The Emerging BRIC Economies: Evidence from the Interest Rate Transmission Mechanism

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ABSTRACT

The purpose of this paper is to examine the interest rate transmission mechanism for the emerging BRIC economies (Brazil, Russia, India and China). We analyze the way wholesale interest rates are transmitted to the bank retail rates both in short and the long run and we test the symmetry hypothesis. A disaggregated error correction model is applied for the estimation of the interest rate pass-through effectiveness and asymmetric behaviour in these economies. Our results show that rigidities in the transmission process are present, significant variations across Brazil, Russia and India exist as well as non-completeness, at least in some cases. Also, there is a result which is common for the three economies regarding the pass through behaviour; CB rate decreases are transmitted to the loan rates. The differentiation of banks' speed of upward and downward adjustment behaviour for the economies analysed is considered as *asymmetric* in most of the cases in both loan and deposit markets. We believe that our results can be useful for the BRIC regulatory authorities in their attempt to monitor the competitiveness of their banking systems and reinforce financial stability and monetary policy effectiveness.

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1. Introduction

The main aim of this paper is to unveil the existence and importance of an interest rate pass through (hereafter PT) behaviour in the so called BRIC economies (Brazil, Russia, India and China). These four economies are considered as the dominant emerging market economies in terms of output growth and population size. Also, it has been argued by a number of economists that the combination of large human capital, less mature economies and access to natural resources have contributed to estimates which predict BRICs outperforming most developed economies in size and importance in a few decades (Wilson and Purushothaman, 2003). Even though to some extent the focus of these particular four economies is arbitrary, in both demographic and economic terms they are among the largest countries in the world. In particular, their annual average GDP for the period 2001-2006 counts for approximately 9.5% of the global output (see Table 1, Appendix A). Moreover, the average GDP growth for China, India and Russia is 9.7%, 7.3% and 6.2%, respectively (see Figure 1, Appendix A), while world's average GDP growth is 4.2% for the same period. Having said that, their GDP per capita substantially underperforms that of the developed economies (see Table 1, column 2, Appendix A).

In this paper, we focus on the interest rate transmission channel of monetary policy i.e. how the wholesale rates (central bank and interbank money market rates) are transmitted to the retail rates (deposit and lending rates). The two wholesale rates can be considered as target or vehicle policy variables, which are related to central bank's choices regarding monetary policy effectiveness. The money market rate can be considered as a policy controlled variable because Central Bank authorities can influence and control it through their short-term interest rate policy. We also analyse how the monetary transmission process works in these emerging economies and whether their responses to upward/downward interest rate changes are symmetric or asymmetric. A number of studies have dealt with the transmission from the policy-controlled interest rate to the retail rates[1]. Regarding the degree of stickiness in different economies, recent empirics do not reach any conclusive evidence[2]. According to Lowe and Rohling (1992), the existence of any price (or interest rate) rigidity/sluggishness can be explained by the *agency costs* theory (Stiglitz and Weiss, 1981), the *adjustment costs* theory (Cottarelli and Kourelis, 1994), the *switching costs* theory (Klemperer, 1987), and finally the *risk sharing* theory (Fried and Howitt, 1980)[3].

We employ the disaggregated general to specific (hereafter GETS) methodology to examine the short and long run rigidities between the wholesale and the retail rates as well as the symmetric or asymmetric behaviour in the economies selected. There are a number of reasons that lead us to believe that our paper contributes to the existing literature. To the best of our knowledge, it is the first attempt made to unveil the existence and importance of an interest rate pass through behaviour for the BRIC economies. Second, the disaggregated GETS methodology used has two main advantages: 1) it can jointly and simultaneously test the short-run and long–run stickiness/rigidities within the same PT dynamic model (Rao and Singh, 2006) and 2) it can be used to test the existence of symmetric (aggregated GETS) or asymmetric transmission behaviour (disaggregated GETS) between the examined variables. Third, our model allows us to make inferences about the relative importance of the

[1] The issue of interest rate pass-through along with the adjustment process has been undertaken by a number of scholars such as Wang and Thi (2007), Payne and Waters (2007), Chionis and Leon (2006), Hofmann (2006), Sander and Kleimeier (2004), Atesoglou (2003-4), Angeloni and Ehrman (2003), Burgstaller (2003), De Bondt (2002), Petturson (2001), Toolsema, Sturm, and De Haan (2001), Bredin, Fitzpatrick, and O'Reilly (2001) and Mojon (2000).

[2] Among others see Cottarelli and Kourelis (1994), Borio and Fritz (1995), Donnay and Degryse (2001), Sander and Kleimeier (2000) and Toolsema, Sturm, and De Haan (2001).

two different policy vehicle variables; the central bank rate and money market rate that regulatory authorities should target and monitor, respectively.

The empirical results for the emerging BRIC economies are mixed as far as it concerns both the monetary transmission process and the PT completeness. Also, it is evident from our results that rigidities in the transmission process, significant variations across BRIC countries and non-completeness at least in some cases, are present. Nevertheless, it seems that there is a result which is common for Brazil, Russia and India regarding the PT behaviour that is CB rate decreases are transmitted to the loan rates.

The paper is structured as follows. Section 2 presents the theoretical framework of interest rate PT behaviour. In section 3 the econometric approach regarding the PT interest rate model is analysed. The empirical results are given in Section 4. Section 5 concludes the paper.

2. Data, theoretical framework and econometric methodology

Data used for the BRIC countries are collected from the International Financial Statistics produced by the International Monetary Fund. We use monthly data for Brazil, Russia, India and quarterly for China. The examined time period is not identical for all the economies. In the case of Brazil the time period ranges from 1998:1 to 2007:8, in Russia from 1998:1 to 2007:9, while in the case of India ranges between 1998:03 to 2007:07. As far as the retail rates is concerned, we use the "*deposit rate*" (i_D) and the "*lending rate*" (i_{loan}), correspondingly. Note that data is

[3] For a brief summary of these theories see Toolsema, Sturm and Haan (2001).

not available regarding the Indian and Chinese MM rate (i_{mm}).

The interest rate PT literature is mainly related to the way central bank (CB hereafter) and interbank money market rates (MM hereafter) are transmitted to the retail rates (deposit and lending). Such PT interest rate equations usually take the following simple algebraic form:

$$i_{R,t} = c + \sum_{j=1}^{k} k * i_{R,t-j} + \sum_{i=1}^{n} \phi * i_{W,t-i} + e_t \tag{1}$$

where, $i_{R,t}$, stands for the different kinds of loan and deposit rates and

$i_{W,t}$, stands for the CB or MM rates and

$$\Delta i_{R,t} = c + \sum_{j=1}^{k} \rho * \Delta i_{R,t-j} + \sum_{i=1}^{n} \lambda * \Delta i_{W,t-i} - \theta * e_{t-1} + u_t \tag{2}$$

is a simple Error Correction Model (hereafter ECM).

There are two main theoretical issues which are worth examining. First, the long-run and short-run interest rate rigidities (the φ's and the $\lambda' s$ coefficients in eq. 1 and eq. 2, respectively) from the wholesale to the retail market rates and second, the speed of retail rates adjustment initiated from the wholesale interest rate changes (the θ coefficient of the error correction term in eq. 2).

Econometrics wise the literature on PT transmission models[4] focuses on the ECM model. However in the simple ECM (eq. 2) the retail rates and the speed of adjustment coefficient (θ) cannot be analysed separately when the wholesale rates are increasing or decreasing. Bachmeier and Griffin (2003) and Rao and Rao (2005)

[4] For a complete survey on econometric models of asymmetric price transmission see Frey & Manera (2007).

presented an alternative dynamic approach originating from the LSE-Hendry GETS methodology which tackles the above issues. The disaggregated GETS model could be presented in the following form:[5]

$$\Delta i_{R,t} = \sum_{i=1}^{j1} \beta^{-}_{R,t}\, \Delta i^{-}_{R,t-i} + \sum_{i=0}^{j2} \beta^{-}_{W,t}\, \Delta i^{-}_{W,t-i} + \theta^{-}\,(i_{R,t} - \varphi_0 - \varphi_1 i_{W,t} - \varphi_2 T\ )_{t-1} +$$

$$+ \sum_{i=0}^{j3} \beta^{+}_{W,t}\, \Delta i^{+}_{W,t-i} + \sum_{i=1}^{j4} \beta^{+}_{R,t}\, \Delta i^{+}_{R,t-i} + \theta^{+}\,(i_{R,t} - \varphi_0 - \varphi_1 i_{W,t} - \varphi_2 T\ )_{t-1} + \xi_t \qquad (3)$$

where, θ^{-} and θ^{+} are the speed of adjustment coefficients in the positive and negative case, respectively and T the time trend. As Rao and Rao (2005) pointed out, the (+)/(–) superscript on the coefficients indicate a positive/negative change in the variables included in the model. On the one hand, for any positive change ($\Delta i_{W,t}$>0) in the independent variable, a corresponding response of all positive coefficients (β^{+}, θ^{+}) is expected. On the other hand, the corresponding negative coefficients (β^{-}, θ^{-}) will respond in any negative change of the dependent variable ($\Delta i_{W,t}$<0).[6] Following again Rao and Rao (2005), eq. 3 can also take the following form:

$$\Delta i_{R,t} = \gamma_o + \gamma_1 T + \sum_{i=1}^{j1} \beta^{-}_{R,t}\, \Delta i^{-}_{R,t-i} + \sum_{i=0}^{j2} \beta^{-}_{W,t}\, \Delta i^{-}_{W,t-i} + \theta^{-}\,(i_{R,t} - \varphi_1 i_{W,t})_{t-1} +$$

$$+ \sum_{i=0}^{j3} \beta^{+}_{W,t}\, \Delta i^{+}_{W,t-i} + \sum_{i=1}^{j4} \beta^{+}_{R,t}\, \Delta i^{+}_{R,t-i} + \theta^{+}\,(i_{R,t} - \varphi_1 i_{W,t})_{t-1} + \xi_t \qquad (4)$$

The choice between the two disaggregated GETS models (3) and (4) depends on the performance and plausibility of the estimation results.

The main advantages of the disaggregated GETS model include: (a) its capability of

[5] This model is tested by the Non-Linear Least Squares (N.L.L.S.) methodology.
[6] In econometric terms the corresponding "activation" will be triggered in eq. 3 with the help of

estimating both negative and positive short-run elasticities (e.g. the $\beta^{-}_{W,t}$ *and* $\beta^{+}_{W,t}$ in eq. 3 and 4)[7], and (b) the direct and simultaneous estimation of the long-run (φ_1 or alternatively $\varphi_0 + \varphi_1$) and the short-run price transmission rigidities in the same model. Thus, using a GETS model two different *impact multipliers* (a negative and a positive one), two *interim multipliers* and two different speed of adjustments, can simultaneously be estimated.

Before we proceed to the disaggregated GETS model implementation it is necessary to test for the number of co-integrated vectors (r) between the dependent and the independent variable by using the Johansen's methodology (Johansen, 1995)[8]. In addition, the number of the existing co-integrating vectors from the Johansen's process, is sensitive to the number of lagged variables (n) of the initial vector (Karfakis, 2004). Due to this sensitivity five different lag selection criteria will be implemented. These include: the modified Likelihood Ratio test statistic (LR), the Final Prediction Error test (FPE), the Akaike Information Criterion (AIC), the Schwarz Information Criterion (SC) and finally the Hannan-Quinn information criterion (HQ). In most of the examined cases the aforementioned selection criteria do not all agree about the optimal lag length. In such case, the majority rule is applied as a sub-optimal solution.

4. Empirical Results

We employ the Johansen (1995) methodology on testing the existence of a long-run

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dummy variables (e.g. DUM). More specifically, all positive coefficients will take the value of 1 when a positive change in the dependent variable occurs and will be zero otherwise (1-DUM).

[7] The ability of testing both negative and positive short-run pass through elasticities ($\beta^{-}_{W,t}$ *and* $\beta^{+}_{W,t}$) in the same model is actually enriching the Cottarelli and Kourelis (1994) pass through interest rates *multipliers* with positive and negative values.

relationship among retail and wholesale rates in the BRIC economies. According to the eigenvalue and trace tests in some of the bivariate cases there is a unique co-integrated vector of order 1 (r=1) which supports the hypothesis that interest rates in the BRIC economies tend to co-integrate pairwise (see Table 2-5 in Appendix B).

4.1. Speed of Adjustment Estimates and the Degree of Pass Through Completeness

We estimate the disaggregated GETS model for the two types of interest rates in the economies analysed. Starting with the Brazilian economy (Table 6, column 2), the coefficients of the two error correction terms θ^{+} and θ^{-}, are statistically significant (although the speed of adjustment in both cases are quite low) when the wholesale rate is the CB rate (i_{CB}) and the retail rate is the loan rate (i_{L}). This means that CB rate increases and decreases are both transmitted to the loan rate. Also, the θ^{-} coefficient is statistically significant when the wholesale rate is the MM rate (i_{MM}) and the retail rate is the deposit rate (i_{D}) (Table 6, column 3). This implies that only MM rate decreases are transmitted to the deposit rate.

We continue our analysis by examining the degree of PT completeness between the two types of interest rates in Brazil. Coefficient ϕ_{1} (in eq. 5 and 5a) measures the degree of pass-through. Complete PT exists when ϕ_{1}=1 which implies that all the change in the policy-vehicle rate (either CB or MM) will be transmitted to the retail rates. The interest rate PT is complete in the long run (0.96) and is also statistically significant when the wholesale rate is the MM rate (i_{MM}) and the retail rate is the deposit rate (i_{D}) (Table 6, column 3 and Table 9). In contrast, ϕ_{1} is 0.48, when the

[8] So, when the number of co-integrated vectors is equal to one (r=1) the GETS model can be estimated. If, r=0, there is no PT relationship between the dependent and independent variable.

CB is the policy-controlled interest rate, which indicates an incomplete PT to the loan rates (Table 6, columns 2). In other words, not all the change in the policy rate is transmitted to the loan rates. Perhaps, this can be attributed to switching costs and informational asymmetries (Payne, 2006-7). Lastly, most of the impact multipliers are statistically insignificant.

As far as Russia is concerned, we also estimate the disaggregated GETS model for the two types of interest rates. According to Table 7, column 2, the coefficient of the error correction term θ^{-} is statistically significant when the wholesale rate is the CB rate (i_{CB}) and the retail rate is the loan rate (i_L). The magnitude of θ^{-} is roughly ten times higher (in absolute terms) than that of θ^{+} (-0.42 and -0.04 respectively), although the later is not significant. Also, θ^{+} and θ^{-} coefficients are statistically significant when the wholesale rate is the MM rate (i_{MM}) and the retail rates are either the loan rate (i_L) or the deposit rate (i_D) (Table 7, columns 3 and 4). Overall, this implies that MM rate increases and decreases are both transmitted to the deposit and loan rates. Regarding the degree of PT completeness between the two types of interest rates in Russia, the interest rate PT is nearly complete in the long run (0.87) and statistically significant between the CB rate and the loan rate (i_L) (Table 7, column 2 and Table 10). In contrast, ϕ_1 is 0.61 and 0,40 (when the deposit rate and loan rate is the retail rate, respectively) which indicates that not all of the change is transmitted when the MM rate is the policy-controlled interest rate (Table 7, columns 3 & 4). This is again could be attributed to switching costs and informational asymmetries.

We continue our analysis of the BRIC economics with India. The coefficient of the error correction term θ^{-} is statistically significant when the wholesale rate is the CB rate (i_{CB}) and the retail rate is the loan rate (i_L), although the speed of adjustment is quite low (Table 8, column 2). This means that only CB rate decreases are transmitted to the loan rate. Regarding the degree of PT completeness between the two types of interest rates in India, the interest rate PT is greater than 1 in the long run (1.21) and statistically significant between the CB rate and the loan rate (i_L) (Table 8, column 2 and Table 11).

Finally, data for China (CB rate and retail rates) have negligible variation and thus the GETS model does not produce any results regarding speed of adjustment estimates and the degree of PT completeness. In order to overcome this problem we rather estimate long run elasticities by employing a Vector Error Correction Model (VECM). Our results shows that ϕ_1 is 0.53, when the CB is the policy-controlled interest rate, which indicates an incomplete PT to the loan rates (Table 12). Also, ϕ_1 is rather large (1.42) when the CB is the policy-controlled interest rate and retail rate is the deposit rate.

The above results on the interest rate stickiness/rigidities for the banking systems of the BRIC countries can be explained mainly by four theoretical frameworks also mentioned in Introduction. These are the agency costs due to asymmetric information, the adjustment costs, the switching costs and the risk sharing theories.

4.2. Testing the Symmetry Hypothesis

Lastly, we ask what is the effect of an upward or downward change in the policy-controlled variables to the retail rates, in the different banking systems. More specifically, we test symmetry hypothesis that $\theta^{+}=\theta^{-}$. The existence of a symmetric speed of adjustment is tested by using the Wald χ^{2} - test.

Our empirical tests regarding the symmetry hypothesis in Brazil (Table 13) shows that, when the wholesale rate is the CB rate (i_{CB}) and the retail rate is the loan rate (i_{L}), it seems that the negative asymmetry is stronger than the positive one. This means that banks tend to pass to borrowers more of the decreases of the original CB rate change rather than its increases. Additionally, when the wholesale rate is the MM rate (i_{MM}) and the retail rate is the deposit rate (i_{D}), there is only a negative asymmetry, which means that banks tend to pass to depositors only decreases of the original MM rate change. The magnitude of the decrease of the deposit rate in this case is given by the long run elasticity which, as we saw in Table 6, is 0.96. Since only a negative asymmetry (θ^{-} is statistically significant) is observed, we can infer that for a 1% decrease in the CB rate, banks pass to depositors 0.96 of that decrease.

We present the results for Russia in Table 14. On the one hand, when the wholesale rate is the CB rate (i_{CB}) and the retail rate is the loan rate (i_{L}), there is only a negative asymmetry, which means that banks tend to pass to borrowers only decreases of the original CB rate change. The magnitude of the decrease of the deposit rate in this case is given by the long run elasticity which, as we saw in Table 5, is 0.87. Since only a negative asymmetry (θ^{-} is statistically significant) is observed, we can infer that for a 1% decrease in the CB rate, banks pass to borrowers 0.87 of that decrease. On the other hand, when the wholesale rate is the MM rate (i_{MM}) and the retail rate is the deposit rate (i_{D}), a symmetry exists, that is $\theta^{+}=\theta^{-}$. This means that banks tend to pass to depositors equally the decreases and increases of the original MM rate change. Lastly, when the wholesale rate is the MM rate (i_{MM}) and the retail rate is the loan rate (i_L), it seems that the negative asymmetry is stronger than the positive one. This means that banks tend to pass to borrowers more of the decreases of the original MM rate change rather than its increases.

Finally, we present the results for India in Table 15. When the wholesale rate is the CB rate (i_{CB}) and the retail rate is the loan rate (i_L), there is only a negative asymmetry, which means that banks tend to pass to borrowers only decreases of the original CB rate change. The magnitude of the decrease of the deposit rate in this case is given by the long run elasticity which, as we saw in Table 8, is 1.21.

Thus, the differentiation of banks' speed of upward and downward adjustment behaviour for the BRIC economies -with the exception of China- is considered as *asymmetric* in both loan and deposit markets in the three economies analysed. Such behaviour is theoretically consistent with the *Customer Reaction Hypothesis* (Hannan and Berger, 1991) regarding the loan market in Russia, India and Brazil. It is also in line with the *Bank's Collusive Hypothesis* (Berger and Hannan, 1989; Hannan and Berger, 1991; Neumark and Sharpe, 1992) regarding the deposit market in Brazil. Moreover, the interest rate rigidity/sluggishness might depend on the concentration level of the retail market (degree of oligopoly) as well as on the temporal or non-temporal nature of wholesale interest rate changes (Panagopoulos, Reziti and Spiliotis, 2007).

5. Conclusions

This study focuses on how the monetary transmission process works, the likely PT completeness and the effect of an upward or downward change in the policy-controlled variables to the retail rates in the emerging BRIC economies. The empirical results for Brazil, Russia and India are mixed regarding the monetary transmission process and the PT completeness. Moreover, our results show that rigidities in the transmission process are present, significant variations across the three economies exist as well as non-completeness, at least in some cases. Having said that, it seems that there is a result which is common for Brazil, Russia and India regarding the PT behaviour; CB rate decreases are transmitted to the loan rates. As far as it concerns China our GETS econometric methodology does not produce any results at all, regarding the monetary transmission process.

Lastly, the differentiation of banks' speed of upward and downward adjustment behaviour for the economies analysed is considered as *asymmetric* in both loan and deposit markets. The speed of retail rates adjustment can be interpreted as the commercial bank managers' power to transmit to their clients any wholesale rate changes. Such speed is possibly affected by the degree of the retail market competitiveness in the banking sector. For example, in a competitive banking environment, the deposit rates are expected to be raised by the bank managers, in response to a wholesale rates increase. The asymmetry results for Brazil, Russia and India might be explained by this framework. Our results for the Russian and Indian banking sector, where the Customer Reaction Hypothesis seems to prevail, show that bank managers are happy to transmit central bank rate decreases to borrowers. The same applies for the transmission of the money market rate decreases to borrowers in the Russian banking system. As far as the Brazilian banking sector is concerned it seems that bank managers are eager to transmit money market rate decreases to depositors (Collusive Hypothesis) and central bank rate decreases to borrowers (Customer Reaction Hypothesis).

Policy interest rates (the official central bank rate or the implicitly controlled money market rate by the Central Bank) play an important role in any economy and are crucial for Governments, commercial banks and investors' decision making. We believe that our results can be useful for the BRIC regulatory authorities in their attempt to monitor the competitiveness of their banking systems and reinforce financial system stability and effectiveness. This is in turn will hopefully contribute to the macroeconomic stability of these economies.

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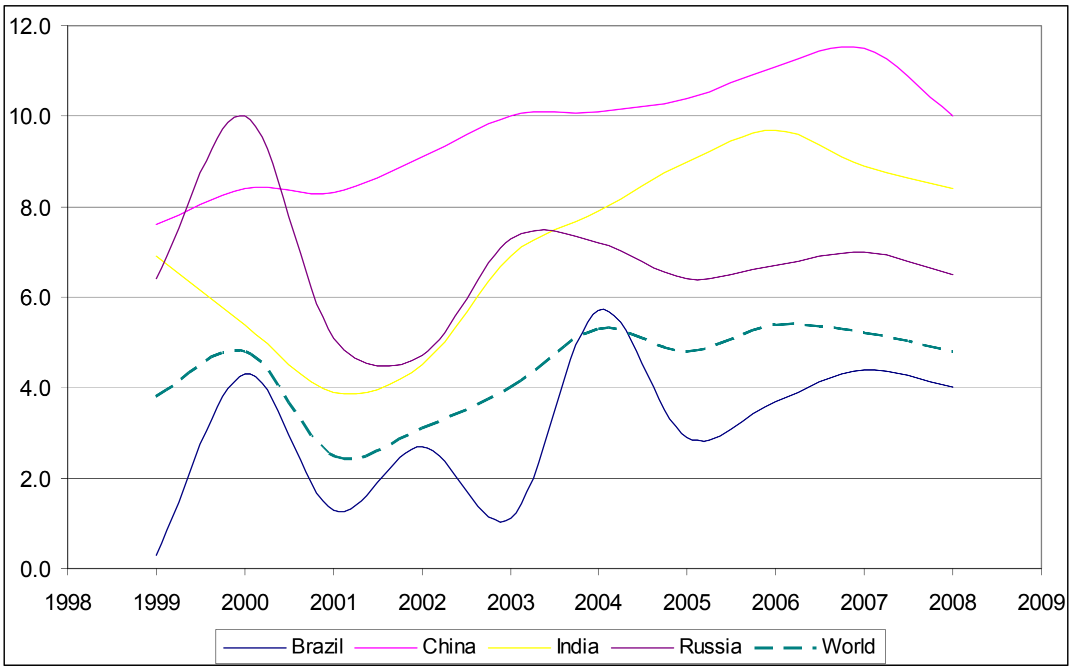
Appendix A

Table 1:Economy & Income, 2001 – 2006

	GDP (million $)	GDP (per capita)	GDP per cent of global	Population (million)	Population Density
Brazil	704,143.3	3,834.7	1.7	182.6	21.5
Russia	571,123.9	3,975.0	1.3	144.2	8.4
India	665,982.2	618.4	1.6	1,071.6	325.7
China	1,877,205.3	1,449.2	4.7	1,292.2	134.6
BRIC *Total*	3,818,454.8	1,413.5	9.5	2,690.6	69.9
USA	11,451,587.5	39,133.5	29.3	292.3	30.3
EMU	8,622,166.1	27,696.2	21.8	310.8	122.8
Japan	4,280,463.9	33,552.1	11.0	127.6	335.7
World	39,338,622.4	6,196.8	100	6331.1	47.3

Figure 1: GDP growth, 2001 – 2006



Appendix B

Table 2: The Johansen Pairwise Co-intregration Tests in Brazil

Causality test	No. of Lags	Rank	Max. Eigenvalue	Trace	No. of Co-integrating Vectors (of r order)
i_{CB} vs. i_D	(2)	r=0	6.28	6.77	r=0
		r≤1	0.48	0.48	
i_{CB} vs. i_L	(2)	r=0	7.79	9.15	r=0
		r≤1	1.35	1.35	
i_{mm} vs. i_D	(2)^s	r=0	17.34	18.50	r=1
		r≤1	1.16	1.16	
i_{mm} vs. i_L	(2)	r=0	18.55	21.49	r=1
		r≤1	1.93	1.93	

The critical value for accepting that r=1 at the 5% level for both the Maximum Eigenvalue test and the Trace test is 3.84. ***s.*** The lag selection has been done according to the *Schwarz* Information Criterion (*SC*).

Table 3: The Johansen Pairwise Co-intregration Tests in Russia

Causality test	No. of Lags	Rank	Max. Eigenvalue	Trace	No. of Co-integrating Vectors (of r order)
i_{CB} vs. i_D	(2)	r=0	8.03	20.17	r=0
		r≤1	0.96	0.78	
i_{CB} vs. i_L	(2)[g]	r=0	27.81	28.64	r=1
		r≤1	0.82	0.82	
i_{mm} vs. i_D	(2)	r=0	23.60	26.15	r=1
		r≤1	2.54	2.54	
i_{mm} vs. i_L	(1)[h]	r=0	19.88	21.02	r=1
		r≤1	1.14	1.14	

The critical value for accepting that r=1 at the 5% level for both the Maximum Eigenvalue test and the Trace test is 3.84. ***g***. The lag selection has been done according to the *FinalPrediction Error* test (*FPE*) and the *Akaike* Information Criterion (*AIC*). ***h***. The lag selection has been done according to the *Lagrange Ratio Criterion* (LR), the *Schwarz* Information Criterion (*SC*) and the *Hannan-Quinn* information criterion (*HQ*).

Table 4: The Johansen Pairwise Co-intregration Tests in India

Causality test	No. of Lags	Rank	Max. Eigenvalue	Trace	No. of Co-integrating Vectors (of r order)
i_{CB} vs. i_L	(2)	r=0	9.65	10.37	r=0
		r≤1	0.71	0.71	

The critical value for accepting that r=1 at the 5% level for both the Maximum Eigenvalue test and the Trace test is 3.84.

Table 5: The Johansen Pairwise Co-intregration Tests in China

Causality test	No. of Lags	Rank	Max. Eigenvalue	Trace	No. of Co-integrating Vectors (of r order)
i_{CB} vs. i_D	(2)	r=0	33.66	35.93	r=1
		r≤1	2.26	2.26	
i_{CB} vs. i_L	(2)	r=0	28.23	29.10	r=1
		r≤1	0.87	0.87	

The critical value for accepting that r=1 at the 5% level for both the Maximum Eigenvalue test and the Trace test is 3.84.

Table 6: Results for Brazil

Independent variable	Central bank (i_{CB}) rate		Money Market (i_{mm}) rate	
Dependent variable	Deposit rate (i_D)	Loan rate (i_L)	Deposit rate (i_D)	Loan rate (i_L)
C.V. (r)	r=0	r=0	r=1	r=1
	(1)	(2)	(3)	(4)
Regressor	Coefficients - t-ratios	Coefficients - t-ratios	Coefficients - t-ratios	Coefficients - t-ratios
$\Delta i^+_{D,t-1}$	0.29 (1.10)	-	-0.16 (-0.42)	-
$\Delta i^-_{D,t-1}$	0.33 (2.01)	-	0.68 (3.01)	-
$\Delta i^+_{D,t-2}$	-0.48 (-2.21)	-	-0.60 (-2.07)	-
$\Delta i^-_{D,t-2}$	0.17 (0.97)	-	0.53 (2.34)	-
$\Delta i^+_{L,t-1}$	-	0.27 (1.61)	-	0.22 (1.14)
$\Delta i^-_{L,t-1}$	-	0.05 (0.29)	-	-0.01 (-0.10)
$\Delta i^+_{L,t-2}$	-	-0.16 (-0.88)	-	-0.21 (-1.18)
$\Delta i^-_{L,t-2}$	-	0.19 (1.18)	-	0.21 (1.24)
$\Delta i^+_{CB,t-1}$	-0.13 (-0.53)	-0.08 (-0.89)	-	-
$\Delta i^-_{CB,t-1}$	0.09 (0.49)	0.12 (1.44)	-	-
$\Delta i^+_{CB,t-2}$	-0.18 (-0.81)	-0.09 (-0.85)	-	-
$\Delta i^-_{CB,t-2}$	-0.59 (-3.07)	-0.20 (-2.31)	-	-
$\Delta i^+_{MM,t-1}$	-	-	0.26 (0.79)	-0.01 (-0.21)
$\Delta i^-_{MM,t-1}$	-	-	-0.12 (-0.43)	0.10 (1.02)
$\Delta i^+_{MM,t-2}$	-	-	-0.19 (-0.66)	-0.13 (-1.10)
$\Delta i^-_{MM,t-2}$	-	-	-0.87 (-4.41)	-0.13 (-1.43)
θ^+	-0.19 (-1.65)	-0.22 (-2.79)	0.13 (0.42)	-0.08 (-1.29)
θ^-	-0.09 (-1.50)	-0.23 (-2.93)	-0.90 (-3.37)	-0.09 (-1.39)
ϕ_0 (or γ_0)	-0.07 (-0.81)	0.62 (2.96)	0.07 (1.78)	0.29 (1.64)
ϕ_1	1.13 (4.87)	0.48 (6.68)	0.96 (91.76)	0.35 (1.30)
T (time)	-0.0004 (-1.33)	-0.0007 (-2.57)	-0.0008 (-2.35)	-0.0001 (-1.12)
R^2	0.39	0.34	0.47	0.29

For the determination of the optimal lag structure the following information criteria are used: the *modified LR* test statistic (*LR*), the *Final Prediction Error* test (*FPE*), the *Akaike* Information Criterion (*AIC*), the *Schwarz* Information Criterion (*SC*) and the *Hannan-Quinn* information criterion (*HQ*).

Table 7: Results for Russia

Independent variable	Central bank (i_{CB}) rate		Money Market (i_{mm}) rate	
Dependent variable	Deposit rate (i_D)	Loan rate (i_L)	Deposit rate (i_D)	Loan rate (i_L)
C.V. (r)	r=0	r=1	r=1	r=1
	(1)	(2)	(3)	(4)
Regressor	Coefficients - t-ratios	Coefficients - t-ratios	Coefficients - t-ratios	Coefficients - t-ratios
$\Delta i^{+}_{D,t-1}$	-0.25 (-2.43)	-	-0.15 (-1.04)	-
$\Delta i^{-}_{D,t-1}$	-0.12 (-0.39)	-	-0.21 (-1.92)	-
$\Delta i^{+}_{D,t-2}$	0.10 (0.96)	-	0.27 (2.16)	-
$\Delta i^{-}_{D,t-2}$	0.08 (0.37)	-	-0.07 (-0.61)	-
$\Delta i^{+}_{L,t-1}$	-	-0.27 (-2.38)	-	-0.37 (-3.29)
$\Delta i^{-}_{L,t-1}$	-	-0.04 (-0.15)	-	-0.37 (-2.42)
$\Delta i^{+}_{L,t-2}$	-	-0.06 (-0.59)	-	-0.15 (-1.46)
$\Delta i^{-}_{L,t-2}$	-	-0.08 (-0.40)	-	-0.16 (-1.16)
$\Delta i^{+}_{CB,t-1}$	0.45 (2.08)	0.01 (0.11)	-	-
$\Delta i^{-}_{CB,t-1}$	0.04 (0.46)	-0.06 (-0.45)	-	-
$\Delta i^{+}_{CB,t-2}$	-0.37 (-2.73)	-0.05 (-0.66)	-	-
$\Delta i^{-}_{CB,t-2}$	0.12 (1.06)	-0.03 (-0.34)	-	-
$\Delta i^{+}_{MM,t-1}$	-	-	0.03 (1.02)	0.07 (3.73)
$\Delta i^{-}_{MM,t-1}$	-	-	-0.10 (-2.58)	0.002 (0.12)
$\Delta i^{+}_{MM,t-2}$	-	-	-0.07 (-1.98)	0.02 (1.22)
$\Delta i^{-}_{MM,t-2}$	-	-	-0.07 (-1.92)	-0.03 (-1.85)
θ^{+}	-0.05 (-1.10)	-0.04 (-0.59)	-0.13 (-3.09)	-0.08 (-2.09)
θ^{-}	-0.25 (-1.43)	-0.42 (-2.00)	-0.18 (-4.25)	-0.10 (-2.61)
ϕ_0 (or γ_0)	-0.02 (-0.64)	-0.02 (-1.27)	0.07 (0.93)	0.21 (1.60)
ϕ_1	0.54 (9.71)	0.87 (30.54)	0.61 (4.70)	0.40 (2.71)
T (time)	0.0002 (0.69)	0.0003 (1.56)	0.0003 (0.63)	-0.0004 (-0.87)
R^2	0.23	0.24	0.31	0.34

For the determination of the optimal lag structure the following information criteria are used: the *modified LR* test statistic (*LR*), the *Final Prediction Error* test (*FPE*), the *Akaike* Information Criterion (*AIC*), the *Schwarz* Information Criterion (*SC*) and the *Hannan-Quinn* information criterion (*HQ*).

Table 8: Results for India

Independent variable	Central bank (i_{CB}) rate	
Dependent variable	Deposit rate (i_D)	Loan rate (i_L)
C.V. (r)	r=	r=0
	(1)	(2)
Regressor	Coefficients - t-ratios	Coefficients - t-ratios
$\Delta i^+_{D,t-1}$	-	-
$\Delta i^-_{D,t-1}$	-	-
$\Delta i^+_{D,t-2}$	-	-
$\Delta i^-_{D,t-2}$	-	-
$\Delta i^+_{L,t-1}$	-	-0.003 (-0.04)
$\Delta i^-_{L,t-1}$	-	-0.23 (-1.31)
$\Delta i^+_{L,t-2}$	-	-
$\Delta i^-_{L,t-2}$	-	-
$\Delta i^+_{CB,t-1}$	-	0.20 (3.52)
$\Delta i^-_{CB,t-1}$	-	0.42 (1.94)
$\Delta i^+_{CB,t-2}$	-	-
$\Delta i^-_{CB,t-2}$	-	-
$\Delta i^+_{MM,t-1}$	-	-
$\Delta i^-_{MM,t-1}$	-	-
$\Delta i^+_{MM,t-2}$	-	-
$\Delta i^-_{MM,t-2}$	-	-
θ^+	-	-0.03 (-1.50)
θ^-	-	-0.12 (-3.15)
ϕ_0 (or γ_0)	-	-0.007 (-1.47)
ϕ_1	-	1.21 (31.56)
T (time)	-	0.0002 (2.43)
R^2	-	0.27

For the determination of the optimal lag structure the following information criteria are used: the *modified LR* test statistic (*LR*), the *Final Prediction Error* test (*FPE*), the *Akaike* Information Criterion (*AIC*), the *Schwarz* Information Criterion (*SC*) and the *Hannan-Quinn* information criterion (*HQ*).

Table 9: Brazilian Rigidities Estimates

Dependent variable	P-T variable	L-R rigidities
Deposit Rates ($\Delta i_{D,t}$)	$\Delta i^{+}_{CB,t-1}$ / $\Delta i^{-}_{CB,t-1}$	1.13
Loan Rates ($\Delta i_{L,t}$)	$\Delta i^{+}_{CB,t-1}$ / $\Delta i^{-}_{CB,t-1}$	0.48
Deposit Rates ($\Delta i_{D,t}$)	$\Delta i^{+}_{MM,t-1}$ / $\Delta i^{-}_{MM,t-1}$	0.96
Loan Rates ($\Delta i_{L,t}$)	$\Delta i^{+}_{MM,t-1}$ / $\Delta i^{-}_{MM,t-1}$	0.35

*The estimated number has no economic meaning

Table 10: Russian Rigidities Estimates

Dependent variable	P-T variable	L-R rigidities
Deposit Rates ($\Delta i_{D,t}$)	$\Delta i^{+}_{CB,t-1}$ / $\Delta i^{-}_{CB,t-1}$	0.54
Loan Rates ($\Delta i_{L,t}$)	$\Delta i^{+}_{CB,t-1}$ / $\Delta i^{-}_{CB,t-1}$	0.87
Deposit Rates ($\Delta i_{D,t}$)	$\Delta i^{+}_{MM,t-1}$ / $\Delta i^{-}_{MM,t-1}$	0.61
Loan Rates ($\Delta i_{L,t}$)	$\Delta i^{+}_{MM,t-1}$ / $\Delta i^{-}_{MM,t-1}$	0.40

Table 11: Indian Rigidities Estimates

Dependent variable	P-T variable	L-R rigidities
Deposit Rates ($\Delta i_{D,t}$)	$\Delta i^{+}_{CB,t-1}$ / $\Delta i^{-}_{CB,t-1}$	-
Loan Rates ($\Delta i_{L,t}$)	$\Delta i^{+}_{CB,t-1}$ / $\Delta i^{-}_{CB,t-1}$ / $\Delta i^{-}_{MM,t-1}$	1.21

*The estimated number has no economic meaning

Table 12: China Rigidities Estimates

Dependent variable	P-T variable	L-R rigidities
Deposit Rates ($\Delta i_{D,t}$)	$\Delta i^{+}_{CB,t-1}$ / $\Delta i^{-}_{CB,t-1}$	1.42¶
Loan Rates ($\Delta i_{L,t}$)	$\Delta i^{+}_{CB,t-1}$ / $\Delta i^{-}_{CB,t-1}$ / $\Delta i^{-}_{MM,t-1}$	0.53¶

* Statically insignificant result.
¶ This result is obtained implementing a VECM (1) with quarterly data (1990Q1-2007Q3).

Table 13: The Asymmetry results for Brazil

Model	Hypothesis $H_0: (\theta^+ = \theta^-)$*	Result
i_{CB} vs. i_D	Both $\theta's$ are statistically insignificant	-
i_{CB} vs. i_L	13.6	negative (-) asymmetry
i_{mm} vs. i_D	Only the negative change (θ^-) is statistically significant	negative (-) asymmetry
i_{mm} vs. i_L	Both $\theta's$ are statistically insignificant	-

* We test the symmetry hypothesis by applying the Wald (x^2) test. The critical value of x^2 with one degree of freedom is 3.84 (5% confidence interval) and 5.02 (2.5% confidence interval).

Table 14: The Asymmetry results for Russia

Model	Hypothesis $H_0: (\theta^+ = \theta^-)$*	Result
i_{CB} vs. i_D	Both $\theta's$ are statistically insignificant	-
i_{CB} vs. i_L	Only the negative change (θ^-) is statistically significant	negative (-) asymmetry
i_{mm} vs. i_D	1.97	symmetry
i_{mm} vs. i_L	6.63	negative (-) asymmetry

* We test the symmetry hypothesis by applying the Wald (x^2) test. The critical value of x^2 with one degree of freedom is 3.84 (5% confidence interval) and 5.02 (2.5% confidence interval).

Table 15: The Asymmetry results for India

Model	Hypothesis $H_0: (\theta^+ = \theta^-)$*	Result
i_{CB} vs. i_D	-	-
i_{CB} vs. i_L	Only the negative change (θ^-) is statistically significant	negative (-) asymmetry

* We test the symmetry hypothesis by applying the Wald (x^2) test. The critical value of x^2 with one degree of freedom is 3.84 (5% confidence interval) and 5.02 (2.5% confidence interval).