrator of some of this literature: for example Engel (1993, 1999, 2000) and Engel and Rogers (1996, 2001). Other important works include Rogers and Jenkins (1995), Obstfeld and Taylor (1997) and Parsley and Wei (2001a, 2001b). Mussa's (1986) classic paper stimulated much of this research.

the price that consumers pay for imported goods. However, there are other interpretations of the evidence on exchange rates and consumer prices. For example, there might be important relative price effects but not for final consumer goods. One possibility is that intermediate firms (distributors, marketers or retailers) substitute between domestic and foreign goods based on relative price changes, but set prices for consumers in a way that is unresponsive to exchange-rate changes.

Understanding the extent of to which exchange rates alter relative prices is crucial for examining the desirability of exchange-rate flexibility among advanced nations Milton Friedman (1953) was an early advocate of flexible exchange rates, on the grounds that they could allow rapid change in relative prices between countries (p. 162):

"A rise in the exchange rate … makes foreign goods cheaper in terms of domestic currency, even though their prices are unchanged in terms of their own currency, and domestic goods more expensive in terms of foreign currency, even though their prices are unchanged in terms of domestic currency. This tends to increase imports [and] reduce exports."

This passage makes two assumptions: that goods prices are unchanged in the currency of the producer of the good, and that there is significant pass-through of the exchange rate change to the buyer of the good. On the nominal price stickiness, Friedman argues that the choice of exchange-rate regime would matter little if nominal goods prices adjusted quickly to shocks (p. 165):

"If internal prices were as flexible as exchange rates, it would make little economic difference whether adjustments were brought about by changes in exchange rates or by equivalent changes in internal prices. But this condition is clearly not fulfilled. … At least in the modern world, internal prices are highly inflexible."

Friedman makes the following famous analogy (p. 173):

"The argument for flexible exchange rates is, strange to say, very nearly identical with the argument for daylight saving time. Isn't it absurd to change the clock in summer when exactly the same result could be achieved by having each individual change his habits? All that is required is that everyone decide to come to his office an hour earlier, have lunch an hour earlier, etc. But obviously it is much simpler to change the clock that guides all than to have each individual separately change his pattern of reaction to the clock, even though all want to do

so. The situation is exactly the same in the exchange market. It is far simpler to allow one price to change, namely, the price of foreign exchange, than to rely upon changes in the multitude of prices that together constitute the internal price structure."

In his case against the euro, Feldstein (1992) makes a similar argument:

"A currency union means, of course, that nominal exchange rates cannot adjust to achieve a needed change in the real exchange rate. The local price level must, therefore, adjust to bring about the change in the real exchange rate. Thus a 10% fall in the real value of a currency can be achieved either by a 10% fall in the nominal exchange rate or by a 10% fall in local wages and prices.

Either form of adjustment can bring the real exchange rate to its equilibrium value, but a decline in domestic prices is likely to require a period of increased unemployment. It would certainly be better to have a decline in the nominal exchange rate. The shift to a single currency in Europe would preclude such nominal exchange-rate adjustments and force real exchange-rate reductions to be achieved through lower local wages and prices."

In assessing this relative-price effect and its significance for the choice of exchange-rate regime, Friedman is certainly correct to emphasize the importance of nominal goods price stickiness. As Buiter (1999) has forcefully emphasized, the decision to join a monetary union, or the choice of an exchange-rate regime, is a monetary issue. Relative-price behavior is usually independent of monetary regime in a world of perfect goods price flexibility. The choice of monetary regime in this case only matters for short-run adjustment problems – the period during which nominal prices are adjusting.

I shall begin the survey by laying out a simple version of the type of new open economy macroeconomic model that has built on the pioneering work of Obstfeld and Rogoff (1995, 1998, 2000a.) (Hereinafter, I shall call these authors OR.) Their initial work has assumed that nominal prices are fixed in the producers' currencies, so that prices for consumers change one-for-one in the short run with changes in the nominal exchange rate. This is exactly the assumption of Friedman and Feldstein. I shall call this the PCP (for "producer-currency pricing") model. The OR models offer a sound analytical foundation for the claim that flexibility of exchange rates is

desirable in this setting.[2] They derive three important results: (1) Exchange-rate flexibility is desirable as a means of achieving relative price adjustment under PCP pricing. Indeed, in their models, flexible exchange rates are a perfect substitute for flexible nominal prices. That is, the flexible nominal price allocations are achieved with PCP pricing but flexible exchange rates. (2) The policy that achieves the flexible price allocation is a constrained Pareto optimum. The monetary authorities can do no better. (3) This optimal policy is completely self-oriented. No policy coordination across countries is required or desirable. In this sense, exchange rates are perfectly flexible and optimal.

A number of recent papers (Betts and Devereux (1996, 2000), Chari, Kehoe, and McGrattan (2000), and others) have examined OR-style models in which nominal prices are set in advance in the currency of consumers. In that case, nominal exchange rate changes do not, in the short run, change any prices – nominal or real – faced by consumers. I shall call this the LCP (for "local-currency pricing") model. Devereux and Engel (2001) have examined monetary policy in this setting, and have concluded that there is no case for nominal exchange rate flexibility – indeed, a fixed exchange rates are preferred. I shall demonstrate their case briefly.

However, there are other possible interpretations of the evidence that consumer prices do not respond much to exchange rates. One is the approach of OR (2000b). In their model, transportation costs and distribution costs increase the cost of imported goods, and serve to segment national markets. Even if imported goods are nearly perfect substitutes for domestically produced goods, they may not be consumed in great quantity because their cost is higher. In that case, an exchange rate change will have only a small effect on the consumer price index.

A related approach observes that the actual physical good is only a small part of what the consumer buys. The consumer also pays for the nontraded marketing, distribution and retailing

[2] See Lane (2001) for an excellent general survey of the work stimulated by Obstfeld and Rogoff.

services that bring the good to the buyer. Perhaps these costs are quite large, and dominate the cost of the physical good. If so, the influence of exchange-rate changes on real allocations is likely to be small, since the exchange rate change only affects a small part of the cost of the good cum service purchased by the consumer. This is the approach taken by McCallum and Nelson (1999).

The new open economy macro literature also probably has not paid enough attention to another possibility: that the low degree of pass-through of exchange rates to prices may not primarily reflect price stickiness, but instead optimal price discrimination. Bergin and Feenstra (2001) and Bergin (2001) build general equilibrium models in which pass-through is not 100 percent even when there is price flexibility. Corsetti and Dedola (2001) describe a setting in which incomplete pass-through arises because of the differential distribution costs in home and foreign markets.

Another approach is one where imported goods are intermediate products for which there are domestic substitutes. Local producers combine imported intermediates with local goods to make a final good for consumers. The price for consumers may be sticky in the local price, but the intermediate import price may be sticky in the currency of the producer of that good. So, the importer might switch between the imported intermediate and the locally produced alternative when the exchange rate changes. Obstfeld (2001) argues that in this type of economy, there may indeed be a significant expenditure-switching effect. It is not consumers who switch between imports and locally-produced goods, but rather local producers who combine intermediate goods to make the final consumer product. On the other hand, Devereux, Engel and Tille (1999) posit that while distributors may indeed import goods priced in the exporter's currency, they have little opportunity for substitution with domestically produced products. It is both the degree of pass

through and the amount of substitutability that determine the strength of the expenditure-switching effect.

I have mentioned now several alternatives to the LCP model – ones in which consumer prices do not respond much to exchange rate changes, but in which nominal exchange rate flexibility still is important in allowing relative price movements. One additional wrinkle that needs to be considered is the observation of Corsetti and Pesenti (2001), which is that in some settings even if flexible nominal exchange rates can substitute for flexible nominal prices, such an arrangement may not be optimal. They show how there may be a tradeoff facing policymakers between closing the output gap (that is, achieving the flexible-price equilibrium) and eliminating deviations from the law of one price. It may be that limiting exchange rate movements can actually improve on the flexible price equilibrium when in the presence of monopolistic distortions that engender price discrimination across borders.

The new open economy macroeconomic models have delivered important new insights into monetary and exchange rate policy objectives in open economies. But as these models have developed, they point to areas where we need more empirical study. Until we have those studies in hand, we must be cautious about interpreting existing evidence as being supportive of any type of exchange-rate regime.

2. Models of exchange rates and relative prices

I examine some "new open economy macroeconomic" models in this section that have the property that measured consumer prices are not very responsive to nominal exchange rate changes. These models are fully-integrated equilibrium models in which households and firms make optimal choices, but in which some nominal prices are not completely responsive to

shocks. I will work with a simplified framework in which I can embed all of the approaches I want to discuss.

The older open-economy macroeconomic literature that put an emphasis on the strength of the "expenditure-switching effect" is a direct sire of the newer literature. What the newer literature is trying to achieve is a firmer micro foundation for our understanding of how nominal exchange rates can help to reallocate resources in a more desirable way. The new studies build micro-based macro models which try to match some of the stylized facts about exchange rates and prices, in the hope of getting some insight into the channels through which exchange rates influence aggregate outcomes. The models can also provide a welfare-based criterion for choosing between exchange-rate regimes.

There are two countries in the general model. I will assume that there is a single period, though most of the results I discuss carry over to a multi-period framework. I assume households in the home country maximize:

$$U = \frac{1}{1-\rho} C^{1-\rho} + \chi \ln\left(\frac{M^D}{P}\right) - \eta L .$$

C is a consumption aggregate. Households consume goods produced in the home country and in the foreign country. I will discuss a few different models with different sets of assumptions on goods preferences. All of the models assume homothetic preferences (so consumption aggregates and price indexes are defined), but I will make no further assumptions beyond that for now.

Real balances, $\frac{M^D}{P}$, appear in the utility function, where P is the optimal price index. Households get disutility from work, L. η is a shock to disutility of work.

Foreign households are assumed to have similar utility functions:

$$. \; U^* = \frac{1}{1-\rho} C^{*1-\rho} + \chi \ln\left(\frac{M^{D*}}{P^*}\right) - \eta^* L^*$$

Starred (*) variables are the foreign counterparts to the home-country variables.

Money is supplied exogenously through transfers. In equilibrium we have money supply equals money demand in each country: $M = M^D$, and $M^* = M^{D*}$. Four variables will determine the aggregate state of the economy: the distaste for work for the representative home agent, η; the analogous variable for the representative foreign agent, η^*; aggregate per capita home money supply, M; and aggregate per capital foreign money supply, M^*.

I will assume there are complete financial markets of the type discussed in Devereux and Engel (2000). Specifically, there are assets traded that have payoffs specific to each possible state of the world. These assets are traded of course prior to the realization of the state. Most of the models we consider have home and foreign consumers facing different prices for the same good on spot markets. That is, the markets are segmented. We assume that it is impossible to make state-contingent trades that allow payoffs in physical goods, as that would allow households to get around paying the price set in their market. Instead, payoffs are specified in nominal terms. In that case, optimal contracts ensure that the marginal utility from an additional unit of currency is proportional between home and foreign consumers in all states (where I have assumed the constant of proportionality is one):

$$\frac{C^{-\rho}}{P} = \frac{C^{*-\rho}}{SP^*}.$$

S is the nominal exchange rate, expressed as the home currency price of foreign currency.

The assumption of complete markets is, of course, unrealistic. It is a useful benchmark, and here it allows us to arrive at a simple flexible model that can be used to analyze relative-price effects in general equilibrium. We can reproduce Friedman's claim that nominal exchange

rate flexibility allows desirable relative price adjustments to occur rapidly under his assumption of nominal prices fixed in producer's currencies, but we can also analyze other assumptions about how prices are set.

The following equilibrium conditions emerge using the first-order conditions for the household optimization problem:

$$M = \chi P C^{\rho} \qquad M^{*} = \chi P^{*} C^{*\rho}$$

$$W = \eta P C^{\rho} \qquad W^{*} = \eta^{*} P^{*} C^{*\rho}$$

Here, W and W^{*} are the home and foreign wage, respectively.

This framework, while making very specific assumptions about preferences, has the advantage that it is easy to analyze under a variety of assumptions about goods pricing, and about preferences over goods. We can derive a solution for the nominal exchange rate that does not depend on any assumptions about the production side of the economy, about how nominal prices are set, or without making any further assumption on goods utility:

$$S = \frac{M}{M^{*}}.$$

Now we turn to the production side of the economy. There are a large number of goods produced in each country, each by a monopolist (who faces a constant elasticity of demand, given our CES assumption on preferences.) We will initially consider models in which output for each firm i is produced using only a labor input: $Y_i = L_i$, and $Y_i^{*} = L_i^{*}$.[3] We will consider a variety of possible assumptions about how prices are set. Prices may be flexible – that is, set

[3] One of the models we examine later will have an iceberg transportation cost for shipping goods overseas. We will also consider models in which intermediate goods are used as inputs into final goods production.

with full information about the state. Or, in the new open economy models, firms must set nominal prices in some currency prior to knowledge about the state.

3. Flexible Nominal Prices

It is helpful first to examine some of the properties of this model under completely flexible nominal prices. We shall assume home and foreign households have identical CES preferences over consumption goods. Firms face constant elasticity demand curves, and therefore set prices as a constant mark-up over wages. We allow firms to discriminate across home and foreign markets. But because we assume identical preferences and CES utility, firms choose to set the same price in both markets.

Aggregating across all home firms, we get

$$P_H = \mu W ,$$

where P_H is the home currency price of home goods. We have also $P_H = SP_H^*$, where P_H^* is the foreign-currency price of home goods. Likewise,

$$P_F^* = \mu W^* ,$$

and $P_F = SP_F^*$.

We can also derive these equations for nominal wages in equilibrium:

$$W = \frac{\eta}{\chi} M \qquad\qquad W^* = \frac{\eta^*}{\chi} M^*$$

It follows from the equilibrium conditions that

$$\frac{P_H}{P_F} = \frac{P_H^*}{P_F^*} = \frac{\eta}{\eta^*} .$$

The relative price of home goods falls when there is an increase in η, which is the parameter measuring the distaste for work. When home households prefer to work less, home firms must pay higher wages to entice workers into the workforce. Those wage costs are passed onto to consumer in the form of higher prices.

I will not undertake a formal welfare analysis of the models I present here. Instead, I will focus on what turns out to be a critical aspect of the welfare analysis: to what extent an exchange-rate regime is beneficial in achieving the adjustment of the price of home goods relative to foreign goods. Under the Friedman framework, exchange-rate flexibility allows immediate adjustment of that relative price in response to real shocks. But, as we shall see, that finding is a special case that depends critically on how Friedman assumes nominal goods prices are set.

4. Sticky Nominal Prices: PCP Case

Now consider the model when firms must set nominal prices in advance. In the one-period framework here, this means that prices are set in advance of knowledge of the preference shocks and money supply realizations. Perhaps there are menu costs or some other sorts of costs that make it more profitable to set a non-state-contingent nominal price. First we take up the case in which firms set prices in their own currencies. That is, home firms set prices in the home currency, whether for sale to home or foreign households. We call this the PCP case.

Because of our assumptions of zero transportation costs for firms to ship the goods overseas, and identical preferences of home and foreign households, firms do not set a different price for home and foreign households (even though, in principle, we allow for price discrimination.) That is, the law of one price holds for goods sold at home and in the foreign country.

It follows that

$$\frac{P_H}{P_F} = \frac{P_H^*}{P_F^*} = \frac{P_H}{SP_F^*}.$$

Under the PCP assumption, both P_H and P_F^* are fixed ex ante and do not respond to shocks to demand or money supply. Define $\kappa \equiv \frac{P_H}{P_F^*}$. Because these nominal prices are set in advance of the realization of the state, κ does not depend on the outcomes of the random variables. Then the relative price of home to foreign goods varies inversely with the exchange rate:

$$\frac{P_H}{P_F} = \frac{\kappa}{S}.$$

Substituting in the expression for the equilibrium exchange rate, we get under PCP pricing:

$$\frac{P_H}{P_F} = \kappa \frac{M^*}{M}.$$

Here we can see the gist of Friedman's argument for flexible exchange rates. If the exchange rate were fixed, there would be no channel to translate real demand shocks into a relative price change. That is, if the exchange rate were held constant at a value of $\bar{S}$, the relative price of home to foreign goods would not depend on the shocks that hit the economy:

$$\frac{P_H}{P_F} = \frac{\kappa}{\bar{S}}.$$

But with exchange-rate flexibility and the correct monetary policy (for example, one in which monetary policy responds to local shocks so that $M = k/\eta$ and $M^* = k^*/\eta^*$), the real demand shocks can be translated precisely into the same relative price effect that occurs under flexible prices. Here, the appropriate monetary policy involves having the monetary authorities set

monetary policy in a way that ignores the real shocks. In fact, if $\frac{k}{k^*} = \kappa$, the relative price will equal exactly its value under flexible prices:

$$\frac{P_H}{P_F} = \frac{P_H^*}{P_F^*} = \frac{\eta}{\eta^*}.$$

Although I have only shown that under flexible exchange rates we can achieve exactly the relative price response that we find under flexible prices, Obstfeld and Rogoff (2000a) demonstrate a stronger result. They show that in fact when monetary authorities follow policies that allow the exchange rate to adjust in such a way that the relative price mimics the flexible-price solution, we can achieve exactly the same welfare as under flexible prices. That is, very much in accord with Friedman's intuition: flexible exchange rates are a perfect substitute for flexible goods prices in the presence of real shocks.

Moreover, in the models of OR (1998, 2000a), mimicking the flexible price allocation is the constrained globally efficient monetary policy. While the flexible-price equilibrium itself is not Pareto efficient (because of the monopoly distortions), optimal monetary policy can do no better than to replicate the flexible-price allocation.

Moreover the monetary policy I set out above is not only the policy that would be set by a global central planner. It is, as OR (2000a) show, the policy that self-interested national economic planners would follow. That is, there is no gain to international monetary coordination. Central banks following policies that maximize their own country's welfare can achieve the constrained globally efficient outcome. Thus, a system in which central bankers do not cooperate at all and allow the exchange rate to float freely is optimal, as Friedman claimed.[4]

[4] OR (1998, 2000a) have delicate sets of assumptions on preferences and market structure that insure that markets are actually complete. But OR (2001) show that these basic conclusions are to a first order robust to market incompleteness.

This model, however, has implications that seem counterfactual: that exchange rate changes are passed through one-for-one into consumer prices, and that the law of one price holds for all goods. It is this characteristic of the model that has led some researchers to consider the local-currency pricing version of the sticky-nominal price model.

5. Sticky Prices: LCP Case

An alternative model for price setting is that firms set prices in the currency of consumers of the product. That is, when a home firm sells in the home market it sets prices in the home currency. But for sales to the foreign market, it sets prices in the foreign currency. We call this the "LCP" (for "local currency pricing") case.

It follows immediately in this case that a flexible nominal exchange rate cannot achieve the optimal relative price adjustment. P_h and P_f are both set in the domestic currency and do not respond to contemporaneous shocks. We cannot replicate the flexible-price solution of $\frac{P_H}{P_F} = \frac{P_H^*}{P_F^*} = \frac{\eta}{\eta^*}$ with flexible exchange rates, no matter what the monetary policy. In fact, Devereux and Engel (2000) go further and demonstrate that the optimal monetary policy in this case delivers fixed exchange rates.[5] Or, put another way, if the foreign country is following optimal monetary policy, while the home country is using the exchange rate as its policy instrument, the optimal exchange rate policy is to fix.

There is a simple way to understand the striking difference in optimal policy in the PCP world versus the LCP world. There are two types of deviations from efficiency which monetary policy might be able to rectify in a sticky-price world. One is that relative prices might not

[5] Bacchetta and van Wincoop (2000) and Devereux and Engel (1998) also examine exchange-rate rules with local-currency pricing. However, those analyses do not examine the real shocks that are at the heart of the issues we discuss here.

respond in the correct way to real shocks, so that we might not achieve $\frac{P_H}{P_F} = \frac{P_H^*}{P_F^*} = \frac{\eta}{\eta^*}$. In the absence of optimal relative price changes, consumers do not receive the correct signals and do not alter their demand for goods in the appropriate way when real shocks hit. As a consequence, resources will not be allocated efficiently.

The other type of inefficiency comes because deviations from purchasing power parity lead to incomplete risk sharing. As noted above, with a complete set of nominal contingent claims traded, in equilibrium $\frac{C^{-\rho}}{P} = \frac{C^{*-\rho}}{SP^*}$. Asset markets do not deliver complete risk sharing unless purchasing power parity holds, $P = SP^*$.

When prices are set in producers' currencies (PCP), purchasing power parity does hold, so asset markets do deliver complete risk sharing. In that case, monetary policy can be devoted entirely toward ensuring that relative prices respond in the appropriate way to real shocks. But, of course, exchange rate flexibility is needed to deliver the relative price response.

Under local currency pricing, relative prices simply cannot change in the short run in response to real shocks. It is useless for monetary policy makers to devote any effort to achieving an efficient relative price response. But, under LCP pricing, both P and P^* are predetermined and not affected by real shocks. If the nominal exchange rate is fixed so that purchasing power parity holds, $S = \frac{P}{P^*}$, then asset markets will achieve complete risk sharing. So fixed exchange rates are optimal.

This model is also apparently consistent with the empirical evidence that consumer prices are unresponsive to exchange rate changes in the model. The law of one price does not hold in the model: $P_h \neq SP_h^*$ and $P_f \neq SP_f^*$.

Corsetti and Pesenti (2001) develop a model of "partial" pass-through of exchange rates to final consumer prices. Ex ante, firms may pass-through only a fraction λ (taken to be exogenous) of any exchange rate change to consumer prices. The PCP model is one extreme in which $\lambda = 1$, and the LCP is the other extreme in which $\lambda = 0$. They examine optimal monetary policy, and the optimal degree of exchange-rate flexibility in this framework. Since Corsetti and Pesenti assume goods are sold directly to consumers (as do OR, and Devereux and Engel), it seems as though the empirically relevant case is the one in which λ is nearly zero since pass-through to consumer prices is very small in the short run.

Corsetti and Pesenti show in their model that optimal policy minimizes a function of the "output gap" and deviations from the law of one price. The output gap is "the distance between actual and equilibrium employment levels." In the context of the model above, the equilibrium employment level in the home country is the flexible price level of L. OR (2000a) show that in the PCP setting, the flexible price level of L is attainable under floating exchange rates when policy is set as described above: $M = k/\eta$ and $M^* = k^*/\eta^*$. That policy allows the terms of trade to change exactly as under flexible nominal prices, so labor demand in home and foreign industries is the same as under flexible prices. That is, it eliminates the output gap. Since the law of one price holds for all goods in the PCP model, we can conclude from the theorem of Corsetti and Pesenti that such a policy is optimal.

But it is not always the case that eliminating the output gap is the optimal feasible policy. Corsetti and Pesenti's theorem implies that policy makers can improve welfare by using monetary policy to help eliminate deviations from the law of one price. Sometimes there is tension between that goal and the goal of eliminating the output gap. The Corsetti and Dedola (2001) model, discussed below, is an example where monetary policy can eliminate the output

gap with sufficient exchange-rate flexibility, but where that policy is not optimal because it leaves intact deviations from the law of one price that would exist under flexible prices.

Sutherland (2001) derives results that are similar to Corsetti and Pesenti: when the degree of pass-through is close to unity, exchange-rate flexibility is desirable. Sutherland shows that when we let leisure enter the utility function in a more general way (i.e., not the quasi-linear specification of the model of section 2), that exchange rate flexibility may be desirable for a small open economy even when pass-through is low. When the elasticity of substitution between leisure and consumption is high, stabilizing the exchange rate may reduce the average terms of trade for the small country. This occurs because the optimal ex ante price of exports is sensitive to the degree of exchange rate volatility. Of course, this is quite a different case for exchange-rate flexibility than the one advanced by Friedman.

In essence, Devereux and Engel (2001) take the evidence against the law of one price for consumer goods as support for the position that nominal exchange rate changes are not capable of achieving desirable relative price changes. But there are other ways to interpret the evidence that do not rely on LCP behavior. We turn to a few of these alternatives.

6. Shipping Costs

The evidence on deviation from the law of one price for consumer goods uses data that is not refined enough to distinguish between domestically produced goods and imported goods. Even relatively narrowly defined goods, such as in the studies of Parsley and Wei (2001a, 2001b) do not make this distinction. A box of facial tissue (one of the goods in the Parsley and Wei, 2001a, study) bought in Japan may be imported or not, and it probably is not exactly the same brand and type of tissue that is purchased in the U.S.

One explanation for why the law of one price fails for tissues is that Japanese and American consumers are consuming slightly different products. That is, suppose there are two types of facial tissue, one produced in the home country and the other produced in the foreign country. Assume no difference in tastes, but assume there are shipping costs as in OR (2000b). With CES utility and an elasticity of substitution between types of tissues greater than one, home residents will spend a greater share of income on the home-produced good. If the elasticity and the per-unit transport costs are high enough, foreign goods may constitute a small share of overall consumption and thus a small share in the measured price of home-country tissue consumption. The converse will characterize the foreign country. So, the law of one price may hold literally for specific types of tissues, but may fail grossly for the price index of tissues.

Let P_i be the price of a particular good, such as facial tissues. However, P_i is itself an index over the price of two types of tissues – one produced at home and one in the foreign country. Suppose home and foreign households have the same preferences for facial tissue:

$$C_i = \left(\alpha C_{iH}^{\lambda-1/\lambda} + (1-\alpha) C_{iF}^{\lambda-1/\lambda} \right)^{\lambda/\lambda-1},$$

where the *i* subscript is for the good "facial tissues", of which there are two types: *H* for home and *F* for foreign. Let the per unit iceberg transport cost for exported goods be $\delta > 1$. Suppose the law of one price holds for the prices not including transport cots. We have $P_{iH}^* = \delta P_{iH} / S$ and $P_{iF} = \delta S P_{iF}^*$. The rest of the macro model is the same as specified above.

Under flexible nominal prices, $\frac{P_{iH}}{P_{iF}}$ and $\frac{P_{iH}^*}{P_{iF}^*}$ respond to real shocks. If nominal prices are sticky as in the Friedman framework of PCP, it is clear that a flexible exchange rate is necessary to achieve a desirable response of $\frac{P_{iH}}{P_{iF}}$ (or $\frac{P_{iH}^*}{P_{iF}^*}$) to movements in demand. This

framework potentially is also consistent with the observation that measured consumer prices do not respond much to exchange rate changes. We have:

$$P_i = \left(\alpha^{\lambda} P_{iH}^{1-\lambda} + (1-\alpha)^{\lambda} P_{iF}^{1-\lambda}\right)^{1/1-\lambda} = \left(\alpha^{\lambda} P_{iH}^{1-\lambda} + (1-\alpha)^{\lambda} \delta^{1-\lambda} S^{1-\lambda} P_{iF}^{*1-\lambda}\right)^{1/1-\lambda},$$

and,

$$P_i^* = \left(\alpha^{\lambda} P_{iH}^{*1-\lambda} + (1-\alpha)^{\lambda} P_{iF}^{*1-\lambda}\right)^{1/1-\lambda} = \left(\alpha^{\lambda} \delta^{1-\lambda} S^{\lambda-1} P_{iH}^{*1-\lambda} + (1-\alpha)^{\lambda} P_{iF}^{*1-\lambda}\right)^{1/1-\lambda}.$$

The pass-through elasticity for the home country, for example, is

$$\varepsilon = \frac{(1-\alpha)^{\lambda} \delta^{1-\lambda} S^{1-\lambda} P_{iF}^{*1-\lambda}}{\alpha^{\lambda} P_{iH}^{1-\lambda} + (1-\alpha)^{\lambda} \delta^{1-\lambda} S^{1-\lambda} P_{iF}^{*1-\lambda}}.$$

For $\lambda > 1$, $\varepsilon \to 0$ as $\delta \to \infty$. If the foreign good is a sufficiently high substitute for the domestic good, then if the cost of the foreign good is high enough there will not be much effect of exchange rates on home consumer prices. The point here is that the empirical studies of consumer prices cannot measure the price of imported goods specifically. They only measure prices of (sometimes very narrowly defined) categories of consumer goods. The price indexes of these categories may not be very responsive to exchange rate changes.

Here we have a model in which the nominal exchange rate can play the role of adjusting relative prices. Exchange rate flexibility allows $\frac{P_{iH}}{P_{iF}}$ (or $\frac{P_{iH}^*}{P_{iF}^*}$) to adjust to changes demand. The model also fits the stylized fact that measured consumer price levels do not respond much to exchange rate changes.

But the problem with this model is that the reason there is so little pass-through of exchange rates to consumer prices in the home country is that foreign goods are a small share of total consumption. In fact, ε measures not only the elasticity of consumer prices with respect to a change in the price of foreign goods; it also measures the share of foreign goods in expenditures. So pass-through can only be small in this model if the expenditure share on

foreign goods is small. The case for floating rates is weak in this case. Floating rates might be needed to achieve optimal relative price adjustments, but those relative price adjustments are not very important to the functioning of the economy in this model.

In fact, Obstfeld and Rogoff (2000b) reason that the low pass-through to consumer prices could not be fully explained by transportation costs, and that some other factors must be at play.

7. Non-traded Distribution Services and PCP

One possible explanation for the apparent non-responsiveness of consumer prices to exchange rate changes is that CPIs measure a basket of both prices of consumer goods and the distribution services that bring the goods to consumers. The argument is that the law of one price might very well hold for the actual physical good (as in PCP models), but the measured consumer price includes the price of the distribution service which is nontraded and for which the law of one price need not hold. (See, for example, McCallum and Nelson, 1999.)[6]

Let the home price of imported good *i* be a composite of a traded goods price $\overline{P}_{iF}$ for which the law of one price holds, $\overline{P}_{iF} = S\overline{P}^{*}_{iF}$, and the price of a nontraded distribution service, P_{iN}:

$$P_{iF} = \left(\alpha^{\lambda} P_{iN}^{1-\lambda} + (1-\alpha)^{\lambda} \overline{P}_{iF}^{1-\lambda}\right)^{1/1-\lambda} = \left(\alpha^{\lambda} P_{iN}^{1-\lambda} + (1-\alpha)^{\lambda} S^{1-\lambda} \overline{P}_{iF}^{*1-\lambda}\right)^{1/1-\lambda}.$$

If P^{*}_{iF} is fixed in foreign currency terms, the pass-through of exchange rates is given by:

$$\varepsilon = \frac{(1-\alpha)^{\lambda} S^{1-\lambda} \overline{P}_{iF}^{*1-\lambda}}{\alpha^{\lambda} P_{iN}^{1-\lambda} + (1-\alpha)^{\lambda} S^{1-\lambda} \overline{P}_{iF}^{*1-\lambda}}.$$

As $\alpha \to 1$, $\varepsilon \to 0$. That is, as the share of the nontraded distribution service increases toward unity, the pass-through elasticity falls toward zero.

[6] The model of OR (2000a) could be interpreted this way. The "final good" in that type of model is a composite of a traded home-produced good, a traded foreign-produced good and a nontraded distribution service.

To flesh out this model a bit, assume the market for traded goods is competitive, and that it takes a single unit of labor to make a good. So, $\overline{P}_{iF}^{*} = W^{*}$, and for goods produced in the home country, $\overline{P}_{iH} = W$. Then $\frac{\overline{P}_H}{\overline{P}_F} = \frac{W}{SW^{*}}$. Under nominal wage and price flexibility, we have $\frac{\overline{P}_H}{\overline{P}_F} = \frac{\eta}{\eta^{*}}$.

Suppose instead that nominal wages are fixed ex ante. Goods markets are competitive, so $\overline{P}_{iF}^{*} = W^{*}$ and $\overline{P}_{iH} = W$, which implies that $\overline{P}_{iF}^{*}$ and $\overline{P}_{iH}$ are also fixed. To achieve the flexible-price outcome when nominal wages are fixed, we need nominal exchange rate flexibility and monetary policy in which $M_t = k/\eta$ and $M^{*} = k^{*}/\eta^{*}$. This is in essence a version of the PCP model. But, the final consumer price does not show complete pass-through because of the distribution costs.

As in the model with transportation costs, if the nontraded marketing services are such a large component of the cost of consumer goods that we barely observe any effect of exchange rate pass-through, then the physical import must not be a very important component of our consumer basket. Even if exchange-rate flexibility is desirable for achieving relative price adjustments, it is not very important.

There is no requirement that there be only one explanation for why there is little response of consumer prices to exchange rates. Perhaps a combination of the model involving nontraded distribution services, and the model with transportation costs (from section 6) would bring us close to a description of the real world: one in which pass-through to consumer prices is small, but imports are not a negligible fraction of consumption.

Corsetti and Dedola (2001) take a special case of the above model in which the elasticity of substitution between the physical product and the distribution service is zero, so that the

traded good and the non-traded distribution service must be combined in fixed proportions. In this model, the distribution sector is competitive, so the final goods price is equal to the cost: $P_{iF} = \overline{P}_{iF} + \sigma P_{iN}$. However, Corsetti and Dedola do not assume that the law of one price holds for the traded good. That is, they do not have $\overline{P}_{iF} = S\overline{P}^{*}_{iF}$. Instead, the exporting firm, which is a monopolist, marks up the price optimally. So, if it takes one unit of labor to produce the physical good in the foreign country, and θ (> 1) is the elasticity of demand for the product, Corsetti and Dedola show that the optimal price set by the exporter is: $\overline{P}_{iF} = \frac{\theta}{\theta - 1}\left(SW^{*} + \frac{\sigma}{\theta} P_{iN} \right)$. The final goods price is then given by $P_{iF} = \frac{\theta}{\theta - 1}\left(SW^{*} + \sigma P_{iN} \right)$.

The elasticity of pass-through of the exchange rate to the price of the imported physical good is $\frac{SW^{*}}{SW^{*} + \frac{\sigma}{\theta} P_{iN}}$ and the pass-through elasticity for the final good is $\frac{SW^{*}}{SW^{*} + \sigma P_{iN}}$. Both elasticities are smaller than unity. Actually, the pass-through to the final good would be exactly the same if the producer incurred the distribution costs itself, rather than selling to a distributor. But Corsetti and Dedola want to explain the observations that (1) there is less than 100 per cent pass-through to imported goods prices, but (2) more pass-through to imported goods prices than to final goods prices.

In this model, if wages were flexible, and using the general model of section 2, relative wages are given by $\frac{W}{SW^{*}} = \frac{\eta}{\eta^{*}}$. As Corsetti an Dedola demonstrate, if nominal wages are fixed ex ante, but the exchange rate is freely floating, then the flexible-wage allocation can be achieved through the inward-looking monetary policies that have $M = k/\eta$ and $M^{*} = k^{*}/\eta^{*}$.[7]

[7] This is true assuming the values of the constants are chosen appropriately, of course.

The fact that the law of one price does not hold for traded goods implies that the flexible exchange-rate policy might not be optimal. As Corsetti and Dedola point out, the Corsett-Pesenti theorem shows that the monetary authorities face a trade-off when there is price discrimination. They want to use monetary policy to eliminate the output gap (i.e., achieve the flexible-price allocation), but they can also use monetary policy to help eliminate the distortionary failures of the law of one price. An inward-looking non-cooperative monetary policy that seeks only to achieve the flexible-price allocation and allows the exchange rate to float freely may be less desirable than a cooperative policy that to stabilizes exchange rates some extent and helps eliminate international price differences.

Nonetheless, if this model is the sole explanation for the observed low pass-through elasticities, it would require the distribution sector's cost component, σ, to be very large.

8. Price Discrimination

In Corsetti and Dedola's model, firms set goods prices flexibly, but segment home and foreign markets so that the law of one price fails for traded goods. Their model has the feature that the optimal mark-up varies with the exchange rate. However, in their set-up, the difference in local distribution costs is important in the failure of the law of one price. Another approach in which exporting firms actively price discriminate is that of Bergin and Feenstra (2001).

In their model, preferences are not CES but instead translog. Assume that all goods are tradable, and that each good requires a unit of labor to produce. Further, assume as in section 7, that nominal wages are fixed ex ante (home wages fixed in the home currency and foreign wages in the foreign currency.)

Assume that there are N goods produced in each country, a fraction $1-\phi$ of which are tradable. Thus in each country there are $\tilde{N} = (2-\phi)N$ different goods that are consumed.

Under symmetric translog preferences, the unit expenditure function is defined by (here I follow Bergin, 2001 and Bergin and Feenstra, 2001):

$$\ln(P) = \sum_{i=1}^{\tilde{N}} \frac{\ln(P_i)}{\tilde{N}} + \frac{1}{2}\sum_{i=1}^{\tilde{N}}\sum_{j=1}^{\tilde{N}} \frac{\gamma \ln(P_i)\ln(P_j)}{\tilde{N}(\tilde{N}-1)}.$$

The elasticity of demand for each product is $1+\frac{\gamma}{\tilde{N}\varphi_i}$, where φ_i is the expenditure share on product *i*. The expenditure share depends on the prices of all goods:

$$\varphi_i = \frac{1}{\tilde{N}} + \sum_{j=1(j\neq i)}^{\tilde{N}} \frac{\gamma \ln(P_j)}{\tilde{N}(\tilde{N}-1)} - \frac{\gamma}{\tilde{N}}\ln(P_i).$$

Bergin (2001) shows that the price set by firms depends on costs and on prices of competing goods. The foreign firm selling traded goods sets different prices for sale to foreign households (P_F^*) and home households (P_F):

$$P_F^* = \frac{(2-\phi)(1+\gamma)}{(2-\phi)(1+2\gamma)-\gamma} W^* + \frac{(1-\phi)\gamma}{(2-\phi)(1+2\gamma)-\gamma} P_H^*.$$

$$P_F = \frac{(2-\phi)(1+\gamma)}{(2-\phi)(1+2\gamma)-\gamma(1-\phi)} SW^* + \frac{\gamma}{(2-\phi)(1+2\gamma)-\gamma(1-\phi)} P_H.$$

Using similar equations for the home country, we derive:

$$P_F^* = \left(1-\frac{\gamma}{1+2\gamma}\frac{1-\phi}{2-\phi}\right)W^* + \left(\frac{\gamma}{1+2\gamma}\frac{1-\phi}{2-\phi}\right)(W/S).$$

$$P_F = \left(1-\frac{\gamma}{1+2\gamma}\frac{1}{2-\phi}\right)SW^* + \left(\frac{\gamma}{1+2\gamma}\frac{1}{2-\phi}\right)W.$$

Here we see that if nominal wages are fixed ex ante, the elasticity of pass-through is less than unity. The elasticity is given by

$$\varepsilon = \frac{\left(1 - \frac{\gamma}{1+2\gamma}\frac{1}{2-\phi}\right)SW^*}{\left(1 - \frac{\gamma}{1+2\gamma}\frac{1}{2-\phi}\right)SW^* + \left(\frac{\gamma}{1+2\gamma}\frac{1}{2-\phi}\right)W}.$$

As long as $\gamma > 0$, this ε is less than unity. Note however that the foreign price of the foreign good is also sensitive to the exchange rate. In fact, if all goods were traded ($\phi = 0$), the law of one price would hold for these goods. Thus, substantial deviations from the law of one price require that there be a large proportion of goods that are traded (and that $\gamma > 0$.) But in this model, those nontraded goods are not necessarily distribution services (as in the models of section 7), but can be any nontraded product or service.

While Bergin (2001) is a model in which all nominal prices are flexible, and Bergin and Feenstra (2001) takes an approach that is somewhat non-comparable to the other models, it appears we can draw conclusions similar to those in Corsetti and Dedola (2001). Namely, if wages were flexible, and using the general model we have set up earlier, relative wages are given by $\frac{W}{SW^*} = \frac{\eta}{\eta^*}$. If nominal wages are fixed ex ante, but the exchange rate is freely floating, then the same relative wage can be achieved through the inward-looking monetary policies that have $M = k/\eta$ and $M^* = k^*/\eta^*$.

But in this case, while flexible exchange rates can achieve the same relative wage as under complete price and wage flexibility, they are not a perfect substitute for wage and price flexibility. Specifically, they cannot yield the same terms of trade as under flexible prices because of the incomplete pass-through. For the home country, the terms of trade are:

$$\frac{P_F}{SP_H^*} = \frac{\left(1 - \frac{\gamma}{1+2\gamma}\frac{1}{2-\phi}\right)SW^* + \left(\frac{\gamma}{1+2\gamma}\frac{1}{2-\phi}\right)W}{\left(1 - \frac{\gamma}{1+2\gamma}\frac{1}{2-\phi}\right)W + \left(\frac{\gamma}{1+2\gamma}\frac{1}{2-\phi}\right)SW^*}.$$

With flexible prices and wages, and using the general model of section 2, the terms of trade are:

$$\frac{P_F}{SP_H^*} = \frac{\left(1-\frac{\gamma}{1+2\gamma}\frac{1}{2-\phi}\right)\eta^* + \left(\frac{\gamma}{1+2\gamma}\frac{1}{2-\phi}\right)\eta}{\left(1-\frac{\gamma}{1+2\gamma}\frac{1}{2-\phi}\right)\eta + \left(\frac{\gamma}{1+2\gamma}\frac{1}{2-\phi}\right)\eta^*}.$$

But no policy for exchange rates can achieve those terms of trade when W and W^* are fixed.

This model requires further study. It seems likely that some exchange rate flexibility would be desirable, but since the flexible-price allocations are not obtainable, the exact form of optimal monetary policy is not immediately obvious.

9. Imports as intermediates

Obstfeld (2001) models imported goods as intermediate products. They are combined with products produced locally to make final consumer goods (which are nontraded). There is complete pass-through of exchange rates to imported goods prices in this framework. That is, the price of imported goods is set in the producers' currencies, so the imported price varies one for one with the exchange rate. But imported goods are not sold directly to consumers. The price of the final good is set in the consumers' currencies.

This model, then, is completely consistent with the observation that consumer prices do not respond much to exchange rate changes in the short run. But there is still an important role for exchange-rate flexibility in changing relative prices. The final goods producer faces a "sourcing" decision – to use imported intermediates or locally produced intermediates. There is not perfect substitutability between the two, but there is some.[8] So, a nominal exchange rate adjustment can change the price of imported relative to locally produced intermediates.

[8] Specifically, in Obstfeld's framework there is a unitary elasticity of substitution.

There is a single final consumer good, sold by a monopolist that buys intermediate inputs in competitive markets. The price of the final good in the home country is P, and it is fixed in home-currency.

The cost of producing the good is not fixed ex ante. The cost is given by:

$$\Gamma = \left(\alpha^{\lambda} P_H^{1-\lambda} + (1-\alpha)^{\lambda} S^{1-\lambda} P_F^{*1-\lambda}\right)^{1/1-\lambda}.$$

Here, P_H is the price of the home-produced intermediate good. That good is produced using a variety of labor inputs. In the Obstfeld set-up, each household is a monopoly supplier of a unique type of labor. Nominal wages are fixed ex ante. The intermediate goods market is competitive with free entry. The price, P_H, is in principle flexible but under competitive conditions it is equal to the ex ante fixed nominal wage (given the normalization that the total number of units used to produce one unit of intermediate is one.)

Likewise, P_F^* is the price of the foreign produced intermediate in the foreign currency. The structure of the foreign intermediate market is the same as in the home market, which implies that P_F^* is fixed ex ante in the foreign currency. The home-currency price, $P_F = SP_F^*$, changes with the exchange rate.

Under flexible nominal prices, using the general model of section 2, we find

$$\frac{P_H}{P_F} = \frac{P_H^*}{P_F^*} = \frac{\eta}{\eta^*}.$$

With fixed nominal wages, we have for example in the home country $\frac{P_H}{P_F} = \frac{P_H}{SP_F^*}$. Since P_H and P_F^* will be fixed under the market conditions described, we need exchange rate flexibility to allow relative price adjustment. Indeed, since $S = \frac{M}{M^*}$ with a suitably designed

monetary policy of the form $M = k/\eta$ and $M^* = k^*/\eta^*$, the flexible price equilibrium can be mimicked. Indeed, Obstfeld demonstrates that prices and allocations are identical under flexible prices as under sticky nominal wages with this inward-looking monetary policy that has exchange rate flexibility.[9]

Obstfeld and Rogoff (2000) present evidence that shows there is much more pass-through of exchange rates to imported goods prices than to final consumer prices. While the pass-through is certainly not 100 per cent (as in the model just described), there appears to be a sufficient degree of pass through to allow for a significant expenditure-switching effect following from nominal exchange rate changes.

An important aspect of the Obstfeld (2001) model is the idea that there are final goods producers or distributors who can substitute between locally produced and imported intermediates. Devereux, Engel and Tille (1999) take an approach that is quite similar to Obstfeld (2001). However they take the limiting case of the cost function in which the elasticity of substitution is zero. That is, their model can be interpreted as one in which the distributor combines imported goods and locally produced goods in fixed proportion.[10] In that case, of course, there is no possibility of substitution between imported goods and local goods when the exchange rate changes, even though there is complete pass-through of the exchange rate to imported prices.

Potentially there are wealth effects from exchange rate changes in this case. The demand for imported goods is fixed because their price is fixed in consumers' currencies and the distributor cannot substitute toward locally produced goods. When the home currency depreciates, it raises the price that local distributors must pay for imported goods and lowers

[9] In fact, in terms of real variables and prices of output, the model is isomorphic to the PCP model of Obstfeld and Rogoff (2000a).

[10] That is not exactly the set-up in Devereux, Engel and Tille, but there is little difference in substance between the model I describe here and their precise model.

their profits. Foreign distributors have a windfall gain. In Devereux, Engel and Tille (1999), these profit effects are not consequential because of their assumption of complete markets. But Tille (2000) investigates the importance of these wealth effects on equilibrium demands. These wealth effects, however, are a completely different channel through which exchange rates affect equilibrium than the relative price effects that are so important to the Friedman-Feldstein analysis.

The model of Devereux, Engel and Tille (1999) is best described as one in which imports are primarily branded final goods. The distributor cannot substitute any local product for that brand. That is, a Toyota dealer cannot substitute a Chevrolet Lumina for a Camry if the yen becomes too expensive. The Obstfeld (2001) model is best thought of as a model in which the consumer cannot differentiate between local and imported sources of inputs. Perhaps the typical product in this set up is a can of beans, which may be filled with either imported or locally grown varieties.

The empirical question is to what extent substitution occurs at some stage before the good reaches the consumer. For the question of exchange-rate flexibility, the key is whether substitution can occur between imported and local products. That is, if the U.K. is considering adopting the euro versus keeping an independent pound, the question is whether in response to a pound depreciation British consumers can substitute toward British goods. Let me clarify what by way of an example. Suppose the imported good is wine. If the euro appreciates relative to the pound and dollar and thereby raises the pound price of French wine (as in the PCP specification), then British might substitute away from French wine toward American wine. But for that margin of substitution, the flexibility of the pound/euro rate does not matter at all. Even if the pound/euro rate were fixed, the price of French wine would rise relative to American wine. The question is the degree to which a euro appreciation leads British distributors to substitute

away from goods produced on the Continent toward U.K. produced goods. If a large degree of such substitution occurs (as in the Obstfeld (2001) model) then exchange-rate flexibility is desirable. If little such substitution occurs (as in Devereux, Engel and Tille (1999)), then there is not so strong a case for an independent currency with freely floating rates.

10. Conclusions

The famous case for flexible exchange rates advanced by Friedman (1953) is based on a view that appears at odds with empirical evidence. Friedman's approach assumes that nominal prices are set in producers' currencies, and exchange rate changes are passed through completely to final users of the goods. Thus an exchange rate change delivers a relative price adjustment between foreign and domestically produced goods.

Recent theoretical papers confirm Friedman's policy prescription under his assumption about goods pricing. Empirical evidence appears to contradict this assumption, because consumer prices are not very responsive to exchange rates. If there is no effect of exchange rates on prices that are paid by demanders of goods, then the exchange rate does not play the role in adjusting relative prices that Friedman posits. However, we have seen that there are several interpretations that still assign an important expenditure-switching role to the exchange rate, yet can reconcile the evidence of low exchange rate pass-through to consumer prices.

In many cases, nominal exchange-rate flexibility is a perfect substitute for nominal wage and price flexibility. If exchange rates are allowed to adjust freely, the same real allocations are achieved as under price and wage flexibility. But even so, Corsetti and Pesenti (2001) raise doubts as to whether full exchange-rate flexibility is optimal. In cases where there are deviations from the law of one price, some control of the exchange rate might be desirable even if it moves the economy away from the flexible-price, zero output gap equilibrium.

It is sometimes argued that in the presence of local-currency pricing, there is a prima facie case for stable nominal exchange rates. Volatile nominal exchange rates can lead to large short-run deviations from the law of one price when goods prices are set in consumers' currencies. So, the case is made that fixing the exchange rate at the appropriate level can eliminate the distortion that arises when consumers face different prices for identical goods. But Engel and Rogers (2001) demonstrate that the logic of this argument is not airtight. Fixing the exchange rate, or joining a currency union, entails altering monetary policy, which in itself has welfare implications. That paper produces a simple example to show that the loss of independence of monetary policy might entail a cost equal in size to the welfare costs of deviations from the law of one price.[11]

The example of Engel and Rogers (2001), as well as all of the models discussed here assume that the exchange rate is driven by monetary and real factors, and there is no significant role for speculative bubbles. If bubbles are important in determining exchange rates, then perhaps a stronger case for fixed exchange rates or currency union can be made. Bubbles would cause real distortions, especially under local currency pricing. Friedman (1953) was aware of this, but defended floating exchange rates with his well-known refutation of the possibility of destabilizing exchange-rate speculation (p. 175):

> "People who argue that speculation is generally destabilizing seldom realize that this is largely equivalent to saying that speculators lose money, since speculation can be destabilizing in general only if speculators on the average sell when the currency is low in price and buy when it is high."

Friedman, of course, was writing at a time when the world had limited experience with exchange rate flexibility. Perhaps his conclusions would be less sanguine in view of our experience with floating exchange rates in the post-Bretton Woods era.

[11] Devereux and Engel (2001) find fixed exchange rates are optimal under LCP when monetary policy rules are optimal. The example in Engel and Rogers (2001) is one where exchange rates are fixed but monetary policy rules are suboptimal.

The new open economy macroeconomics has given us a structured way to think about the issues that are important when considering the desirability of floating exchange rates versus currency union. Unfortunately for policy makers facing a near-term deadline for choosing an exchange-rate system, our knowledge has not advanced far enough to offer a firm recommendation backed up by appropriate theory. We will undoubtedly see many advances in this area of research over the next decade, further refining the models to determine exactly what matters for the choice of exchange rate regime. In addition, the models point the direction for empirical researchers to take to gather the precise information we need to calibrate the size of the expenditure-switching role for exchange rates.

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