

**TESTING THE TRILEMMA HYPOTHESIS AND MEASURING THEIR EFFECTS ON INFLATION,  
GROWTH AND VOLATILITY FOR POLAND**

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**Abstract**

*This paper finds evidence of the trilemma for Poland. Exchange rate stability, monetary independence and financial integration have a tradeoff. Mainly because of its plan to join the ERM II and pursuing for inflation targeting, the policy combination of exchange rate stability and monetary independence has been prevalent since 1991. More exchange rate stability raises the growth rate but also increases output volatility. More financial integration reduces the inflation rate, inflation volatility and output volatility. More monetary independence does not affect inflation, growth and volatility. Hence, these impacts may be considered in reviewing and selecting a policy combination.*

**Keywords:** *trilemma, exchange rate stability, monetary policy independence, financial integration.*

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## 1. Introduction

Three macroeconomic policies - exchange rate stability, monetary autonomy and free capital mobility - have been considered and pursued by many countries in order to reduce exchange rate volatility, engage in monetary easing to improve a sluggish economy or monetary tightening to dampen an over-heated economy, and attract foreign investments. The trilemma of international economics and finance suggests that only two of these three policies can be achieved simultaneously (Ghosh, Gulde and Ostry, 1997; Edison, Klein, Ricci and Sløk, 2002; Prasad, Rogoff, Wei and Kose, 2003; Levy-Yeyati and Sturzenegger, 2003; Eichengreen and Leblang, 2003; Frankel, Schmukler and Serven, 2004; Shambaugh, 2004; Obstfeld, Shambaugh and Taylor, 2005, 2009, 2010; Henry, 2006; Kose, Prasad, Rogoff and Wei, 2006; Prasad and Rajan, 2008; Aizenman, Chinn and Ito, 2008b, 2011a; Aizenman and Ito, 2012; and others). Australia maintains monetary independence and free capital flows and permits the exchange rate to move freely. Hong Kong focuses on exchange rate stability and free capital mobility and allows the internal interest rate to follow the world interest rate. China pursues a stable exchange rate and independent monetary policy and places some capital controls.

This paper tests the trilemma hypothesis and examines potential effects of these three trilemma policies on inflation, economic growth, inflation volatility and output volatility for Poland. The study of this subject is significant. Because Poland is a member of the EU and plans to join the ERM II, it would be more inclined to pursue these three trilemma policies in order to stabilize the zloty/euro exchange rate, pursue price stability, and attract international capital. An analysis of previous studies indicates that none of the previous studies has used the latest data for financial integration (Chinn and Ito, 2006, 2008; Aizenman, Chinn and Ito, 2011b) to examine the relationships between inflation, economic growth, inflation volatility and output volatility and these three trilemma policies for Poland.

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Several recent studies have examined the related subjects. Based on a sample of 18 industrial countries including many EU countries and 28 developing countries, Frankel, Schmukler and Serven (2004) find that although several large advanced countries can select their own rates over the long run, most other countries with flexible exchange rates react fully to international interest rates in the long run. In the short run, countries with flexible exchange rates respond to international interest rates with slower speed, suggesting that they possess some degree of monetary autonomy.

Using a multi-country sample including Poland, Obstfeld, Shambaugh and Taylor (2005) show that the trilemma can be considered as a guide for macroeconomic policy framework. Countries without pegging exchange rates and capital controls would retain sufficient amount of monetary autonomy whereas countries pegging exchange rates and not having capital controls would lose significant monetary autonomy.

Using a large sample of 179 countries including Poland, Aizenman, Chinn and Ito (2008b) show that greater exchange rate stability leads to more inflation or output volatility and a lower inflation rate; greater monetary independence results in higher inflation; and more financial integration lowers the inflation rate. Aizenman, Chinn and Ito (2011a) reveal that those emerging market countries with more converged policies and relatively large foreign reserves would experience less output volatility whereas those countries with relatively low foreign reserves would suffer more output volatility. Aizenman and Ito (2012) find that the three macroeconomic policies in emerging economies are converging toward an intermediate ground as they pursue managed exchange rates backed up by large international reserves, some degree of monetary autonomy, and restrained financial integration. These emerging economies experience less output fluctuations whereas emerging economies with relatively low international reserves as a percent of GDP would suffer relatively high output fluctuations if they select policy divergence.

Based on a sample of eight new EU countries outside of the euro zone including Poland, Căpraru and Ilnatov (2011) study potential impacts of different exchange rate systems on monetary autonomy. They show that countries with the fixed or intermediate exchange rate system are less sensitive to ECB's interest rate than countries with the floating exchange rate system and that countries with the intermediate exchange rate system preserve more monetary independence. It suggests that countries with the flexible exchange rate system have less monetary independence than countries with the fixed or intermediate exchange rate system.

## 2. The Model

Extending Aizenman, Chinn and Ito (2008b, 2011a), Aizenman and Ito (2012) and other previous studies, we can express the trilemma equation as:

$$C = f(S_t, I_t, F_t) \quad (1)$$

where

- C = a constant,
- S = exchange rate stability,
- I = monetary independence, and
- F = financial integration or free capital mobility.

If the goodness of fit in equation (1) is relatively high, it suggests that these three policies are binding and constrained. An increase in the value of one of the trilemma policies will reduce the value of one or both of the other policies. Note that equation (1) is written in the general form because different functional forms such as the linear, log-log, log-linear and linear-log relationships will be considered and tested.

We can use equation (2) to test potential impacts of exchange rate stability, monetary independence and financial integration on the inflation rate, the growth rate of real GDP, inflation volatility and output volatility:

$$X_t = h(S_t, I_t, F_t) \quad (2)$$

where  $X$  represents one of the following dependent variables

- $\pi$  = the inflation rate,
- GR = the growth rate of real GDP,
- IV = inflation volatility, and
- YV = output volatility.

More exchange rate stability is expected to stabilize the currency value and price level, reduce uncertainty, and help economic growth. On the other hand, more exchange rate stability may increase or reduce inflation or inflation volatility, depending upon whether the pegged anchor currency would appreciate, depreciate or be volatile. Depending upon monetary easing or tightening, the timing and the magnitude, more monetary independence may increase or reduce the inflation rate, the growth rate of real GDP, inflation volatility and output volatility. More capital inflows are expected to increase aggregate demand and the supply of funds, reduce lending rates, help economic growth, and may increase or reduce the inflation rate or inflation volatility. However, large amounts of abrupt capital outflows would reduce aggregate demand, destabilize an economy, cause currency depreciation, hurt economic growth, and may increase or reduce the inflation rate or inflation volatility (Chinn and Ito, 2008b; Aizenman, Chinn and Ito, 2011a; Aizenman and Ito, 2012).

### 3. Empirical Results

$S$ ,  $I$  and  $F$  are obtained from Aizenman, Chinn and Ito (2008b, 2010, 2011b) and Chinn and Ito (2006, 2008) and have values ranging from zero to one. A higher value of  $S$ ,  $I$  or  $F$  indicates more exchange rate stability, monetary independence or financial integration. Exchange rate stability is represented by:

$$S = 0.01/[0.01 + \sigma(\Delta \log(\varepsilon))], \quad (3)$$

where  $\sigma$  and  $\varepsilon$  stand for the standard deviation and the nominal exchange rate. Monetary independence is measured by:

$$I = [1 - c(r, r^*)]/2, \quad (4)$$

where  $c$ ,  $r$  and  $r^*$  stand for the correlation coefficient, the money market rate in Poland and the money market rate in Germany. The index for financial integration is derived from the information regarding the requirement of the surrender of export proceeds, the presence of multiple exchange rates, and restrictions on current and capital account transactions, which are published by the International Monetary Fund.  $\pi$  is represented by the percent change in the consumer price index. IV is represented by the standard deviation of the inflation rate over a five-year period. GR is measured by the percent change in real GDP. YV is measured by the standard deviation of GR over a five-year period. The consumer price index and real GDP are obtained from the IMF. The sample period ranges from 1991 to 2010.

Table 1 presents empirical results for the trilemma test. Note that a value of 2 is assigned to the constant  $C$  and that a value of 2 is added to each of  $S$ ,  $I$  and  $F$  in order to avoid a zero or negative value when a logarithmic scale is used. The Newey-West method is employed if consistent estimates of covariance and standard errors are needed. Four different functional forms are considered. As shown, the relatively high values of R-squared suggest that the goodness of fit is relatively high. All the coefficients are positive and significant at the 1% level. The log-linear regression has the smallest values of the mean absolute percent error or Akaike information criterion. Hence, the log-linear relationship yields smaller forecast errors than the conventional linear relationship. Based on the estimated coefficients, it appears that Poland places more emphasis on exchange rate stability and monetary independence than financial integration. Poland

plans to join the ERM II and will be required to maintain the zloty/euro exchange rate within an allowable range in order to adopt the euro in the future. Poland has adopted inflation targeting since 1999 and has set the current inflation target as  $2.5\% \pm 1\%$ . The National Bank of Poland sets the nominal money market rate consistent with its inflation target. Hence, Poland put more weights on exchange rate stability and monetary independence.

Based on the log-linear regression, Graph 1 presents different policy combinations and compares their weighted values. As shown in the graph, the policy combination of exchange rate stability and monetary independence has been dominant since 1991. The policy mix of exchange rate stability and financial integration ranks second, and the policy mix of monetary independence and financial integration ranks third.

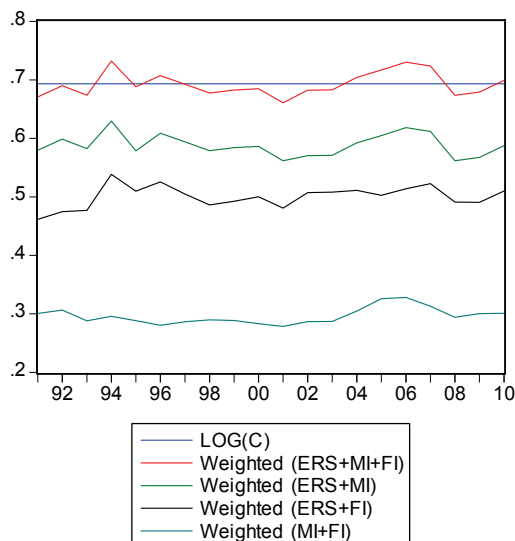
Table 2 reports the impacts of these three trilemma variables on the inflation rate, the growth rate of real GDP, inflation volatility and output volatility. More exchange rate stability leads to a higher growth rate and more output volatility. More monetary independence does not have any impact on inflation, economic growth, inflation volatility and output volatility. More financial integration results in a lower inflation rate, less inflation volatility and less output volatility. These results suggest that more financial integration generates positive benefits whereas more exchange rate stability yields both positive and negative effects.

Table 1: Estimated regressions for the trilemma test

|            | <i>Exchange rate stability</i> | <i>Monetary independence</i>  | <i>Financial integration</i>  | $R^2$  | MAPE  | AIC    |
|------------|--------------------------------|-------------------------------|-------------------------------|--------|-------|--------|
| Linear     | 0.500 <sup>a</sup><br>(3.975)  | 0.241 <sup>a</sup><br>(3.155) | 0.132 <sup>c</sup><br>(1.781) | 0.9992 | 2.401 | -2.579 |
| Log-log    | 0.481 <sup>a</sup><br>(4.013)  | 0.238 <sup>a</sup><br>(3.215) | 0.118<br>(1.686)              | 0.9988 | 2.008 | -4.332 |
| Log-linear | 0.173 <sup>a</sup><br>(3.975)  | 0.084 <sup>a</sup><br>(3.155) | 0.046 <sup>c</sup><br>(1.781) | 0.9992 | 1.668 | -4.699 |
| Linear-log | 1.389 <sup>a</sup><br>(4.013)  | 0.687 <sup>a</sup><br>(3.215) | 0.341<br>(1.686)              | 0.9988 | 2.889 | -2.213 |

Notes: Figures in the parenthesis are t-statistics. Superscript letter a or c indicates that a coefficient is significant at the 1% or 10% level. There is no intercept in the estimated regression. In the log-linear form, the dependent variable is transformed into the logarithmic scale. In the linear-log form, the independent variables are transformed into the logarithmic scale. Sample period: 1991-2010.

Graph 1: Analysis of different policy combinations



Notes:

C = a constant,

ERS = exchange rate stability,

MI = monetary independence, and

FI = financial integration.

Table 2: Estimated regressions for the inflation rate, the growth rate, inflation volatility and output volatility

| Dependent variable   | Exchange rate stability        | Monetary independence | Financial integration             | Constant           | R <sup>2</sup> |
|----------------------|--------------------------------|-----------------------|-----------------------------------|--------------------|----------------|
| Inflation rate       | -7.943<br>(-0.193)             | 27.045<br>(1.220)     | -74.661 <sup>a</sup><br>(-3.638)  | 30.911<br>(1.761)  | 0.567          |
| Growth rate          | 19.562 <sup>b</sup><br>(2.007) | -4.290<br>(-0.741)    | 5.981<br>(1.178)                  | -1.579<br>(-0.413) | 0.329          |
| Inflation volatility | 83.290<br>(0.348)              | 184.261<br>(1.715)    | -300.416 <sup>b</sup><br>(-2.497) | 54.717<br>(0.690)  | 0.526          |
| Output volatility    | 7.337 <sup>b</sup><br>(2.366)  | 0.212<br>(0.069)      | -9.428 <sup>a</sup><br>(-4.407)   | 4.312<br>(2.398)   | 0.467          |

Notes: Figures in the parenthesis are t-statistics. Superscript letter a or b indicates that a coefficient is significant at the 1% or 5% level, respectively. Sample period: 1991-2010.

#### 4. Summary and Conclusions

This paper has found evidence of the trilemma for Poland, implying that there is a tradeoff among exchange rate stability, monetary independence and financial integration. The policy combination of exchange rate stability and monetary independence has been prevalent since 1991. The prevalent policy combination of exchange rate stability and monetary independence is mainly due to its plan to join the ERM II and adoption of inflation targeting. More exchange rate stability raises the growth rate and output volatility, and more financial integration reduces the inflation rate, inflation volatility and output volatility. In comparison, the findings of a positive effect of exchange rate stability on output volatility and a negative impact of financial integration on the inflation rate in this paper are similar to those found by Aizenman, Chinn and Ito (2008b), but other results in this paper are different from those reported by Aizenman, Chinn and Ito (2008b). Hence, the findings based on an individual country may be different from the results based on a pooled sample of many countries.

There are several policy implications. In studying the trilemma, nonlinear relationships need to be examined. The log-linear relationship is expected to yield smaller forecast errors than the widely used linear relationship. It would be beneficial for Poland to pursue more exchange rate stability in order to raise the growth rate of real GDP. However, it also causes more output volatility. Monetary policy may need to be evaluated as more monetary autonomy does not reduce inflation, increase growth, or reduce volatility. More financial integration benefits Poland as it reduces inflation and volatility. To determine whether the results are robust, regression parameters need to be re-estimated when the sample size increases in the future.

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