Slides for Chapter 9

Determinants of the

Real Exchange Rate
The Law of One Price (LOOP)

says that a good should cost the same abroad and at home.

Formally, if LOOP holds, then

\[ P = P^* S, \]

where

- \( P \) = domestic currency price of the good
- \( P^* \) = foreign currency price of the good
- \( S \) = nominal exchange rate, (domestic currency price for 1 unit of foreign currency)
Examples of goods for which the LOOP holds:
Gold
Oil
Wheat
Luxury Consumer Goods (Hermes neckties, MontBlanc pens, Rolex watches, Beats, etc.)

Examples of goods for which the LOOP fails:
Big Mac [will discuss the Big Mac Index later]
Housing
Transportation
Haircuts
Restaurant Meals
Reasons Why the LOOP May Fail

• a good has non-traded inputs such as:
  – labor
  – rent
  – electricity

• government policies/regulations (taxes)

• barriers to trade (tariffs, quotas)

• pricing to market
From the idea of the LOOP to PPP Theory

PPP stands for Purchasing Power Parity

Generalize the law of one price (LOOP)

Let:
\[ P = \text{domestic currency price of a domestic \underline{basket} of goods} \]
\[ P^* = \text{foreign currency price of a foreign \underline{basket} of goods} \]
\[ S = \text{nominal exchange rate, [domestic currency per unit of foreign currency]} \]
\[ e = \text{real exchange rate (RER)} \]
Define $e$, the **real exchange rate** as follows:

$$e = \frac{SP^*}{P}$$  \hfill (*)

units? = \frac{\text{domestic baskets}}{\text{foreign baskets}}

If

$e = 1$, we say PPP (Purchasing Power Parity) **holds**.

$e > 1$, home basket is undervalued, or foreign basket overvalued.

If $\Delta e > 0$, we say the RER **depreciates**

$e < 1$, home basket is **overvalued**, or foreign basket **undervalued**.

If $\Delta e < 0$, we say the RER **appreciates**.
Suppose the LOOP holds for all goods, does PPP (i.e., $e = 1$) have to hold?

No, because the foreign and domestic baskets could

– contain different items
– have different weights for the same items.
Absolut PPP
We say that absolut PPP holds, when

\[ e = 1 \]

Relative PPP
We say that relative PPP holds, when

\[ \Delta e = 0 \]
How to test relative PPP?

Take logs of (*):

$$\ln e_t = \ln(StP_t^*) - \ln(P_t)$$

If relative PPP holds, then $\Delta \ln e_t = 0$ and hence $\ln(StP_t^*)$ should be moving over time in tandem with $\ln(P_t)$
Test 1 of Relative PPP in the long run:

The next graph tests relative PPP by plotting $\ln(S_tP_t^*)$ and $\ln(P_t)$ for the dollar pound real exchange rate over the period 1820 to 2001.

The broken line is $\ln(S_tP_t^{UK})$

The solid line is $\ln(P_t^{US})$
Dollar-Sterling PPP Over Two Centuries

Note: The figure shows U.S. and U.K. consumer price indices expressed in U.S. dollar terms over the period 1820-2001 using a log scale with a base of 1900=0.

Observations on the figure

1. Overall the comovement between U.S. and U.K. prices over the past 180 years has been very high! This suggests that relative PPP holds in the long run.

2. The dollar appreciated over the past 200 years vis-a-vis the Pound.
Test 2 of Relative PPP in the long run:

$P_t$ — U.S. Price level in dollars;
$P^*_t$ — foreign price level in foreign currency

Take the $k$-period log difference of (*)

$$\ln e_t - \ln e_{t-k} = \ln \left( \frac{P^*_t}{P^*_{t-k}} \right) - \ln \left( \frac{P_t}{P_{t-k}} \right) + \ln \left( \frac{S_t}{S_{t-k}} \right)$$
If relative PPP holds in the long run, then
\[ \ln e_t - \ln e_{t-k} = 0 \]

This implies that
\[ \ln \left( \frac{P_t^*/P_{t-k}^*}{P_t/P_{t-k}} \right) - \ln \left( \frac{S_t}{S_{t-k}} \right) = 0 \]

This equation says that the difference between foreign long run inflation and U.S. long run inflation should be equal to the rate of depreciation of the foreign currency against the dollar.

This is intuitive, a country with a higher rate of inflation than the United States should depreciate.
Taylor and Taylor test whether relative PPP holds in the long run by considering average inflation differentials and average depreciation rates against the U.S. dollar over the 29 year period 1970 to 1998 for 20 industrialized countries and 26 developing countries. Each country is one observation. If relative PPP holds in the long run, then a plot of long-run inflation differentials against long-run depreciation rates against the dollar should lie on the 45 degree line.

The next graph shows that this is indeed the case — providing more support to the claim that in the long-run relative PPP holds.

Note: The figure shows countries' cumulative inflation rate differentials against the United States in percent (vertical axis) plotted against their cumulative depreciation rates against the U.S. dollar in percent (horizontal axis). The sample includes data from 20 industrialized countries and 26 developing countries.

Q: Does Relative PPP hold in the short run?

A: No. As we saw above in the time series plot, the real exchange rate, which in that plot is given by the difference between the two lines, changes from year to year, and hence relative PPP fails in the short run.

Also recall from Chapter 8 that in monthly data we observed the following average changes in real exchange rates: over the short period September 1982 to January 1988

<table>
<thead>
<tr>
<th>Country</th>
<th>$\ln e_t - \ln e_{t-1}$ (in percent)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Germany</td>
<td>-6.35 %</td>
</tr>
<tr>
<td>Switzerland</td>
<td>-8.35%</td>
</tr>
<tr>
<td>France</td>
<td>-6.25%</td>
</tr>
<tr>
<td>Mexico</td>
<td>-3.32%</td>
</tr>
</tbody>
</table>

We conclude that in the short-run relative PPP does not hold. In fact $e_t$ is VERY volative in the short run.
Summary:

- Relative PPP holds over the long run.
- Relative PPP fails to hold over the short run.
- Changes in RER are highly persistent.
Absolute PPP

Absolute PPP holds if $e_t = 1$, that is if the purchasing power of $\$1$ is the same in the United States and abroad.

To test relative PPP we need only to observe

$\%\Delta S_t, \%\Delta P^*_t, \%\Delta P_t$

But to test absolute PPP we do need to observe the **level** of $P_t$ and not just an index.

It is very hard to get data for the level of $P_t$, because statistical agencies that produce the CPI typically publish an index and not the actual price level of a typical basket.
The 2003-07 ICP round, coordinated by the World Bank, represents the most extensive and thorough effort ever to measure PPP rates across countries. The PPP revisions were released December 17, 2007, and are preliminary estimates for the 2005 benchmark year. An extensive collection of detailed price data from across more than 100 emerging and developing economies replaces previous benchmark PPP estimates, which date to 1993 or earlier in most cases. Moreover, China participated in the survey program for the first time and India for the first time since 1985. For advanced economies, the Eurostat-OECD PPP program, which updates rates on a more frequent basis, provided the revisions for 46 other economies.
## Scope and coverage of data collection

<table>
<thead>
<tr>
<th>Category</th>
<th>Africa</th>
<th>Asia</th>
<th>CIS</th>
<th>OECD - Eurostat</th>
<th>Latin America</th>
<th>W. Asia</th>
<th>Ring</th>
</tr>
</thead>
<tbody>
<tr>
<td>Food and non - alcoholic beverages</td>
<td>356</td>
<td>223</td>
<td>198</td>
<td>422</td>
<td>147</td>
<td>353</td>
<td>281</td>
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<tr>
<td>Alcoholic beverages and tobacco</td>
<td>41</td>
<td>19</td>
<td>20</td>
<td>72</td>
<td>8</td>
<td>21</td>
<td>30</td>
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<tr>
<td>Clothing and footwear</td>
<td>128</td>
<td>78</td>
<td>104</td>
<td>319</td>
<td>136</td>
<td>162</td>
<td>132</td>
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<td>Housing and utilities</td>
<td>21</td>
<td>17</td>
<td>22</td>
<td>64</td>
<td>18</td>
<td>12</td>
<td>35</td>
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<tr>
<td>Furnishing and household equipment</td>
<td>95</td>
<td>85</td>
<td>91</td>
<td>460</td>
<td>77</td>
<td>83</td>
<td>124</td>
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<tr>
<td>Health</td>
<td>144</td>
<td>112</td>
<td>75</td>
<td>244</td>
<td>51</td>
<td>69</td>
<td>162</td>
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<td>Transportation</td>
<td>55</td>
<td>65</td>
<td>47</td>
<td>365</td>
<td>33</td>
<td>29</td>
<td>96</td>
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<td>Communication</td>
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<td>16</td>
<td>81</td>
<td>8</td>
<td>12</td>
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<td>Recreation and Culture</td>
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<td>70</td>
<td>79</td>
<td>336</td>
<td>54</td>
<td>59</td>
<td>96</td>
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<td>7</td>
<td>5</td>
<td>10</td>
<td>11</td>
<td>7</td>
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<tr>
<td>Restaurants</td>
<td>51</td>
<td>25</td>
<td>45</td>
<td>117</td>
<td>14</td>
<td>20</td>
<td>60</td>
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<tr>
<td>Misc., goods and services</td>
<td>34</td>
<td>56</td>
<td>36</td>
<td>136</td>
<td>22</td>
<td>31</td>
<td>44</td>
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<tr>
<td><strong>Total consumption</strong></td>
<td><strong>1000</strong></td>
<td><strong>776</strong></td>
<td><strong>740</strong></td>
<td><strong>2621</strong></td>
<td><strong>578</strong></td>
<td><strong>862</strong></td>
<td><strong>1035</strong></td>
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<td>General Government</td>
<td>50</td>
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<td>50</td>
<td>50</td>
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<td>Construction</td>
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<td>34</td>
<td>34</td>
<td>34</td>
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<td>34</td>
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<tr>
<td><strong>Equipment</strong></td>
<td><strong>108</strong></td>
<td><strong>108</strong></td>
<td><strong>108</strong></td>
<td><strong>108</strong></td>
<td><strong>108</strong></td>
<td><strong>108</strong></td>
<td><strong>108</strong></td>
</tr>
</tbody>
</table>
ICP contains 146 countries

China included for the first time

India included for the first time since 1985

The ICP Survey reports the real exchange rate. They call it the ‘Price Level Index’)

\[ \text{PLI} \equiv \frac{SP^*}{P} \]

where now \( P^* \) and \( P \) are actual price levels (and not indices!).

Here is what they find for the year 2005 (most recent available):
<table>
<thead>
<tr>
<th>Country</th>
<th>$e \times 100$</th>
</tr>
</thead>
<tbody>
<tr>
<td>United States</td>
<td>100</td>
</tr>
<tr>
<td>Ethiopia</td>
<td>26</td>
</tr>
<tr>
<td>Bangladesh</td>
<td>35</td>
</tr>
<tr>
<td>India</td>
<td>33</td>
</tr>
<tr>
<td>Pakistan</td>
<td>32</td>
</tr>
<tr>
<td>China</td>
<td>42</td>
</tr>
<tr>
<td>Germany</td>
<td>111</td>
</tr>
<tr>
<td>Sweden</td>
<td>124</td>
</tr>
<tr>
<td>Switzerland</td>
<td>140</td>
</tr>
<tr>
<td>Japan</td>
<td>118</td>
</tr>
</tbody>
</table>


⇒ *Absolute PPP fails!*
Why does absolute PPP fail?

One reason is that many goods are not traded internationally, and hence price discrepancies will not be arbitraged away via trade.

The price index is an average of all prices in the economy, traded goods prices, $P_T$, and nontraded goods prices, $P_N$

$$P = \phi(P_T, P_N)$$

Example:

$$P = (P_T)\alpha(P_N)^{1-\alpha}$$
Suppose the LOOP holds for traded goods:

\[ P_T = SP_T^* \]

but not for nontraded goods

\[ P_N \neq SP_N^* \]

Suppose the foreign price level, \( P^* \), is constructed as

\[ P^* = \phi(P_T^*, P_N^*) \]
The real exchange rate then is:

\[
e = \frac{SP^*}{P} = \frac{S\phi(P_T^*, P_N^*)}{\phi(P_T, P_N)} = \frac{SP_T^*\phi(1, P_N^*/P_T^*)}{P_T\phi(1, P_N/P_T)} = \frac{\phi(1, P_N^*/P_T^*)}{\phi(1, P_N/P_T)}. \tag{1}
\]

\[e > 1 \text{ if } \frac{P_N^*}{P_T^*} > \frac{P_N}{P_T}.\]
PPP Exchange Rates

PPP Exchange rates, $S^{ppp}$ in theory:

What nominal exchange rate would result in a real exchange rate of 1?

$$e = 1 = \frac{S^{ppp}_t P^*_t}{P_t}$$

Solve for $S^{ppp}_t$

$$S^{ppp}_t = \frac{P_t}{P^*_t}$$

Practical problem: typically price data is an index, but here we need a level, the actual cost of a certain basket of goods.
How are PPP exchange rates computed?

\[ S_{t}^{ppp} = \frac{P_t}{P_t^*} = \frac{S_t}{PLI} \]
Application: McDonald’s Big Mac Index

\[ P_{t}^{US} = \text{dollar price of a Big Mac in the U.S.} \]
\[ P_{t}^{i} = \text{local currency price of Big Mac in country } i \]

Then the PPP exchange rate, \( S_t^{PPP} \), is such that:

\[ S_t^{PPP} P_{t}^{i} = P_{t}^{US} \]

If \( S_t^{PPP} > S_t \), then

\[ P_{t}^{US} > S_t P_{t}^{i} \]

and we say that the dollar is overvalued (and the foreign currency undervalued)

If \( S_t^{PPP} < S_t \), then

\[ P_{t}^{US} < S_t P_{t}^{i} \]

and we say the dollar is undervalued (and the foreign currency overvalued).
The Big Mac index
Local currency under(-)/over(+) valuation against the dollar, %

<table>
<thead>
<tr>
<th>Country</th>
<th>80</th>
<th>40</th>
<th>0</th>
<th>+40</th>
<th>80</th>
</tr>
</thead>
<tbody>
<tr>
<td>Norway</td>
<td></td>
<td></td>
<td></td>
<td>7.80</td>
<td></td>
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<tr>
<td>Switzerland</td>
<td></td>
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<td>7.14</td>
<td></td>
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<tr>
<td>Brazil</td>
<td></td>
<td></td>
<td>5.25</td>
<td></td>
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<td>Canada</td>
<td></td>
<td></td>
<td>5.01</td>
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<tr>
<td>Euro area†</td>
<td>0.1</td>
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<td></td>
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<tr>
<td>Britain</td>
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<td></td>
<td>4.63</td>
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<tr>
<td>United States‡</td>
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<td></td>
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<tr>
<td>Australia</td>
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<td></td>
<td>4.47</td>
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<td>Turkey</td>
<td></td>
<td></td>
<td>3.76</td>
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<td>Japan</td>
<td></td>
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<td>2.97</td>
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<td>China§</td>
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<td>2.74</td>
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<tr>
<td>Russia</td>
<td></td>
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<td>2.62</td>
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<tr>
<td>Egypt</td>
<td></td>
<td></td>
<td>2.43</td>
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<td></td>
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<tr>
<td>Indonesia</td>
<td></td>
<td></td>
<td>2.30</td>
<td></td>
<td></td>
</tr>
<tr>
<td>South Africa</td>
<td></td>
<td></td>
<td>2.16</td>
<td></td>
<td></td>
</tr>
<tr>
<td>India**</td>
<td></td>
<td></td>
<td>1.54</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

*At market exchange rates (Jan 22nd 2014)
†Weighted average of member countries
Application: PPP Exchange Rates and Standard of Living Comparisons

• standard of living comparisons are tricky because of differences in relative prices.

• comparisons of per capita income (in $) tend to overstate the differences in real purchasing power between rich and poor countries because rich countries are systematically more expensive than poor countries.

Why? Because typically the price of nontraded goods is lower in poor countries.
Higher prices in rich countries
such differences in relative prices cause important differences in the basic measurements of real incomes and real standards of living

<table>
<thead>
<tr>
<th>Country</th>
<th>Per Capita GDP</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>US$</td>
</tr>
<tr>
<td>United States</td>
<td>41,674</td>
</tr>
<tr>
<td>India</td>
<td>707</td>
</tr>
<tr>
<td>US/India</td>
<td>59</td>
</tr>
</tbody>
</table>

Example:

At market exchange rates GDP per capita in the United States in 2005 was 69 times as large as that of India. However, at PPP exchange rate U.S. per capita GDP was only 19.6 times as large as that of India.

$707 can buy 3 times as many goods in India (at Indican prices) than it can in the U.S. at U.S. prices.
A new view of world economy

World Share of GDP
Based on market exchange rates

- Low-income economies, 2%
- Middle-income economies, 19%
- High-income economies, 78%

World Share of GDP
Based on PPP

- Low-income economies, 7%
- Middle-income economies, 32%
- High-income economies, 61%
Determinants of the Real Exchange Rate in the Medium Term:

The Balassa-Samuelson Model
Recall that:

\[ e = \frac{\phi\left(1, \frac{P^*_N}{P^*_T}\right)}{\phi\left(1, \frac{P_N}{P_T}\right)} \]

From here clear that the real exchange rate depreciates if \( \frac{P^*_N}{P^*_T} \) increases relative to \( \frac{P_N}{P_T} \).

Q: What could make \( \frac{P^*_N}{P^*_T} \) go up relative to \( \frac{P_N}{P_T} \)?

A: Productivity growth in the traded sector relative to the non-traded sector in the foreign country being faster than in the domestic country.
The Balassa-Samuelson effect is the tendency for countries with higher productivity growth in tradables compared to nontradables to have higher prices (and hence appreciated real exchange rates.

The Model

2 goods: $Q_T$ and $Q_N$

$Q_T =$ traded output
$Q_N =$ nontraded output
Production

Production of Tradable:

\[ Q_T = a_T L_T \]

Production of Nontradable:

\[ Q_N = a_N L_N \]

\( L_T \) = labor input in the traded sector
\( L_N \) = labor input in the nontraded sector
\( a_T \) = exogenous labor productivity in the traded sector
\( a_N \) = exogenous labor productivity in the nontraded sector
\( W \) = wage rate
Traded Goods Sector
Firms choose $Q_T$ and $L_T$ to maximize profits

$$\text{profits} = P_T Q_T - W L_T.$$ 

subject to

$$Q_T = a_T L_T.$$ 

Eliminate $Q_T$

$$\text{profits} = P_T a_T L_T - W L_T.$$ 

Choose $L_T$ to maximize profits

$$\frac{\partial \text{profits}}{\partial L_T} = 0 \Rightarrow P_T a_T = W$$

(*)
Nontraded Goods Sector
Firms choose $Q_N$ and $L_N$ to maximize profits

$$\text{profits} = P_N Q_N - W L_N.$$ 

subject to

$$Q_N = a_N L_N.$$ 

Eliminate $Q_N$

$$\text{profits} = P_N a_N L_N - W L_N$$

Choose $L_N$ to maximize profits

$$\frac{\partial \text{profits}}{\partial L_N} = 0 \Rightarrow P_N a_N = W \quad (**$$)
Combining (*) with (**) yields

\[ \frac{P_N}{P_T} = \frac{a_T}{a_N} \]  

That is, the Balassa-Samuelson model predicts that in equilibrium the relative price of nontradables in terms of tradables is inversely related to the ratio of labor productivity in the traded sector to that in the nontraded sector.

Is this prediction of the Balassa-Samuelson model borne out in the data?
Take natural logarithms of (2) and consider changes over time

\[ \% \Delta \left( \frac{P_N}{P_T} \right) = \% \Delta a_T - \% \Delta a_N \]

This expression says that the percent change in the relative price of nontradables is equal to the growth rate differential between factor productivity in the traded sector and the nontraded sector.

We wish to test whether this relationship holds over the long run in actual data.
De Gregorio, Giovannini, and Wolf (EER, 1994) collect data on $\%\Delta \left( \frac{P_N}{P_T} \right)$ and on $\%\Delta a_T - \%\Delta a_N$ for 14 OECD countries over the period 1970-1985.

That is they have 14 observations.

The next slide shows what they find.
Differential Factor Productivity Growth and Changes in the Relative Price of Nontradables

Note: The figure plots the average annual percentage change in the relative price of nontradables in terms of tradables, $\% \Delta \left( \frac{P_N}{P_T} \right)$, (vertical axis) against the average annual growth in total factor productivity differential between the traded sector and the nontraded sector, $\% \Delta a_T - \% \Delta a_N$, (horizontal axis) over the period 1970-1985 for 14 OECD countries. Source: José De Gregorio, Alberto Giovannini, and Holger C. Wolf, “International Evidence on Tradable and Nontradable Inflation,” European Economic Review 38, June 1994, 1225-1244.
Comments on the figure:

• If Balassa-Samuelson model is true, then all 14 observations should line up on the 45 degree line. This is not quite the case.

• Still the figure demonstrates that 15-year averages for OECD countries display a positive relationship between \( \% \Delta \left( \frac{P_N}{P_T} \right) \) and \( \% \Delta \left( \frac{a_T}{a_N} \right) \), as predicted by the Balassa Samuelson model.
What are the predictions of the Balassa-Samuelson Model for the Behaviour of the Real Exchange Rate?

A relationship like (x) must also hold in the foreign country

\[
\frac{P_N^*}{P_T^*} = \frac{a_T^*}{a_N^*}
\]

where

- \(P_T^*\) = foreign currency price of traded goods abroad
- \(P_N^*\) = foreign currency priced of nontraded goods abroad
- \(a_T^*\) = exogenous labor productivity in the traded sector abroad
- \(a_N^*\) = exogenous labor productivity in the nontraded sector abroad
Thus the Balassa Samuelson model predicts that,

\[
e = \frac{\phi \left( 1, \frac{P_N^*}{P_T^*} \right)}{\phi \left( 1, \frac{P_N}{P_T} \right)} = \frac{\phi \left( 1, \frac{a_T^*}{a_N^*} \right)}{\phi \left( 1, \frac{a_T}{a_N} \right)}
\]

Hence \( e \uparrow \), if \( \frac{a_T^*}{a_N^*} \) increases relative to \( \frac{a_T}{a_N} \), that is, the real exchange rate of the domestic country depreciates if relative productivity growth in the traded sector relative to productivity growth in the nontraded sector is faster in the foreign country than in the domestic country.
Suppose the price index is given by

$$\phi(P_T, P_N) = P_T^{1-\alpha} P_N^\alpha$$

then we have that

$$\% \Delta e = \alpha \left[ \% \Delta \left( \frac{a_T^*}{a_N^*} \right) - \% \Delta \left( \frac{a_T}{a_N} \right) \right]$$

Canzoneri, Cumby, and Diba (JIE, 1999) collect data on productivity differential for the United States, Germany, Italy and Japan over the period 1970 to 1993.

Consider the bilateral real exchange rate between the German Mark (DM) and the Italian Lira (£): According to the Balassa Samuelson model we have

$$\% \Delta e^{DM/\£} = \alpha \left[ \% \Delta \left( \frac{a_T}{a_N} \right) - \% \Delta \left( \frac{a_T^G}{a_N^G} \right) \right]$$
Over the long run, here 1970 to 1993, Balassa Samuelson explains well the observed real depreciation of the German mark against the Italian Lira.
Add discussion on effects of trade barriers on real exchange rates
Short Term Determinants of the Real Exchange Rate
Sudden Stops and the Real Exchange Rate

Case Study: The End of the Argentine Convertibility Plan

What was the Argentine Convertibility Plan? April 1991-December 2001, 1 peso = 1 dollar

<table>
<thead>
<tr>
<th></th>
<th>'99-'01</th>
<th>'02</th>
</tr>
</thead>
<tbody>
<tr>
<td>GDP Growth Rate</td>
<td>-2.8%</td>
<td>-10.9%</td>
</tr>
<tr>
<td>Inflation</td>
<td>-1.3%</td>
<td>41%</td>
</tr>
<tr>
<td>$S_{Peso}/$</td>
<td>1.0</td>
<td>3.5</td>
</tr>
</tbody>
</table>

Dec. 2001 Argentina defaults on its (domestic and) foreign debt. → leads to a cutoff from international capital markets. [This is called a Sudden Stop.]
What happens to the RER?

\[ e_{\text{Peso} / \$} = \frac{S_{\text{Peso} / \$}^P_{US}}{P_{Arg}} \]

Take log differences

\[ \% \triangle e_{\text{Peso} / \$} = \% \triangle S_{\text{Peso} / \$} + \% \triangle P_{US} - \% \triangle P_{Arg} \]
\[ = 250\% + 2.5\% - 41\% \]
\[ \simeq 200\%. \]

⇒ After the default Argentina experiences a real depreciation of about 200\%. 
How can we understand this?

– Tariff? — No, not really.

– Balassa Samuelson — Not that likely an explanation.

Here is a different explanation: The Sudden Stop ($C_T \downarrow$) caused the real depreciation.

The next slides provide some evidence in support of the claim that Argentina experienced a sudden stop in 2002.
Interest Rates shoot up
Figure 1.4. Interest Rate Spreads over U.S. Treasuries
(In basis points)

Source: Datastream.
Current Account Reversal

(the graph shows $-CA_t$)

- we see current account deficits until the year 2000

- then drastic current account reversal beginning in 2001 with current account surpluses in 2001 and 2002
Figure 1.2. Capital Flows
(In billions of U.S. dollars)
Large Real Exchange Rate Depreciation
Figure 2.1. Monthly Real Effective Exchange Rate
(1990 = 100)

Source: IMF database.
Large Contraction in GDP
Figure 1.3. Real Quarterly GDP Growth
(In percent)
Why did the Real Exchange Rate Depreciate so Much?

Recall

\[ e^{\text{Peso}/\$} = \frac{s^{\text{Peso}/\$}_{\text{US}}}{p_{\text{Arg}}} \]
\[ = s^{\text{Peso}/\$} \frac{\phi(P^\text{US}_T, P^\text{US}_N)}{\phi(P^\text{arg}_T, P^\text{arg}_N)} \]
\[ = \frac{\phi(1, P^\text{us}_N/P^\text{us}_T)}{\phi(1, P^\text{arg}_N/P^\text{arg}_T)} \]

Taking log differences

\[ \%\Delta e^{\text{Peso}/\$} = \alpha \left[ \%\Delta (P^\text{us}_N/P^\text{us}_T) - \%\Delta (P^\text{arg}_N/P^\text{arg}_T) \right] \]
\[ \simeq 0\% - \alpha \%\Delta (P^\text{arg}_N/P^\text{arg}_T) \]
\[ 200\% \simeq -0.75 \%\Delta (P^\text{arg}_N/P^\text{arg}_T) \]
So the question of why did the real exchange rate depreciate so much becomes: “Why did the relative price of nontradables fall so much in Argentina after the Sudden Stop”.
What happens in a **Sudden Stop**?

Narrative: Argentina had a large trade deficit before the Sudden Stop. With the default it has no more access to international capital markets. The CA must swing into balance, or surplus, $CA \geq 0$ and there must be a trade balance reversal from deficits to surplus, $TB => 0$. With a trade balance reversal domestic demand for traded goods falls, and absent any relative price changes domestic demand for nontraded goods also falls. Weak domestic demand for nontradables will lead to a decline in the relative price of nontradables bringing about a real depreciation.

We will embed this narrative into a theoretical model next.
The TNT Model

2 goods: $Q_T$ and $Q_N$

$Q_T$ = traded output

$Q_N$ = nontraded output

$P_T$ = domestic currency price of traded good

$P_N$ = domestic currency price of nontraded good

Law of one price holds for traded goods: $P_T = S P_T^*$
Production

Production of Tradables:

\[ Q_T = F_T(L_T); \quad F_T'(\cdot) > 0; ; \quad F_T''(\cdot) < 0; \]

\( L_T \) = labor input in the traded sector

Production of Nontradables:

\[ Q_N = F_N(L_N); \quad F_N'(\cdot) > 0; ; \quad F_N''(\cdot) < 0; \]

\( L_N \) = labor input in the nontraded sector
Labor Supply

Fixed Labor Supply: \( L = L_T + L_N \)

\( L = \) total labor supply

Increase in labor input in the traded sector must be compensated one for one by decreases in the nontraded sector

\[
dL_T = -dL_N \tag{3}
\]
Construct the **Production Possibility Frontier**

\[
dQ_T = F'_T(L_T)dL_T \tag{4}
\]

\[
dQ_N = F'_N(L_N)dL_N \tag{5}
\]

[insert graph]

What is the slope of the PPF?

Divide (5) by (4) and use (3) to obtain:

\[
\frac{dQ_N}{dQ_T} = -\frac{F'_N(L_N)}{F'_T(L_T)}
\]
This equations says that the slope of the PPF is equal to the marginal rate of transformation between traded and nontraded goods.

Suppose we move down the PPF, producing more tradables. Then $L_T$ must rise and $L_N$ must fall. This raises the marginal product of labor in the nontraded sector, $F'_N(L_N)$, and lowers the marginal product of labor in the traded sector, $F'_T(L_T)$. This is so because we are assuming that the production functions display decreasing returns to scale, which is to say we assume that the marginal product of labor is decreasing with labor.

This assumption then implies that the PPF becomes steeper as $Q_T$ rises. It follows that the PPF is concave towards the origin,

Our argument is that a Sudden Stop moves the economy down its PPF, reallocating production from the nontraded sector to
the nontraded sector. The above relation says that the sudden stop causes the economy to produce at a point where the PPF is steeper. But we want to link the Sudden Stop to a real exchange depreciations. Is there a link between the slope of the PPF and the relative price of nontradables in terms of tradables? We will show that link in the next slide.
Traded Goods Sector
Firms choose $Q_T$ and $L_T$ to maximize profits

$$\text{profits} = P_T Q_T - W L_T.$$ 

subject to

$$Q_T = F_T(L_T).$$

Eliminate $Q_T$

$$\text{profits} = P_T F_T(L_T) - W L_T$$

Choose $L_T$ to maximize profits

$$\frac{\partial \text{profits}}{\partial L_T} = 0 \Rightarrow P_T F_T'(L_T) = W$$

\[\text{(*)}\]
Nontraded Goods Sector
Firms choose $Q_N$ and $L_N$ to maximize profits

$$\text{profits} = P_N Q_N - W L_N.$$  

subject to

$$Q_N = F_N(L_N).$$

Eliminate $Q_N$

$$\text{profits} = P_N F_N(L_N) - W L_N$$

Choose $L_N$ to maximize profits

$$\frac{\partial \text{profits}}{\partial L_N} = 0 \Rightarrow P_N F'_N(L_N) = W \quad (***)$$
Combining (*) with (**) yields

$$\frac{P_T}{P_N} = \frac{F'_N(L_N)}{F'_T(L_T)}$$

(6)

As we move down the PPF its slope becomes steeper and steeper implying that the relative price of nontradables relative to tradables falls.
A Sudden Stop is a situation in which the production of nontradables must fall and the production of tradables must rise. That is a move down the production possibility frontier. What will induce firms to shift production out of the nontraded sector and into the traded sector? The relative price of nontraded goods must fall.

Hence a Sudden Stop leads to a real exchange rate depreciation.
A Second Example of observing a large Real Exchange Rate depreciation after a Sudden Stop

Case Study: Chile 1979-1985

In 1982 (after the default of Mexico in August) credit dries up for highly indebted developing countries, particularly in Latin America. These countries were running large current account deficits. The Sudden Stop forces them to run TB surpluses to service their existing debts. What is the required external adjustment?

\[ Q_T \uparrow \quad \text{and} \quad Q_N \downarrow \]

This adjustment caused a large real exchange rate depreciation (and with it costly reallocations of production away from the nontraded sector towards the traded sector)
Chile, Real Exchange Rate Depreciation and Trade Balance Reversal, 1979-1985

<table>
<thead>
<tr>
<th>Year</th>
<th>$\Delta e$</th>
<th>$\frac{TB}{GDP}$</th>
</tr>
</thead>
<tbody>
<tr>
<td>1979</td>
<td>-1.7</td>
<td></td>
</tr>
<tr>
<td>1980</td>
<td>-2.8</td>
<td></td>
</tr>
<tr>
<td>1981</td>
<td>-8.2</td>
<td></td>
</tr>
<tr>
<td>1982</td>
<td>20.6</td>
<td>0.3</td>
</tr>
<tr>
<td>1983</td>
<td>27.5</td>
<td>5.0</td>
</tr>
<tr>
<td>1984</td>
<td>5.1</td>
<td>1.9</td>
</tr>
<tr>
<td>1985</td>
<td>32.6</td>
<td>5.3</td>
</tr>
</tbody>
</table>

cumulative RER depreciation of close to 90 percent.