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Standard Taylor rules revisited - A cross country study for European countries*

by

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Abstract

In this paper we want to estimate basic Taylor rules with a cross country study approach for European countries before the reorganization of the system of central banks. We compare basic and extended Taylor rules to give a hint if the exchange rate plays a significant role in the decision making of monetary policy. Fixed Effects, GMM and SGMM estimators are used to check for robustness. The obtained results adumbrate that there may be an influence of exchange rate changes on the monetary policy decision making process but the results are not fully robust and deliver only a weak tendency.

JEL - Classification: C32, E52, F31

Keywords: Cross Country Study, Taylor Rules, Exchange Rate, FE Estimation, SGMM Estimation

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1 Introduction

Due to the noticeable relation of a low US $ to a high € before the financial crisis, the question arises what importance the exchange rate should have in economic theory. Our main issue in this term paper is the analysis of monetary policy.

To influence the economy, central banks set their monetary policy instrument, i.e., the central bank interest rate. Main goal is to stabilize the economy by holding inflation at its target. The basic theory modeling the decision process of how the interest rate is set is subject of Taylor's paper [13]. He identified a relationship between the central bank interest rate set by central banks and the inflation rate as well as output. Clarida, Galí and Gertler [6] extended the basic ideas of Taylor for New Keynesian models. They used the deviation of the explanatory variables inflation and output to their target values to explain the central bank interest rate. In this context, the target for inflation is set to 2%.[1]

A high variety of different monetary policy rules based on the ideas of the former authors are given in Glenn Rudebusch's and Lars Svensson's paper "Policy rules for inflation targeting" [12]. The overview is taken as basis to compare different monetary policy rules in the following sections.

We estimate Taylor rules for 14 European countries before the integration of several central banks into the European System of Central Banks in 1999. Due to this criterion, we use data from 1978 until 1998. The main goal is to give a hint if the central banks which were autonomous in this time used implicitly the exchange rate as indicator for the interest rate decision.

As estimation techniques, fixed effects (FE), generalized method of moments (GMM) and system generalized method of moments (SGMM) for the cross country analysis are used. For comparison purposes we estimate at first a basic version of a Taylor rule which contains as regressors the inflation rate and the output. In more extended versions, the exchange rate per US $ in levels as well as in first differences is added.

In the next section the Taylor rules as well as the three estimation methods mentioned above are briefly described. Two different data sets as well as the preparation of the data are characterized in section three. In the fourth section we present our results. The last section concludes.

[1] For more information see Walsh [14].

2 Theoretical foundations

The following subsection gives an overview of the different Taylor Rules which will be estimated. The second subsection contains a brief description of the three estimation methods used.

2.1 The Model

For comparison purposes, we want to estimate at first two basic Taylor rules where the central bank interest rate is influenced by the inflation rate and the output. Additionally to this standard form, we add to all analyzed Taylor rules a smoothing term of the interest rate as well as a time trend. Explicitly, the first basic Taylor rule to be examined is:

$$i_{jt} = \alpha_j + \delta t + a_1 i_{jt-1} + a_2 \pi_{jt} + a_3 y_{jt} + \varepsilon_{jt}. \tag{1}$$

We want to estimate equation (1) for all countries $j = 1, \ldots, N$ and for all time periods $t = 1, \ldots, T$. α is a country specific constant and δ is the homogenous slope factor of a time trend. i denotes the interest rate, π the inflation rate and y describes the output. ε is the residual of the estimation. In equation (1), we take inflation and output in its level form.

The second basic Taylor rule is an equation of the form:

$$i_{jt} = \alpha_j + \delta t + b_1 i_{jt-1} + b_2 \widetilde{\pi}_{jt} + b_3 \widetilde{y}_{jt} + \varepsilon_{jt}. \tag{2}$$

$\widetilde{\pi}$ denotes the deviation of the inflation rate to its target[2] and $\widetilde{y}$ is the deviation of output to its country specific mean.[3] As before, a smoothing term for the interest rate is implemented. In equation (2), the explanatory variables are modeled as deviation from their targets, i.e., as gap.

Next step is to extend the basic monetary policy rules described above by the exchange rate which is done in two different ways: We implement the exchange rate in levels or as first differences. First differences mean in this context the difference between the exchange rate today and the exchange rate of the former period, i.e, the change in the exchange

[2] The inflation target is set to 2%, see also Walsh [14].

[3] The basic Taylor rule in equation (2) is described in detail in Clarida, Galí and Gertler [6] and Rudebusch and Svensson [12].

rate. The two alternative ways of implementation are described in the following equations:

$$
\begin{aligned}
i_{jt} &= \alpha_j + \delta t + c_1 i_{jt-1} + c_2 \pi_{jt} + c_3 y_{jt} + c_4 ex_{jt} + \varepsilon_{jt} && (3)\\
i_{jt} &= \alpha_j + \delta t + d_1 i_{jt-1} + d_2 \pi_{jt} + d_3 y_{jt} + d_4 \Delta ex_{jt} + \varepsilon_{jt} && (4)\\
i_{jt} &= \alpha_j + \delta t + e_1 i_{jt-1} + e_2 \widetilde{\pi}_{jt} + e_3 \widetilde{y}_{jt} + e_4 ex_{jt} + \varepsilon_{jt} && (5)\\
i_{jt} &= \alpha_j + \delta t + f_1 i_{jt-1} + f_2 \widetilde{\pi}_{jt} + f_3 \widetilde{y}_{jt} + f_4 \Delta ex_{jt} + \varepsilon_{jt} && (6)
\end{aligned}
$$

2.2 Econometric methods

In the following section we derive the theoretical basics of the estimation methods used. “Inflation” and “output” in this section denote the variables in general and do not distinguish between the level and the deviation form.[4]

As a first step, the regressors for all countries j and all time periods t are rearranged in one large matrix X:[5]

Let Π_j and Y_j denote the $T \times 1$ vectors of the inflation and the output for each country j and all time periods $t = 1, \ldots, T$. Therefore the stacked instrument matrix

$$
X = \begin{pmatrix} C & TR & \Pi_1 & Y_1 \\ \vdots & & & \vdots \\ C & TR & \Pi_N & Y_N \end{pmatrix}
$$

has dimension $NT \times 4$. C is a constant and TR denotes the trend variable.

$I_{\text{-}1j}$, the $T \times 1$ vector for the lagged interest rate is stacked for all countries in $I_{\text{-}1}$. Let I be the $NT \times 1$ matrix containing the stacked observations for the interest rate of all time periods t and all countries j. Using Fixed Effects methods (FE), we estimate the equation system:

$$
I = I_{\text{-}1}\lambda + X\beta + \epsilon \qquad (7)
$$

where λ is the estimator for the lagged interest rate, β is the 4×1 vector containing the estimators of the remaining regressors and ϵ is the $NT \times 1$ vector of the estimation

[4] We derive the estimators only for the basic Taylor rules (1) and (2). For the remaining equations, the instrument matrix has to be extended.

[5] All instruments are assumed to be strictly exogenous. We model the lagged interest rate as instruments separately.

residuals.[6] The FE estimators are found by:[7]

$$\begin{pmatrix} \widehat{\lambda} \\ \widehat{\beta} \end{pmatrix} = \left(\begin{pmatrix} I_{\text{-}1} \\ X \end{pmatrix}' \begin{pmatrix} I_{\text{-}1} \\ X \end{pmatrix} \right)^{-1} \begin{pmatrix} I_{\text{-}1} \\ X \end{pmatrix}' I.$$

Using GMM estimation techniques, equation (7) has to be rearranged in first differences form.[8] Therefore, $(T-1)$ equations for each country j are remaining. Equation (7) changes to:

$$\Delta I = \Delta I_{\text{-}1}\lambda + \Delta\widetilde{X}\beta + \Delta\epsilon. \tag{8}$$

Due to first differences, the constant is no longer part of X. So the new matrix including the instruments in first differences is:[9]

$$\Delta\widetilde{X} = \begin{pmatrix} 1 & \Delta\Pi_1 & \Delta Y_1 \\ \vdots & & \vdots \\ 1 & \Delta\Pi_N & \Delta Y_N \end{pmatrix}.$$

To obtain appropriate instruments in $I_{\text{-}1j}$ for every country j, we choose for time period t all lagged variables i_{js} where $s < t$. These are inserted at the corresponding position in W_j:

$$W_j = \begin{pmatrix} i_{j0} & 0 & \cdots & 0 \\ 0 & (i_{j0}, i_{j1}) & \cdots & 0 \\ \vdots & & & \vdots \\ 0 & \cdots & \cdots & \left(i_{j0}, \ldots, i_{j(T-2)}\right) \end{pmatrix}$$

Stacking the matrices W_j to one matrix W

$$W = \begin{pmatrix} W_1 \\ \vdots \\ W_N \end{pmatrix}$$

and combining with the instrument matrix ΔX, we get

$$Z = \left(W, \Delta\widetilde{X}\right)$$

[6]The residuals are assumed to be independently identically distributed with mean zero and finite variance across all j and t.

[7]Variables labeled with a $\wedge$ denote estimated variables.

[8]The following description is based on Arellano and Bond [2].

[9]Taking first differences of the trend returns a vector of ones: $(t+1) - t = 1$ for all t.

which has dimension $N(T-1) \times (3+T-1)$.[10]

In Arellano and Bond [2] the following moment conditions have to be satisfied:

$$\begin{aligned} E(Z'\Delta\epsilon) &= 0 \\ E(Z'\Delta\epsilon\Delta\epsilon' Z') &= Z'\left[\sigma^2\left(\mathbb{I}_N \otimes A\right)\right] \end{aligned}$$

where the main diagonal of the $(T-1) \times (T-1)$ matrix A is filled with 2 and the upper and lower diagonal with -1. $\mathbb{I}_N$ denotes the $N \times N$ identity matrix.

Applying the GMM estimation technique, we have to rearrange all regressors in one matrix and all estimators in one vector:

$$G = \left(I_{\text{-}1}, \Delta\widetilde{X}\right) \quad \text{and} \quad \widehat{\gamma} = \begin{pmatrix} \widehat{\lambda} \\ \widehat{\beta} \end{pmatrix}$$

As initial consistent estimator, we use IV techniques:

$$\widehat{\gamma}_{init} = \left[G'Z\left(Z'\Omega Z\right)^{-1} Z'G\right]^{-1} G'Z\left(Z'\Omega Z\right)^{-1} Z'\Delta I$$

with $\Omega = \mathbb{I}_N \otimes A$.

Using the residuals $\Delta\widehat{\varepsilon}_j$ based on the preliminary IV estimation, we finally get the GMM estimator as:

$$\widehat{\gamma} = \left(G'Z\widehat{V}^{-1}Z'G\right)^{-1} G'Z\widehat{V}^{-1}Z'\Delta I$$

where[11]

$$\widehat{V}^{-1} = \sum_{j=1}^{N} Z_j'\Delta\widehat{\varepsilon}_j\Delta\widehat{\varepsilon}_j' Z_j.$$

For the estimation with system GMM, equation (7) is used.[12]

The moment condition for the system GMM estimator is

$$E\left[P_j'\left(I_j - \lambda I_{\text{-}1j} - \beta\widetilde{X}\right)\right] = 0 \tag{9}$$

where[13]

$$P_j' = \left(P_{1j}', P_{2j}', P_{3j}', P_{Xj}'\right)'.$$

[10] Z contains the matrix with the lagged instruments of i as well as the differenced exogenous explanatory variables.

[11] We look at the decomposed vectors $\Delta\widehat{\varepsilon}_j$ and the decomposed matrices Z_j for each country j.

[12] We follow Bundell and Bond [5] and Arellano/Bover [3] as well as Binder [4].

[13] Equation (9) implies the initial observation restrictions of Bundell/Bond [5] and Arellano/Bover [3] as well as the homoskedasticity condition of Ahn/Schmidt [1]. Due to the elimination of redundant moment conditions we do not need to use the constant as a regressor.

P_{1j} has dimension $(T-1)T/2 \times T$:

$$P_{1j} = \begin{pmatrix} -i_{j0} & i_{j0} & 0 & \cdots & 0 \\ 0 & (-i_{j0}, -i_{j1})' & (i_{j0}, i_{j1})' & \cdots & 0 \\ \vdots & & & & \vdots \\ 0 & 0 & \cdots & (-i_{j0}, -i_{j1}, \ldots, -i_{j(T-2)})' & (i_{j0}, i_{j1}, \ldots, i_{j(T-2)})' \end{pmatrix}.$$

P_{2j} and P_{3j} of dimension $(T-1) \times T$ are:

$$P_{2j} = \begin{pmatrix} 0 & \Delta i_{j1} & 0 & \cdots & 0 \\ 0 & 0 & \Delta i_{j2} & \cdots & 0 \\ \vdots & & & & \vdots \\ 0 & 0 & \cdots & 0 & \Delta i_{j(T-1)} \end{pmatrix}, \quad P_{3j} = \begin{pmatrix} -i_{j1} & i_{j2} & 0 & \cdots & 0 \\ 0 & -i_{j2} & i_{j3} & \cdots & 0 \\ \vdots & & & & \vdots \\ 0 & \cdots & 0 & -i_{j(T-1)} & i_{jT} \end{pmatrix}.$$

P_{Xj} is equal to the X matrix without the first column, i.e., the constant, for the corresponding country j.

Due to the two step property of the SGMM, we derive the initial estimator as:

$$\widehat{\gamma}_{init} = \left[s'_{P\overline{X}} \left(\Sigma_P\right)^{-1} s_{P\overline{X}}\right]^{-1} s'_{P\overline{X}} \left(\Sigma_P\right)^{-1} s_{PI}$$

where $\overline{X}$ is the new regressor matrix equal to X after replacing the first column of X, i.e., the constant, with I_{-1}. $s_{P\overline{X}} = \frac{1}{N}\sum_{j=1}^{N} P_j'\overline{X}_j$, $s_{PI} = \frac{1}{N}\sum_{j=1}^{N} P_j' I_j$ and $\Sigma_P = \frac{1}{N}\sum_{j=1}^{N} P_j' P_j$. Using the residuals $\widehat{u}_j = I_j - \widehat{\gamma}_{init}\overline{X}_j$ and replacing Σ_P with $D_{\widehat{u}}$, we get the system GMM estimator:

$$\widehat{\gamma} = \left[s'_{P\overline{X}} \left(D_{\widehat{u}}\right)^{-1} s_{P\overline{X}}\right]^{-1} s'_{P\overline{X}} \left(D_{\widehat{u}}\right)^{-1} s_{PI}$$

with

$$D_{\widehat{u}} = \frac{1}{N}\sum_{j=1}^{N} P_j' \left(\frac{1}{N}\sum_{j=1}^{N} \widehat{u}_j \widehat{u}_j'\right) P_j.$$

3 Data sets and preparation for estimation

To obtain a bright overview of different countries in Europe, we take countries which are now part of the European System of Central Banks (ESCB) as well as countries which do not participate.[14] The date range contains the years 1978 to 1998.[15]

For the estimation of equation (1) to (6) we differentiate between two data sets of the central bank rate. The first data set includes the discount rate as an approximation of the central bank interest rate.[16] The data is given as annual averages. We take five years averages.[17]

The second data set contains the interest rates on which the individual central banks target on.[18] The data is only available as quarterly averages. Therefore we compute the five years averages for our estimation.

The remaining variables are the same for both data sets. To derive the inflation rate π we use the consumer price index (CPI) data series available from Eurostat. π is defined as the percentage deviation of the consumer price index of today and of the former period. We take five years averages of the available monthly data in percentage units. Finally, the Penn World Table data series rgdp of annual data is used for the output y.[19] When we look at deviations of the explanatory variables, i.e., equation (2), (5) and (6), we subtract the mean of the country specific data series from the single GDP data.[20] We use the annual averages exchange rate series available from the Penn World Table[21] to compute five years averages for the estimation.

4 Results

The results presented in the appendix are obtained by programming with MATLAB. Table 1 shows the estimation results for equation (1). The FE estimator of the output coefficient for both data sets as well as the coefficient of inflation for the second data set

[14]The data sample contains Austria, Belgium, Denmark, Finland, France, Germany, Ireland, Italy, Netherlands, Norway, Portugal, Spain, Sweden and the United Kingdom. Due to a lack of data availability, we do not add Greece. Luxembourg is not included because of the very small size of the economy. Switzerland's central bank sets two different interest rates as upper and lower bounds. Therefore it carries out a different type of monetary policy and is not added.

[15]The last period is due to the reorganization of the European System of Central Banks.

[16]Italy directly targets the discount rate. The data is available on the website of the IMF data base.

[17]We use percentages as unit.

[18]The data is available on the homepages of the country specific central banks.

[19]The GDP is given in US Dollar and per capita. We compute five years averages.

[20]For π, we subtract the target of 2% from each inflation value.

[21]All exchange rates are given in home currency per US $.

are not significant on a 10% significance level.[22] All remaining variables as well as those of the GMM and the SGMM are significant for both data sets including the discount rate or the central bank interest rate. The lagged interest rate has a positive sign except using GMM techniques in the first data set. The trend variable has a negative, the inflation rate a positive impact in all cases. The output gap coefficient has a positive sign for GMM and SGMM estimation and a negative sign in FE estimation.[23]

The GMM and SGMM estimation seem to be relatively robust in the standard estimation. Except the estimated negative coefficient for the lagged interest rate in the GMM estimation, the results are reasonable. The coefficients are relatively small compared to the recent literature[24] but highly significant. This can be due to the scaling properties of the data because when we compare the size of the output coefficient in percentages to the size of the inflation coefficient they are close to the results found in the literature.

When we transform the variables into deviations in equation (2), only the inflation rate in the SGMM estimation using the central bank interest rate is not significant.[25] As before, the lagged interest rate has a positive impact except in the GMM estimation of the first data set. This pattern remains for all following estimations. The inflation rate has a positive sign whereas the output gap has a positive sign for the FE and GMM estimation and a negative sign for the SGMM estimation. As described above, the coefficients for the output gap are very small and the coefficients of the inflation rate are smaller than expected. Only SGMM estimation techniques reflect a negative impact of output on the interest rate. This pattern[26] holds true for all remaining estimations. GMM seems to give the best estimation results compared to recent literature.[27]

In table 3 and 4 the results for equations (3) and (4) are reported. Using SGMM estimation techniques neither the exchange rate itself nor the differenced exchange rate is significant for the data set including the discount rate. The exchange rate levels in

[22]The bad results of the FE estimation can be due to inconsistencies and biasedness forced by the small number of countries and time periods.

[23]The negative estimator using FE estimation techniques is not significant.

[24]See for example Lubik and Schorfheide [9].

[25]See table 2.

[26]Also the changing signs described above for the levels and deviations case as well as the small size of coefficients stay the same.

[27]Especially when we use directly the central bank interest rate, all coefficients can be estimated significantly with the expected signs.

equation (3) are not significant for the FE and the GMM estimation of data set two.[28] Estimated with SGMM the exchange rate level seems to have a negative impact whereas the FE estimator as well as all coefficients for the differenced exchange rate have a positive sign.

Comparing the results in table 5 and 6 we see that the FE estimator is only significant for the change in the exchange rate using data set two with regressors in gaps. For the GMM estimation, the exchange rate level is not significant using the central bank interest rate as dependent variable.[29] All other coefficients of EX and ΔEX are significant and of comparable size as before.

Overall, we see that the FE estimators are close to each other comparing equations (1), (3) and (5) or (2), (4) and (6).[30] The same is true for the SGMM estimators. The sign pattern of the basic Taylor rules stays the same for all estimations.

The negative coefficient of the lagged interest rate using the discount rate as dependent variable is not reasonable.[31] This problem as well as different signs also for the output gap or the exchange rate level can be due to the small number of time periods and countries. The difficulties of estimation, i.e., obtaining unexpected signs and insignificant results seem to be forced by the data set and inconsistency or biasedness problems of the estimators because they are existent even in the basic Taylor rules.[32]

Finally comparing the results within one data set the estimators seem to be close to each other using one estimation technique. But due to several insignificant results they do not give a strong hint whether the exchange rate or the change in the exchange rate had an impact on the monetary policy decision of a European central bank. Only a weak tendency is identifiable that the change in the exchange rate could have played a significant role.

[28] All coefficients of EX or ΔEX range between 10e-03 and 10e-04.

[29] Also the coefficient of the exchange rate level for data set one is not significant using SGMM estimation.

[30] Several coefficients of the FE estimation are insignificant. The FE estimation performs worst.

[31] Taking the discount rate as approximation for the central bank interest rate as it is done in several papers bear some risks.

[32] The expected results, i.e. a positive impact of the lagged interest rate as well as a positive impact of the inflation rate and the output are violated also in the estimation of equation (1) and (2).

5 Conclusions

The underlying cross country study tries to give a hint if a central bank in Europe took the exchange rate in levels or first differences into account when setting the interest rate in the period 1978-1998. There seems to be some evidence that the change in the exchange rate played a role but the results are not fully robust. Even the usage of SGMM estimation does not create robust and expected estimation results. Therefore there are probably strong problems forced by the data set.

Main idea to work on is to find a better technique of estimation which can deal with the existing data problems. Another point is to use more advanced theories of the monetary policy decision process. This can be, e.g., to work with forward looking Taylor rules or modified regressors as the growth rate of output instead of output itself.

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A Estimation Results

The following tables show the estimation results for equations (1)-(6).[33] Each table is split into the two data sets described in section 3. Bold estimators are not significant on a 10% significance level.

	Discount Rate			Central Bank Interest Rate		
Parameter	FE	GMM	SGMM	FE	GMM	SGMM
C	8.7888 (4.3309)			7.8609 (5.7708)		
I_{-1}	0.4548 (4.6464)	-0.3220 (-2.2609)	0.8205 (26.4167)	0.4918 (5.9520)	0.4467 (1.8488)	0.7375 (43.1823)
TR	-1.6241 (-3.2689)	-12.1470 (-14.8641)	-1.7930 (-10.3637)	-1.2501 (-1.9894)	-12.2464 (-5.0032)	-2.0482 (-12.5333)
Π	0.1223 (1.7901)	0.2337 (17.4604)	0.1855 (4.1014)	**0.0926** **(1.2331)**	0.2552 (4.5698)	0.1372 (4.3078)
Y	**-0.0000** **(-0.2907)**	0.0028 (12.9253)	0.0003 (8.8808)	**-0.0001** **(-0.6393)**	0.0029 (4.7351)	0.0004 (18.6171)

Table 1: Results for equation (1)

	Discount Rate			Central Bank Interest Rate		
Parameter	FE	GMM	SGMM	FE	GMM	SGMM
C	24.8101 (5.1775)			19.8745 (2.9758)		
I_{-1}	0.5876 (6.6735)	-0.3274 (-2.2909)	0.6315 (18.7676)	0.5452 (8.4936)	0.4511 (1.8514)	0.5251 (27.0347)
TR	-8.7010 (-3.8279)	-12.1435 (-14.8008)	0.9693 (7.6385)	-6.5567 (-2.4431)	-12.2281 (-4.9806)	1.3847 (19.2831)
Π	0.1593 (2.7644)	0.2353 (17.2682)	0.0941 (3.1205)	0.1228 (2.0034)	0.2557 (4.4603)	**0.0640** **(1.5712)**
Y	0.0019 (2.9145)	0.0028 (12.8492)	-0.0006 (-14.9325)	0.0013 (2.0462)	0.0029 (4.7187)	-0.0007 (-22.5571)

Table 2: Results for equation (2)

[33]The numbers in brackets denote the t-statistics.

	Discount Rate			Central Bank Interest Rate		
Parameter	FE	GMM	SGMM	FE	GMM	SGMM
C	9.4495 (4.3887)			08.2267 (6.0639)		
I_{-1}	0.4134 (3.6844)	-0.3848 (-2.9800)	0.8294 (24.1350)	0.4670 (5.1112)	0.4517 (1.8383)	0.7518 (39.1190)
TR	-1.5942 (-3.0704)	-12.0560 (-10.1791)	-1.7892 (-7.3000)	**-1.1398** **(-1.6802)**	-11.6004 (-4.0460)	-2.1476 (-11.5965)
Π	**0.1156** **(1.7662)**	0.2322 (14.6975)	0.1868 (3.6542)	**0.0871** **(1.1329)**	0.2497 (4.3556)	0.1371 (4.5317)
Y	**-0.0001** **(-0.4450)**	0.0027 (8.6867)	0.0003 (7.1385)	**-0.0001** **(-0.8347)**	0.0027 (3.8146)	0.0004 (16.1620)
EX	0.0006 (2.0907)	0.0027 (2.1070)	**-0.0002** **(-0.6696)**	**0.0005** **(1.2405)**	**0.0008** **(0.3681)**	-0.0003 (-2.7756)

Table 3: Results for equation (3)

	Discount Rate			Central Bank Interest Rate		
Parameter	FE	GMM	SGMM	FE	GMM	SGMM
C	10.2074 (4.1859)			8.5713 (5.8287)		
I_{-1}	0.3783 (3.2907)	-0.4481 (-4.2544)	0.8116 (25.3092)	0.4550 (6.0303)	**0.3919** **(1.7131)**	0.7181 (37.8520)
TR	-1.5510 (-3.0396)	-10.6344 (-12.4202)	-1.7760 (-10.3307)	-1.0963 (-1.8117)	-11.6712 (-4.5117)	-1.8628 (-12.8799)
Π	**0.1109** **(1.7241)**	0.2147 (11.5556)	0.1850 (4.0211)	**0.0818** **(1.1178)**	0.2345 (4.2249)	0.1355 (3.9693)
Y	**-0.0001** **(-0.6221)**	0.0023 (9.3113)	0.0003 (9.0272)	**-0.0001** **(-1.1133)**	0.0027 (4.2793)	0.0004 (20.2322)
ΔEX	0.0083 (1.9346)	0.0058 (2.9337)	**0.0007** **(0.2367)**	0.0090 (3.5139)	0.0062 (1.8439)	0.0043 (3.7069)

Table 4: Results for equation (4)

	Discount Rate			Central Bank Interest Rate		
Parameter	FE	GMM	SGMM	FE	GMM	SGMM
C	24.7603 (5.1244)			19.7984 (2.9575)		
I_{-1}	0.5759 (5.3931)	-0.3905 (-3.0211)	0.5940 (14.8335)	0.5379 (7.6956)	0.4559 (1.8404)	0.5137 (29.7830)
TR	-8.6380 (-3.6851)	-12.0525 (-10.1038)	1.1178 (7.7899)	-6.5141 (-2.4129)	-11.5890 (-4.0319)	1.4049 (21.0811)
Π	0.1577 (2.7125)	0.2339 (14.5441)	0.0874 (3.2302)	0.1213 (1.9460)	0.2503 (4.2582)	**0.0615** **(1.4831)**
Y	0.0019 (2.7844)	0.0027 (8.6109)	-0.0006 (-14.3495)	0.0013 (2.0129)	0.0027 (3.8037)	-0.0007 (-22.6944)
EX	**0.0002** **(0.5667)**	0.0027 (2.0823)	**0.0005** **(1.0496)**	**0.0003** **(0.7983)**	**0.0008** **(0.3565)**	0.0004 (5.5398)

Table 5: Results for equation (5)

	Discount Rate			Central Bank Interest Rate		
Parameter	FE	GMM	SGMM	FE	GMM	SGMM
C	24.2923 (4.8329)			18.9283 (2.8240)		
I_{-1}	0.5579 (4.8440)	-0.4530 (-4.3388)	0.5826 (18.0465)	0.5283 (8.1114)	**0.3954** **(1.7145)**	0.5033 (28.8741)
TR	-8.3548 (-3.3673)	-10.6307 (-12.4927)	1.1932 (7.7362)	-6.1106 (-2.2654)	-11.6498 (-4.4914)	1.4469 (21.1259)
Π	0.1552 (2.6279)	0.2160 (11.4822)	0.0849 (3.0846)	0.1160 (1.8788)	0.2346 (4.1341)	**0.0665** **(1.4679)**
Y	0.0018 (2.5087)	0.0023 (9.3650)	-0.0007 (-9.1591)	0.0012 (1.8330)	0.0027 (4.2631)	-0.0007 (-23.1801)
ΔEX	**0.0035** **(0.6453)**	0.0058 (2.8839)	0.0068 (2.0465)	0.0067 (1.9763)	0.0063 (1.8640)	0.0081 (7.3511)

Table 6: Results for equation (6)