A Review Essay on Purchasing Power Parity

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Ⅰ. Introduction

This paper reviews both the theoretical foundation of purchasing power parity (PPP) and the empirical evidences of it. Purchasing power parity is a simple proposition that once converted to a common currency, price levels across countries should be equal. Given no trade impediments such as transportation costs, tariffs, nontariff barriers, and other possible frictions, international goods market arbitrage ensure the law of one price (LOP) over a set of tradable goods. This implies that aggregate price levels should be highly correlated internationally.

Gustav Cassel (1916) argued that the rate of exchange between two countries is primarily determined by the quotient between each country's real purchasing power of money. He also proposes to call this real parity "The Purchasing Power Parity". But this kind of notion has been traced to the scholars of the Salamanca school in the sixteenth century Spain. The proponents of PPP assert that the exchange rate would be set to equilibrate to a ratio of aggregate price indices for the two countries

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(absolute version of PPP) or weakly that the percentage change in the exchange rate should equal the difference between the percentage rate of inflations in the two countries (relative version of PPP).

A few empirical regularities are found in an exstensive and ever growing literature on PPP. The first thing is that PPP does not hold in the short run, especially under flexible exchange rate regime. Furthermore the deviations from PPP fade out glacially at the rate of 15 percent per year rather than die out quickly (1 to 2 years). This represents the long term convergence of PPP, which reinforce the traditional arguments that PPP is a long-run relationship between the domestic price level and the exchange rate adjusted foreign price level. That is, PPP deviations are persistent over the medium run of about 3 to 4 years. These persistent deviations from PPP are not fully explained by the price regidity. Rudiger Dornbush(1976)' real exchange rate overshooting hypothesis implies that deviations from PPP should die out quickly over 1 to 2 years. There are still no ways to reconcile the short-term volatility of real exchange rates with the extremely slow convergence of PPP. Kenneth Rogoff (1996) calls this "the purchasing power parity puzzle". The second is that PPP woks well with fixed exchange rates relative to flexible rates. The institutional asrgument for this is found in Ronald Mckinnon (1993). According to him, under the gold standard during the years 1879-1913 the exchange rate variation band is small relative to the "fixed-rate" dollar standard (1950-1970), and the common price level was autonomously or automatically determined by the worldwide supply of and demand for gold; purchasing power parity across countries generally hold when measured by whole sale price indices.[1]

Rudiger Dornbush (1976) argued that given short-run price stickiness, monetary shock overshoots the real exchange rate from the equilibrium level of real exchnge rate in the short run. This implies that PPP deviations represented by real exchange rate differentials could occur in the short run. Comparing the real exchange rate behavior between fixed and flexible exchange rates, Michael Mussa(1986) forcefully

1) According to Ronald Mckinnon (1993), the joint interaction with U. S. real output and its money supply determines the U.S. price level for tradable goods. Through the fixed exchange rate, there is a direct link from the U.S. tradable goods' price levels to the price levels for tradables in the rest of the world.

showed that real exchange rate tends to be more volatile under flexible exchange rates than under fixed exchange rates. He attributes the different behavior of real exchange rate between two regimes to the short-run regidity of prices. In contrast to this argument, Equilibrium approach to real exchnge rate determination (e.g. Alan Stockman (1980); Robert Lucas (1982)) says that real exchange rate is just a relative price between domestic and foreign goods, which implies that real exchange rate is endogenously determined as the result of individual optimization to clear markets; in this case, the real exchange rate could be in some equilibrium level other than the PPP level regardless of the exchange regime.

Lastly, purchasing power parity works well when monetary shocks are overwhelmingly predominant. Empirical support for this is found in Jacob Frenkel (1978). Under more stable monetary environments, purchasing power parity does not hold (e.g., Jacob Frenkel (1981); Paul Krugman (1978)).

Note that both the exchange rate and each country's aggregate price level are determined simultaneously and endogenously in the real world. Considering this simultaneity and the endogeneity of the exchange rate and the aggregate price level, the purchasing power parity would be regarded as the equlibrium relationship of each country's real purchasing power rather than a precise theory of exchange rate determination.

In section 1, we discuss the theoretical formulation for PPP. In section 2, we also review the purchasing power disparity from the theoretical point of view. In section 3, we show the empirical evidences for both falure of PPP and the support for PPP, and also discuss the relative importance of PPP shocks. In section 4, we discuss the macroeconomic implications for the deviations from PPP. Finally concluding remarks follow. In the appendix we derive the the real exchange rate in terms of monetary shocks and real shocks using Dornbush's discrete time version model. monetary shock does matter in the movements of real exchang rate in the short run, which deemed to be neutral in the long run. Of course permanent real shocks can induce permanent changes in the real exchange rate.

Ⅱ. Theoreical Review for PPP

The law of one price (LOP) is the basic building block for any variation of purchasing power parity. The law of one price simply states that given no transportation costs and official trade barriers (tariff and nontariffs), internationally integrated competitive market ensures the same world price for the identical tradable good when converted into common currencies. As Rudiger Dornbush(1885) argued, the law of one price for individual goods extends to the aggregate price levels under the condition that 1) domestic price index function has the same functional form with the foreign price index function and 2) the same goods enter each country's market basket. In this context, the spatial arbitrage of the law of one price takes the following formula of the strong or absolute version of PPP.

$$(1)\quad P = EP^*,$$

where E is the exchange rate, P^* is the foreign price level, and P is the domestic price level.

In equation (1), the right - hand side is the foreign price level which is expressed in domestic currency units.

This absolute version of PPP implies that the real exchange rate ($EP^*=P$) is 1 at all time spans. As we show, the absolute version of PPP holds under the very hypothetical economy. In reality, this hypothetical economic environment is not true. In the presence of trade impediments, the law of one price does not hold. As we have already argued, the failure of the law of one price does lead to the debacle of the absolute version of PPP, which implies that the real exchange rate (EP^*/P) is not 1.

With no trade obstacles, perfect commodity arbitrage ensures that the law of one price prevails throughout the world. Notice that the failure of the LOP for individual good does not mean market failure. Market efficiency would be obtained privided that the price mechnism could capture all of the trade impediment costs. Trade impediment themselves do not indicate market inefficiency.

Even though the law of one price would not prevail in the real world, it will not

preclude the fact that the domestic price level is highly correlated with the foreign price level in common currency units. This yields the weak or relative version of PPP which relies on the Cassel - Ricardo Neutral money version of PPP. As Gustav Cassel (1916) said, in the presence of usually different rates of money supply between countries during a war, the rate of exchange should be expected to deviate from its old parity in proportion to the inflation rate of each country[2] As Paul Samuelson (1964) argued, Gustav Cassel's PPP doctrine simply means that the economy is in a standard money neutrality proposition. The absolute price level of all goods could double or halve without affecting the relative prices and thus the real resource allocation pattern.

The weak or relative version of PPP states that the percentage change in the exchange rate equals the percentage change in the relative price between two countries. This statement has taken the following form.

$$(2)\quad EP^* = rP$$

where r is any constant. In other words : $(E(t)/E(t-1))(P^*(t)/P^*(t-1)) = (P(t)/P(t-1))$ where t subscripts denote time.

Note that r is any constant reflecting the given obstacles to trade. As we have already argued, PPP theory is an equilibrium relationship between the domestic price level (P) and the foreign price level (EP^*), rather than the precise theory of the exchange rate determination. In the time series context, if there is an equilibrium relationship between P and EP^*, there should exist a unique cointegrating vector which makes the linear combination of P and EP^* stationary[3]. In this case, P and EP^*

2) Under the gold standard (1879 - 1914), the exchange rate is the relative gold price between two countries. The outbreak of World War I has collapsed the gold standard as speculators rushed to convert their currencies into gold in expecting the devaluations of their currencies. In reestablishing the new relative gold parities (virtually the exchange rate) after the war, Gustav Cassel proposes to use the PPP exchange rate as the new gold parities. For more details, see the Kenneth Rogoff (1996).

3) Following Engle and Granger (1987), we know that two time series - $E(t)P^*(t)$ and $P(t)$ - are cointegrated of order (d, b) if :

1) $E(t)P^*(t)$ and $P(t)$ are integrated of order d. Thus, to have stationary stochastic processes, we should difference $E(t)P^*(t)$ and $P(t)$ d times.

2) there exists a scalar r ($r \neq 0$) such that the series $E(t)P^*(t) - rP(t)$ is integrated of order $(d - b)$.

For more detailed applications, see Kim and Enders (1991), and Walter Enders (1988)

are nonstationary stochastic processes.

In a strict sense, the absolute or strong version of PPP would not hold because the price index function would be different internationally and each country would produce different kinds of goods; furtheremore, there would be trade obstacles in a different way between countries. On the other hand, the relative version of PPP may hold in a weak sense if there is no money illusion in the economy. The constant r in the relative version of PPP would be circumventing the qualifications arising from any obstacles to the absolute version of PPP.[4]

The next issue is what kind of price index is appropriate in calculation of PPP. If we believe in money neutrality, any kind of price index, such as whole sale price index, consumer price index, Gross Domestic Product (GDP) deflator, production cost index, and relative export price index, can be used in calculation of PPP.[5] In a Ricardian framework, Paul Samuelson (1964) argued that production cost parity would not be appropriate in the sense that the borderline goods would be changed by the demand shock in some countries. The change in borderline goods causes the change in exchange rate. If we restrict ourselves within an artificial economy with constant returns to scale technology and perfect competition market structure, the marginal cost (market price) of any good is the function of only the factor prices. A money neutral economy does not alter the relative factor prices and thus not change the price level, which is the marginal cost of any good. In short, none of these price indexes would matter in a money neutral economy.

Note that the constqant r in the relative version of PPP is a function of economic environment, such as trade obstacles, demand condition, and the change in relative efficiency of labor. Then, we have to give attention to choosing the particular time span in an empirical study for PPP. The time span we choose may consist of different

4) Interpreting deviations from relative PPP can be very difficult. Nonstationarity of the real exchange rate means that the mean of the real exchange rate does not exist. This implies that r (EP*/P) is not a constant. In this case, an assessment whether the currency concerned is overvalued or not depends on the base year chosen.

5) Ronald Mckinnon (1993) argued that purchasing power parity holds only when measures in terms of whole sale price indices. His argument is based upon Ballasa - Samuelson hypothesis that different rates of productivity can lead to international differences in price movements when measured in terms of consumer or other price indices with nontradable components.

economic environments which give rise to a misleading PPP. Paul Samuelson (1964) argued this situation in the following way : if some economic balance such as trade balance is the function of real exchange rate, that is, $F(W/Rw) = 0$, where $W/Rw = P/EP^*$ and W and w denote unit labor costs at home and abroad in the respective currencies, then the function F could change.

As stated by Samuelson (1964, p. 153), "Naive PPP must assume that the function F is not a function with time. Sophisticated PPP asserts that F has not changed much or estimates how it has changed. Unless very sophisticated, indeed, PPP is a misleadingly pretentious doctrine, promising us what is rare in economics, detailed numerical predictions."

Ⅲ. Theoretical Review on Purchasing Power Disparities

Deviations from PPP can be explained in several different ways. In this section we first consider structural departures from PPP which cause equilibrium relative prices to change. The second thing we consider is transitory deviations from PPP. These transitory deviations from PPP are usually the result of the differential speed adjustment of prices in goods and asset markets. In addition to these deviations from PPP, econometric misspecification can yield misleading PPP estimates.

The structural deviations from PPP was first examined more than 30 years ago by Bella Balassa (1964) and Paul Samuelson (1964). They emphasized the importance of nonmonetary factors in the process of price determination in explaining the long-run deviations from PPP. In a Ricardian framework, they argued that the currency of the country with higher productivity was highly overvalued relative to that of the country with lower productivity. According to their argument, a very substantial overvaluation of the dollar can not be wholly attributed to statistical defects of the calculation. The critical assumption of their argument is that there is a sectoral difference of technology between traded and nontraded goods. With internationally smaller difference of technology in the service sector (nontraded goods sector) and perfect factor mobility within each country (equalized wages within each country), services will be relatively

more expensive in countries with higher levels of productivity. This implies that even though the law of one price does hold for tradable goods, the overall price level including the nontraded goods should be higher in technologically advanced countries.

Similar story with the Balassa - Samuelson hypothesis is found in Jagdish Bhagwati (1984). His theory depends on the assumption that with no factor mobility rich countries are more capital intensive relative to poor countries. Given that factor price eqalization theorem does not hold due to large initial factor endowment disparities between countries, the rich countries with a higher capital labor ratio will have higher wage rates. If countries have no technological difference in nontradable goods sector, then the price of nontradables in rich countries should be be higher than that in poor countries. Consequently overall price level in rich countries is higher than that in poor countries.

In the above line of framework, the real exchange rate (EP*/P) in fast growing countries will tend to appreciate and vice versa for relatively slow growing countries.[6]

Note that it is theoretically possible for the real exchange rate to be in equilibrium at a level other than the PPP level. In equilibrium exchange rate models (e.g., Stockman 1980; Lucas 1982), the equilibrium real exchange rate is determined endogenously as the result of optimizing behavior by agents in clearing market.

In addition to the structural departures from PPP, we are now in a position to explain the short - run deviations from PPP. Rudiger Dornbush (1976) argued that exchange raate overshooting would arise from the different adjustment speed of markets. That is, exchange rate and asset markets adjust quickly relative to goods markets. his argument is based upon the wage and price stickiness in the short run. Given price rigidities in the short run, monetary disturbances can cause the real exchange rate to deviate from its long run level.[7]

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6) A uniform rise in traded goods productivity at home will increase the wages in that sector, which implies a nationwide increase in wages. With no productivity gains in the nontraded goods sector, the price of nontraded goods will increase, which results in the increase in overall price levels.

7) Price stickiness arises not only from the long - term wage contract but also from the market imperfections. Old Keynesians assume the sticky prices as given. New Keynesians such as Gregory Mankiew (1985), George Akerlof and Janet Yellen (1985) and others attacked to find why price is sticky in the short run. Their explanation is that under imperfect market structure the agents (monopoly firms) must incur a small menu cost if they alter their posted price after an aggregate demand shock. Their implicit argument is that if any kind of demand shocks are negligible, they don't have to change the posted price.

Ⅳ. Empirical Evidences

1. Failure of PPP

Empirical studies on the LOP showd that it was flagrantly and systematically violated by empirical datas (e.g. Peter Isard, 1977;David Richardson, 1978). Peter Isard showed some evidence that the changes in exchange rate substantially alter the relative dollar equivalent prices of the most narrowly defined domestic and forreign manufactured goods for which prices can easily be matched. Furthermore, these relative price changes seem to persist for at least several years and can not be shrugged off as transitory. In this context, he casts doubt on forming the aggregate price index which obeys the LOP.[8]

The most striking finding on the deviations from LOP was found in Charles Engel (1993). His finding is that the relative prices of very similar goods across two counteries (e.g. U.S. and Canada) are more volatile than the relative prices of very different goods within either country).

David Hsieh (1982) has formed the determination of the real exchange rate by using the productivity approach with Ricardian framework. He emphasizes the real factors in the determination of the real exchange rates. His argument is that if real factors are as important in exchange rate determination as the nominal forces, then the monetary approach to exchange rate determination can explain only part of the movement of exchange rates. His econometric results are consistent with his view. Eventually, his work has supported Balassa's hypothesis of structural deviations from PPP.

Rudiger Dornbush (1985) has argued that, once real exchange rate (EP*/P) has followed random walk, PPP performance will depend upon the particular price index chosen for comparison. In his empirical study, he has used GDP deflators because they have a clear methodological definition. His empirical study showed that relative GDP deflators expressed in a common currency unit are far from constant, which implies that the weak version of PPP does not hold. He has shown some evidence that PPP performance depends upon different price indices (CPIs, WPIs, and GDP

8) This kind of evidences was followed by Alberto Giovanni (1988), Michael M. Knetter (1989, 1993) and others. Among them, Michael M. Knetter looks at 7-digit export unit values from a single source to multiple destinations. He finds that deviations from the LOP are proportionally dependent on transportation costs varying on shipping distances.

deflators) provided that real exchange rate movement is nonstationary. That is, different price indices yield a different correlation of inflation rates expressed in U.S. dollars. The stricking fact is that this result depends upon whether the data are quarterly or annual.

Jacob Frenkel (1981) has indicated two sources for the deviations from PPP. One is the real shocks to the economic system, which cause the relative price to change. He argued that the purchasing power disparities during the 1970s would be explained well by the real shocks (oil embargo, supply shocks, commodity booms and shortages, shifts in the demand for money, different productivity growth). The other one is the different speed of adjustment between the price indices of goods and services and the exchange rate. The modern monetary approach to exchange rate determination (Mussa, 1979) views the exchange rates as the relative prices of assets, which are fundamentally different from the price indices of goods and services. The exchange rates, like other asset prices, are very sensitive to the "news" that alters expectations concerning the future course of events. In this context, exchange rates reflect not only current circumstances but also reflect future events.

Using standard unit root tests, John Huizinga (1987) showed that deviations from PPP are short - run phenomenon. He also found the mean reverting behavior of major country real exchange rates except the Japanese yen. Implicit in his finding was that long - horizon data set would seem to make the PPP hold.

Note that even though we could not accept the absolute version of PPP, the possible equilibrium relationship between domestic and foreign price levels in common currency units can not be ignored. To capture the equilibrium relationship between price levels across countries, Corbae and Ouiliaris (1988), Enders (1988), and others used unit - root and cointegration tests to reject PPP for industrialized countries such as U.S., European, and Japanese economies. Most of the empirical studies on PPP have concerned the developed coutries. In this light, Kim and Enders (1991) have considered behavior of the real exchange rate for the Pacific Rim nations covering the developing nations. These nations - particularly Japan and Korea - represent rapidly growing nations with strong trading ties to the United States and Europe. They showed that domestic prices were not co - integrated with foreign price levels and the exchange rate using Korea as the referent nation.

Using data set from 1874 - 1971 for Norway and the United Kingdom, Edison and

Jan T. Kloveland (1987) found that output growth rates and terms of trade shocks are significant factors in explaining deviations from PPP. This result is consistent with the Balassa - Samuelson hypothesis. Cumulated current account deficits may induce the long - run real exchange rate depreciation.

2. Support for PPP

As we have already argued, the law of one price is the basic building block for PPP. Remarkably we found the empirical evidence for the LOP in the empirical study of Kenneth A Froot, Michael Kim, and Rogoff (1995). They found that the volatility of deviations from LOP has been remarkably stable over the several centuries.

Craig Hakkio (1984) reexamined the PPP theory in a multi exchange rate world. He argued that the failure of PPP would be the result of imprecise parameter estimates. That is, many of the emprical studies for purchasing power disparities use the bilateral exchange rate model which ignores the international interdependence. His multilateral exchange rate model take into account the cross sectional variability in the data set. By doing this, he was unable to reject the hypothesis that PPP theory holds in several currencies simultaneously.

Hali J. Edison (1987) asserted that a naive version of the PPP relationship did not represent the exchange rate (dollar/pound). After taking into account the effects of changes in structural factors, he has supported the Ricardo - Cassel neutrality version of PPP in the long run.

Contrary to the Keynesian theory, monetary approach to exchange rate determination asserts that exchange rate changes will be proportional to relative inflation rate. This assertion implies taht the causation runs from the change in the relative inflation rate to the change in the exchange rate. However, Paul Krugmann (1978) pointed out that simple regression tests lead people to reject the hypothesis of PPP. He also argued that the recognition of the endogeneity of both prices and exchange rates made PPP results considerably more favorable, while not definitive, to PPP hypothesis.

Jacob A. Frenkel (1981) argued taht PPP theory worked well in the 1920s but not during the 1970s. Contrary to this view, Davutyan and Pippenger (1985) contended that PPP did not collapse during the 1970s. They argued that Frenkel's finding of the collapse of PPP during the 1970s was due to the result of an increase in the

importance of real shocks relative to monetary shocks. In addition, they believe that PPP works at least as well under monetarty stability as it does during inflation.

Jeffrey A. Frankel (1985) found that the real exchange rate did not follow the random walk hypothesis in the long run. He was also unable to reject the random walk hypothesis in the short run. Thus, the hypothesis of the nonstationarity of the real exchange rate has not been established convincingly.

Proponents of PPP argued that the failure of supporting PPP was due to the lack of power. This implies that one must rely on longer data sets to reliably reject the random walk behavior of real exchange rates. In this context, James R. Lothian and Mark P. Taylor (1996) found strong evidence of mean - reverting behavior of dollar - stering and franc - stering real exchange rates using annual data spanning two centuries. Their econometric estimates imply a half life of PPP deviations of about 6 years for dollar - stering and a little under 3 years for franc - stering. Included in this line of empiriacal strategy are Niso Abuaf and Phillipe Jorion (1990), Jack D. Glen (1992) and others.

These studies have the consensus on the half - life of PPP devaitions of 3 - 5 years. The criticisms on this result came from the long horizon data sets which blend fixed and flexible exchange rate data. As Michael Mussa (1986) forcefully showed, the real exchange rates tend to be more volatile under floating than under fixed exchange rates. This implies that long samples required for statistical significance may be inappropriate because of regime changes.

To circumvent this kind of problems, Frankel and Rose (1996) reexamined the PPP deviations using a pannel data set including 45 annual post WWII observations for 150 countries. Their pannel even with post - 1973 flexible rate data shows the strong evidence of mean reverting of real exchange rates. Interestingly, in parallel with estimates obtained in the long - horizon data, Their results also strongly suggest an half life of PPP deviations of about four years.

3. The Relative Importance of PPP Shocks

The empirical finding until now is that PPP does not hold in the short run especially under flexible rates and that convergence to PPP is extremely slow. This raises the interesting question on the nature of the driving forces to induce the deviations from

PPP. There are two theoretically divergent views on the behavior of the real exchange rates. Rudiger Dornbush (1976) argued that given price stickiness in the short run the change in the real exchange rate simply reflects the change in the nominal exchange rate. Of course, the change in the nominal exchange rates should be induced by the monetary and financial shocks. An increase in the money supply initially causes real and nominal exchange rate depreciation. Over time, the real exchange rate converges to its equlibrium level.

Contrary to the above diseqilibrium view on the movements of the real exchange rates, equilibrium approach (e.g., Alan Stockman (1980); Robert Lucas (1982)) argued that the real exchange rate is not changed by the nomial shocks such as monetary and financial shocks. Only real shocks can induce the change in the real exchange rate since the real exchange rate is just a relative price between domestic and foreign goods. Their arguments are based on the price flexibility at any time.

These two approaches have the common view that real shocks does matter at any time span and that monetary shocks should be neutral in the long run. Given these two views, it is interesting to attempt to identify the sources of real exchange rate fluctuations during the flexible rates after 1973. The job of idetifying PPP shocks was done by Kim and Enders (1991). They have investigated the PPP relationships in the Pacific rim nations which experienced the rapid economic growth. Using unrestricted multivariate Vector Autoregression models containing the real exchange rate changes (deviations from PPP) and other macro economic variables, they showed that interest rates and industrial production do not appear to cause movements in real exchange rates. On the other hand, money shocks did Granger - cause the real exchange rate. In support of the long - run neutrality of money, money shocks did not cause permanent changes in the real exchange rate. Imposing the long - run neutrality of money, Richard Clarida and Jordi Gali (1994) showed that monetary shocks alone account for roughly 45 percent of the forcast error variance for the dollar - DM real rate over the modern floating rates, and 34 percent for the yen - dollar rate.[9]

9) The key identifying assumption is that money shocks should have temporary but not permanent effects on the movements of real exchange rates. They have employed the structural vector autoregression approach pioneered by Blanchard and Quah (1989).

V. Macroeconomic Implications of Purchasing Power Disparity

The deviations from PPP poses some macroeconomic issues. The issues considered are as follows. With strict PPP, there is no problem in comparing real incomes internationally. The failure of the relative version of PPP implies that the economies concerned are not in the money neutrality proposition. Then, there could be systematic deviations from PPP, which is the Balassa - Samuelson hypothesis. That is, purchasing power disparity implies that the relative prices between tradables and nontradables differ internationally. These internationally different relative prices can lead us to the distortion of international income comparison. As Paul Samuelson (1974) argued, one country's real income relative to its couterparts could be overstated or understated depending on the chosen price index.

Given the relative version of PPP, real interest differential between countries equals the expected rate of real depreciation : [10]

$$(3)\quad r = r^* + dq/q$$

where, r = domestic real interest rate, r^* = foreign real interest rate.

If the relative version of PPP holds, dq/q will vanish. With no restrictions on capital mobility, there would be international comovements in real interest rates. Balassa - Samuelson argument is that the economy with rapid ecnomic growth relative to its couterparts will show the real exchange rate appreciation. This implies that the relatively growing economy will experience the lower real interest rates than its couterparts. Following Rudiger Dornbush (1985), we can postulate the actual real exchange rate adjustment mechnism as follows : $dq/q = (1/s)(q' - q)$, where q' is the trend level of real exchange rate and s is a constant. The mechanism is that

10) With internationally free capital mobility, nominal interest parity condition should hold. That is, $R = R^* + (E^e - E)/E$, where R = domestic nominal interest rate, R^* = foreign nominal interest rate, E = nominal exchange rate, E^e = expected nominal exchange rate. Given the failure of the relative version of PPP, the real exchange rate should not be some constant. Then $q = EP^*/P$, where q = real exchange rate.
After taking logarithm of q, differentiating it with repect to time t yields the following equation : $[(dq(t)/dt)/q(t)] = [(dE(t)/dt)/E(t)] + [(dP^*(t)/dt)/P^*(t)] - [(dP(t)/dt)/P(t)]$. Substituting this equation into nominal interest parity condition yields equation (3).

once the real exchange rate deviates from the trend level of real exchange rate, then deviations from the trend rate die out with the adjustment speed (1/s). Substituting this mechanism into equation (3) yields equation (4).

$$(4)\quad q = q' - s(r - r^*)$$

Above equation implies that the country which experienced real exchange rate depreciation will have relatively lower real interest rates than its couterparts. Following the Keynesian absorption approach, we assume that $Y = f(q - q')$, wherre $f' > 0$, Y = real GNP. Then the macroeconomic policy implications would be as follows. Loosening monetary policy relative to its counterparts will eventually cause real depreciation so that real output will increase. The mechanism would be that the increase in competitiveness due to both the decrease in real interest rate and real exchange rate depreciation dominates the cost factor with the real exchange rate depreciation.

Note that the real exchange rate is the relative price of home goods between countries. Either persistent productivity differential or change in aggregiate demand patterns makes the real exchange rate deviate from its long - run level, which results in intrinsic differential interest rates across countries. Along this line of argument, we say that the real interest rate in developing countries is lower than that of developed countries.

The nonstationarity of the real exchange rate increases the portfolio diversification risk (Branson and Henderson, 1984). The deviations from PPP motivate the international portfolio diversification. If we assume the mean preserving spread for asset returns, then the nonstationarity of the real exchange rate will increase the risk premium.

Ronald Mckinnon (1988) has proposed a new monetary standard centered on fixed exchange rates between the Japanese yen, the German mark, and the U.S. dollar. His argument is summarized as follows (Rudiger Dornbush, 1987).

Ronald Mckinnon's position is that fixed exchange rates are superior to flexible exchange rates in the sense that :

1) With fixed exchanges, we can adjust to real disturbances and achieve price

stability.

2) In the presece of incomplete commodity markets and exchange rate volatility resulting from money demand shocks, fixed exchange rates are socially preferable to flexible exchange rates.

3) The real exchange rate could not affect the current account.

4) PPP is a good nominal anchor to equilibrium exchange rates.

5) World monetary growth should be targeted to achieve price level.

Contrary to this argument, with a microtheoretical approach, Harvey Lapan and Walter Enders (1980) argued that exchange regime comparison should be based on the people's preferences. Furthermore, in the presence nontraded goods, they argued that the relative prices (tradables versus nontradables) are more stationary in the flexible exchange rates.

Rudiger Dornbush (1987) argued that the trend changes in equilibrium real exchange rates between Europe, the U.S. and Japan occur because of the emergence of the newly industrialized countries like Korea, Brazil, and other trading countries. In this line of argument, our point is that if the real exchange rate is nonstationary, then the PPP exchange rate can not be used as a nomminal anchor to equilibrium exchange rates.

If we interpret the real exchange rate as the relative price of imprtables in terms of exportables, then the nonstationarity of the real exchange rates make the resource allocation pattern more complicated. Considering nontradable sectors, then the complexity of the resource allocation pattern would be strengthened.

Note that PPP is the major building block for the monetary approach to exchange rate determination. The nonstationarity of the real exchange rate implies that the exchange rate behavior suggested by the monetary approach is not appropriate.[11]

11) Not assuming PPP, we can costruct the generalized model of the long-run exchange rate. The basic idea in formulating the generalized model is that we combine the definition of the real exchange rate with national money-market equilibrium condition. Unlike the monetary approach, the real exchange rate is the additional determinants in explaining the long-run behavior of the exchange rate. Thus, the deviations from PPP induced by real shocks such as government spending, oil embargo, and etc. directly affect ths nominal exchange rate. For furthermore details, see Paul Krugman and Maurice Obstfeld (1991).

Ⅵ. Conclusion

We have reviewed both the theoretical foundation of PPP and the empirical evidences on it. The empirical evidences on PPP are summarized as follows. Firstly, purchasing power parity does not hold in the short run, especially under flexible rates. Furtheremore, the deviations from PPP do persist in the medium run, which is not fully explained by the price and wage regidities. Thus there is still no way to reconcile the short - term volatility of real exchange rates with the extremely slow convergence of PPP. Kenneth Rogoff (1996) call this "purchasing power parity puzzle". Secondly, purchasing power parity holds well with fixed exchange rates rather than with flexible rates. Thirdly, Purchasing power parity works well under the overwhelmingly predominant monetary environments.

As Balassa - Samuelson hypothesis indicates, in the presence of nontraded goods, structural deviations from PPP could occur. But the law of one price implies that aggregate price levels across countries should equal when measured by tradable goods price indices such as WPI. One possible reason for purchasing power disparities is due to imperfect commodity price arbitrage across countries. Even though the current trend of economic integration would facilitate the commodity price arbitrage across countries, we could not neglect the increasing possible frictions such as nontariff barriers. The ever - lasting imperfect commodity arbitrage across countries may induce the independent nominal exchange rate movements regardless with relative domestic price levels across countries. Therefore purchasing power disparities may persist over the medium run, even when measured by tradable goods across countries.

Even with above constraints on PPP, the empirical fact of long run convergence of PPP may suggest that it could be a useful guide in fixing the nominal exchange rate when new international monetary order (possible restoration to the pseudo fixed rates) is needed.

Appendix : Real Excahnge Rate Determination : Two - Country Version of the Rudiger Dornbush Model

Traditional theory of real exchange rate determination suggests that any variety

of monetary shocks can induce temporary but not permanent deviations from PPP. Real shocks, on the other hand, can induce changes in the real exchange rate; a real shock which is permanent can induce a permanent deviation from PPP.

To prove these propositions, we have employed a discrete-time version of the Rudiger Dornbush model;[12]

$$M(t) - P(t) = -a^{-1}R(t) + cY(t) \quad \cdots\cdots \quad (1)\ [\text{portfolio balance}]$$

$$M^*(t) - P^*(t) = -a^{-1}R^*(t) + cY^*(t) \quad \cdots\cdots \quad (1')$$

$$R(t) = R^*(t) + E(t+1) - E(t) \quad \cdots\cdots \quad (2)\ [\text{interest parity}]$$

$$P(t+1) - P(t) = b[E(t) + P^*(t) - P(t)] - dY(t) - fR(t) \quad \cdots \quad 3)\ [\text{price adjustment}]$$

$$P^*(t+1) - P^*(t) = -b^*[E(t) + P^*(t) - P(t)] - d^*Y^*(t) - fR^*(T) \quad \cdots \quad (3')$$

where P and E denote the domestic prices and the nominal exchange rate, * denotes foreign country's counterpart, M denotes money supply, and R denotes the nominal interest rate. The term Y(t) denotes a production level. All the parameters are positive constants. All variables but r are in logs. Price adjustment equations (3 and 3') represent the excess demand for domestic goods. For simplicity, we have assumed that both economies have the same parameter values in the portfolio balance equatioin.

To solve the model, we have to distinguish endogenous variables from exogenous variables. The endogenous variables are P(t), P*(t), E(t), R(t), and R*(t), whereas the exogenous variables are M(t), M*(t), Y(t), and Y*(t).

Substituting (1) and (1') into (2), (3), and (3') yields the following vector first-order difference equatuion :

$$rex(t+1) = Arex(t) + exog(t).$$

where $rex = [E, P, P^*]'$, $A = [(1, a, -a), (b, (1-b-af), b), (-b^*, b^*, (1-b^*-af)]'$, and $exgo = [(ac(Y-Y^*) - a(M-M^*)), -(d+fac)Y + faM, -(d^*+fac)Y^* + faM^*]'$. Here, of course, ' indicates the transpose of the matrix.

The stability condition in the vector difference equation restricts the parameter space. That is, the determinant $(A - \lambda i) = 0$, where the characteristic roots are less than

12) Following Rudiger Dornbush (1976), David Backus (1986), we have adapted the model in a two-country version. we have assumed the perfect foresight world.

1 in absolute value. Rewriting the above vector difference equation, then

$$[I - AL]rex(t+1) = exgo(t)$$

multiflying $(1 - AL)^{-1}$ in both sides then yields

$rex(t+1) = [I - AL]^{-1}exgo(t)$, where L is the lag operator.

If we assume that the characteristic equation has three distinct roots (for example, $|\lambda_1|>1$, $|\lambda_2|>1$, $|\lambda_3|<1$), then the paths of price levels $[P(t+1), P^*(t+1)]$ and the nominal exchange rate are determined by the future, current, and past values of the relative money supply shocks and the relative productivity shocks.[13]

We are now in a position to see the long-run properties of this model. Note that the "steady state" solution has the following properties :

1) Money supply "shock" has a temporary but not permanent effect on real exchange rates.

proof.

We have already proved the fact that the time paths of $E(t)$, $P(t)$, $P^*(t)$ are determined by the future, current, and past values of monetary shock, which implies that monetary shock has a temporary effect on the real exchange rate $[E(t) + P^*(t) - P(t)]$.

We are now in a position to prove the second part of the proposition; monetary shock has no permanent effect on the real exchange rate. Consider the steady-state version of the model;

$$M - P = -a^{-1}R + cY \quad \cdots\cdots \quad (1)$$

$$M^* - P^* = -a^{-1}R + cY \quad \cdots\cdots \quad (2)$$

$$0 = bQ - dY - fR \quad \cdots\cdots \quad (3)$$

$$0 = -b^*Q - d^*Y^* - fR \quad \cdots\cdots \quad (4)$$

where $Q = E + P^* - P$, and italic letters denote the steadty-state value of the variable.

Manipulating 3 and 4 yields Q and R;

$$Q = [dY - d^*Y^*]/(b+b^*), \quad R = -[b^*dY + bd^*Y^*]/f(b+b^*)$$

13) To map all bounded sequences into bounded sequences, we applies $(I-AL)^{-1}$ such that we choose the "backward" expansion if $|\lambda|<1$ and the forward expansion if $|\lambda|>1$.

Substituting R into (1) yields P;

$$P = M - cY + a^{-1}[-(b^*dY + bd^*Y^*)/f(b+b^*)]$$

Substituting R into (2) yields P^*;

$$P^* = M^* - cY^* + a^{-1}[-(b^*dY + bd^*Y^*)/f(b+b^*)]$$

Substituting P and P^* into Q, we can get E;

$$E = (dY - d^*Y^*)/(b+b^*) + (M - M^*) - c(Y - Y^*)$$

$\partial E/\partial M = 1$, $\partial P/\partial M = 1$; it shows the conventional homogeneity property.

$\partial Q/\partial M = 0$; monetary shock has no permanent effect on the real exchange rate.

Q.E.D.

2) Productivity shock (real shock) has a permanent effect on the real exchange rate.

proof.

$\partial Q/\partial Y = d/(b + b^*)$, $\partial Q/\partial Y^* = -d^*/(b + b^*)$; real shock does matter in the long run.

Q.E.D.

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