The distorting effect of capital controls

Abstract: Using panel data on capital controls which distinguishes capital controls by several factors (e.g. capital import or capital export controls) the present paper shows, that capital controls have a significant impact on international interest rate differentials. These effects are especially strong in the case of capital import controls on portfolio capital as they have been suggested in response to the Asian Crises to prevent further crises. These results contradict the thesis, that capital controls can achieve a restructuring of the maturity of capital inflows without a distortion of the international capital allocation.

JEL: E43**,** F33**,** G15

Keywords: Interest rate differentials, capital controls

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1. Introduction

The present paper deals with the question whether capital controls – which are employed by roughly two thirds of the IMF members – distort the international allocation of capital. This is achieved by analyzing the empirical evidence on the impact of capital controls on real interest rates.

The existence of interest rate effects is not as obvious as it might seem at the first glance. Especially when capital controls are employed as an instrument to prevent a financial crisis, which is common at least since the Asian crisis and the subsequent crises in Latin America and the transition economies of eastern Europe, it is not intended to guide capital to a politically chosen use. First of all it is attempted to prevent capital flows which are purely driven by speculative motives and not based on fundamentals, following the seminal idea of Tobin (1978). A large fraction of today's capital flows seems to be driven by speculation. Since speculators often focus on short term gains and the prospects for these short term gains are often calculated on chart analysis and not based on fundamental issues, there is the danger that the behavior of speculators impairs the efficiency of the capital market.

By analyzing the real interest rate effect of capital controls the present paper tests whether capital controls are truly restricted to the narrow goal of preventing the (allegedly) detrimental capital flows, which are driven by speculation. If capital controls do only constrain the excess volatility causes by speculation, the interest rate mechanism should remain intact. Therefore, a systematic derivation of the market interest rate should not be caused by capital controls.[1]

Until now, literature in this field has been focussed on time series analyses of specific countries or regions. Thus there are lots of evidence on the impact of specific regulations, employed in some countries. Dooley and Isard (1980) show for example, that the capital controls employed in Germany during the 1970s caused a significant increase in interest rates.[2] Similar results have been achieved by Ito (1983, 1986) for the Japanese capital controls based on interest rate differentials between Japan and the US. Several recent papers analyze the Chinese capital market, which has gradually been liberalized in the past years. However, the still existing interest rate differentials imply the existence of capital market barriers.[3]

While country specific studies on the impact of capital controls are numerous, there is little evidence based on panel or cross country data. Partly this is due to the measurement problems concerning capital controls, which are causing severe difficulties when comparing capital controls between different countries. However, the availability of appropriate data has improved significantly in the last decade.[4] Nevertheless, these studies do not account for the difference between capital controls based on the direction of the capital flows which are regulated. A panal analysis accounting for this difference is first found in El-Shagi (2008). The indicators derived in this paper are also used in the present paper.

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1 Based on a dynamic model Herrera, Valdes (2001) further argue, that even controls targeted towards the creation of interest rate differentials do not necessarily succeed in this attempt.

2 A very interesting result of their analysis is, that the expectation of capital controls is sufficient to cause an interest rate movement.

3 See Liu, Otani (2005), Ma, Ho, McCauley (2004) and Ma, McCauley (2007).

4 This is first of all due to the contributions of Quinn (1997, 2000), Quinn, Inclán, Toyoda (2001) and Gwartney, Lawson (esp. 2001 and 2003), where capital controls were measured for a large number of countries.

The remainder of the paper is structured as follows: First, the basic interest rate model and the data, which is employed for the econometric analysis is presented. In this context several estimations of unexpected inflation, which is an essential control variable in the analysis of interest rate differentials, are made. Additionally, the design of the capital control indicators used in the present paper is briefly summarized in this section.

The subsequent section includes the econometric analysis of the impact of capital controls on interest rates. Two methods are employed for estimation. First, a pooled-OLS-model is used. The second model used for estimation is a fixed-effects-vector-decomposition model.

2. Model design and data

2.1 The core model

Even in the absence of artificial capital market barriers it is unlikely that the market mechanism causes real interest to be equal worldwide. Different country risks result in different risk premia, causing persistent interest rate differentials. Furthermore, the market mechanism only affects expected or planned real interest rates. However, only the finally realized (real) interest rates can be observed. Therefore it has to be taken into account that the realization of risks, which might have been known before, can affect real returns heterogeneously and thus cause rent differentials.

To minimize possible distortions the present paper focusses on credit and debit interest rates paid by banks to capture the capital market returns. The advantage of this selection is that only the realization of inflation risks and the conjunct exchange rate risks have to be taken into account, because the payoff from bank deposits usually does not depend on the actual success of the counterparty.

Risk premia nevertheless have to be taken included in the analysis, since they affect capital supply and hence the behavior of banks.

The interest rate model on which the present paper relies can be summarized by the equation:

$$r_{i,t} - r_t^{planned} = \beta_0 + \beta_1 \pi_{i,t}^{unexpected} + \beta_2 risk_i + \gamma' CC_{i,t} + \varepsilon_{i,t} \quad ,$$

where *r* denotes the real interest rate, π the inflation rates, CC the vector of capital controls and t respectively i time and country indices.

2.2 Interest rate data

The choice of the interest rates paid or demanded by banks ensures a broad data base, additional to the advantage detailed above.

The real interest rate is calculated as arithmetic mean of credit and deposit interest rate, deflated with the (percentual) change of the GDP deflator. All relevant data is taken from the world development reports of the Worldbank.

A reference interest rate, which is constructed as the average real interest rate of some OECD member countries with few capital controls, is used as approximation of the planned real interest rate. If there is no global shock, which affects the interest rate in these countries simultaneously, this reference interest rate should be quite close to the planned real interest rate. Since a shock which hits all these countries does most likely affect all countries worldwide, there would be no significant impact on the interest rate differentials anyway.

2.3 The estimation of unexpected inflation

Unexpected inflation, which is essential for the analyses performed in this paper due to its impact on real interest rates, cannot be measured precisely. The hypotheses about the generation of expectations differ extremely. To avoid that the results concerning the effect of capital controls on interest rates are distorted by a biased assumption of the expectation mechanism, the final regressions are run based on four different models of inflation expectations.

Model 1 is a simple version of adaptive expectations. Expected inflation is given by the inflation of the last period.

The three other models base on various econometric analyses of the autoregressive behavior of inflation. For the choice of the econometric model it has to be taken into account, that the ultimate goal is not to depict inflation as precisely as possible, but to reconstruct the expectation mechanism of economic subjects. Therefore, only exogenous variables which are well known to these subjects ex ante can be employed. The most important of these variables is the past inflation. Other potential driving forces of inflation as the political alignment of the ruling party turned out to be insignificant and are therefore not considered in the following models. Some of the models are intentionally designed very simple, to account for the possibility that only a few basic considerations actually drive inflation expectations.

A major problem for any econometric model which is analyzing inflation development is the high variance of inflation especially in times of high inflation. Even if it is possible to avoid the arising technical problems through adequate econometric methods, it is highly questionable whether the estimates can legitimately be interpreted as expected inflation in high inflation periods. Additionally, the capital markets are likely to collapse in times of hyperinflation, rendering these estimates useless for the current purpose as control variable in a capital market model. While there is data on interest rates for such periods, bank deposits (and credits) do only play a minor role, since many investors prefer real assets to avoid the immensely high inflation risks. However, capital controls are mostly employed by less developed countries, which are often facing inflation problems. Thus the elimination of high inflation countries because of problematic inflation estimates has to be performed very carefully to avoid the destruction of the database which is necessary to analyze capital controls. For the following analyses only countries are taken into consideration where the inflation rate never exceeds 50 % per year. Within this sample, which is still including sufficient countries which are employing capital controls, inflation can be explained fairly well. Separate time series analyses for the different countries show that the results are similar in all countries. Thus it can be assumed that no outliers are included, which might distort the results.

From a strictly econometric perspective the most appropriate method for the present dynamic panel problem is an Arellano-Bond-estimation, which is avoiding the construction-conditioned correlation of a country specific error component and the lagged dependent variable.[5]

Since all available past values of the dependent variable are used as instruments in the traditional GMM in the version of Arellano and Bond, the sample length of more than 40 years per country on average results in an extraordinarily high number of instruments which is rendering the Sargan-test useless. Because inflation rates from a distant past have only little explanatory power for today the number of lagged dependent variables is limited to 15. Period specific dummies are

5 Arellano, Bond (1991).

not employed. While such dummies might be meaningful, it is unlikely that they represent shocks which have been known ex ante.

Within this specification the Sargan test indicates an overidentification problem, the Arellano-Bond-test shows, that there is first order serial correlation of idiosyncratic errors. This problem can be avoided by not employing the inflation rates from the immediate past as instruments. However, the remaining instruments are weaker. The resulting estimate is used as inflation expectation according to model 2. The crucial problem of this estimation is that the differentiation and instrumentation necessary to perform the GMM cause large information losses, even if the full set of instruments could be employed without problems. Therefore it is necessary to consider further alternatives.

The distortion of the results when using GLS-estimators or FGLS-estimators with dynamic panels should be small in the present example due to the sample length of more than four decades. Therefore it seems reasonable to use this approach as an alternative, especially considering the problems of the Arellano-Bond estimator in the present context. In addition to the inflation of the last year the inflation development of the year before is used as independent variable to account for the possibility that inflation is increasing or decreasing over extended periods or that increasing inflation is causing opposing policies which are in turn reducing inflation. As a Hausman specification tests indicates that country specific random effects result in inconstistent estimates, model 3 is based on a GLS-estimator with fixed effects.

Nevertheless, this kind of model still ignores the conditional autoregressive heteroscedasticity found in inflation time series.[6] However, using an ARCH- or GARCH-model for the whole panel

6 Engle developed his method to estimate ARCH based on inflation time series as an archetypical example for this problem. See Engle (1982).

is problematic since inflation variance is differing strongly between countries. By construction the variance in these models is mean reverting and thus the inflation variance in high inflation countries would be underestimated while the inflation variance in low inflation countries would be overestimated due to the use of a common mean. Within a sample of few countries it is possible to correct these problems by using country specific dummies in the estimation of the conditional variance.[7] Nevertheless, this is impossible for the number of countries used in the present data set. Therefore, countries are separated into groups according to the variance of the error terms resulting from estimations using simple, single country AR(1)-models. Within each of these groups a separate estimation is run using an ARCH(1)-model, where the lagged inflation is the exogeneous variable. The change of inflation rates in the past periods is no longer significant in these ARCH-models and is thus not employed in the reported results. Model 4 of inflation expectations is based on these grouped ARCH-models.

A further advantage of the models is the possibility to use the variance estimate as risk variable in the following interest rate analysis. Since inflation time series in several countries are short in comparison to the time series used in financial econometrics (which are often covering several hundred very short periods) no Ljung-Box-test (or comparable test) to determine the number of lagged dependent variables is employed. Instead, only the last period is used.[8]

The sample covers all countries, where data is available for the indented analysis of capital controls and inflation data covering at least 20 years. If available, inflation data since 1961 is used. The error terms derived from the inflation estimates are employed as indicator for unexpected inflation in the interest rate model. To give a brief impression of the precision of the

7 This is suggested by Cermeño, Grier (2001), who are employing Monte Carlo simulations to show that this improves results significantly.

8 Anyway, the inclusion of further periods does not affect the results strongly.

estimates, table 1 summarizes the variance of the error term of the various estimates.[9]

2.4 Measuring capital controls

Most older empirical works on capital controls either use a simple dummy variable, which is merely catching violations of article VIII of the IMF agenda, or the share of years in which this dummy equals "1" for a given country in the course of the observation period.[10] The lacking precision of these indicators caused heavily flawed results. Therefore, recent studies try to find more detailed indicators which include information on the intensity of capital controls. [11] [12] For many questions this division by intensity is entirely sufficient. However, it is not appropriate for the analysis of interest rate effects, because capital controls can increase or decrease the supply of capital and can thus have ambiguous impact in the interest rate.[13]

The index developed in El-Shagi (2008), which is used in the present paper, is based on data from the detailed country reports in the IMF's Annual Reports on Exchange Arrangements and

9 While the time series used for inflation analysis reach back to the 1960s, it has been shown by Mishkin (2007) that inflation dynamics have changed in the last few years. However, even if this change is persistent and not a transitory phenomenon it is questionable that expectation behavior adjusts to such changes very quickly. Since the chance in inflation dynamics started in the mid 1990s, it is entirely appropriate to use the full time series.

10 Alesina, Grilli, Milesi-Ferretti (1993), Rodrik (1998), Rodrik (1999), Klein, Olivei (1999).

11 Quinn (1997), Gwartney, Lawson, Block (1996), Gwartney, Lawson (2001), El-Shagi (2008).

12 To avoid the precision problem several authors replace "de jure" control indicators by "de facto" control indicators. Kraay (1998), Swank (1998) and O'Donnel (2001) use actual capital flows, Baele et. al. (2004) use interest rate differences for homogeneous assets within the Euro area. Since the present paper deals with the impact of capital controls on the capital market this approach, where capital market indicators serve as control indicator simultaneously, is not feasible for the present purpose. This strand of literature is catching capital controls via their distorting effect, and thus it is impossible to discuss distorting effects of capital controls based on this data.

13 Goh (2005) discusses this empirically for some selected examples.

Exchange Restrictions because the data from the table in the data appendices is not sufficiently detailed. The fundamental division is into capital import and capital export controls. Both of these are further divided into two separate indices. Hence, altogether four indices – each reaching from 0 (free capital flows) to 10 (heavy capital market restrictions) – are reported.

As portfolio investment can be repatriated more quickly than direct investment, controls affecting these kinds of investment should have different results. Furthermore, direct investment is often made based on long term plans. Various kinds of control, as transaction fees or taxes, are therefore less important, if direct investment is concerned. Thus separate indices are used for portfolio capital import controls and for foreign direct investment controls.

Export controls are further distinguished by the question, whether capital exports by residents or capital exports by foreigners are controlled. In contrast to residents, foreigners can choose to stay outside of the regulated capital market in the beginning to avoid the risk arising from repatriation controls. The expected increase of the domestic capital supply might therefore be counterbalanced. Domestic residents have to overcome the control in order to be able to invest abroad. Therefore they have limited alternatives to the domestic capital market, if tight regulations are used. Export controls on domestic residents might therefore be more successful in increasing domestic capital supply.

For three of the four distinguished types of controls there is data on several different control instruments or controlled sectors. The respective indicators are defined as the share of controlled sectors multiplied by 10 (analogous to Gwartney and Lawson). It is not possible to compute this kind of index for controls on foreign direct investment because only data on the general existence of foreign direct investment controls exists. However, the dummy describing the existence of foreign direct investment controls is multiplied by 10 as well, to ensure comparability to the other results.

The indicators are available for the period from 1997 to 2003.

3. Regression results and interpretation

3.1 Pooled OLS

Since country specific risks (and possibly other country specific factors which are determining the interest rate) are hardly observable, the most obvious econometric way to model interest rate differentials seems to be a simple fixed effects model. However, it is problematic to use fixed effects in a model which is designed to find the effect of capital controls, due to the low variance of capital controls during the observation time. Because of this low variance capital controls are mostly a country specific factor themselves. If country fixed effects and capital controls are both considered in an econometric model the fixed effect variable tend to “absorb” the impact of capital controls. The results are thus heavily distorted and the consequences of capital controls are severely underestimated.

Therefore, it is necessary to consider the most important country specific factors explicitly to avoid the necessity of generic country specific effects. This allows to analyze the impact of capital controls on interest rate differentials within a simple pooled OLS framework.

Two kinds of country specific risks are considered in the present analysis. First, the risk arising from the general level of development is included in the regression by dummy variables, representing the income group (according to the World Bank division in income groups).

Secondly, inflation risk is given by the variance of the inflation rate.[14]

The results of the regressions clearly show the correlation of interest rates and capital controls. Controls therefore seem to have significant interest rate effects and are not restricted to the elimination of speculative, market distorting behavior.[15] Table 2 summarizes the results of the four regressions which are based on unexpected inflation according to the four different expectation models derived in section 2. The regression coefficients change slightly. However, order of magnitude and algebraic sign do not change. The results mostly match expectations.

Inflow controls clearly increase the interest rate with a regression parameter between 0.35 and 0.62. Inflow controls thus obviously limit capital supply which is reflected in the interest rates. Outflow controls have an analogue negative impact. However, the magnitude is significantly smaller.

Controls in repatriation of capital have an insignificant impact. The sign is mostly negative but in one case positive. The constraining impact on outflows seems to be offset by a negative effect on foreign investment.

Only the negative and highly significant correlation of controls on foreign direct investment and interest rates is surprising. It should be assumed that such import controls restrict capital supply. However, controls on foreign direct investment usually cover only few sectors and thus are no general impediment to capital flows as a whole.[16] Additionally it has to be kept in mind, that the

14 In the version of the regression based on the inflation estimation using ARCH the estimated variance of the residual of inflation is used instead.

15 Theoretically, there might be an endogeneity problem if capital controls are implemented due to capital market problems. However, it is very unlikely that for example capital import restrictions are a political reaction on high interest rates. Thus it is quite obvious that the results are distorted or even driven by a reverse causality.

16 It is noteworthy in this context that it has been shown by Easterly (1993) that distortions, which are favoring one kind of capital accumulation over another kind of capital accumulation can be highly detrimental for growth.

indicator concerning capital controls is the least precise of the employed indicators on capital controls.

The impact of the control variables is mostly not surprising. In most regressions unexpected inflation has a significant negative impact. Nevertheless, the impact of the indicator of unexpected inflation based on the inflation modelling using the Arellano-Bond method is relatively small and insignificant, what is most likely due to the mentioned precision problems of this estimation method. [17] Risk indicators are positively correlated with the interest rate, what is most likely due to the risk premia. The impact of the middle income group dummy is positive, reflecting the high risk of emerging markets. Surprisingly, the impact of the low income group dummy is negative. This might be a statistical artifact, caused by the small number of poor nations included in the sample. The risk realization in the sample period in low income economy might drive the results more than expected risks. Furthermore, the latter correlation is only significant when the ARCH-estimation of inflation is used.

It can be seen in table 2 that the share of explained variance is quite high with 0.35 to 0.48, especially if it is considered that the interest rate is a highly volatile macroeconomic variable. It is interesting to see, that the best interest rate estimation is based on the most simple inflation estimation using a fixed effects model. This is not only reflected in a high R^2 but also in the coefficient being close to “-1”, which should be the size of the impact of the true unexpected inflation.

17 It should not be considered irrational if expectations are based on a model which is questionable from an econometric perspective. While econometricians usually focus on efficient parameter estimates, these are mostly irrelevant for the economic subjects who are interested in a precise forecast.

3.2 Fixed Effects Vector Decomposition

While some essential country specific factors are included, there are still remaining unobservable country specific effects. The results are thus potentially biased. A possible solution is a fixed effects vectors decomposition approach (following Plümper and Tröger, 2005). This allows to compute the impact of capital controls as part of a total fixed effect, which is later on separated into unobservable and observable components (including capital controls).

Therefore interest rates are first analyzed in a simple fixed effects model, where only timevariant exogenous variables are included and thus the total time-invariant factors are captured by the country fixed effects. In a second step the resulting country specific effects are regressed on the observable country specific including capital controls. The error term from this second regression is regarded as unobservable country specific effect. In a last step the interest rate differentials are regressed on all exogenous variables, including time-variant variables, observable time-invariant variables and the computed unobservable country specific effect. While the basic decomposition of the country specific effect takes place in step two, the last step is necessary to achieve valid estimations of the standard error and therefore of variance.

The disadvantage of this approach is that variations of capital controls over time have to be ignored. Instead, averages over time are used. The trade-off for the consistent estimation therefore is the disposal of some of the available data. Since these changes of capital controls are rare within the analyzed sample, the vector decomposition nevertheless is a valid approach to the given problem.

The results from the pooled OLS model in the previous chapter remain mostly unchanged. Capital import restrictions have significant positive impact on the interest rate in the fixed effect vector decomposition model as well. However, the magnitude of the effect is substantially larger. Both, capital export restrictions on domestic residents and repatriation restrictions, have a negative impact. Nevertheless, capital export restrictions are now insignificant, while repatriation restrictions are highly significant. The results are summarized in table 3.

3.3 Interpretation of the results

The positive correlation of interest rate differentials and capital controls which is robust to changes of the estimation method indicates strong interest rate effects and thus strong allocation distortions caused by portfolio capital import restrictions. This is an essential result, because especially portfolio capital inflow restrictions have been advocated with the argument that the maturity composition of capital imports should be altered without affecting total capital flows strongly. However, the actually implemented instruments obviously fail to achieve this target (or have been implemented with other targets in mind).

The negative impact of repatriation controls and of outflow controls is not robust. Since none of the two methods can be dismissed as substantially flawed, this robustness problem must not be considered a mere statistical artifact.

Nevertheless, a merely weak impact is easily explicable for both kinds of control. Using repatriation controls can lock foreign capital within the country but at the same time further foreign investment is discouraged due to the risks which are created by the control. In fact, the negative coefficient which is significant according the the results from the vector decomposition approach is more surprising than the lack of robustness. Possibly, the positive effect on capital supply is slightly overestimated, because several countries implemented repatriation controls in the aftermath of the Asian Crises. Because the sample is quite short, the lock in effect of capital is overrepresented in comparison to the discouragement.

Concerning capital outflow controls on domestic residents it has to be kept in mind, that only countries in a desperate situation, which are already facing significant capital flight, usually resort to methods like strict capital outflow restrictions. Since there is usually a homebias in favor of the domestic economy, capital flight problems indicate severe domestic problems. Therefore the incentives to circumvent capital outflow restrictions – by illegal means if necessary – are very high. Possibly, investors prefer hoarding or "investment" in real assets to domestic credit supply. Even if low interest rates are visible these are often the consequence of further interventions by the government and not caused by market mechanisms on the domestic credit market.

4. Résumé

The original idea of the advocates of capital controls to regulate financial markets without impact on the interest rates only to limit investment peak and valley and without distortions of long term capital allocation obviously did not work out. Economic and political reality are controls which are strongly affecting economic behavior. Using the arguments of some economists other targets are pursued with capital controls. Lax monetary and fiscal policies, which are more easy to cover using capital controls, might play a substantial role.

Keeping in mind, that several components of the costs of capital controls – like bureaucratic overhead, corruption, etc. – have not yet been considered, the resume concerning capital controls has to be negative.

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Tables

Table 1: *Inflation expectation models: Specification and variance of the error term*

Modell Nr.	Specification	û²
1	$inflation_t^{erwartet} = inflation_t$	6.133273
2	Two step GMM following Arellano and Bond	7.890021
3	GLS with fixed country specific effects	5.414052
4	Grouped ARCH	5.316914

Source*: Own calculations based on Data of the Worldbank and the IMF*

Table 2: Causes of interest rate differentials based on a pooled OLS estimation

Variable	Estimation based on expectation model 1	Estimation based on expectation model 2	Estimation based on expectation model 3	Estimation based on expectation model 4
Unexpected Inflation	-0.3455359** (-2.37)	-0.1272181 (-1.19)	-0.6871261*** (-4.99)	-0.6253512*** (-3.88)
Poor Country	-3.49404* (-1.92)	-3.140945* (-1.77)	-3.072352* (-1.81)	-2.499695 (-1.32)
Middle income country	2.052115*** (3.27)	2.218808*** (3.50)	2.161759*** (3.67)	2.848486*** (4.74)
Risk indicator[1]	0.0612714** (2.41)	0.0602663** (2.19)	0.0568444*** (2.75)	0.0304872 (1.44)
Inflow controls	0.5721881*** (3.35)	0.620554*** (3.48)	0.5657775** (3.61)	0.3580134** (1.92)
Outflow controls	-0.3820945** (-2.10)	-0.4471142** (-2.56)	-0.2932994* (-1.73)	-0.3822016** (-2.20)
Repatriation controls	-0.1312725 (-0.85)	-0.1079232 (-0.72)	-0.1794315 (-1.25)	0.002539 (0.02)
Controls on FDI	0.301457*** (-4.34)	-0.2953116*** (-4.10)	-0.3063152*** (-4.89)	-0.2912175*** (-4.53)
constant	0.7168994 (1.47)	0.6697443 (1.33)	-0.1835079 (-0.35)	1.600279** (3.30)
R^2 ***(adjusted R^2)***	0.3446 (0.3242)	0.2837 (0.2614)	0.4608 (0.4440)	0.4034 (0.3849)

t-statistics in parantheses ((based on White-standard-errors)

[1] The risk indicator refers to the variance of inflation in the regressions based on the expectation model 1,2 an 3. In the regression model based on the ARCH model of expected inflation, the risk parameter is the estimated variance of the error term, i.e. The estimated variance of unexpected inflation.

* = significant on 10% level
** = significant on 5% level
*** = significant on 1% level

Source: *Own calculations based on Data of the Worldbank and the IMF*

Table 3: Causes of interest rate differentials based on a fixed effects vector decomposition estimation

Variable	Estimation based on expectation model 1	Estimation based on expectation model 2	Estimation based on expectation model 3	Estimation based on expectation model 4
Unexpected Inflation	-0.4028105*** (-7.03)	-0.1513472*** (-3.19)	-0.7652538*** (-12.30)	-0.751354*** (-12.04)
Poor Country	-2.954575** (-2.37)	-2.664664** (1.97)	-2.376135** (-2.22)	-1.504873 (-1.31)
Middle income country	1.98601*** (2.78)	2.082734*** (2.69)	2.167642*** (3.53)	3.118336*** (5.09)
Risk indicator[1]	0.0635666*** (6.03)	0.0621896*** (5.46)	0.0587801*** (6.50)	0.0223789** (2.17)
Inflow controls	1.095282*** (3.93)	1.063663*** (3.53)	1.18123*** (4.93)	0.8667735*** (3.50)
Outflow controls	-0.314462 (-1.58)	-0.3652044* (-1.70)	-0.2262292 (-1.32)	-0.4326078** (2.53)
Repatriation controls	-0.6050028*** (-1.93)	-0.5148322*** (-2.31)	-0.7310948*** (-4.12)	-0.3766937**
Controls on FDI	-0.3853918*** (4.61)	-0.3974133*** (-4.40)	-0.3904932*** (-5.45)	-0.3282303 (-4.50)
constant	1.130395 (1.50)	1.193437 (1.47)	0.123545 (0.19)	1.805109*** (2.89)
R^2 ***(Adjusted R^2)***	0.5351 (0.4243)	0.4569 (0.3274)	0.6581 (0.5767)	0.6496 (0.5661)

t-statistics in parantheses

[1] The risk indicator refers to the variance of inflation in the regressions based on the expectation model 1,2 an 3. In the regression model based on the ARCH model of expected inflation, the risk parameter is the estimated variance of the error term, i.e. The estimated variance of unexpected inflation.

* = significant on 10% level
** = significant on 5% level
*** = significant on 1% level

Source: *Own calculations based on Data of the Worldbank and the IMF*