TWO SHORT PAPERS IN EXCHANGE RATE ECONOMICS

by

Meher Manzur
Chen Dongling
Kenneth W. Clements

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DEPARTMENT OF ECONOMICS
The University of Western Australia
Nedlands, Western Australia, 6009
REAL EXCHANGE RATES AND DIVISIA MOMENTS OF WORLD TRADE

by

Meher Manzur
Chen Dongling
and
Kenneth W. Clements

Economic Research Centre
Department of Economics
The University of Western Australia

Abstract

This paper introduces new indexes of prices and quantities of world trade and demonstrates their link with real exchange rates. These indexes are applied to data from the Group of Seven countries. One of our results is that the elasticity of exports with respect to the real exchange rate is .4.
Let $s_i$ be exchange rate of country $i$ ($i=1, \ldots, n$), defined as the domestic currency cost of $\$1$; $q_i$ be the volume of exports from $i$ to all other countries; $p_i$ be the price of exports from $i$ in terms of local currency; $p_i s_i$ be the $i\text{th}$ price in $\$1$; and $M = \sum_{i=1}^{n} p_i q_i$ be the value of exports from the $n$ countries, or "world trade" for short. Furthermore, let $w_i = p_i q_i / M$ be the value share of country $i$ in world trade; and $\bar{w}_i = (w_i + w_{i,t-1})/2$ be the arithmetic of $w_i$ in years $t-1$ and $t$.

Let $D$ be the log-change operator ($D x_t = \log x_t - \log x_{t-1}$). We define the Divisia price and volume indexes of world trade as

\[(1) \quad DP_t = \sum_{i=1}^{n} \bar{w}_i Dp_i t, \quad DQ_t = \sum_{i=1}^{n} \bar{w}_i Dq_i t.\]

The index $DP$ is the average growth in export prices, while $DQ$ is the corresponding volume index.

Let $Dp_i t$ be the log-change in US prices and $Dr_i t = Ds_i t - (Dp_i t - DP_t)$ be the change in the real exchange rate of country $i$; $Dr_i t > 0$ when there is a real depreciation of the currency of $i$. The deflated change in the real exchange rate is $Dr_i t - DR_t$, where $DR_t = \Sigma_{i=1}^{n} \bar{w}_i DDr_i t$ is a Divisia index. It can be shown (Manzur et al., 1990) that

\[(2) \quad Dr_i t - DR_t = - (Dp_i t - DP_t).\]

The expression $Dp_i t - DP_t$ is the change in the price of exports from $i$ relative to the world average. Consequently, equation (2) states that the deflated real exchange rate change coincides with change in
the relative price of exports from the country in question (apart
from sign). Under purchasing power parity, \( D_{pit} = D_{plt} - D_{plt'} \),
\( D_{rit} - D_{rt} = 0 \), and \( D_{plt} - D_{plt'} = 0 \), \( i = 1, \ldots, n \). Accordingly, the
relative price of a country's exports only changes when there is a
deviation from PPP.

Equation (1) defines first-order Divisia moments of the \( D_{pit} \)'s
and \( D_{qi t} \)'s. The corresponding second-order moments are the Divisia
variances,

\[
\Pi_t = \sum_{i=1}^{n} v_{it}(D_{pit} - D_{pt})^2,
\quad \Xi_t = \sum_{i=1}^{n} v_{it}(D_{qi t} - D_{qt})^2.
\]

These measure the degree to which export prices and quantities vary
disproportionately. When all prices and quantities change
proportionately, these two variances vanish. In view of (2), \( \Pi \) also
measures real exchange rate variability.

Using data from the 0-7 countries (so that \( n=7 \)), the price
and quantity indexes are given in columns 2 and 3 of Table 1. (Data
sources etc. are contained in Manzur et al., 1990, available on
request.) On average, export prices rise by 4.9 percent per annum,
while export volumes increase by 6.1 percent. The negative values of
\( \Delta P \) in the first half of the 1980s reflect the strength of the dollar.
Columns 4 and 5 of the table contain the variances. In 19 out of 26
cases, the quantity variance \( \Xi \) exceeds the price variance \( \Pi \); this
agrees with previous findings (Clements, 1982; Meisner, 1979;
Selvanathan, 1988; Theil and Suhm, 1981). Those years when \( \Pi \) is very
large (e.g., 1981 and 1986) coincide with large changes in nominal
exchange rates. As \( \Pi \) is the variability of real exchange rates, this
confirms previous findings that changes in nominal rates are
associated with deviations from PPP in the short run (see, e.g., Manzur, 1990).

The associated Divisia price-quantity covariance and correlation are

\[ \Gamma_t = \sum_{i=1}^{7} \bar{w}_{it} (D_{p_it} - D_{P_t})(D_{q_it} - D_{Q_t}) \]

\[ \rho_t = \frac{\Gamma_t}{\sqrt{\Pi_{t}} \sqrt{\Pi_{t}^{'}}} \]

These measure the comovement of real exchange rates and exports. The covariances and the correlations are given in columns 6 and 8, respectively, of Table 1. As can be seen, the correlation is negative in most cases, with an average of -.33. Thus, the enhanced (reduced) competitiveness brought about by a real depreciation (appreciation) on average stimulates (retards) exports. It can be shown (Clements, 1982) that under the conditions of (i) homotheticity and (ii) preference independence, the negative of the ratio \( \Gamma/\Pi \) is an estimate of the real exchange rate elasticity of exports. Using means, this ratio is \(-7.92/20.86 = -.38\), implying that a 10 percent real depreciation of the currency of country \( i \) stimulates its exports by about 4 percent.

The Divisia variance of the log-changes of the export shares is

\[ \phi_t = \sum_{i=1}^{7} \bar{w}_{it} \left[ D_{w_{it}} - \frac{1}{7} \bar{w}_{it} D_{w_{it}} \right]^2 \]

where \( D_{w_{it}} = \log w_{it} - \log w_{it-1} \). This \( \phi \) measures the change in the structure of world trade. Column 7 of Table 1 gives this variance.

The variances and covariances satisfy \( \phi_t = \Pi_t + \Pi_{t-1} + 2\Gamma_t \).

REFERENCES


IS TIME SLOWING DOWN? EVIDENCE FROM THE FOREIGN EXCHANGE MARKET

by

Meher Manzur*
Economic Research Centre
Department of Economics
The University of Western Australia

Abstract

This paper applies a new methodology for testing PPP to 1920s data. The results indicate that PPP performs quite well in both the short and long run. The results also identify two years as being a measure of the long run insofar as PPP is concerned. By contrast, the long run for the current floating rate experience is about five years. In this sense, (economic) time has slowed down.

* I am grateful to Ken Clements for his guidance in preparing this paper.
Manzur (1990) introduces a new methodology based on Divisia index numbers to test the purchasing power parity (PPP) hypothesis for all major currencies simultaneously. His results indicate that during the recent period of floating rates (i) PPP holds quite well as a long-run phenomenon; (ii) PPP does not hold in the short run; and (iii) the long run insofar as PPP is concerned is about five years. In this paper we apply the methodology to the flexible exchange rate experience of the 1920s. A comparison of the 1920s and the recent float allows us to analyze whether (economic) time has slowed down in terms of the speed of adjustment to the long run.

Let there be $n$ major countries in the world and let the price levels in these countries in terms of domestic currencies be $p_1, \ldots, p_n$. If the $n$ exchange rates (defined as the domestic currency cost of US$1) are $s_1, \ldots, s_n$, then these price levels in terms of US dollars are $p_1/s_1, \ldots, p_n/s_n$, which we write as $p_1, \ldots, p_n$. Consider a consumer who purchases the quantities $q_1, \ldots, q_n$ from the $n$ countries. The cost of this basket in US dollars is $p_1 q_1 + \ldots + p_n q_n = M$. Let $\omega_i = p_i q_i / M$ be the share of $i$ in $M$.

Writing $D$ for log-change operator ($Dx_t = \log x_t - \log x_{t-1}$), we define the Divisia indexes for the $n$ countries as

$$D_{Pt} = \frac{1}{n} \sum_{i=1}^{n} \omega_{it} Dp_{it}, \quad D_{P1} = \frac{1}{n} \sum_{i=1}^{n} \omega_{it} Dp_{it}^1, \quad D_{St} = \frac{1}{n} \sum_{i=1}^{n} \omega_{it} Ds_{it},$$

where $\omega_{it} = (\omega_{it} + \omega_{i,t-1})/2$ is the arithmetic of $\omega_{it}$ in periods $t-1$ and $t$. These indexes are weighted first-order Divisia moments of the $Dp_i$'s, $Dp_1$'s and $Ds_i$'s. The corresponding second-order moments are the Divisia variances: $V_{PP} = \sum_{i=1}^{n} \omega_{it} (Dp_{it} - Dp_{t})^2$, $V_{P1} = \sum_{i=1}^{n} \omega_{it} (Dp_{it}^1 - Dp_{it})^2$ and $V_{S} = \sum_{i=1}^{n} \omega_{it} (Ds_{it} - Ds_{t})^2$. These measure the degree to which prices and exchange rates vary disproportionately across
countries. The associated Divisia price-exchange rate covariances are
\( P_{it} = \sum_{i=1}^{n} \frac{v_{it} - d_{it}}{v_{it} - d_{it}} \) and \( v_{it} = \sum_{i=1}^{n} \frac{v_{it} - d_{it}}{v_{it} - d_{it}} \), while the domestic price-exchange rate correlation coefficient is \( \rho_t = \frac{\sum_{i=1}^{n} v_{it} - d_{it}}{\sqrt{\sum_{i=1}^{n} (v_{it} - d_{it})^2 \sum_{i=1}^{n} (v_{it} - d_{it})^2}} \).

The relative version of PPP states that the percentage change in the exchange rate is equal to the inflation differential: \( D_{sit} = D_{plt} - D_{plt} \), where \( D_{plt} \) is inflation in the US and \( D_{plt} \) is the deviation from parity. Under PPP, \( e_{it} = 0 \) and \( v_{it}^p = v_{it}^s = v_{it}^p = v_{it}^s = 0 \) and \( \rho_t = 1 \) (see Manzur, 1990). That is, under PPP (i) the domestic-currency price and exchange rate variances coincide; (ii) the variance of US dollar prices and their covariance with exchange rates both vanish; and (iii) domestic prices and exchange rates are perfectly correlated.

Using quarterly data for the period 1921(1) to 1925(1) for the US, the UK and France, we test the above restrictions for PPP. (Details of the data are given in a separate Appendix available on request. To avoid the results being dominated by the German hyperinflation, we omit that country.) Table 1 gives a summary of the data. Since the data in this table refer to averages over the seventeen-quarter period, they can be used to analyse the long-run relationship between exchange rates and prices. Columns 2 and 4 of the table reveal that, on average, exchange rates changes approximate inflation differentials, which is encouraging for PPP. The Divisia moments of these long-run data are given in Table 2. As can be seen, \( \bar{v}_{pl}^p = 0 \), while \( \bar{v}_{pl}^p \), \( \bar{v}_{pl}^s \) and \( \bar{v}_{pl}^s \) are not too different, as required by PPP. Remarkably, the value of the domestic-currency price-exchange rate correlation coefficient, given in column 8, is unity to two decimal places. Thus, PPP seems to work quite tightly in the 1920s as

<table>
<thead>
<tr>
<th>Country</th>
<th>Average (1)</th>
<th>Average price change (2)</th>
<th>Average inflation differential (3)</th>
<th>Mean exchange share (4)</th>
</tr>
</thead>
<tbody>
<tr>
<td>US</td>
<td>-0.03</td>
<td>-0.06</td>
<td>1.78</td>
<td>1.10</td>
</tr>
<tr>
<td>UK</td>
<td>0.03</td>
<td>-1.00</td>
<td>1.80</td>
<td>1.40</td>
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<tr>
<td>France</td>
<td>0.06</td>
<td>1.00</td>
<td>1.00</td>
<td>1.00</td>
</tr>
</tbody>
</table>

Entries in columns 1-3 are multiplied by 100 and those in columns 4-6 are multiplied by 1,000.

Table 3

<table>
<thead>
<tr>
<th>Year/quarter</th>
<th>Price index</th>
<th>Variance of</th>
<th>Price-exchange rate</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Domestic currencies</td>
<td>Domestic currency prices</td>
<td>Exchange rates</td>
</tr>
<tr>
<td></td>
<td>( v_{pl}^p )</td>
<td>( v_{pl}^s )</td>
<td>( v_{pl}^s )</td>
</tr>
<tr>
<td></td>
<td>(1)</td>
<td>(2)</td>
<td>(3)</td>
</tr>
<tr>
<td>1924(2)</td>
<td>28.16</td>
<td>2.03</td>
<td>38.70</td>
</tr>
<tr>
<td>1924(3)</td>
<td>7.81</td>
<td>14.91</td>
<td>16.61</td>
</tr>
<tr>
<td>1924(4)</td>
<td>5.72</td>
<td>20.29</td>
<td>28.66</td>
</tr>
<tr>
<td>1925(1)</td>
<td>4.69</td>
<td>6.35</td>
<td>16.16</td>
</tr>
<tr>
<td>1925(2)</td>
<td>4.16</td>
<td>4.90</td>
<td>8.72</td>
</tr>
<tr>
<td>1925(3)</td>
<td>23.42</td>
<td>9.71</td>
<td>17.79</td>
</tr>
<tr>
<td>1925(4)</td>
<td>7.32</td>
<td>16.14</td>
<td>23.46</td>
</tr>
<tr>
<td>1926(1)</td>
<td>1.26</td>
<td>24.75</td>
<td>16.84</td>
</tr>
<tr>
<td>1926(2)</td>
<td>14.74</td>
<td>2.27</td>
<td>11.58</td>
</tr>
<tr>
<td>1926(3)</td>
<td>5.33</td>
<td>3.04</td>
<td>8.37</td>
</tr>
<tr>
<td>1926(4)</td>
<td>17.10</td>
<td>14.00</td>
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<tr>
<td>1927(2)</td>
<td>14.34</td>
<td>4.81</td>
<td>17.78</td>
</tr>
<tr>
<td>1927(3)</td>
<td>2.55</td>
<td>4.81</td>
<td>7.36</td>
</tr>
<tr>
<td>1927(4)</td>
<td>1.52</td>
<td>5.55</td>
<td>7.07</td>
</tr>
<tr>
<td>1928(1)</td>
<td>3.44</td>
<td>4.53</td>
<td>8.07</td>
</tr>
</tbody>
</table>

Mean: 0.00

All entries except those in the last column are multiplied by 10,000.
a long-run phenomenon.

Table 3 is the short-run (quarterly) version of Table 2. As can be seen from column G, the domestic price-exchange rate correlation is positive in most cases and on average is .48. This and other results of this table indicate that the performance of PPP is not too bad in the short run; in comparison to the short run in the 1970s and 1980s (Manzur, 1990), PPP works better in the 1920s. This finding agrees with Frenkel (1978). For further studies of exchange rates in the 1920s, see Bernholz (1982), Junge (1984) and Krugman (1978).

We also calculate the Divisia price-exchange rate correlations with changes in prices and exchange rates over two quarters, three quarters and so on, up to sixteen quarters. If \( k \) is the length of the change, we can write these as \( \rho_t(k) \), \( k = 1, \ldots, 16 \). For a given length of change, the average condition is \( \bar{\rho}(k) = \frac{1}{17-k} \sum_{t=1}^{17} \rho_t(k) \). These \( \bar{\rho}(k) \) are plotted against the length of change in Figure 1. It can be seen that the values initially increase with the length of the change and approach unity after about eight quarters; this upper value is in agreement with the long-run value of the correlation given in Table 2. Thus the results tend to identify two years as being a broad measure of the length of the long run insofar as PPP is concerned for the 1920s.

Interestingly, application of the same methodology to the 1970s and 1980s reveals that the long run is about five years (Manzur, 1990). Consequently, the passage of more than fifty years has meant that the time has slowed down in an economic sense. This is opposite to what one would expect on the basis of lowering of transport costs, faster international transmission of information etc. One explanation is the difference in the nature of the shocks to the international monetary system (Frenkel, 1981). If most of the shocks are of a monetary origin, as was case for the 1920s, internal relative prices would be more or less unaffected and the speed of adjustment to the long run faster. The opposite is the case if the shocks are real, as in the recent floating-rate period, the two oil-shocks in the 1970s and the US budget deficit being prominent examples.

REFERENCES


