# REAL INTEREST RATES AND FISCAL POLICY: A GLOBAL STUDY

Ellis Heath
Division of Economics and Finance
College of Business and Economics
West Virginia University
P.O. Box 6025
Morgantown, WV 26508-6025
E-mail: ebheath@mail.wvu.edu
Phone: (304)293-7872
Fax: (304)293-5652

October 26, 2008

**Abstract**

Using a dynamic panel data set, I examine the effect of fiscal policy on real interest rates for a sample of 59 nations covering the time period from 1970 through 2006. Controlling for both country and time effects, I find that changes in national savings affect real interest rates. A one-percent increase in a country's deficit to output ratio corresponds to an increase in that country's real interest rate. This increase is statistically and economically significant; it ranges in magnitude from approximately 12 to 15 basis points. A surprising secondary result also emerges: a country's financial openness does not appear to play an important role in the determination of their real interest rate.

## INTRODUCTION

In the forefront of every nation's fiscal policy debate exists the issue of whether to run a budget deficit or a budget surplus. Given that the latter is rarely attained by most countries, the debate then reduces to one that concerns the size of the budget deficit. One of the arguments given against increasing the magnitude of a budget deficit is the cost that will be incurred by the economy from a resulting increase in the real interest rate. When government spending grows more than government receipts, the private sector pays the price through an increase in real interest rates in response to the lower pool of loanable funds available to the economy. Recently, this debate has garnered more attention given that the US has gone from having a rare budget surplus to the more typical budget deficit. Other nations have seen similar fluctuations.

Gale and Orszag (2004) give a thorough overview of the different economic effects of budget deficits on real interest rates. They present two theoretical views: a Ricardian equivalence explanation and a Keynesian IS-LM explanation. Barro (1974) shows that if Ricardian equivalence prevails, national savings will always be constant, regardless of national deficits. If a government is operating under a national deficit, private savings will increase in anticipation of future tax increases or lower government spending. The change in the national budget will then be offset by an equal change in private savings. Since national savings provide the pool of loanable funds to the economy, there will be no change in the real interest rate. The Keynesian IS-LM view, however, implies that Ricardian equivalence might fail. Under this explanation, private savings does not completely offset changes in the national budget. In a closed economy, the real interest rate responds sharply to changes in the national budget, since changes in the national budget have an important impact on national savings. If the economy is an open one, it is possible that national savings will be affected by capital from abroad. If fiscal policy is

expansionary, the real interest rate will increase. The new higher real interest rate will attract foreign capital. This new source of capital will expand the pool of loanable funds and drive down the real interest rate. Whether the real interest rate returns to its original level or not will depend on the degree of financial openness that exists in the economy in question. In the Keynesian IS-LM view, exchange rate regimes are important as well. While they will not change the type of response in the real interest rate, a floating or fixed currency will affect the magnitude of their response. A fixed currency will dampen this effect since the central bank will have to move the LM curve in order to offset the change in the real interest rate and maintain their currency at a constant value.

Empirically, most findings support the Keynesian view. Changes in national savings do affect real interest rates. Using a measure of projected deficits to control for business cycle effects, Laubach (2003) finds that an increase in the deficit-GDP ratio by one percent raises the ten-year Treasury note by at least 24 basis points. Engen and Hubbard (2004) duplicate the Laubach study, but with more control variables; at 18 basis points, they find the same effect but of a much smaller magnitude. In an international study Ardagna, Caselli and Lane (2004) find that for OECD countries a one-percent increase in the national deficit-GDP ratio results in a cumulative change of 150 basis points for the real interest rate, while the one-time, initial increase is approximately 10 basis points.

I use a dynamic panel data set of 59 nations from 1970 through 2006. I control for both exchange rate regimes and financial openness. As in the previous literature, I find that fiscal policy affects real interest rates, but not as much as previous studies would suggest. A one-percent increase in the national deficit to national output ratio in real terms increases the national real interest rate. The effect is statistically and economically significant. The benchmark result

ranges in magnitude from around 12 to 15 basis points, depending on which measure of financial openness is used. This study is unique in that it covers a range of very different nations. It is not limited to nations with similar economies, rather it encompasses both advanced, developed and transition economies.

A second finding is the apparent unimportance of financial openness. At no stage is the financial openness variable statistically significant in the determination of the real interest rate. This is a puzzling result. This result does not change when using a *de jure* measure of financial openness instead of a *de facto* one. It is robust to sub-samples of countries, as well.

The section that follows goes over the methodology and data set used in this study. The third section provides a discussion of the results. The fourth section provides some robustness checks and the final section concludes.

## METHODOLOGY AND DATA

In an effort to analyze the behavior of real interest rates when faced with changes in national budgets among a variety of nations, I make adjustments to an empirical model given by Giavazzi et al. (2000) and Kamps (2006). I assume that the real interest rate depends on the growth rate of per capita income and the ratio of the national savings to GDP. The model is dynamic due to the fact that I also assume that there is persistence in the real interest rate, so lagged values of the real interest rate are included.[1] I also control for financial openness and exchange rate regimes.

*Pooled OLS*

The general specification of the model assumes *n* lags of the dependent variable and is given as follows:

[1] For example, see Barro and Sala-i-Martin (1990) concerning real interest rate persistence.

$$r_t = \beta_0 + \beta_1 y_t + \beta_2 s_t + \beta_3 (s_t * fo_t) + \beta_4 xch_t + \sum_{n=1}^{p} \alpha_p r_{t-n} + \varepsilon_t \qquad (1)$$

Here, *r* stands for the real interest rate, *y* is the growth in per capita income, *s* is national savings-to-GDP ratio. Positive values of *s* indicate a budget surplus, while negative ones imply a national deficit. The variable *fo* is a measure of financial openness and *xch* is a binary variable that captures whether the *i*th country's exchange rate regime is floating or fixed by assigning a value of 1 for the former and 0 for the latter. Of course, *t* is a time subscript and *n* is the lag length. Also, as given by equation (1), I assume that financial openness interacts with the national budget to affect the real interest rate.

*Fixed Effects*

Given the range of countries being examined and the time period being covered, certain specific effects would be expected. These may be sensitive to either country factors and/or time factors. If the individual country effects are due to variables being omitted, then, it is possible that there could be correlation issues with the other independent variables. Additionally, since the sample of countries used this study is not truly random, controlling for fixed effects would seem more appropriate.[2] To account for this, the above model will be estimated again, but in the following manner:

$$r_t = \beta_0 + \beta_1 y_t + \beta_2 s_t + \beta_3 (s_t * fo_t) + \beta_4 xch_t + \delta_i + \eta_t + \sum_{n=1}^{p} \alpha_p r_{t-n} + \varepsilon_t \qquad (2)$$

Country fixed effects and time fixed effects are controlled for using dummy variables (not shown here for convenience) and are represented by the additional vectors $\delta$ and $\eta$, respectively.

[2] The Hausman test confirms this.

*Generalized Method-of-Moments (GMM)*

Since the dependent variable *r* depends on past values of *r*, dynamic effects may need to be accounted for. With this in mind and in order to obtain consistent parameters for this model, following Arellano and Bond (1991) a generalized method-of-moments (GMM) approach is used to estimate the parameters. First-differencing equation (2) above gives the following:

$$\Delta r_t = \beta_0 + \beta_1 \Delta y_t + \beta_2 \Delta s_t + \beta_3 \Delta (s_t * fo_t) + \beta_4 \Delta xch_t + \sum_{n=1}^{p} \alpha_p \Delta r_{t-n} + \Delta \varepsilon_t \quad (3)$$

The individual country and time effects are now eliminated and estimation can be done using GMM procedures. For the dependent variable, the lagged variable $r_{t-2}$ is used as an instrument and for the independent variables, their own differences are used.

Given the assumption that there tends to be some degree of persistence in the real interest rate, one would expect past values of *r* to be positively correlated with current values; therefore, $\alpha_p$ should be positive and statistically significant. Also, if $\beta_1$ is statistically significant, it should be positive, given that theory would suggest that increases in per capita income drive the real interest rate up if they have any effect at all. The sign of $\beta_2$ should be negative if it is significant; this would confirm Keynesian IS-LM behavior of real interest rates in response to changes in the national budget. However, if this parameter is not statistically different from zero, then Ricardian equivalence would appear to prevail. The parameter $\beta_3$ for the interaction variable *(s*fo)* should be positive if financial openness is important, since financial openness will offset the national savings effect on real interest rates by providing capital when shortages in the loanable funds market occur and vice versa. At first glance, it is not clear what the expected sign of the coefficient $\beta_5$ should be. Since central banks in countries with fixed exchange rates use monetary policy to offset changes in the interest rate, it could be either sign. Fortunately, this will not matter since the purpose of including it here is simply to control for different currency regimes.

*Data*

The data for this study is annual and covers the period from 1970 through 2006.[3] The lag used for the real interest rate independent variable is one.[4] The real interest rate is calculated by subtracting the inflation rate from the national treasury bill rate. The inflation rate is calculated using the consumer price index of each country. The real per capita GDP growth rate is obtained from the countrys' GDP series, population series and consumer price index. The national savings ratio is calculated using the countrys' surplus/deficit series and GDP series, both in real terms. Following Edison et al. (2002), the *de facto* financial openness series is a ratio of the countrys' capital inflows and outflows to GDP. All of the above series are taken from the International Monetary Fund's *International Financial Statistics* database. The *de jure* financial openness index is taken from the Chinn-Ito index.[5] The exchange rate information was taken from the IMF *De Facto Exchange Rate Arrangements and Anchors of Monetary Policy*.

## DISCUSSION OF RESULTS

*Fiscal Policy, Real Interest Rates and de jure Financial Openness*

The first column of table I shows the results from the pooled OLS estimation using the *de jure* financial openness variable. At first glance, these benchmark results would appear to support Ricardian equivalence; that is, fiscal policy is not important in the determination of real interest rates. But, if this were the case, the financial openness variable should not matter either. Here, it does. However, while the financial openness variable is statistically significant, economically its effect on real interest rates is small. It does have the expected sign, since the coefficient's positive

[3] See Appendix A for a list of the countries included in this paper and see Appendix B for the summary statistics for the data.
[4] Running the regressions with two or more lags does not change results significantly and furthermore the second lag is insignificant statistically.
[5] The latest version of this index can be found at http://www.ssc.wisc.edu/~mchinn.

sign would indicate that financial openness improves the real interest rate impact, but economically, this is very small at 2 basis points. The coefficients for the other regressors are significant and as expected.

In all likelihood, the pooled OLS estimation is not adequate. Given the wide sample and broad time period, one would expect some sort of fixed effects to occur. In the second column of table I the results from estimating equation (2) are given. Controlling for both time and country fixed effects suggests that fiscal policy does matter both statistically and economically. A one-percent change in the national savings to GDP ratio corresponds to a 12 basis point change in the real interest rate, regardless of country or time period. If a country increases its national deficit by one percent relative to its GDP, an increase of 12 basis points in the real interest rate would be expected. This estimate is higher than the estimate given by Ardagna, Caselli and Lane (2004), but a bit less than Laubach's (2003) and Engen and Hubbard's (2004).

While the short-run effect found by Ardagna, Caselli and Lane (2004) was not of great magnitude, they did find that the long-run effect was prominent at 150 basis points after 10 years. Assuming that the financial openness coefficient is not statistically different from zero as the results indicate, based on the results from column two of table I, the long-run effect of a change in national savings would approach approximately 16 basis points.[6] This effect would be permanent, but small compared to the 150 basis point effect in Ardagna, Caselli and Lane (2004).

Due to the fact that a lag of the dependent variable appears as an independent variable, controlling just for fixed effects may not be sufficient. Instrumenting and using the GMM technique as given by Arellano and Bond (1991), fiscal policy appears to matter a bit more. Statistically, the coefficient for national savings is stronger. Economically, the basis point impact

[6] See Figure I

on the real interest rate is slightly more at 15 basis points. Looking at figure II, the long-run effect is also greater at just under 20 basis points after 10 years.

In both the fixed effects and the GMM regressions, what stands out is that the coefficient for financial openness is never statistically significant. In all cases the control variables are important and they have signs that are expected.

*Fiscal Policy, Real Interest Rates and de facto Financial Openness*

In table II the results from the pooled OLS estimation using the *de facto* financial openness variable are given. As in the *de jure* case, fiscal policy does not seem to matter. However, neither does financial openness. Of the control variables only the currency regime and the one-year lag of the real interest rate appear important statistically.

As stated earlier, the pooled OLS estimation does not seem appropriate. Using two-way fixed effects for country and time, results similar to those in the *de jure* fixed effects regression are obtained. Financial openness is the only variable that does not appear to matter statistically. The other coefficients are all of similar magnitudes and statistical significance levels. The one-time basis point effect of an increase in the national deficit on the real interest rate is approximately 15 basis points. The long-term effect is around 16.25 basis points as given in figure III.

Under the GMM estimation, the statistical significance and economic magnitude are similar. In other words, fiscal policy appears to matter, but financial openness does not. Here, the basis point increase in the real interest rate from a one-percentage increase in the deficit-to-GDP ratio is approximately 13 basis points. The long-term effect approaches 20 basis points as shown in figure IV.

## SENSITIVITY ANALYSIS

Sub-sample data sets also support the finding that financial openness does not appear to be important in the determination of real interest rates. The first two rows of tables III and IV show the results for sub-sample analysis based on whether a country is industrial or not. The results in the third row are from examining countries that are members of the OECD.[7] However, only in the sub-sample for non-industrial countries is national savings important.

In the previous analysis, the lagged dependent variable as a regressor is ignored. When this is accounted for, the two original results are both supported: national savings is statistically and economically important for the determination of real interest rates and financial openness does not appear to matter for real interest rates.

## CONCLUDING REMARKS

While Ricardian equivalence suggests that fiscal policy has no effect on the determination of the real interest rate, most empirical evidence suggests otherwise. However, even though the literature appears to support the Keynesian IS-LM hypothesis that fiscal policy matters for real interest rates, there is often much disagreement over the degree of economic importance. Most of the focus on this issue is centered on the US economy. Those studies that have ventured farther looked at countries that are similar to the US.

Here, I test the link between fiscal policy and real interest rates on a much broader sample. I look at developed, developing and transition economies. Controlling for exchange rate regimes and financial openness, I find evidence that supports the Keynesian IS-LM hypothesis, but only slightly. While fiscal policy is statistically and economically important in the

[7] Not all countries of the OECD are in the original sample. Here, only the countries from this sample that are in the OECD are looked at.

determination of real interest rates, in this study I find the effect to be smaller than estimated in previous studies, both in the short run and in the long run. Increases in the national deficit to GDP ratio are linked positively with changes in the real interest rate. I find that the strongest effect is in the short-run. This effect ranges from 12 to 15 basis points. However, after approximately 5 years, the effect approaches its maximum level of around 16 to 20 basis points. Therefore, the long-run effect is not as important.

Additionally, I find a surprising result: financial openness does not appear to play an important role in the determination of real interest rates. This result is robust to country selection and measure of financial openness, as well as real interest rate persistence. This result is truly puzzling. Possible explanations are that current measures of financial openness suffer from measurement error and/or the degree of financial openness in the world is close among different economies and therefore due to a lack of variation it does not appear to have much explanatory power for the determination of real interest rates.

**REFERENCES**


Ardagna, S., F. Caselli and T. Lane (2004). "Fiscal Discipline and the Cost of Public Debt Service: Some Estimates for OECD Countries," Working Paper 10788. Cambridge, MA: National Bureau of Economic Research (September).

Arellano, M., and S. Bond (1991). "Some tests of specification for panel data: Monte Carlo Evidence and an Application to Employment Equations," *Review of Economic Studies*, 58, 277-297.

Barro, R.J. (1974). "Are Government Bonds Net Worth?" *Journal of Political Economy*, 82(6), 1095-1117.

Barro, R.J. and X. Sala-i-Martin (1990), "World Real Interest Rates," O.J. Blanchard and S. Fischer (eds) *NBER: Macroeconomics Annual 1990*, 15-74.

Edison, H.J., R. Levine, L. Ricci and T. Slok (2002), "International financial integration and economic growth," *Journal of International Money and Finance*, 21(2002), 749-776.

Engen, E.M., and R.G. Hubbard (forthcoming). "Federal Government Debt and Interest Rates," in *NBER Macroeconomics Annual*, edited by M. Gertler and K. Rogoff, MIT Press.

Gale, W.G. and P.R. Orszag (2004). "Budget Deficits, National Saving and Interest Rates," *Brookings Papers on Economic Activity No. 2.*

Giavazzi, F., T. Jappelli, and M. Pagano (2000), "Searching for non-linear effects of fiscal policy: Evidence from industrial and developing countries," *European Economic Review*, 44(2000), 1259-1289.

Kamps, C. (2006), "Are the effects of fiscal policy really nonlinear? A note," *Empirica*, 33, 113-125.

Laubach, T. (2003), "New Evidence on the Interest Rate Effects of Budget Deficits and Debt," Washington: Board of Governors of the Federal Reserve System, May.

# Appendix A
## Countries in sample

| | | |
|---|---|---|
| Australia | Iceland | Philippines |
| Bahamas | Israel | Poland |
| Bahrain | Italy | Seychelles |
| Barbados | Jamaica | Singapore |
| Belgium | Kenya | Slovenia |
| Belize | Kuwait | South Africa |
| Bolivia | Kyrgyz Rep. | Spain |
| Brazil | Latvia | Sri Lanka |
| Canada | Lesotho | St. Kitts & Nevis |
| Cyprus | Lithuania | St. Lucia |
| Czech Rep. | Malawi | Swaziland |
| Egypt | Malaysia | Sweden |
| Ethiopia | Malta | Switzerland |
| Fiji | Mexico | Thailand |
| France | Moldova | Trinidad & Tobago |
| Germany | Morocco | Uganda |
| Greece | Nepal | United Kingdom |
| Grenada | Netherlands | United States |
| Haiti | New Zealand | Zambia |
| Hungary | Papua N. Guinea | |

# Appendix B

| Name | Definition | Summary Statistics for Data | | | | | Source(s) |
|---|---|---|---|---|---|---|---|
| | | Mean | Median | Maximum | Minimum | Standard Deviation | |
| *r* | Difference between nominal short-term interest rate and the annual rate of change of the private consumption deflator | 1.47 | 2.17 | 33.21 | -81.10 | 6.36 | Treasury Bill Rate (60C.ZF) and CPI (64.XZF) from IMF's *International Financial Statistics* database |
| *y* | Annual growth rate of real per capita GDP | 1.18 | 1.74 | 30.17 | -37.91 | 5.82 | GDP (99B.CZF), Population (99Z.ZF) and CPI (64.XZF) from IMF's *International Financial Statistics* database |
| *s* | Ratio of national savings to GDP | -2.94 | -2.83 | 16.11 | -31.63 | 4.33 | Government Cash Surplus/Deficit (cCSD.CG) and GDP (99B.CZF) from IMF's *International Financial Statistics* database |
| *fo (de jure)* | Financial Openness measure | 0.64 | 0.18 | 2.60 | -1.77 | 1.52 | Chinn-Ito Index from http://www.ssc.wisc.edu/~mchinn |
| *fo (de facto)* | Financial Openness measure | 25.72 | 5.10 | 1321.54 | 0.00 | 88.34 | Flows of capital (78BDD+78BED+78BFD+78BGD) and GDP (99B.CZF) from IMF's *International Financial Statistics* database |
| *xch* | Binary variable that taks on value of 0 if currency regime is managed and 1, otherwise | 0.53 | - | - | - | 0.50 | Various |

Observations: 833

## Table I

*de jure financial openness*

| | Default | With Time and Country Effects | *GMM* |
|---|---|---|---|
| Lagged real interest rate | **0.71*** ** | **0.20*** ** | **0.35*** ** |
| | (0.02) | (0.03) | (0.03) |
| Per Capita GDP | **0.03** ** | **0.25*** ** | **0.19*** ** |
| | (0.02) | (0.03) | (0.03) |
| National Savings | -0.01 | **-0.12** ** | **-0.13** ** |
| | (0.02) | (0.05) | (0.06) |
| Financial Openness | **-0.02** ** | -0.04 | -0.02 |
| | (0.01) | (0.02) | (0.03) |
| Currency Regime | **0.41** ** | **1.88*** ** | **3.96*** ** |
| | (0.18) | (0.62) | (0.79) |

Standard errors are given in parenthesis. Bold face indicates coefficients have p-value less than or equal to 0.10 (*** ≤ 0.01; ** ≤ 0.05; * ≤ 0.10). There are 752 observations for the first two columns and 680 for the last one.

## Table II

*de facto financial openness*

| | Default | With Time and Country Effects | *GMM* |
|---|---|---|---|
| Lagged real interest rate | **0.72*** ** | **0.20*** ** | **0.35*** ** |
| | (0.02) | (0.03) | (0.03) |
| Per Capita GDP | 0.02 | **0.25*** ** | **0.19*** ** |
| | (0.02) | (0.03) | (0.03) |
| National Savings | -0.03 | **-0.15*** ** | **-0.15*** ** |
| | (0.02) | (0.05) | (0.05) |
| Financial Openness | 0.0001 | 0.00003 | 0.0002 |
| | (0.0002) | (0.0003) | (0.0004) |
| Currency Regime | **0.44** ** | **1.87*** ** | **3.96*** ** |
| | (0.18) | (0.62) | (0.79) |

Standard errors are given in parenthesis. Bold face indicates coefficients have p-value less than or equal to 0.10 (*** ≤ 0.01; ** ≤ 0.05; * ≤ 0.10). There are 752 observations for the first columns and 680 for the last one.

## Table III

*de jure* Sensitivity Analysis (FE)

| | National Savings | Financial Openness |
|---|---|---|
| Industrial Countries | -0.04 | 0.004 |
| | (0.05) | (0.02) |
| No Industrial Countries | **-0.13**** | -0.05 |
| | (0.07) | (0.04) |
| OECD Countries in sample | -0.01 | 0.002 |
| | (0.05) | (0.02) |

Standard errors are given in parenthesis. Bold face indicates coefficients have p-value less than or equal to 0.10 (*** ≤ 0.01; ** ≤ 0.05; * ≤ 0.10). There are 316 observations for the first row, 436 for the second and 306 for the last one.

## Table IV

*de facto* Sensitivity Analysis (FE)

| | National Savings | Financial Openness |
|---|---|---|
| Industrial Countries | -0.04 | 0.0000 |
| | (0.05) | (0.0004) |
| No Industrial Countries | **-0.18***** | 0.0001 |
| | (0.07) | (0.0004) |
| OECD Countries in sample | -0.03 | 0.002 |
| | (0.05) | (0.002) |

Standard errors are given in parenthesis. Bold face indicates coefficients have p-value less than or equal to 0.10 (*** ≤ 0.01; ** ≤ 0.05; * ≤ 0.10). There are 316 observations for the first row, 436 for the second and 306 for the last one.

## Table V

*de jure* Sensitivity Analysis (GMM)

| | National Savings | Financial Openness |
|---|---|---|
| Industrial Countries | **-0.11**** | 0.02 |
| | (0.05) | (0.02) |
| No Industrial Countries | **-0.15**** | -0.02 |
| | (0.07) | (0.04) |
| OECD Countries in sample | **-0.08**** | 0.009 |
| | (0.05) | (0.02) |

Standard errors are given in parenthesis. Bold face indicates coefficients have p-value less than or equal to 0.10 (*** ≤ 0.01; ** ≤ 0.05; * ≤ 0.10). There are 295 observations for the first row, 385 for the second and 283 for the last one.

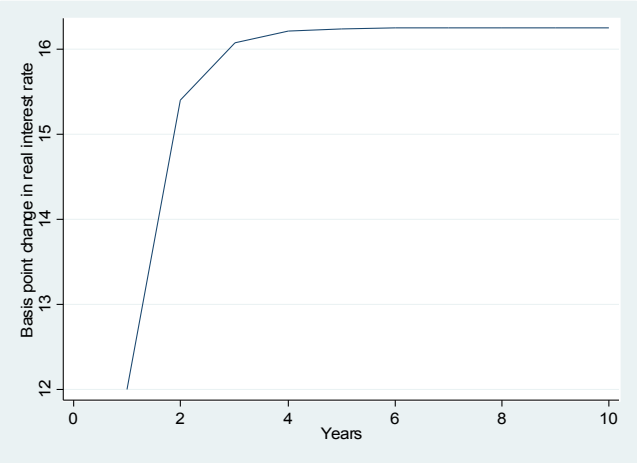
## Table VI

*de facto* Sensitivity Analysis (GMM)

| | National Savings | Financial Openness |
|---|---|---|
| Industrial Countries | **-0.10**** | 0.0001 |
| | (0.04) | (0.0004) |
| No Industrial Countries | **-0.19***** | 0.0003 |
| | (0.07) | (0.0005) |
| OECD Countries in sample | **-0.10**** | 0.003 |
| | (0.05) | (0.002) |

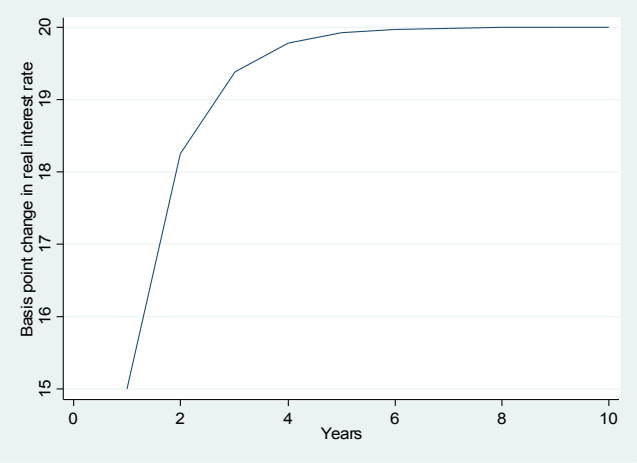
Standard errors are given in parenthesis. Bold face indicates coefficients have p-value less than or equal to 0.10 (*** ≤ 0.01; ** ≤ 0.05; * ≤ 0.10). There are 295 observations for the first row, 385 for the second and 283 for the last one.

## Figure I



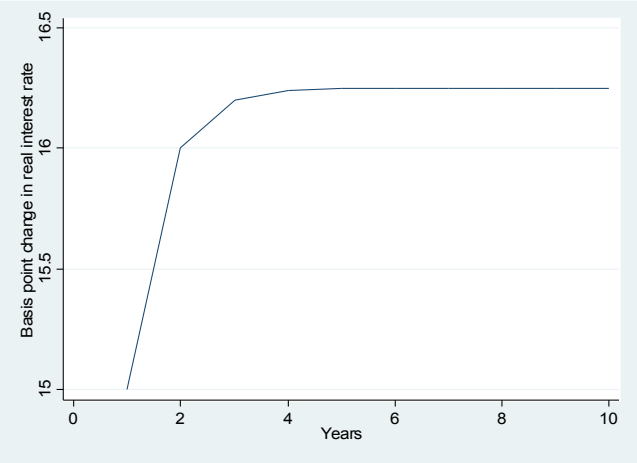

The above graph shows the outcome of a one-percentage point increase in the deficit-to-GDP ratio on the real interest rate using results from *de jure* fixed effect estimation.

## Figure II



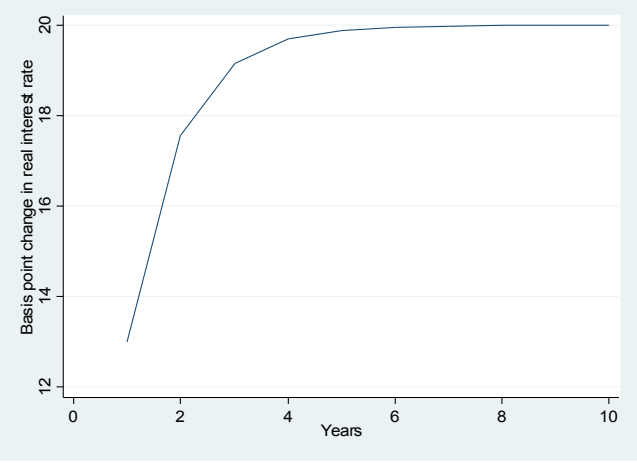

The above graph shows the outcome of a one-percentage point increase in the deficit-to-GDP ratio on the real interest rate using results from *de jure* GMM estimation.

## Figure III




The above graph shows the outcome of a one-percentage point increase in the deficit-to-GDP ratio on the real interest rate using results from *de facto* fixed effect estimation.

## Figure IV




The above graph shows the outcome of a one-percentage point increase in the deficit-to-GDP ratio on the real interest rate using results from *de facto* GMM estimation.