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## Test of the Impossible Trinity Hypothesis for Five Selected Countries in the Asian and Pacific Regions

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## Abstract

This paper examines the functional form of the impossible trinity hypothesis for five selected countries in the Asian and Pacific regions including Australia, Japan, New Zealand, Singapore and South Korea. The linear, log-log and semi-log forms are compared. Based on the mean absolute percent error and Akaike information criterion, we find that the semi-log form on the dependent variable performs better than the other three forms. The goodness of fit is relatively high, suggesting that there is support for the impossible trinity hypothesis. These countries may adopt different policy combinations. Australia maintains a middle ground approach to all three goals. South Korea emphasizes monetary policy independence and financial market openness and allows the exchange rate of the won to fluctuate freely based on market forces.

# 1. Introduction

Many countries would like to achieve three macroeconomic goals, namely, financial market openness, monetary policy independence and exchange rate stability in order to attract foreign investments, lower the interest rate or increase the money supply to stimulate a weak economy, and avoid volatile exchange rate movements. The impossible trinity or trilemma hypothesis suggests that only two of the three goals can be achieved simultaneously (Mundell, 1963). Individual countries may choose two of the three goals based on their own experiences and needs in economic growth. Countries in the EU pursue financial market openness and exchange rate stability and let the European Central Bank make monetary policy decisions. The U.S. achieves financial market openness and monetary policy independence and allows exchange rates to fluctuate. China maintains monetary policy independence and exchange rate stability and places some restrictions on foreign investments, capital flows, and international trade (Mankiw, 2010). This paper examines the functional form of the impossible trinity hypothesis for five selected countries in the Asian and Pacific regions to compare the linear, log-log, and semi-log forms to determine which functional form is appropriate. If an incorrect functional form is chosen, we may draw different conclusions.

There are several recent seminal studies of the impossible trinity or trilemma in international economics and finance. Obstfeld, Shambaugh and Taylor (2005) indicate that the trilemma can be considered as a guide for policy framework because countries pegging exchange rates without capital controls would lose significant monetary policy independence whereas countries not pegging exchange rates without capital controls would maintain sufficient amount of monetary policy autonomy.

Aizenman, Chinn and Ito (2008a) find evidence of a linear relationship and a tradeoff among three trilemma variables. For Industrialized countries, after early 1990s, financial openness increased, the degree of monetary policy independence declined, and exchange rate stability rose significantly. For developing countries, maintaining exchange rate stability was a top priority up to 1990, and since 2000, they have pursued managed exchange rate flexibility and retained some monetary policy autonomy. According to the study for developing countries by Aizenman, Chinn and Ito (2011a), greater exchange rate stability results in more output volatility whereas greater monetary independence leads to smaller output volatility. Greater exchange rate stability and greater financial openness could reduce the inflation rate whereas greater monetary autonomy results in a higher inflation rate. While a higher degree of exchange rate stability could also lead to volatile investment spending.

Examining the trilemma for emerging economies, Aizenman and Ito (2011a) reveal that the three trilemma policies are converging toward a middle ground characterized by managed exchange rate flexibility backed up by large amounts of foreign reserves, middle level of monetary policy independence and financial

openness. Those emerging economies pursing a converged policy mix would experience smaller output volatility in the last 20 years. Holding of more international reserves would provide emerging economies with broader policy combinations. Aizenman and Sengupta (2011) examin the trilemma for China and India. They show that China has achieved considerable exchange rate stability but failed to allow financial integration to play any significant role and that India has moved toward a middle ground among the three policy goals with a relatively stable exchange rate, financial integration, and a large amount of international reserves. To the author's best knowledge, previous studies examine the impossible trinity hypothesis using the linear relationship without comparing with other functional forms.

## 2. The Model

Extending previous studies (Aizenman, 2010; Aizenman, Chinn and Ito, 2008a, 2010, 2011a; Aizenman and Ito, 2011a, 2012; Aizenman and Sengupta, 2011; and others), we can express the impossible trinity hypothesis in general form as:

$$K = f(ES_t, MI_t, FO_t) \tag{1}$$

where

K      = a constant,
ES    = exchange rate stability,
MI    = monetary policy independence, and
FO    = financial market openness.

The following linear, log-log and semi-log forms are tested and compared to determine which one is appropriate:

$$K = \alpha_1 ES_t + \alpha_2 MI_t + \alpha_3 FO_t + \mu_t \tag{2}$$

$$\log K = \phi_1 \log ES_t + \phi_2 \log MI_t + \phi_3 \log FO_t + \varepsilon_t \tag{3}$$

$$\log K = \beta_1 ES_t + \beta_2 MI_t + \beta_3 FO_t + v_t \tag{4}$$

$$K = \lambda_1 \log ES_t + \lambda_2 \log MI_t + \lambda_3 \log FO_t + \omega_t \tag{5}$$

If the predicted value in (2), (3), (4) or (5) is close to the constant K or log(K), the trilemma is binding in the sense that the three policy goals are linearly or nonlinearly constrained, and there will be a tradeoff among the three policy goals. If the value of one of the terms increases, the value of one or both of the remaining terms will decline.

## 3. Empirical Results

The data are obtained from Aizenman, Chinn and Ito (2008b, 2011b). ES is represented by $0.01/[0.01 + sd(\Delta \log(EX))]$, where sd and EX stand for the standard deviation and the nominal exchange rate measured as own currency units per U.S. dollar. MI is measured by $[1 - corr(R, R^*)]/2$, where corr, R and $R^*$ stand for the correlation coefficient, the domestic money market rate and the U.S. money market rate. FO is derived from the information regarding restrictions compiled in the IMF's *Annual Report on Exchange Arrangements and Exchange Restrictions* (*AREAER*). Specifically, FO is the first standardized principal component of the variables indicating the presence of multiple exchange rates, restrictions on current and capital account transactions, and the requirement of the surrender of export proceeds (Chinn and Ito, 2006, 2008). ES, MI or FO has values ranging from zero to one. A higher value of ES, MI or FO indicates more exchange rate stability, monetary policy independence or financial market openness. In order to take a logarithmic scale and have positive values, a value of one is added to ES, MI and FO. A value of 2 is chosen for the constant of K. The sample period ranges from 1970 to 2009 for Australia, Japan, New Zealand and South Korea and from 1972 to 2009 for Singapore.

The AFD test on the regression residuals is performed in order to determine whether these time series variables may have a long-term stable relationship. For each of the countries, the value of the test statistic is greater than the critical value in absolute values at the 1% or 5% level. Thus, these time series variables in each of the countries are cointegrated and have a long-term equilibrium relationship.

Estimated parameters, R-squared and other related statistics are reported in Table 1. The Newey-West method is employed in empirical estimation so that the covariance and standard errors are consistent and unbiased. According to the values of R-squared, the goodness of fit is relatively high for all the five countries, suggesting the support for the impossible trinity hypothesis. Except for the insignificant coefficient of exchange rate stability for South Korea, all other coefficients are positive and significant at the 1% level. The semi-log form on the dependent variable for all the five countries has the smallest value of the mean absolute percent error or Akaike information criterion. Hence, the semi-log form on the dependent variable performs better than the linear and other functional forms.

Based on the semi-log (A) version, several comments can be made. Australia places similar weights on all three policy goals. Japan puts more weights on exchange rate stability and financial market openness than monetary policy independence. New Zealand assigns more weight on monetary policy independence than the other two policy options. Singapore gives more weights on exchange rate stability and monetary policy independence than financial market openness. South Korea places little weight on exchange rate stability and

Table I: Estimated Regressions of the Impossible Trinity

|  | ES | MI | FO | $R^2$ | MAPE | AIC |
|---|---|---|---|---|---|---|
| **Australia** | | | | | | |
| Linear | 0.440 | 0.479 | 0.431 | 0.996 | 9.778 | -1.246 |
|  | (3.257) | (4.007) | (5.668) | | | |
| Log-log | 0.561 | 0.490 | 0.690 | 0.978 | 16.441 | -1.569 |
|  | (4.030) | (3.241) | (7.405) | | | |
| Semi-log (A) | 0.153 | 0.166 | 0.149 | 0.996 | 6.762 | -3.365 |
|  | (3.257) | (4.007) | (5.668) | | | |
| Semi-log (B) | 1.617 | 1.414 | 1.992 | 0.978 | 24.118 | 0.550 |
|  | (4.030) | (3.241) | (7.405) | | | |
| **Japan** | | | | | | |
| Linear | 0.451 | 0.333 | 0.492 | 0.999 | 5.565 | -2.268 |
|  | (5.154) | (3.070) | (15.837) | | | |
| Log-log | 0.469 | 0.341 | 0.703 | 0.994 | 8.182 | -2.793 |
|  | (6.589) | (2.898) | (16.022) | | | |
| Semi-log (A) | 0.156 | 0.115 | 0.171 | 0.999 | 3.847 | -4.387 |
|  | (5.154) | (3.070) | (15.837) | | | |
| Semi-log (B) | 1.352 | 0.983 | 2.030 | 0.994 | 11.918 | -0.674 |
|  | (6.589) | (2.898) | (16.022) | | | |
| **New Zealand** | | | | | | |
| Linear | 0.395 | 0.599 | 0.370 | 0.997 | 8.169 | -1.558 |
|  | (3.493) | (3.467) | (6.859) | | | |
| Log-log | 0.593 | 0.645 | 0.575 | 0.980 | 14.508 | -1.664 |
|  | (5.267) | (2.651) | (10.055) | | | |
| Semi-log (A) | 0.137 | 0.208 | 0.128 | 0.997 | 5.647 | -3.678 |
|  | (3.493) | (3.467) | (6.859) | | | |
| Semi-log (B) | 1.711 | 1.860 | 1.659 | 0.980 | 21.385 | 0.456 |
|  | (5.267) | (2.651) | (10.055) | | | |
| **Singapore** | | | | | | |
| Linear | 0.439 | 0.514 | 0.305 | 0.998 | 6.450 | -1.945 |
|  | (3.632) | (4.254) | (6.278) | | | |
| Log-log | 0.483 | 0.555 | 0.441 | 0.991 | 10.176 | -2.432 |
|  | (2.969) | (3.703) | (4.993) | | | |
| Semi-log (A) | 0.152 | 0.178 | 0.106 | 0.998 | 4.456 | -4.065 |
|  | (3.632) | (4.254) | (6.278) | | | |
| Semi-log (B) | 1.394 | 1.601 | 1.274 | 0.991 | 14.814 | -0.313 |
|  | (2.969) | (3.703) | (4.993) | | | |
| **South Korea** | | | | | | |
| Linear | 0.101 | 0.637 | 0.698 | 0.998 | 7.605 | -1.712 |
|  | (1.448) | (5.814) | (10.278) | | | |
| Log-log | 0.172 | 1.030 | 0.851 | 0.979 | 15.919 | -1.624 |
|  | (1.549) | (5.407) | (7.510) | | | |
| Semi-log (A) | 0.035 | 0.221 | 0.242 | 0.998 | 5.267 | -3.831 |
|  | (1.448) | (5.814) | (10.278) | | | |
| Semi-log (B) | 0.497 | 2.971 | 2.454 | 0.979 | 23.168 | 0.496 |
|  | (1.549) | (5.407) | (7.150) | | | |

Notes:

Figures in the parenthesis are t-statistics.

In the Semi-log (A) form, the dependent variable is measured in the logarithmic scale.

In the Semi-log (B) form, the independent variables are measured in the logarithmic scale.

MAPE is the mean absolute percent error.

AIC is Akaike information criterion.

similar weights on monetary policy independence and financial market openness, suggesting that the Bank of Korea would allow the won exchange rate to fluctuate freely based on market forces.

## 4. Summary and Conclusions

This paper has examined the impossible trinity or trilemma hypothesis for five selected countries in the Asian and Pacific regions. The linear and nonlinear relationships among exchange rate stability, monetary policy independence and financial market openness have been examined. Except for the insignificant coefficient of exchange rate stability for South Korea, all other coefficients are positive and significant at the 1% level. The goodness of fit is relatively high. There is support for the impossible trinity hypothesis. The semi-log form on the dependent variable has smaller values of the mean absolute percent error and Akaike information criterion than the linear and other forms. These countries may pursue different policy combinations. Australia puts similar emphasis on all three policy goals whereas New Zealand places more emphasis on monetary policy independence than the other two goals. Japan, Singapore and South Korea emphasize two of the three goals and place less weight on the remaining goal.

These findings suggest that in studying the impossible trinity, the functional form needs to be examined and tested to determine the specific form that has the smallest value of the mean absolute percent error or Akaike information criterion. The choice of functional forms may affect test results and conclusions. In empirical work, a separate test of each of individual countries would be desirable as each country may pursue different policy combinations.

It should be noted that exchange rate stability, monetary policy independence or financial market openness may have potential negative implications. Maintaining a stable exchange rate may under-value or over-value a currency, cost a great deal of international reserves to avoid speculative attacks, need to use sterilized intervention to mitigate pressures of appreciation, and result in misallocation of resources. Monetary policy independence may cause inflationary concerns when a central bank increases the money supply too much to stimulate a weak economy or monetizes the government debt. Financial liberalization may cause too much speculation and large capital outflows and destabilize an economy.

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