Purchasing Power Parity within the United States

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Economics has many articles of faith. One of the most dearly held is Purchasing Power Parity, which posits that the price of the same good in different regions should be equivalent when no barriers to arbitrage exist. If a BMW costs $20,000 in Germany and $40,000 net of transportation costs in the United States, some entrepreneur will start buying BMWs in Germany and sending them to this country. BMW's profits may suffer because of its decreased ability to segment these two markets, but the arbitrager will reap huge gains. Purchasing Power Parity is an important assumption in much of international economic theory, and this article examines empirical evidence in support of this proposition.

To date, empirical support for Purchasing Power Parity (PPP) has been mixed. Dornbusch (1978, 1985), Frenkel (1981), Roll (1979), and Giovannetti (1992), as well as work by Meese and Rogoff (1983), have found varying degrees of evidence that PPP fails; in both the short run and the long run, single-currency prices do not equilibrate. On the other hand, studies using annual data over a very long time period, as in Friedman (1980) and Edison and Klovland (1987), have found some support for PPP. But even though some long-run support for various versions of PPP exists, particularly during fixed exchange rate regimes, recent evidence has not supported this simplest of market mechanisms.

The negative empirical results for PPP have elicited two types of responses. The first stresses the flaws in the actual price indices compared, while the second approach places a renewed emphasis on theories that postulate no long-run, stable relationship between prices in different countries. Because price indices in different countries include different goods, many of them nontraded, and different weights for each good, PPP can fail when relative prices change. As a result, PPP may only appear to fail, because of an index number problem. Alternatively, theories that predict changes in the relationship between these prices have been revitalized, based on the evidence that PPP fails. These

theories include both macro models, represented by traditional Keynesian analysis or the new real business cycle theories, and micro models, emphasizing pricing to segmented markets. The macro models tend to emphasize the relationship between changes in the nominal exchange rate and PPP.[1] The micro models stress the goods market structure, the idea being that a firm such as BMW would, and could, segment the markets in these two countries, violating PPP.

This article injects new evidence into the debate. Instead of examining international data, this study analyzes PPP between regions of the United States. By comparing regions within a country, it eliminates many of the hypotheses offered to explain the failure of PPP. The nominal exchange rate between any two regions is immutably fixed at one, thus avoiding any violations of PPP related to its movements, predicted in either the Keynesian or real business cycle macro models. Since national monetary and fiscal policies are essentially identical across regions, different policy mixes cannot be blamed. The new micro theories of why PPP fails, hypothesizing market segmentation, also become much less believable; the ability of firms to isolate markets is much more limited within a country than between countries, as goods arbitrage is much easier. Finally, price indices within a country are much more consistent than those collected internationally because the same agency collects data for each region, the same types of goods and methodology are used, and the weights on each good are more uniform. Yet, even in the absence of these postulated causes for the failure of PPP, empirical tests of PPP fail to hold between different regions in the United States.

Instead of examining international data, this study analyzes PPP between regions of the United States.

The results of this study are suggestive. Volatility in the nominal exchange rate is not required for PPP to fail, since PPP fails to hold within regions of the United States. Instead, the inclusion of nontraded goods in the total consumer price indices (CPIs) for these regions is shown to be the major cause of this failure. When the nontraded components of these indices are removed, PPP holds. Some categories of goods do seem to move in lockstep while others do not, as one would expect, and as PPP predicts.

The next part of this article defines the real exchange rate and explains why it is so closely related to PPP. Previous explanations for PPP's failure are also examined in more detail. Section II outlines the empirical model; a brief description of recent analysis on the statistical properties of time series is required to fully appreciate its elegance. The third section presents the results, and Section IV discusses the implications. A conclusion follows.

I. The Real Exchange Rate

Purchasing Power Parity,

$$P = eP^*, \tag{1}$$

relates the price of a good in the home country, P, with its own-currency price in another country, eP^*. The nominal exchange rate, e, represents the home-currency value of a unit of the foreign currency. The "strong form" of PPP sets this relationship as an equality. The real exchange rate, RXR, is derived by a simple rewriting of the PPP condition,

$$RXR \equiv \frac{e\ CPI^*}{CPI_{us}}, \tag{2}$$

and represents the domestic-currency price of foreign goods relative to home goods. In the BMW example, the real exchange rate would equal one-half: the dollar value of the BMW in Germany divided by its dollar value in the United States.

The strong form of PPP predicts that the real exchange rate equals one, as these two prices equilibrate. In the short run, the real exchange rate may deviate from this value, but in the long run it cannot stray too far from one if the strong form of PPP is to hold. Thus, tests of PPP, tests of equation (1), are identical to tests of whether the real exchange rate equals one. Using consumer price indices (CPIs), and occasionally wholesale price indices, such tests have shown the real exchange rate to diverge significantly from one, with little tendency to revert back. As a result, equation (1) does not hold by equality.

[1] Specifically, macro theory has analyzed the high correlation between the nominal and real exchange rates.

In reality, no theoretical justification demands that the exchange-rate-adjusted price indices used in these tests should equilibrate. The predominant reason that these indices need not be related in the long run is that the CPIs of different areas or countries include nontraded goods. PPP as a goods arbitrage condition should hold only for those goods that can be traded. Without trade, goods arbitrage has no direct way to equate a price in both markets. One cannot pick up a house and an acre of land in Wyoming and move it to downtown Tokyo, or even to downtown San Francisco, for that matter. Thus, the price of land need not be equal in these two regions.

Dornbusch (1978, 1985) emphasizes another potential cause of the instability of the real exchange rate and the failure of PPP; the weights of different goods need not be identical in the price indices of different countries. The French may drink wine and the Germans beer. If the price of wine rises relative to that of beer, the French CPI will rise relative to that of Germany since France weighs the increase in wine prices more heavily. As a result, relative price changes can produce permanent changes in the real exchange rate without violating the goods arbitrage condition. Changes in tastes, or in these weights, can also change the real exchange rate forever, making it look unstable. Comparing indices that include nontraded goods and are composed of differing weights seems to ensure that tests will show instability in the real exchange rate.

The CPIs in France and Germany can also differ for reasons other than measurement problems. In a world of imperfect substitutes, goods prices need not equate. Macro policies that can affect the nominal exchange rate can also affect the real rate. Since France and Germany may have drastically different and variable macroeconomic policies and are subject to different shocks to their production, the real exchange rate can move. Furthermore, imperfect substitution allows firms the possibility of discriminating by price; if demand for some good is much more elastic in Germany than in France and the firm can control the cross-border trade in its good, then the price of that good in Germany will be lower than it is in France. The real exchange rate can be unstable and differ from one for both macro and micro theoretic reasons.

Although measurement issues and theoretical explanations provide compelling reasons why PPP should fail, good reasons also support the idea that the real exchange rate should be stationary. If tastes do not change, then differences in weights need not cause changes in the indices. Different weights and the existence of tariffs and transportation costs may force the real exchange rate away from one. Yet the real exchange rate can still be stable around a mean other than one. For example, assume that the differential between the U.S. and German dollar prices of a BMW is caused by a 100 percent tariff. Although the average real exchange rate for BMWs is one-half, the real exchange rate is stable around that mean; doubling the dollar price in Germany would double the U.S. dollar price, leaving the RXR the same. This stability around the different mean is known as the "weak form" of PPP, and it is perfect for the analysis of an inflationary world.

The test of the weak form of PPP is simply a test of the stability of the real exchange rate, not a test of its stationarity around one.

Suppose the inflation rate is an evenly distributed 10 percent in the home country and zero in the foreign country; the exchange rate should depreciate by 10 percent to ensure that no real variables have changed, such as relative prices between home-produced and foreign-produced goods. Again, this exchange rate movement results from goods market arbitrage; the differential inflation rates alter the relative prices of foreign and domestic goods at the old nominal exchange rate. For example, if the equilibrium of the relative dollar prices of BMWs and Oldsmobiles is two, the 10 percent inflation of Oldsmobile prices at the same nominal exchange rate increases the dollar prices of American cars relative to BMWs. As a result, the increased demand for foreign goods, and therefore for foreign currency, and the decreased demand for domestic goods and currency at the old nominal exchange rate, drive the value of the domestic currency lower. The numerator in equation (2) rises proportionally to the denominator. Although the real exchange rate does not equal one and so the strong form of PPP fails, the weak form of PPP holds,

where the real exchange rate is stable. Thus, the test of the weak form of PPP is simply a test of the stationarity or stability of the real exchange rate, and not a test of the stationarity of the real exchange rate around one, as in the strong form of PPP. Development of the theory of a weak form of PPP has renewed the justification for tests of PPP.

Examining CPIs from different regions of the same country minimizes the above-mentioned measurement problems faced by international comparisons. Within the same country, similarity of culture across regions reduces the biases caused by relative price changes, since the consumers have very similar tastes and, therefore, weights. In fact, among the traded goods, the prices of exactly the same goods will be sampled in the various regions.[2] Furthermore, the many subcategories of the CPI within the United States permit an attempt to disentangle traded and nontraded goods. Even the existence of a nontraded good within the United States is more tenuous than it is internationally. Since labor is unquestionably mobile between regions in the United States, nontraded goods will be a decreasing percentage of the CPI in the long run. For example, it might not be possible to move an acre of land from Seattle to San Francisco, but someone, or some company, in San Francisco can very easily move to Seattle, equilibrating the prices of nontraded goods. The measurement problems with the international PPP studies are, to a large extent, avoided with an interregional study.

The examination of regions within a single country also removes much of the need to consider various theories to explain the failure of PPP. Identical federal monetary and fiscal policies diminish potential fluctuations of the real exchange rate. The absence of nominal exchange rate movements reduces most of the short-run volatility in real exchange rates seen when looking at international data. Finally, pricing to market is more difficult within, rather than between, countries.

Since many of the theoretical explanations for the instability of the real exchange rate do not apply to interregional comparisons, if real exchange rates are found to be unstable interregionally, then other causes must be investigated. As a result, domestic policy implications become more important. Finding the source of the instability will help produce policies to alleviate any problems caused by a long-run divergence of the regional CPIs. The results in this article shed some light on the sources of the breakdown in interregional PPP and provoke some speculation on possible policy implications.

II. The Empirical Model

Recent time series techniques, found in Dickey and Fuller (1979, 1981), Engle and Granger (1987), Hendry (1986), and Engle and Yoo (1987), for example, are designed to examine such issues as the long-run behavior of the real exchange rate. A brief outline of these procedures will facilitate analysis here.

Many macroeconomic time series, GNP or the money supply for example, tend to be unstable. They grow continuously rather than converging toward some long-run mean value. In an inflationary environment, the CPI also fails to revert to a stable level. A series is said to be "nonstationary" if it does not settle around a stable mean. The properties of the statistics that relate one series to another depend on the stationarity of the variables being examined; as a result, researchers must carefully test the stationarity of each variable to ensure that the proper statistical conclusions can be drawn. Dickey and Fuller have constructed the asymptotic properties of the distributions of such tests. A brief explanation of these tests is necessary, since they are at the heart of the analysis concerning the stability of the real exchange rate and therefore the validity of PPP.

If the value of a variable today, P_t, depends on its value in the past,

$$P_t = \beta\ P_{t-1} + \varepsilon_t, \tag{3}$$

and $\beta = 1$ and ε_t is a mean zero random variable with a finite variance, then P is said to be "difference stationary." In other words, in levels P is a random walk, but once it is differenced so that changes in P are examined, it is stationary around ε's zero mean. P's variance is infinite, because, with $\beta = 1$, the error at time $t - 1$, for example, is permanently remembered through the P_{t-1} term in equation (3); thus the variance of P_t is the sum of the variances of the preceding t errors, which gets infinitely large as time progresses.

The problem with comparing nonstationary series in levels is depicted in Figure 1a. The positive growth in both series over time fools the statistical analysis into believing the two series are closely

[2] When using the GDP deflator, changes in terms of trade are an important concern. Analyzing CPIs within one country eliminates this concern. Furthermore, the sample of goods is identical even if the weights are not; this is not clear in foreign comparisons, in which different goods might actually be included in the different samples, so that the weights are zero in their counterparts.

related. No stable long-run relationship may exist between these two variables, but a regression will falsely conclude that one exists; this mistaken conclusion derives from the "spurious correlation" that haunts data not screened for such trends. As a result, much of the empirical work in macroeconomics today is performed on changes, not levels.

All CPIs grow over time and a simple comparison of their levels, as in a direct test of PPP, would show a strong relationship. The regression of the CPI of Philadelphia on the CPI of Los Angeles has a coefficient near one, suggesting that PPP holds. But this coefficient occurs simply because both CPIs are increasing. Differencing the variables and testing their correlation is one method of avoiding any spurious element of the correlation.

Although two series may be nonstationary, they still may have a stable long-run relationship. Income and consumption are both nonstationary, but they are, in theory, tied to each other. In the short run, deviations from this long-run stable relationship occur, but eventually the two series converge to their long-run connection. When such a relationship exists, the two variables are said to be "cointegrated." Cointegration of income and consumption, for example, may be examined by analyzing the residuals from a regression of consumption on income,

$$Y_t = \gamma + \theta\, C_t + \mu_t, \qquad (4)$$

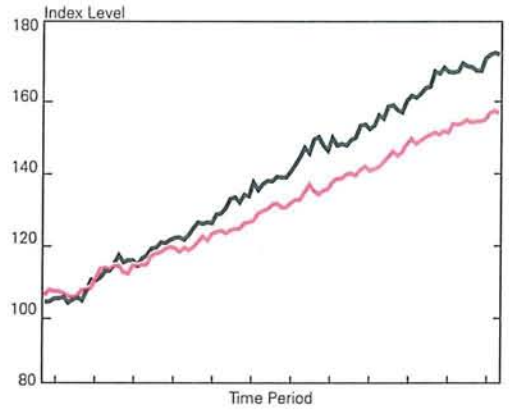
where Y_t is income at time t, C_t is consumption at time t, and both series are difference-stationary. The test for cointegration examines the time series properties of the residuals.[3] If μ is a random walk, then the two series can diverge in the long run. If, on the other hand, μ is stationary, the two variables do not diverge from a long-run stable relationship.[4] Figure 1A graphs two variables without a stable relationship; Figure 1B graphs two variables with one, consumption and income. Note that the two cointegrated series stay together, while the two series that are not cointegrated tend to separate.

A cointegration test is ideal for examining the stability of the real exchange rate. Since this article compares regions of the United States, where the nominal exchange rate is constant and equal to 1, the test of the stability of the real exchange rate is a test of whether the CPIs of two regions are cointegrated. Intuitively this makes sense; the cointegration test on the real exchange rate simply examines whether prices in one part of the country are tied to prices in another. Since these prices could differ because of the existence of nontraded goods, this study also attempts to separate traded and nontraded components of the indices, in order to find the origins of any difficulty.

Figure 1

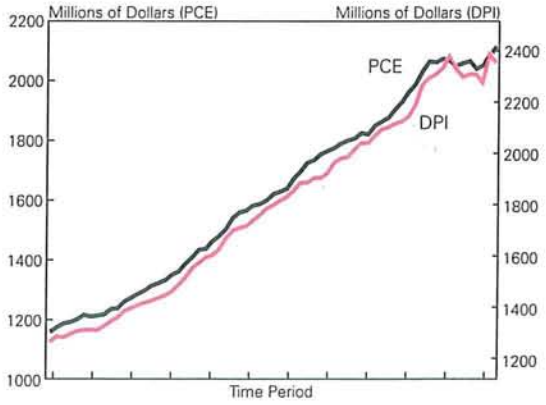
A

A Comparison of Levels of Two Nonstationary Series without a Stable Relationship



B

A Comparison of Two Cointegrated Series: Personal Consumption Expenditures and Disposable Personal Income



[3] Note that the cointegration test also could run income on consumption. The test is not a test of causality, but simply of whether a long-run relationship exists.

[4] In fact, Campbell and Mankiw (1989) find that income and consumption are difference-stationary and cointegrated.

III. The Results

The study uses CPIs for the Philadelphia, Chicago, New York, and Los Angeles metropolitan areas to examine the real exchange rates between these regions. Thus, six real exchange rates can be analyzed. Several problems existed with the data, however. First, each series had to be seasonally adjusted.[5] More importantly, the price index for the non-shelter component of the CPI for each of the six cities went back only to 1980, so this component had to be extended back to the longer sample.[6] Since the total CPI and its shelter component were available for all four cities back to 1956, the extension of the ex-shelter series was relatively simple.[7]

Before examining any cointegration tests, it is necessary to be sure that the variables to be compared are all of the same order of integration. For CPIs, that requires Dickey-Fuller tests to ensure that all the various price indices and subindices are nonstationary in levels and stationary in differences. Table 1 shows the confidence level at which the simple null hypothesis that the price levels of the series are nonstationary can be rejected. The null hypothesis of a random walk cannot be rejected for any variable at the 5 percent level.[8] Performing a test of the hypothesis of stationarity of the first differenced series accepts that they are all stationary. As a result, cointegration tests are performed on the levels of the CPI, as is consistent with previous real exchange rate tests.

Table 1
Results of Dickey-Fuller Tests of the CPIs of Four Metropolitan Areas
Level at which the hypothesis that the series is a random walk can be rejected:

Metropolitan Area	Total	Shelter	Ex-Shelter	Reconstructed (Ex-Shelter)
New York	.998	.218	.405	.999
Philadelphia	.999	.391	.295	.295
Los Angeles	.998	.982	.298	.998
Chicago	.999	.964	.437	.999

Sample period: 1967:12–1992:3.

Table 2
Results of Cointegration Tests of the Six Possible Exchange Rate Combinations of the CPIs of Four Metropolitan Areas

Metropolitan Areas Compared	Level at which the hypothesis that the CPIs are not cointegrated can be rejected:
Chicago—Los Angeles	.04
Philadelphia—Chicago	.16
Philadelphia—New York	.04
New York—Chicago	.35
Los Angeles—New York	.36
Philadelphia—Los Angeles	.06

Sample period: 1967:12–1992:3

Table 2 presents the results of the cointegration tests comparing the total CPIs from all six possible combinations of the four regions. Only two of the six possible real exchange rates, the Chicago-Los Angeles and the Philadelphia-New York, accepted at the 5 percent level that the real exchange rate was stable. The other four appear to be random walks, violating PPP. Even within the same country, negative results are produced, similar to those found in the international literature examining the stability of the real exchange rate. In other words, no long-run relationship exists between the price levels in different regions of the same country.

[5] The BLS does not seasonally adjust CPI data at the metropolitan area level. Each raw series was adjusted using the SAS procedure for x-11. Three years of raw data were used to adjust the first year of sample data. Each succeeding year was adjusted with an additional year of raw data until 10 years of raw data were available. For the remainder of the sample a 10-year rolling base of raw data was used.

[6] The BLS changed its procedure for calculating this subcategory in 1980. The total from 1956 to 1980 was calculated using a different method for shelter. Thus, the only shelter series the BLS presents goes back to 1980. However, the shelter, ex-shelter, and total series are consistent for all four cities in any one year, though they differ from pre-1980 to post-1980. All that matters for this test is that they are the same at each point in time.

[7] The total CPI is simply a weighted average of the shelter and ex-shelter components; thus, the missing ex-shelter subindex can be backed out of the total and shelter indices if the weights used in the construction of the total for each city can be obtained. These weights were available for each city back to 1967. Thus the results cover the period from 1967:12–1992:3. Extrapolating the 1967 weights back to 1956 produces a longer, though less reliable, series.

[8] Adjusted Dickey-Fuller tests were also performed to test for stationarity. The adjusted Dickey-Fuller tests were basically consistent with the unadjusted tests in Table 1. The unadjusted are used because no obvious problems were found with the error terms in the unadjusted tests.

It is important to note that some components of the CPIs for the different regions could be stationary, or cointegrated, while others are not. For example, say an index is the summation of two components, X and Z,

$$T = X + Z, \quad (5)$$

and these two parts have different time series properties: X is stationary and Z is not. T will then be a nonstationary variable even though it has a stationary component. The nonstationarity of the one component will mask the stationarity of the other. Similarly, if two different series, T_i and T_j, have components X_i and X_j that are cointegrated and components Z_i and Z_j that are not, then T_i and T_j will not be cointegrated. Given that the total CPI is the weighted average of the traded and nontraded goods components, it is possible that the source of the violation of PPP is the failure of the nontraded goods prices to be cointegrated.

Labor and capital may be very mobile, but some factors and goods, such as land, are not. Conventional wisdom also says that some prices, for example housing expenses, do seem to differ even in the long run between regions of the country. Certainly the price of land in San Francisco has behaved very differently than has its counterpart in Philadelphia. Although the supply of useful land and housing, as well as factor mobility from high-cost to low-cost regions, would tend to equilibrate these prices, aside from compensating differentials, factor mobility does not appear to have accomplished this feat in the last decade.

Because of the nontradable nature of land, the price indices for each metropolitan area were separated into shelter and ex-shelter components. The shelter component includes housing and renters' costs, which are very sensitive to the differential in real estate prices. This subindex certainly represents a large part of the nontraded goods component of the total CPI. A cointegration test was then performed on each subindex, to see if nontraded shelter is the source of the negative results on the cointegration tests of the total CPIs.

Table 3 presents results for both the shelter and the ex-shelter components for all combinations of the four cities. In four of the six city-by-city comparisons, the expected pattern holds; the two shelter subindices are not cointegrated while the ex-shelter indices are. Only New York violates this pattern; its behavior with Chicago and Los Angeles was unstable in both subcategories. Otherwise all city combinations suggest that the nontraded goods elements contained in the CPI strongly tilt the total CPI results toward a rejection of PPP. The shelter component, representing about one-quarter of the total CPI, appears to be a major cause of the instability of the real exchange rates between these areas. Conversely, the real exchange rate between different areas of the United States for traded goods was generally stable.

Table 3
Results of Cointegration Tests of Subindexes of the CPIs of Four Metropolitan Areas

Metropolitan Areas Compared	Level at which the hypothesis that the subindexes are not cointegrated can be rejected: Ex-Shelter	Shelter
Chicago—Los Angeles	.0002	.49
Philadelphia—Chicago	.001	.91
Philadelphia—New York	.03	.31
New York—Chicago	.22	.24
Los Angeles—New York	.19	.99
Philadelphia—Los Angeles	.005	.15

Sample period: 1967:12 to 1992:3.

IV. Implications

These simple results must be interpreted with care, since the methodology used here is not powerful. Dickey-Fuller tests assume that the variable is a random walk. As Hakkio (1986) discusses, the power of these tests is not great, and the results are only indicative. It is likely that the null of a random walk will be accepted when it is false, making it harder to prove that PPP holds. A longer sample is needed with low-power tests. Unfortunately, the importance of PPP as a theoretical device is diminished if it holds only over centuries.

Even given the low power of these tests, however, the finding of unstable real exchange rates between regions in the United States is surprising, and the cause of this instability may shed light on the origins of the negative results from international data. Looking within a single country makes it more likely that cointegration of the price levels will occur,

since some of the traditional explanations for failure in the international tests are largely avoided in a regional study. The major reason for the finding of an unstable real exchange rate here appears to be the presence of nontraded goods in the CPI.

International Implications

In the international tests, the failure to factor out the nontraded goods component makes it impossible to fully test PPP. Factor mobility is even lower internationally than regionally, leaving very little reason to believe that nontraded goods prices should equilibrate, and more reason to believe nontraded goods prices will determine the results of the real exchange rate tests. If the international tests are to mean anything substantive, if it is important to determine whether or not the real exchange rate is a random walk, then better attempts must be made to control for the nontraded goods in the international indices. Within the United States, it has been shown that the distinction between traded and nontraded goods in the price indices determined the stability of the real exchange rate.

These results are also suggestive because they show that the nominal exchange rate is not responsible for either the short-run or the long-run relative instability of the real exchange rate. Although in international economics the correlation between the nominal and the real exchange rates is high, this study using regional price indices shows that nominal exchange rate volatility need not be an important corollary to real exchange rate instability. Thus, the exchange rate regime is not vital to the finding of instability in the real exchange rate, and arguments for fixed exchange rate regimes built on this evidence are tenuous.

If international tests are to mean anything substantive, then better attempts must be made to control for the nontraded goods in the international indices.

Domestic Implications

The instability in the real exchange rates between regions of the United States is also relevant to the issue of regional shocks and regional disequilibria. If all shocks were national, the real exchange rates between these regions would be stable; it is the interregional disturbances that create real exchange rate movements. The empirical findings in this article support the conclusion that the nontraded goods of a region bear the brunt of the effects of regional disturbances, whether positive or negative. If, for example, the demand for region A's product declines while the demand for region B's increases, either real wages for producers in region A fall or unemployment increases. Blanchard and Katz (1992) find that real wages tend to be rigid, with unemployment ensuing. As a result, labor moves to the high-wage, high-job region B. The decline in employment and income in region A decreases the demand for the nontraded good and, assuming an elasticity of supply for this nontraded good that is less than infinity, the price will fall. The price of the nontraded good in region B rises, again depending on its elasticity of supply. Essentially the losses from the disturbance fall on the immobile, nontraded goods. In equilibrium, unemployment disappears, and the real exchange rate of nontraded goods permanently changes.

Yet is this an equilibrium, since nontraded goods prices are lower in region A and capital and labor are mobile? Why would firms not move from region B to region A and produce at lower costs, either because the nontraded good is a factor of production or because labor has to be paid less, nominally?[9] Unless the goods produced in region B need some other fixed local endowment for their production, then the price of nontradables across regions should also equate in the long run. The long-run instability of the real exchange rate is evidence either for a nontraded, immobile factor needed in the production of the goods from each region, or for economies of scale, so that the growing areas tend to have lower costs and higher productivity. The failure of the nontradable goods prices to be cointegrated could support either increasing returns to scale or specialization due to different regional endowments.

[9] Although it is assumed that the real wage paid to the worker is fixed, regional prices decline with the decline in the price of nontraded goods. Thus, nominal wages could fall in region A, or fail to grow as fast as in region B.

If, however, real wages are flexible, then real exchange rate instability can support a conclusion of labor immobility. With immobile labor, the initial unemployment in region A eventually forces down the real wage in that region. Incomes fall and the price of nontradables declines. Without perfect mobility of labor, it is unavoidable that the price of nontradables will diverge among regions. Still, capital could move to the region with the lower wages and nontradable goods prices, so a reason why capital does not move is also required, in order to explain long-run real exchange rate movements. Many plausible explanations for interregional labor immobility can be found, but few clear reasons exist for capital immobility. One possible reason capital may not move to a low-wage region is that labor is not homogeneous between the two areas; in this case, region A labor will not be as productive as region B labor with region B capital. This heterogeneity would also explain why labor would not move. Alternatively, firms may simply set nominal wages equal to the value of labor's product for the firm. As a result, unemployment need not decrease wages in region A and capital would have no reason to move into that area. Either story predicts that the long-run real exchange rate for nontradables would be unstable.

The policy implications of this story are more interesting still. Traditional analysis would suggest that labor mobility determines whether two regions are an optimal currency area. Labor and capital mobility should force both wages and prices of nontraded goods to equilibrate between regions. Since labor is not mobile, and wages are sticky, a nominal exchange rate depreciation would cure the short-run unemployment problem. The price of tradables would rise relative to nontradables, but the region avoids the transitory unemployment. In this case, the real exchange rate data could be suggesting that the best social policy is to break the United States into different currency regions!

These results show that the nominal exchange rate is not responsible for either the short-run or the long-run relative instability of the real exchange rate.

V. Conclusion

The results of these simple tests of PPP are suggestive. Real exchange rates are not stable when measured by total consumer price indices of the regions in the United States; PPP fails within the United States. Even without the additional problems often cited as reasons for real exchange rate instability in the international comparisons, PPP fails. One major cause of this failure appears to be the inclusion of nontraded goods in these indices. Nontraded goods are less of a problem in interregional trade because no tariff or nontariff barriers to trade exist; thus, this finding must understate the problems found in international empirical literature.

Before other theories are stressed based on the instability of the real exchange rate, care should be given to eliminating the nontraded elements of whatever index is chosen for study. Furthermore, if one wishes to prove that changes in the relative prices of traded to nontraded goods in different countries are the source of the real exchange rate instability, as postulated in real business cycle theories, then a direct proof of nontraded goods prices as the cause should be undertaken.

One interesting sidelight of this research is its implication for regional performance and policy in the United States. Obviously, conclusions can only be tentative, since the power of the tests is weak and no further analysis has been performed. What causes the prices of nontraded goods in different regions to diverge in the long run? Certainly regional booms and busts, caused by shocks to the productivity of a region's endowments, almost by definition have long-run effects on the real exchange rate, but long-run divergences between diversified regions like the four metropolitan areas in this study are not so easy to explain, even by real business cycle theorists. It will be necessary to discover the causes of real exchange rate instability between regions—whether shocks to regional endowments or problems with labor and capital mobility—in order to solve the problems, such as diverse and persistent regional unemployment rates, associated with these swings in the real exchange rate.

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