
ABSTRACT

Applying the demand and supply model, this paper finds that the ARS/USD exchange rate (units of the Argentine peso per U.S. dollar) is positively affected by the Argentine interest rate, U.S. real GDP, the U.S. Stock price, the Argentine inflation rate and the expected exchange rate, and it is negatively associated with the U.S. interest rate, Argentine real GDP, the Argentine stock price and the U.S. inflation rate. In the monetary models, the positive sign of the interest rate differential confirms the Frenkel-Bilson model, and the positive sign of the inflation rate differential confirms the Dornbusch-Frankel model. The demand and supply model exhibits a higher value of R-squared and a lower forecast error than monetary models.

Keywords: Exchange Rates, Interest Rates, Real GDP, Stock Prices, Inflation Rates, EGARCH
JEL Classification: F31, F41

RIASSUNTO

Confronto tra modelli fondamentali e monetari per la determinazione del tasso di cambio peso argentino/dollaro USA

Applicando un modello domanda/offerta questo studio rileva che il tasso di cambio peso argentino/dollaro USA è positivamente influenzato dal tasso di interesse argentino, dal PIL reale USA, dall’andamento della borsa USA, dall’inflazione argentina e dal tasso di cambio atteso, mentre è negativamente associato al tasso di interesse USA, al PIL reale argentino, all’andamento della borsa argentina e all’inflazione USA. Nei modelli monetari, il segno positivo del tasso differenziale di interesse conferma il modello Frenkel-Bilson, mentre il segno positivo del differenziale del tasso di inflazione conferma il modello Dornbusch-Frankel. Il modello
domanda/offerta segnala un valore più alto del coefficiente di determinazione e una previsione di errore inferiore rispetto ai modelli monetari.

1. INTRODUCTION

Argentina experienced several currency crises. In 2002, the peso depreciated approximately 40% mainly because the Argentine government stopped pegging to the U.S. dollar and defaulted $132 billion sovereign debt. In 2013, the peso depreciated 29.63%, and the Argentine government attempted to defend the peso by drawing down foreign reserves to less than $30 billion. In January 2014, the peso depreciated 12.22% mainly due to high inflation caused by high government spending on welfare programs, decrease in commodity prices leading to great deficit in its current account, and rapid increase in the money supply.

This paper examines the Argentine peso/U.S. dollar (ARS/USD) exchange rate. The fundamental model of demand and supply and monetary models are compared to determine which model performs better based on the value of R-squared and the forecast error.

2. LITERATURE SURVEY

There are several recent studies examining the determination of the exchange rate for Argentina and related countries. Several seminal articles such as Meese and Rogoff (1983), Chinn and Meese (1995), Mark (1995), Rogoff (1999), Sarno and Sojli (2009), and Naszodi and Lieli (2014) examine the predictability, the monetary models, the asset pricing model, and the fundamentals in the exchange rate model.

Idil and Dalan (2009) examine exchange rate determination for Argentina, Brazil, Taiwan and Turkey. They find support for the monetary models in the panel sample but weak evidence of monetary models in single-country samples. For Argentina, the coefficient of the interest rate differential or the price differential is positive and significant in the OLS or DOLS method but negative and significant in the JOH-ML method, and the coefficient for the money supply differential or the output differential is not presented. In the VECM, interest rate is a significant variable in correcting the long-run disequilibrium in Argentina and Taiwan whereas the money supply in Brazil and the price in Turkey are the significant variables in correcting the disequilibrium.
Lu et al. (2011) test purchasing power parity for 16 Latin American countries including Argentina during 1995-2007. Based on several selected panel unit root tests, purchasing power parity does not hold. However, based on panel Seemingly Unrelated Regressions Augmented Dickey-Fuller (SURADF) test, purchasing power parity does not hold for Argentina and holds for three countries, namely, El Salvador, Peru, and Suriname.

Ucan et al. (2014) analyzed exchange rate behaviors for five fragile emerging countries (Turkey, Brazil, India, Indonesia and South Africa) based on the monetary models during 1980-2012. The exchange rate and the money supply, real GDP and the short-term interest rate are cointegrated and have a long-term relationship. Exchange rate behaviors in these countries are found to be inconsistent with the flexible or sticky price monetary model.

Cline (2014) studies the fundamental equilibrium exchange rate (FEER) for many countries based on the Symmetric Matrix Inversion Method (SMIM). For Argentina, the percent change in the real effective exchange rate (REER) is -1.0%, the percent change in the dollar exchange rate is -2.9%, and the FEER-consistent dollar exchange rate is 8.17.

Parks (2014) reports the Argentine economy and the peso exchange rate in 2014. Real GDP is expected to decline 2.1%. After the default on some of the government bonds on July 30, 2014, the peso/USD exchange rate hit 14.72 or declined 16% on the black market, and foreign reserves continued to decline to a low of $28.2 billion. The deposit rate of 21%, the inflation rate of around 40%, and the wide difference between the black market exchange rate of 14.72 and the official exchange rate of 8.40 suggest that Argentines are reluctant to hold the peso.

3. THE MODEL

We can express the demand for and supply of the U.S. dollar versus the Argentine peso in the foreign exchange market as:

\[
D_{US} = F(e, Y^{AR}, R^{US}, S^{US}, \pi^{US}, \epsilon) \quad (1)
\]

\[
S_{US} = H(e, Y^{US}, R^{AR}, S^{AR}, \pi^{AR}) \quad (2)
\]

where

\[\text{D}_{US} = \text{demand for the U.S. dollar,}\]

\[\text{S}_{US} = \text{supply of the U.S. dollar,}\]
ε = the ARS/USD (Argentine peso/U.S. dollar) exchange rate,
Y^{AR} = real GDP or income in Argentina,
R^{US} = the real interest rate in the U.S.,
S^{US} = the stock price in the U.S.,
π^{US} = the inflation rate in the U.S.,
ε^{e} = the expected ARS/USD exchange rate,
Y^{US} = real GDP or income in the U.S.,
R^{AR} = the real interest rate in Argentina,
S^{AR} = the stock price in Argentina, and
π^{AR} = the inflation rate in Argentina.

We expect that the demand for the U.S. dollar has a negative relationship with the ARS/USD exchange rate and the U.S. inflation rate and a positive relationship with the U.S. interest rate, the U.S. stock price and the expected ARS/USD exchange rate. The supply of the U.S. dollar is expected to be positively associated with the ARS/USD exchange rate, the Argentine interest rate and the Argentine stock price and negatively influenced by the Argentine inflation rate.

As real GDP or income in Argentina rises, Argentines tend to import more goods and services from the U.S. and increase the demand for the U.S. dollar. However, if some of the increase in real GDP is due to increase in import-substitute goods, Argentina’s imports from the U.S. may decline. Hence, the sign of YAR is uncertain. When real GDP or income in the U.S. rises, Americans tend to import more goods and services from Argentina and increase the supply of the U.S. dollar in exchange for the Argentine peso. However, if some of the increase in real GDP is due to an increase in import-substitute goods, U.S. imports from Argentina may decline. Hence, the sign of YUS is unclear.

Solving for the equilibrium values of the two endogenous variables simultaneously, we can express the equilibrium exchange rate as a function of all the exogenous variables:

\[ \bar{\epsilon} = X(R^{AR}, R^{US}, Y^{AR}, Y^{US}, S^{AR}, S^{US}, \pi^{AR}, \pi^{US}, \epsilon^{e}) \] (3)

According to comparative static analysis, a change in any one of the exogenous variables is expected to have an impact on the equilibrium ARS/USD exchange rate:

\[ \frac{\partial \bar{\epsilon}}{\partial R^{AR}} = -H_{R^{AR}} |J| > or < 0 \] (4)
\[
\begin{align*}
\frac{\partial e}{\partial R_{US}} &= -F_{R_{US}} |F| > 0 \\
\frac{\partial e}{\partial Y_{AR}} &= -F_{Y_{AR}} |F| > 0 \\
\frac{\partial e}{\partial Y_{US}} &= -H_{Y_{US}} |F| > 0 \\
\frac{\partial e}{\partial S_{AR}} &= -H_{S_{AR}} |F| < 0 \\
\frac{\partial e}{\partial S_{US}} &= -F_{S_{US}} |F| > 0 \\
\frac{\partial e}{\partial \pi_{AR}} &= -H_{\pi_{AR}} |F| > 0 \\
\frac{\partial e}{\partial \pi_{US}} &= -F_{\pi_{US}} |F| < 0 \\
\frac{\partial e}{\partial \epsilon} &= -F_{\epsilon} |F| > 0 
\end{align*}
\]

where \( |F| = (F_e - H_e) < 0 \) is the Jacobian for the endogenous variables. Two monetary models can be expressed as:

Flexible-price monetary model (Frenkel, 1976; Bilson, 1978)

\[
E = E(M^{CA} - M^{US}, Y^{CA} - Y^{US}, R^{CA} - R^{US})
\]

Sticky-price monetary model (Dornbusch, 1976; Frankel, 1979)

\[
E = E(M^{CA} - M^{US}, Y^{CA} - Y^{US}, R^{CA} - R^{US}, \pi^{CA} - \pi^{US})
\]

In the monetary models, the sign of the interest rate differential between Argentina and the U.S. may be positive or negative, depending upon whether the Frenkel-Bilson model or the Dornbusch-Frankel model would apply. Furthermore, the traditional view suggests that an increase in the interest rate would cause a currency to appreciate due to capital inflows for higher returns on some financial assets whereas the revisionist view argues that a higher interest rate would cause a currency to depreciate due to a higher default probability, a weaker financial position and a higher exchange rate risk premium (Dekle et al., 2002; Huang et al., 2010).

4. **Empirical Results**

The data were collected from the International Financial Statistics, which is published by the International Monetary Fund. The ARS/USD exchange rate measures units of the Argentine peso per U.S. dollar. Hence, an increase means a depreciation of the Argentine peso or an
appreciation of the U.S. dollar. The interest rate in the U.S. is represented by the U.S. Treasury bill rate. Due to lack of data for the Treasury bill rate in Argentina, the interest rate in Argentina is represented by the deposit rate. Real GDP in the U.S. or Argentina is measured in an index based on the 2010 price. The expected exchange rate is represented by the average ARS/USD exchange rate of the past four quarters. The stock price in the U.S. or Argentina is represented by the share price index with 2005 as the base year. The inflation rate is measured as percent change in the consumer price index. The sample consists of quarterly data ranging from 2002.Q1 to 2013.Q4 and has a total of 48 observations mainly because the exchange rate was pegged to the U.S. dollar during 1993-2001 and because there is lack of consistent data for the CPI and the inflation rate after 2013.Q4.

The ADF test shows that except for the U.S. inflation rate, all other variables have unit roots at the 5% level. To determine whether these time series variables are cointegrated, the ADF test on the regression residuals is performed. The value of the test statistic is estimated to be -3.0838, which is greater than the critical value of -2.6151 in absolute values at the 1% level. Therefore, these time series variables have a long-term stable relationship.

Table 1 reports the estimated regression and other related statistics. The EGARCH method is applied in empirical work in order to yield a positive conditional variance and not to place any restriction on the parameters. As shown, approximately 95.25% of the change in the equilibrium ARS/USD exchange rate can be explained by the nine right-hand side variables. All the coefficients are significant at the 1% level. The equilibrium ARS/USD exchange rate is positively associated with the Argentine interest rate, U.S. real GDP, U.S. stock price, the Argentine inflation rate, and the expected exchange rate. It is negatively affected by the U.S. Treasury bill rate, the Argentine real GD, the Argentine stock price and the U.S. inflation rate. The mean absolute percent error of 3.8749% suggests that the forecast error is relatively small.

It appears that the coefficient of any variable for the U.S. is greater than the coefficient of the corresponding variable for Argentina in absolute values. According to the Wald test, the null hypothesis that the coefficients between an Argentine variable and the corresponding U.S. variable is the same can be rejected at the 1% level. A 1 percentage-point increase in the Argentine deposit rate would raise the ARS/USD exchange rate by 0.0164 whereas a 1 percentage-point increase in the U.S. Treasury bill rate would reduce the ARS/USD exchange rate by 0.1156.
Comparison of the fundamental and monetary models of the determination of the Argentine peso/US Dollar exchange rate

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### Table 1 - Estimated Regression of the ARS/USD Exchange Rate

<table>
<thead>
<tr>
<th>Variable</th>
<th>Coefficient</th>
<th>z-Statistic</th>
</tr>
</thead>
<tbody>
<tr>
<td>C</td>
<td>-29.76060</td>
<td>-17.35638</td>
</tr>
<tr>
<td>Argentine interest rate</td>
<td>0.016350</td>
<td>9.516901</td>
</tr>
<tr>
<td>U.S. interest rate</td>
<td>-0.115636</td>
<td>-9.774192</td>
</tr>
<tr>
<td>Log(Argentine real GDP)</td>
<td>-0.527335</td>
<td>-5.928158</td>
</tr>
<tr>
<td>Log(U.S. real GDP)</td>
<td>6.671224</td>
<td>17.94441</td>
</tr>
<tr>
<td>Log(Argentine stock price)</td>
<td>-0.220571</td>
<td>-2.727886</td>
</tr>
<tr>
<td>Log(U.S. stock price)</td>
<td>0.920231</td>
<td>9.460573</td>
</tr>
<tr>
<td>Argentine inflation rate</td>
<td>0.018770</td>
<td>5.185488</td>
</tr>
<tr>
<td>U.S. inflation rate</td>
<td>-0.109594</td>
<td>-9.589463</td>
</tr>
<tr>
<td>Expected exchange rate</td>
<td>0.540458</td>
<td>9.850918</td>
</tr>
<tr>
<td>R-squared</td>
<td>0.9525</td>
<td></td>
</tr>
<tr>
<td>MAPE</td>
<td>3.8749%</td>
<td></td>
</tr>
<tr>
<td>Sample period</td>
<td>2002.Q1 – 2013.Q4</td>
<td></td>
</tr>
<tr>
<td>Sample size</td>
<td>48</td>
<td></td>
</tr>
</tbody>
</table>

Notes: The dependent variable is the ARS/USD exchange rate (units of the Argentine peso per U.S. dollar).

It appears that the coefficient of any variable for the U.S. is greater than the coefficient of the corresponding variable for Argentina in absolute values. According to the Wald test, the null hypothesis that the coefficients between an Argentine variable and the corresponding U.S. variable is the same can be rejected at the 1% level. A 1 percentage-point increase in the Argentine deposit rate would raise the ARS/USD exchange rate by 0.0164 whereas a 1 percentage-point increase in the U.S. Treasury bill rate would reduce the ARS/USD exchange rate by 0.1156. A one unit increase in the log of the Argentine real GDP would reduce the ARS/USD exchange rate by 0.5273 whereas a one unit increase in the log of U.S. real GDP would raise the ARS/USD exchange rate by 6.6712. A one unit increase in the log of the Argentine stock price index would reduce the ARS/USD exchange rate by 0.2206 whereas a one unit increase in the log of the stock price index in the U.S. would increase the ARS/USD exchange rate by 0.9202. A one-percentage-point increase in the Argentine inflation rate would raise the ARS/USD exchange rate by 0.0188 whereas a one-percentage-point increase in the U.S. inflation would reduce the ARS/USD exchange rate by 0.1096. If the expected exchange rate rises by 1, the actual exchange rate would increase by 0.5405.
If the Argentine money market rate and the U.S. federal funds rate replace the Argentine deposit rate and the U.S. Treasury bill rate in Table 1, their coefficients have the same signs and are significant at the 1% level. The coefficient of the Argentine stock price is negative but insignificant at the 10% level. The R2 value of 0.9612 is slightly higher than 0.9525 as reported in Table 1. The mean absolute percent error is estimated to be 3.4316%, which is slightly lower than that in Table 1.

| TABLE 2 - Estimated Regression of Monetary Models of the ARS/USD Exchange Rate |
|---------------------------------|---------------------------------|
| Variable                        | Frenkel-Bilson Model            |
|                                 | Dornbusch-Frankel model         |
| Intercept                       | Coefficient                    | z-Statistic | Coefficient | z-Statistic |
|                                 | -2.237207                      | -5.601485   | -2.619687   | -15.06384   |
| Log(Money supply differential)  | 1.701926                      | 14.99310    | 1.792576    | 36.81734    |
| Log(Real GDP differential)      | -2.117323                     | -5.372909   | -1.869631   | -10.39777   |
| Interest rate differential      | 0.038507                      | 14.19288    | 0.014763    | 28.61624    |
| Inflation rate differential     | 0.040810                      |              | 0.040810    | 44.16401    |
| R-squared                       | 0.848860                      |              | 0.885145    |
| MAPE                            | 6.597415%                     |              | 5.863626%   |
| Sample period                   | 2002Q1-2013Q4                 |              | 2002Q1-2013Q4|
| Sample size                     | 48                            |              | 48          |

Notes: The dependent variable is the ARS/USD exchange rate (units of the Argentine peso per U.S. dollar). All the coefficients are significant at the 1% level.

Monetary models of exchange rate determination are estimated and reported in Table 2. As shown, values of R-squared are lower and forecast errors are higher than those reported in Table 1. In the Frenkel-Bilson model, the coefficients are significant at the 1% level, and the signs are consistent with the theory. In the Dornbusch-Frankel model, the positive coefficient for the interest rate differential is opposite to the expected sign, and other coefficients have the expected signs and are significant at the 1% level. Hence, the demand and supply model of exchange rate determination performs better than monetary models in terms of the explanatory power and the forecast error.
5. SUMMARY AND CONCLUSIONS

This paper has examined the Argentine peso/U.S. dollar exchange rate based on the demand and supply model. The EGARCH model is employed in empirical estimation. A higher Argentine interest rate, a higher U.S. real GDP, a higher U.S. stock price, a higher Argentine inflation rate and a higher expected exchange rate would cause the Argentine peso to depreciate whereas a higher U.S. interest rate, a higher Argentine real GDP, a higher Argentine stock price, and a higher U.S. inflation rate would cause the Argentine peso to appreciate. In comparison, the demand and supply model yields a higher value of R-squared and a lower mean absolute percent error than monetary models.

There are several policy implications. The results for the interest rates confirm the revisionist view that monetary tightening leading to a higher interest rate would cause a currency to depreciate. The sign of real GDP in Argentina suggests that increase in real GDP partly due to import-substitute goods plays an important role. A strong stock market is expected to increase the demand for stocks and the currency. Maintaining a low inflation rate would protect the value of a currency.

REFERENCES


