# Effects of the Trilemma Policies on Inflation, Growth and Volatility in Bulgaria

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**Abstract.** *This paper finds evidence of the trilemma for Bulgaria, suggesting that exchange rate stability, monetary independence and free capital mobility are binding and constrained. The policy combination of exchange rate stability and monetary independence has been prevalent. More exchange rate stability increases the growth rate of real GDP whereas more monetary independence or free capital mobility reduces the growth rate. The inflation rate, inflation volatility and output volatility are not affected by either one of the three trilemma policies.*

**Keywords:** impossible trinity; three trilemma policies; inflation; economic growth; volatility.

**JEL Codes:** E44, E52, F31, F36.
**REL Codes:** 8E, 8F, 8H.

## 1. Introduction

Many countries would like to achieve exchange rate stability, monetary autonomy and financial openness in order to reduce exchange rate volatility, adjust interest rates or the money supply to stimulate a sluggish economy or cool down an over-heated economy, and attract foreign investments. The trilemma or impossible trinity of international economics suggests that only two of these three policies can be achieved at the same time (Ghosh, Gulde, Ostry, 1997, Edison, Klein, Ricci, Sløk, 2002, Prasad, Rogoff, Wei, Kose, 2003, Levy-Yeyati, Sturzenegger, 2003, Eichengreen, Leblang, 2003, Frankel, Schmukler, Serven, 2004, Shambaugh, 2004, Obstfeld, Shambaugh, Taylor, 2005, 2009, 2010,  Henry, 2006, Kose, Prasad, Rogoff, Wei, 2006, Prasad, Rajan, 2008, Aizenman, Chinn, Ito, 2008b, 2011a, Aizenman, Ito, 2012, and others). The US achieves monetary autonomy and free capital mobility and allows the exchange rate to fluctuate freely and to be determined by market forces. Countries in the Euro zone choose exchange rate stability and free capital mobility and allows the European Central Bank to make monetary policy decisions. China pursues exchange rate stability and monetary independence and places some restrictions on capital mobility.

This paper tests the trilemma and examines potential impacts of these three trilemma policies on inflation, economic growth, inflation volatility and output volatility for Bulgaria. The study of this subject is significant as low inflation, economic growth and stability are among the most important macroeconomic goals. To the author's knowledge, none of the previous studies has used the latest data for free capital mobility or financial integration (Chinn, Ito, 2006, 2008, Aizenman, Chinn, Ito, 2011b) to examine the relationships between inflation, economic growth, inflation volatility and output volatility and these three trilemma policies for Bulgaria

Several recent studies have examined the related subjects. According to Frankel, Schmukler and Serven (2004), 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 large sample including several East European countries, 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 Bulgaria, Aizenman, Chinn and Ito (2008b) find that for developing countries a more stable exchange rate results in more output volatility and higher inflation, and more monetary autonomy causes higher inflation. Aizenman, Chinn and Ito (2011a) reveal that a more stable exchange rate increases output volatility and investment volatility whereas more monetary independence reduces output volatility and that a more stable exchange rate or more free capital mobility reduces inflation whereas more monetary autonomy results in a higher inflation. Aizenman and Ito (2012) show that the three macroeconomic policies in emerging economies are converging toward a middle ground as they pursue managed exchange rates supported by large amounts of international reserves, some degree of monetary independence, and restrained financial openness. 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.

Căpraru and Ihnatov (2011) examine whether different exchange rate systems would affect monetary autonomy based on a sample of eight new EU countries outside of the Euro zone. Bulgaria is one of the countries. They find that countries with fixed or intermediate exchange rate systems are less sensitive to ECB's interest rate than countries with floating exchange rate systems and that countries with intermediate exchange rate systems preserve more monetary independence. It suggests that countries with flexible exchange rate systems have less monetary independence than countries with fixed or intermediate exchange rate systems.

## 2. The model

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

$$C = f(EX_t, MP_t, CM_t) \qquad (1)$$

where:

C = a constant,

EX = exchange rate stability,

MP = monetary independence, and

CM = free capital mobility or financial integration.

If the goodness of fit in equation (1) is relatively high, it suggests that these tree 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 free capital mobility on the inflation rate, the growth rate of real GDP, inflation volatility and output volatility:

$$Y_t = g(EX_t, MP_t, CM_t) \qquad (2)$$

where:

Y stands for one of the following dependent variables:

$\pi$ = the inflation rate,

GR = the growth rate of real GDP,

IV = inflation volatility, and

OV = 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, Ito, 2008b, Aizenman, Chinn, Ito, 2011a, Aizenman, Ito, 2012).

## 3. Empirical results

EX, MP and CM 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 EX, MP or CM indicates more exchange rate stability, monetary independence or free capital mobility. EX is represented by:

$$EX = [1 + \sigma(\Delta \log(e)/0.01)]^{-1}, \qquad\qquad (3)$$

where:

$\sigma$ and e stand for the standard deviation and the nominal exchange rate. MP is measured by:

$$MP = 0.5 - c(r, r^*)/2, \qquad\qquad (4)$$

where c, r and $r^*$ stand for the correlation coefficient, the money market rate in Bulgaria and the money market rate in the US CM 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 detailed in the *Annual Report on Exchange Arrangements and Exchange Restrictions* 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. OV 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.

Table 1 presents estimated parameters, t-statistics and values of R-squared for the linear, log-log, log-linear and linear-log relationships in the trilemma equation. In order to test different functional forms and avoid any zero value after the transformation into the logarithmic scale, a value of 1 is added to each of EX, MP and CM. A value of 2 is chosen for the constant. The Newey-West method is used if consistent estimates of the covariance and standard errors are required. As shown, values of R-squared are relatively high, and all the coefficients are significant at the 1%, 5% or 10% level. Hence, there is support for the trilemma. A comparison of these four different functional forms suggests that the log-linear regression has the lowest values of the mean absolute percent error and Akaike information criterion. Based on the mean absolute percent error, the linear, log-log and linear-log regressions rank second, third and fourth, respectively. Based on the estimated coefficients, it appears that the Bulgarian authorities place more weight on monetary independence than exchange rate stability or free capital mobility.

Table 1

**Estimated regressions for the trilemma test**

|  | Exchange rate stability | Monetary independence | Free capital mobility | $R^2$ | MAPE | AIC |
|---|---|---|---|---|---|---|
| Linear | 0.218[b] (2.726) | 0.918[a] (12.370) | 0.202[b] (2.109) | 0.9970 | 4.363 | -1.212 |
| Log-log | 0.304[b] (2.788) | 1.167[a] (10.037) | 0.295[c] (2.066) | 0.9782 | 7.732 | -1.344 |
| Log-linear | 0.076[b] (2.726) | 0.318[a] (12.370) | 0.070[b] (2.109) | 0.9970 | 3.019 | -3.331 |
| Linear-log | 0.876[b] (2.788) | 3.367[a] (10.037) | 0.551[c] (2.066) | 0.9782 | 11.302 | 0.775 |

**Notes:** Figures in the parenthesis are t-statistics. Superscript lower-case letters a, b and c indicate that a coefficient is significant at the 1%, 5% 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: 1994-2009.
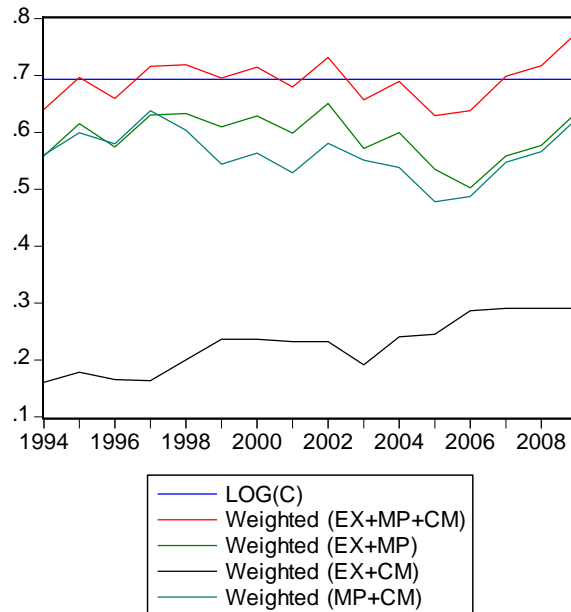


**Figure 1**. *Analysis of policy combinations*

Based on the log-linear regression, Figure 1 presents different policy combinations. The policy combination of exchange rate stability and monetary independence has been prevalent since 1998. Note that, in recent years, the policy combination of monetary independence and free capital mobility has moved closely with the policy combination of exchange rate stability and monetary independence, suggesting that these two different policy combinations may be considered when economic conditions have changed and demand a change.

Table 2 presents estimated regressions for the inflation rate, the growth rate, inflation volatility and output volatility. As the table shows, the explanatory power is relatively high for the regression of the growth rate and relatively low for the regressions of the inflation rate and inflation volatility. The inflation rate, inflation volatility and output volatility are not affected by either one of the three trilemma policies. On the other hand, the growth rate is positively affected by more exchange rate stability and negatively influenced by more monetary independence or more free capital mobility.

Table 2

**Estimated regressions for the inflation rate, the growth rate, inflation volatility and output volatility**

| Dependent variable | Exchange rate stability | Monetary independence | Free capital mobility | Constant | $R^2$ |
|---|---|---|---|---|---|
| Inflation rate | -274.314 (-1.435) | 559.316 (1.105) | 155.742 (0.736) | -34.513 (-0.118) | 0.370 |
| Growth rate | 5.662[c] (1.736) | -14.668[c] (-2.063) | -5.471[c] (-1.950) | 7.508 (1.300) | 0.514 |
| Inflation volatility | 179.255 (1.196) | 525.324 (1.441) | -239.656 (-1.463) | -109.586 (-0.531) | 0.334 |
| Output volatility | -2.969 (-1.109) | 6.781 (1.680) | -1.606 (-0.744) | 3.892 (1.056) | 0.446 |

**Notes:**
Figures in the parenthesis are t-statistics. Small letter c indicates that a coefficient is significant at the 10% level. Sample period: 1994-2009.

## 4. Summary and conclusions

This paper has found support for the trilemma for Bulgaria. It suggests that there is a tradeoff among exchange rate stability, monetary independence and free capital mobility. More exchange rate stability raises the growth rate whereas more monetary independence or more free capital mobility reduces the

growth rate. The inflation rate, inflation volatility and output volatility are not influenced by either one of the three trilemma policies.

There are several policy implications. In testing the trilemma, different functional forms need to be considered. The widely used linear relationship may result in larger forecast errors than other functional forms. It would be beneficial for Bulgaria to pursue more exchange rate stability in order to raise the growth rate of real GDP. Monetary policy may need to be evaluated as more monetary autonomy reduces the growth rate and does not result in other positive outcomes. As the sample size increases in the future, these regressions may need to be re-estimated in order to determine whether the conclusions may change.

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