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### JÜRGEN VON HAGEN:

**The Role of Exchange Rate Policies in the Determination of Capital Controls in Transition Economies**

# The Role of Exchange Rate Policies in the Determination of Capital Controls in Transition Economies[*]

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*Table of Contents*

# 1    Introduction

The reoccurring financial and currency crises in the 1990s have lead many economists and policy-makers to reassessing the implication of heightened capital mobility on exchange rate policy. Some of them believe that the "intermediate" exchange rate regimes, including the conventional adjustable pegs and other tightly managed exchange arrangements such as crawling pegs and crawling bands, are intrinsically vulnerable to speculative attacks, and argue that only "corner solutions", i.e. hard pegs and freely floating rates, are viable in an environment of free capital movement.[1] Some others warn against the excessive volatility on the international financial markets associated with free capital mobility and suggest imposing capital controls to enhance the sustainability of these intermediate regimes.[2]

These two types of arguments can be reconciled within the framework characterized by the "impossible trinity", which observes that free capital mobility, exchange rate stability, and monetary independence cannot be achieved jointly. The difference between the two types of arguments centers on which element should be given up. If countries are willing to forgo monetary independence by adopting the monetary policy of a foreign country, they can fix their exchange rates against the currency of that anchor country even in the presence of free capital mobility. Since only under hard pegs (monetary union, dollarisation, euroisation, or currency boards) do countries really (have to) give up monetary autonomy, it suggests that hard pegs can be viable without the support of capital controls.[3] Alternatively, if countries allow their exchange rates to fluctuate freely, they can pursue independent monetary policies and let the exchange rates to absorb the impacts caused by capital flows. This suggests that freely floating rates can be compatible with free capital mobility, too.[4] Only if countries want to retain both exchange rate stability and monetary autonomy, a common feature of various intermediate exchange rate regimes, do they have to restrict capital mobility. In this scenario capital controls are used to help manage the exchange rate policies.

An implication of these different scenarios is that only intermediate exchange rate regimes are expected to be associated with heavy capital controls; both hard pegs and free

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[1] For more discussion on this "bi-polar" view, see Eichengreen (1994), Summers (2000), and Fischer (2001).

[2] See, for example, Edwards (2000), Masson (2001), Wyplosz (2001), and Williamson (2000).

[3] The collapse of the Argentine currency board in 2002 creates doubts on the viability of currency boards in case of free capital movement, although there is argument that the Argentine arrangement is just "mimicking" a currency board. Some authors argue, therefore, for an even harder exchange rate regime, i.e. formal dollarisation or euroisation. See discussions in Edwards (2002).

[4] It is debatable whether emerging or transition economies can really afford to have a freely floating exchange rate regime, given the importance of the exchange rate for price (in)stability in these typically small and open economies. See Cooper (1999) for elaboration on this point. A consequence of this concern is the so-called "fear of floating" phenomenon pointed out by Calvo and Reinhart (2000).

floats can get along well with free capital mobility. In other words, as flexibility of the exchange rate regime increases, the intensity of capital control follows a hump-shaped trajectory. This non-linear influence of exchange rate regime flexibility on capital control intensity, however, is not well addressed in the literature. The empirical studies on the determination of capital controls find that fixed and tightly managed exchange rate regimes are associated with tighter capital controls than freely floating regimes.[5] But they do not differentiate between hard pegs and soft pegs, so it is impossible to detect the non-linear relation.

In this paper we analyze the determination of capital controls in 25 transition economies in the 1990s. As a component of socialist central planning, capital controls have for long been a common practice in these countries. Since transition started in the early 1990s, they have all undergone a process of capital account liberalization, but the pace varies substantially across countries. While most Central and Eastern European Countries (CEECs), especially those applying for the EU membership, have abolished many control measures in the recent years, the countries in the Commonwealth of Independent States (CIS) still maintain controls on various types of capital transactions. The question is, therefore, why countries differ in their desires for and paces of capital account liberalization.

We conduct empirical analysis to find the important determinants of capital controls in transition economies. Besides the usual determinants suggested in the relevant literature, we lay particular emphasis on the potential non-linear influence of exchange rate policies on capital control intensity. Our empirical model explicitly allow different exchange rate regimes to assert different impacts on the intensity of capital controls. The hump-shaped relationship, if it does exist, should then be manifest in the different coefficients associated with different exchange rate regimes.

The rest of the paper is organized as follows. Section 2 provides a brief review of the theoretical underpinnings for capital controls. Section 3 discusses the measurement of capital controls and their determinants. In section 4 we explain the empirical model for the determination of capital controls and discuss the empirical results. Conclusions are summarized in section 5.

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[5] See Alesina et al. (1994); Grilli and Milesi-Ferretti (1995); Milesi-Ferretti (1998); Berger et al. (2001).

# 2 Theoretical Arguments for Capital Controls

There is a vast literature on the theoretical underpinnings for capital controls.[6] The traditional literature justifies the imposition of capital controls on the ground of preexisting distortions. The literature on the self-fulfilling currency crises provides a rationale for capital controls as a measure to solve the multiple equilibria problem. The political economy literature focuses on a set of institutional and political characteristics of a country to explain the imposition and removal of capital controls.

## 2.1 Capital Controls as Second-Best Solution to Preexisting Distortions

There are various rationales for imposing capital controls, such as to limit volatile short-term capital flows, to retain domestic savings, and to maintain domestic tax base (Mathieson and Rojas-Suarez, 1993). These rationales can be related to some preexisting distortions in the economy. Although the first-best solution should be the elimination of these distortions, if the distortions are dominant in the economy and take time to overcome, it might be welfare-improving to introduce new distortions, such as capital controls, to counteract the negative effects of the old ones.

One distortion widely cited in the literature is the inefficiency of the financial market due to asymmetric information, which results in volatile and probably irrational capital flows. Since the size of such capital flows can easily overwhelm the intervention capacity of a central bank, their ability to destabilize an economy can never be overestimated. This is particularly true with short-term capital flows, which have played a decisive role in the crises in the 1990s. Therefore, throwing "sand in the wheels" of the international market by imposing capital controls can help avoid the problems caused by volatile capital flows as well as their sudden reversal.[7]

Another distortion is high country risk premia charged on the borrowers from developing and transition countries. The main causes of high country risk premia include political instability and lack of protection of property rights (Tornell and Velasco, 1992). Since external borrowing is costly, countries have to rely mainly on domestic savings to finance investment. However, as the risk-adjusted private return is lower than the social rate of return, domestic savings tend to flow out to seek better investment chances. In this case, controlling capital outflows to retain domestic savings become inevitable policy measures.

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[6] Dooley (1996) offers an excellent survey of the relevant literature on capital controls. Also see Williamson and Mahar (1998) for a survey of financial liberalization.

[7] Eichengreen et al. (1995) suggest imposing tax on short-term capital flows to reduce their volatility. Calvo and Reinhart (1999) discuss the consequence of the sudden reversal of short-term capital flows.

Low efficiency in the tax system is also a commonly mentioned distortion that can be counteracted by proper capital control measures. One manifest of such distortion is the difficulty for the authority to tax income generated from foreign sources, which provides strong incentives for the private agents to shift their funds abroad.[8] To avoid tax-motivated capital outflows, some control measures are necessary in the absence of international tax coordination. Moreover, with an inefficient tax system, governments may rely more heavily on inflation tax and seigniorage to secure revenues, or to keep interest rates low to ease the real burden of debt servicing (Aizenman and Guidotti, 1994; Drazen, 1989). Both require capital controls as complementary measures to help maintain domestic tax base.

## 2.2    Capital Controls as First-Best Solution to Multiple Equilibria Problem

Recent studies of currency crises show that these crises can take place even in the absence of policy inconsistency or major distortions in the economy. The crises are of a self-fulfilling nature in the sense that private agents may expect a change in the government policy after the attack on the currency, and that when they do start the attack, it will be optimal for the government to change the course of its policy, validating the private expectation ex post (Obstfeld, 1996).

The key to a successful self-fulfilling speculative attack is to create such a situation that the benefit of keeping a stable exchange rate (i.e. price stability) is not enough to offset the cost in terms of output instability, which is a likely consequence of the interest rate hikes necessary for defending the currency. As long as governments do not pursue exchange rate stability in a single-minded way, there will always be rooms for self-fulfilling speculations (Dooley, 1996).

One lesson from the theory of self-fulfilling currency crises is that there might be multiple equilibria in the determination of the exchange rate consistent with a given set of fundamentals. Switches among different equilibria are the results of changes in the private expectations. The first-best solution, therefore, is to reduce the likelihood of changes in the private perceptions on the sustainability of the current exchange rate. Capital controls can both reduce the chance for such changes in expectations and increase difficulties for a switch among alternative equilibria. If the current exchange rate is believed to be associated with a good equilibrium, capital controls can buy time to let the fundamentals consolidate around that rate, which reduces the likelihood that the private perceptions will change. Capital

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[8] Razin and Sadka (1991) provide some empirical evidence that the government in a developing country can not tax the residents' income from foreign assets at the same rate at which it taxes domestic capital income.

controls can also make it difficult for the speculators to mobilize funds to launch attacks, which reduces the likelihood of a successful switch among multiple equilibria. For these reasons, capital controls can be viewed as a first-best solution to the problems caused by multiple equilibria.

## 2.3    Political Economy of Capital Controls

Research works in the tradition of political economy relate the imposition and removal of capital controls to the characteristics of the political institutions. They also study the controls and decontrols of the international capital transactions from the public finance perspective.

The imposition or removal of capital controls may reflect partisan conflicts in a country. The political partisanship literature usually suggests that left parties generally draw support from people whose income depend either on government social welfare expenditures or on wages from work in unionized sectors, and that right parties tend to receive support from owners and managers of business (Quinn and Inclán, 1997). Given the difference in the socioeconomic class foundations, and given the fact that parties are interested in improving the welfare status of their major constituency, conflicts in the policy preference are inevitable. From distributive perspective, the left-wing governments are found to be more likely to tax the income from capital transactions, and for this purpose, more likely to impose capital controls to maintain this tax base (Epstein and Schor, 1992). Conversely, right-wing governments are more interested in financial liberalization, opening channels for the capital-owners to avoid the capital levy imposed by the left governments (Alesina and Tabellini, 1989).

Capital controls can be imposed to help governments manage public finance issues. On the revenue side, capital controls can assist governments to collect revenues through capital levies, inflation tax, and seigniorage. On the expenditure side, capital controls can help governments to reduce the cost of servicing public debt by keeping the domestic interest rate below the international level. This can be possible only if the domestic financial market is separated from the international one, which can be achieved by imposing capital controls.

# 3    The Measures and Determinants of Capital Controls

## 3.1    Measuring Capital Controls

It is widely recognized that measuring capital controls is difficult (Eichengreen, 2001). The typical source of information for the identification of capital controls is the *Annual Report on*

*Exchange Arrangements and Exchange Restrictions* (*AREAER*) published by the International Monetary Fund (IMF). A widely used measurement is a dummy for capital controls, which takes a value of unity if the capital account is largely closed or zero otherwise.[9] A major shortcoming of this simple approach is that it does not account for differences in the intensity of capital controls. A more differentiated measurement is introduced by Quinn (1997), which codes the intensity of capital controls on a 0—4 scale.[10] However, this index is available only for a limited number of countries for some selected years, which limits its application for our study.

Our measure of capital controls in transition economies is different from both approaches discussed above. Starting from the 1997 issue of *AREAER* (for 1996), IMF began to provide information about the presence or absence of capital controls on ten or eleven types of capital transactions.[11] Based on these disaggregated information, our measure for capital controls is derived by dividing the number of capital transactions subject to controls by the total number of capital transactions.[12] For the early years of the decade, we seek relevant information from various issues of *AREAER* to construct the measure in the same way.[13] This approach produces a continuous-valued index of capital controls.

The index measures directly the pervasiveness of capital controls. We believe it also indirectly captures the intensity of capital controls, since the effectiveness of each control measure depends positively on the complements from other controls. Therefore, a larger value of this index does not merely reflect more types of control being imposed, it is also a proxy for higher intensity of any existing controls. Since the index is, by construction, bounded between 0 and 1, it is inappropriate to use it directly as the dependent variable in regression

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[9] See Epstein and Schor (1992), Alesina et al. (1994), Grilli and Milesi-Ferretti (1995), Milesi-Ferretti (1998), and Bai and Wei (2001).

[10] This index is also used by Quinn and Inclán (1997), Edwards (2001), and Arteta et al (2001).

[11] The 1997 *AREAER* provides separate information about controls on ten types of capital transactions. Starting from the 1998 issue, eleven potential capital controls are identified.

[12] Johnston and Tamirisa (1998) also use the detailed information from IMF's *Annual Report* to construct measures for the intensity of capital controls, which are defined as the number of existing controls, both for overall capital account and for each type of capital transactions. The only difference between their measure and our index is that we normalize the number of observed controls by the total number of potential controls. This normalization is appropriate for our data due to changing number of types of capital transactions, while Johnston and Tamirisa (1998) consider only one single cross section for 1996, so the change in the number of potential controls is not an issue.

[13] It is encountered in the construction of this measure that for some countries or years information on some types of controls are missing, or that some types of transactions are not regulated. We treat these transactions as subject to controls. While this treatment certainly biases the measure toward more closed capital account, it might be justified by the contention that these transactions are less developed and less important in the relevant countries, possibly due to less developed capital market. This is in turn consistent with a more closed capital account.

analysis. We adopt the following transformation: first replace 0 with 0,01 and 1 with 0,99, and then transform the data series after replacement (x) according to the formula log[x/(1-x)].[14]

## 3.2    Determinants of Capital Controls

*Exchange Rate Regimes (ERR)*

The main purpose of this paper is to examine the role of exchange rate policies in the determination of capital controls. Our interpretation of the "impossible trinity" suggests that there is a hump-shaped relationship between flexibility of exchange rate regimes and intensity of capital controls. How to model this non-linearity depends on how the exchange rate regime is measured. One approach is to measure the regime flexibility by a single variable, which takes higher values for more flexible regimes. This variable and its squared term will be included in the regression to capture the non-linear influence. Another approach is to construct dummies for each regime and include all of them in the regression. Then the non-linear relationship will be reflected by the difference in the regime coefficients.

In our analysis we differentiate between official and de facto exchange rate regimes, since discrepancies between these two regimes are quite common.[15] The official exchange rate regimes are those reported by national governments to the IMF. The IMF then classifies exchange rate regimes on a 1—8 scale, with higher values denoting more flexible exchange arrangements (see Appendix for details). The de facto exchange rate regimes are classified based purely on the observed behavior of the exchange rate and foreign reserves. The criterion for regime classification is that observations with low exchange-rate volatility but high reserve volatility belong to fixed regimes, those with high exchange-rate volatility but low reserve volatility belong to flexible regimes, and those with medium level volatility on both dimensions are classified as intermediate regimes. The observations with low volatility on both dimensions are labeled as "inconclusive" regimes, since it is difficult to infer the actual de facto regime in this case.[16] There are two datasets on de facto regimes. One is extracted from Levy-Yeyati and Sturzenegger (2000), hereafter LYS, with 106 country-year observations from transition economies. Another is our own classification for transition economies using the LYS methodology, which has 203 observations.[17] Both datasets provide

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[14] We also experiment with other alternatives, e.g. replacing 0 (1) with the mean between 0 (1) and the second lowest (highest) index value before the transformation. The empirical results with this type of transformed index, however, are very similar to those reported here, showing that our results are robust to different ways of transformation.

[15] See von Hagen and Zhou (2002b) for a more detailed discussion on this issue.

[16] See Levy-Yeyati and Sturzenegger (2000), von Hagen and Zhou (2002b).

[17] Due to missing data on other variables, the number of observations used in estimations is smaller.

a four-regime classification on a 0-3 scale, with "inconclusive" regimes labeled by 0, fixed regimes by 1, intermediate regimes by 2, and flexible regimes by 3.

*Institutional and Structural Features*

The empirical literature finds that low degree of central bank independence is an important determinant of capital controls.[18] The reason is that, with a dependent central bank, the government can easily influence the monetary policy stance and is more likely to rely on seigniorage revenue, which requires capital controls as necessary compliments. The data on central bank independence (CBINDEP) for the transition economies is an index on the legal independence of the central banks developed by Cukierman et al. (2000), with higher values assigned to more independent central banks. The second factor influencing capital controls is a country's commitment to maintain current account convertibility. Such a commitment opens some legal channels for the private agents to circumvent the existing capital controls, eventually leading to the removal of some control measures, especially those on trade-related capital flows. The proxy for this commitment is the acceptance of Article VIII of the IMF's Articles of Agreement. A dummy variable (ART8) is designed to capture this event. It takes a value of one in the year when a country accepts the Article VIII obligation and after, and zero otherwise. The third determinant is the quality of financial institutions. An underdeveloped and weak financial sector, a likely legacy of financial depression under central planning, needs intensive capital controls to shield them from foreign competition. Our proxy for the quality of financial institutions (FINQUAL) is the index of financial reform compiled by the European Bank for Reconstruction and Development (EBRD). The higher the EBRD index, the closer is the financial practice to the Western Standard, and the better is the quality of financial institutions.

*Public Financing Considerations*

A country with an inefficient tax system or a narrow base for income tax tend to impose capital controls to allow the government to collect sufficient revenue for public expenditure. This suggests that tax system efficiency and the size of the government should be considered as determinants of capital controls. We use the share of tax on income, profits, and capital gains in total tax revenue (INCOMTAX) as a proxy for the tax system efficiency, since higher share of income tax reflects not just the enlargement of the tax base, but also the improvement

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[18] See Alesina et al. (1994), Quinn and Inclán (1997), Bai and Wei (2001), and Epstein and Schor (1992).

of efficiency in taxation. The government size is measured by the share of general government expenditures in GDP (GOVEXP). The higher the government expenditure is, the stronger incentive the government may have to maintain or intensify capital controls.[19]

*External Payments Constraints*

The empirical literature typically finds that current account deficits increase the likelihood for imposing capital controls.[20] This suggests that countries facing balance of payments difficulties are more likely to control capital flows, especially outflows, to ease constraints on external payments. In the same vein, heavy external debt may force the government to impose controls on capital outflows to retain foreign exchange revenues for debt-servicing purpose.[21] For the empirical analysis, we measure current account balances (CURRACCT) as a share of GDP, with positive (negative) values denoting surpluses (deficits). The value of external debt (DEBT) is also expressed as a share of GDP.

# 4    The Empirical Model and the Estimation Results

## 4.1    Three Specifications of the Model

We consider three specifications of the empirical model for the determination of capital controls. The first specification relates capital controls to exchange rate regime choices and other explanatory variables through the following equation:[22]

(1)            $Y = Z\alpha_1 + Z^2\alpha_2 + X\theta + \varepsilon,$

where Y is our index for capital controls, Z is the variable for exchange rate regimes (ERR), with larger values corresponding to more flexible exchange rate regimes, X is a row vector containing all the determinants (see below), and $\varepsilon$ is the error term. Note that the non-linearity of the influence of exchange rate flexibility on capital control intensity is modeled by including both Z and $Z^2$. We expect that $\alpha_1$ be positive and $\alpha_2$ negative if such non-linearity does exist.

The second specification substitutes Z with Z*, the latent variable governing the realization of Z. That is,

(2)            $Y = Z^*\alpha_1 + Z^{*2}\alpha_2 + X\theta + \varepsilon.$

Here Z* is usually interpreted as a measure of the desired flexibility of the exchange rate regime, which can be estimated by an ordered probit model.[23] This specification incorporates

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[19] See, among others, Bai and Wei (2001) and Grilli and Milesi-Ferretti (1995).
[20] Grilli and Milesi-Ferretti (1995), Milesi-Ferretti (1998), and Bai and Wei (2001).
[21] See Berger et al. (2001) and Bai and Wei (2001).
[22] For ease of exposition, the country and time subscripts are all omitted.

the idea that it is the intended exchange rate flexibility, which is free of selection errors, that influences the intensity of capital controls.

While the first two specifications can detect the non-linearity in the role of exchange rate regimes, they cannot pin down which regime is associated with the most intensive capital controls. To achieve this objective we construct dummies for each regime, and allow them to assert different influence on capital control intensity. This leads to the third specification:

(3) $\qquad Y = \sum_n Z_n \alpha_n + X\theta + \varepsilon,$

where $Z_n$ is the dummy for the n-th regime. Since we include a constant term in X, one regime dummy must be dropped to avoid perfect multicolliniarity. The excluded regime is then used as the reference regime.

The row vector X contains all the determinants discussed in subsection 3.2, except for ERR. To attenuate the endogeneity bias, the variables related to public finance and external payments are instrumentalized by using their own one-year lagged values as instruments. We include three country group dummies in X to account for group-specific fixed effects:[24] EUCAND1 for the first-round EU accession candidates, EUCAND2 for the second-round candidates, and CIS for the member countries of the Commonwealth of Independent States (CIS). The remaining three countries (Albania, Croatia, and Macedonia) are therefore used as the reference group. We also include two time dummies for the period 1990-1993 (PERIOD1) and 1994-1996 (PERIOD2).[25] The most recent interval (1997-1999) is used as the reference period. The first period corresponds roughly to the starting stage of transition, while the last one to the period of recurrent financial crises.

## 4.2    Results and Discussions

We estimate the empirical model for capital controls with both official and de facto classifications of exchange rate regimes. For each regime classification, three specifications corresponding to (1), (2), and (3) are estimated.

*Results with Official Exchange Rate Regimes*

Table 1 reports the results of using the IMF's eight-regime classifications. The variable ERR in column (1) takes a value of 2 for currency board arrangements (CBA), 3 for conventional

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[23] See von Hagen and Zhou (2002c) for a discussion on the ordered probit model for the determination of Z*.

[24] We use group dummies instead of country dummies for two reasons: to detect group-wise heterogeneity and to save degrees of freedom.

[25] Introducing annual dummies for each calendar year is inappropriate for our sample due to lack of data for some countries in the early years.

pegs (PEG), 4 for horizontal bands (HB), 5 for crawling pegs (CP), 6 for crawling bands (CB), 7 for managed floating (MF), and 8 for free floating (FF).[26] When individual regime dummies are used in column (3), managed floating is dropped as the reference regime.

**Table 1**
**Determination of Capital Controls, with Official Exchange Rate Regimes**

|  | (1) | | (2) | | (3) | |
|---|---|---|---|---|---|---|
|  | Coeff. | t-Ratio | Coeff. | t-Ratio | Coeff. | t-Ratio |
| ERR | 1.45** | 2.40 |  |  |  |  |
| ERR$^2$ | -0.12** | -2.01 |  |  |  |  |
| ERR* |  |  | 0.62*** | 2.97 |  |  |
| ERR*$^2$ |  |  | -0.11* | -1.76 |  |  |
| CBA |  |  |  |  | -1.98*** | -3.36 |
| PEG |  |  |  |  | -0.65 | -1.42 |
| HB |  |  |  |  | -0.26 | -0.53 |
| CP |  |  |  |  | 0.30 | 0.52 |
| CB |  |  |  |  | 0.61 | 1.25 |
| FF |  |  |  |  | 0.05 | 0.10 |
| CBINDEP | -1.66 | -1.35 | -2.29* | -1.80 | -1.74 | -1.45 |
| ART8 | -1.38*** | -3.17 | -1.28*** | -2.94 | -1.37*** | -2.87 |
| FINQUAL | 0.61 | 1.30 | 0.79* | 1.65 | 0.58 | 1.22 |
| INCOMTAX | -0.87 | -0.42 | 1.03 | 0.46 | -1.55 | -0.72 |
| GOVEXP | 6.85*** | 3.96 | 5.91*** | 3.49 | 6.67*** | 3.95 |
| CURRACCT | 11.99*** | 2.85 | 7.43** | 1.98 | 11.88*** | 2.78 |
| DEBT | 1.02** | 2.16 | 1.15** | 2.58 | 0.91* | 1.82 |
| EUCAND1 | -1.47*** | -2.68 | -1.51** | -2.47 | -1.28** | -2.39 |
| EUCAND2 | -0.76 | -1.55 | -1.27** | -2.37 | -0.56 | -1.11 |
| CIS | 0.48 | 0.86 | -0.22 | -0.33 | 0.65 | 1.14 |
| PERIOD1 | -0.69 | -1.03 | -0.39 | -0.57 | -0.82 | -1.21 |
| PERIOD2 | -1.19*** | -3.13 | -1.21*** | -3.26 | -1.24*** | -3.13 |
|  |  |  |  |  |  |  |
| R$^2$-adj. | 0.28 |  | 0.27 |  | 0.28 |  |
| F-value | 5.63*** |  | 5.02*** |  | 4.39*** |  |
| Observations | 168 |  | 157 |  | 168 |  |

*Note: Significance at 10% (5%, 1%) is denoted by * (**, ***). Heteroscedasticity-consistent variance-covariance matrix is used. Constant not reported.*

The first thing to note is that the official exchange rate regime choices do influence the intensity of capital controls in a hump-shaped way. For both *observed* (ERR) and *desired* (ERR*) exchange rate regime choices, the intensity of capital controls first increases in the flexibility of exchange rate regimes, as evidenced by the positive coefficient for ERR or ERR*, but then decreases when very flexible regimes are selected or intended, as can be

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[26] ERR takes a value of 1 for monetary unions or "dollarisation", which is not found in our sample.

inferred from the negative coefficients for the two squared terms. It can be derived from the coefficients for ERR and $ERR^2$ that the most intensive capital controls are associated with crawling bands (ERR = 6).[27] This non-linearity is significant in the data. A closer look at the role of each exchange rate regime reveals that, compared to managed floats, hard pegs are associated with significantly more liberalized capital accounts, while crawling pegs and crawling bands require more intensive capital controls (column (3)). All these results are consistent with the "bi-polar" view, which argues that only hard pegs and very flexible regimes are viable if capital mobility is high. On the other hand, they also explain why we do not often observe the tendency towards corner regimes in transition economies, since most countries with intermediate regimes maintain relatively more intensive capital controls to enhance their viability.

Except for current account balances (CURRACCT), financial institutions quality (FINQUAL), and tax system efficiency (INCOMTAX), all the variables are correctly signed and usually significant. The results show that higher central bank independence and the liberalization of current account contribute to the removal of capital controls, but larger government expenditures or larger stock of external debts make capital controls more intensive, all are consistent with our expectations. Tax system efficiency does not seem to be an important determinant of capital controls, and its role is ambiguous, as evidenced by the insignificant and changing signs of the INCOMTAX variable. The positive coefficients for FINQUAL and CURRACCT suggest that countries with stronger financial institutions or current account surpluses tend to have more closed capital accounts, which is against our expectations.

The reason for the positive coefficients for FINQUAL can be two-folds. On the one hand, it is reasonable to associate higher FINQUAL values with stronger reform efforts, which are usually undertaken when the capital account is still closed to help manage the side-effects of the reform. On the other hand higher index values reflect the introduction of new types of capital transactions, which increase the number of capital controls as well, since the new transactions are likely controlled in the early stage. Both can result in a positive association between FINQUAL and capital control intensity. The positive coefficient for CURRACCT may reflect the influence of reverse causality, even after we applying the instrumental variable method to correct for this problem. It is common in transition economies that capital account liberalization leads to net capital inflows due to improved

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[27] The value of the quadratic term $aZ^2+bZ+c$ is maximized at $Z^* = -b/(2a)$ if $a<0$. With a = -0.12 and b = 1.45, we have $Z^* \approx 6$.

confidence of foreign investors in the recipient countries, which can be used to finance current account deficits. The association between the decontrol of capital account and the deficits of current account results in a positive coefficient for CURRACCT, as we find in our estimations.

The results with country group dummies confirm our expectations that the EU candidates maintain more liberal capital accounts than other transition economies. This is particularly true for the first-round candidates, which have to open their capital accounts early as required by the accession process. The coefficients of the period dummies suggest that the most recent period (1997-1999) witnesses an increase in the intensity of capital controls in transition economies. This might be related to the frequent occurrence of financial crises during this period, which enhances the desirability of capital controls.

*Results with De Facto Exchange Rate Regimes*

In Table 2 we report the results with our own classification of de facto exchange rate regimes in transition economies. Table 3 shows the results based on the LYS classification. In both tables, ERR takes values of 0,1,2,3 for inconclusive, fixed (FIX), intermediate (INTER), or flexible (FLEX) regimes, respectively. In specification (6) and (9), the inconclusive regimes are the omitted regime and serve as the benchmark.

**Table 2**
**Determination of Capital Controls, with Authors Classification of De Facto Regimes**

|  | (4) | | (5) | | (6) | |
|---|---|---|---|---|---|---|
|  | Coeff. | t-Ratio | Coeff. | t-Ratio | Coeff. | t-Ratio |
| ERR | 1.20 | 1.62 |  |  |  |  |
| ERR$^2$ | -0.28 | -1.37 |  |  |  |  |
| ERR* |  |  | 0.19 | 0.69 |  |  |
| ERR*$^2$ |  |  | -0.45*** | -3.08 |  |  |
| FIX |  |  |  |  | 1.06 | 1.56 |
| INTER |  |  |  |  | 1.27* | 1.81 |
| FLEX |  |  |  |  | 1.22* | 1.77 |
| CBINDEP | -1.79 | -1.33 | -1.61 | -1.50 | -1.76 | -1.32 |
| ART8 | -1.29*** | -2.93 | -1.31*** | -3.03 | -1.29*** | -2.91 |
| FINQUAL | 0.74 | 1.46 | 1.45** | 2.46 | 0.73 | 1.44 |
| INCOMTAX | -0.61 | -0.26 | -1.17 | -0.62 | -0.56 | -0.24 |
| GOVEXP | 7.24*** | 4.28 | 5.73*** | 3.34 | 7.20*** | 4.22 |
| CURRACCT | 12.67*** | 3.00 | 9.50** | 2.35 | 12.63*** | 2.99 |
| DEBT | 1.09** | 2.06 | 0.76 | 1.56 | 1.06** | 2.04 |
| EUCAND1 | -1.55*** | -2.48 | -1.84*** | -3.32 | -1.55** | -2.49 |
| EUCAND2 | -1.07** | -2.19 | -0.87* | -1.96 | -1.07** | -2.16 |
| CIS | 0.74 | 1.33 | 1.07** | 2.34 | 0.71 | 1.30 |
| PERIOD1 | -0.68 | -0.96 | 0.55 | 0.92 | -0.70 | -0.98 |

| | | | | | | |
|---|---|---|---|---|---|---|
| **PERIOD2** | -1.11*** | -2.95 | -0.82** | -2.03 | -1.11*** | -2.94 |
| **$R^2$-adj.** | 0.23 | | 0.32 | | 0.23 | |
| **F-value** | 4.54*** | | 6.6*** | | 4.23*** | |
| **Observations** | 167 | | 157 | | 167 | |

*Note: Significance at 10% (5%, 1%) is denoted by * (**, ***). Heteroscedasticity-consistent variance-covariance matrix is used. Constant not reported.*

**Table 3**
**Determination of Capital Controls, with LYS Classification of De Facto Regimes**

| | (7) | | (8) | | (9) | |
|---|---|---|---|---|---|---|
| | **Coeff.** | **t-Ratio** | **Coeff.** | **t-Ratio** | **Coeff.** | **t-Ratio** |
| **ERR** | 2.63*** | 4.37 | | | | |
| **$ERR^2$** | -0.48*** | -2.96 | | | | |
| **ERR*** | | | 2.04*** | 6.53 | | |
| **$ERR*^2$** | | | -0.36*** | -3.19 | | |
| **FIX** | | | | | 1.66* | 1.99 |
| **INTER** | | | | | 3.33*** | 5.14 |
| **FLEX** | | | | | 3.40*** | 4.72 |
| **CBINDEP** | -2.77* | -1.73 | -0.99 | -0.64 | -2.83* | -1.74 |
| **ART8** | -0.99** | -2.30 | -0.92* | -1.82 | -1.04** | -2.38 |
| **FINQUAL** | 0.68 | 1.15 | 0.63 | 1.25 | 0.75 | 1.24 |
| **INCOMTAX** | -7.71*** | -2.64 | -4.57* | -1.70 | -7.50** | -2.56 |
| **GOVEXP** | 8.24*** | 3.06 | 5.78*** | 2.95 | 8.10*** | 2.95 |
| **CURRACCT** | 16.83*** | 4.30 | 8.55** | 2.30 | 16.39*** | 4.36 |
| **DEBT** | 0.24 | 0.26 | 1.20* | 1.87 | 0.39 | 0.40 |
| **EUCAND1** | -0.58 | -0.75 | -0.56 | -0.76 | -0.52 | -0.64 |
| **EUCAND2** | 0.95 | 1.37 | 0.91 | 1.37 | 0.85 | 1.21 |
| **CIS** | 2.35*** | 2.95 | 1.67** | 2.11 | 2.32*** | 2.84 |
| **PERIOD1** | -0.36 | -0.35 | -0.53 | -0.58 | -0.45 | -0.42 |
| **PERIOD2** | -0.80** | -2.08 | -0.58 | -1.64 | -0.89** | -2.04 |
| **$R^2$-adj.** | 0.47 | | 0.53 | | 0.47 | |
| **F-value** | 7.31*** | | 9.03*** | | 6.85*** | |
| **Observations** | 101 | | 101 | | 101 | |

*Note: Significance at 10% (5%, 1%) is denoted by * (**, ***). Heteroscedasticity-consistent variance-covariance matrix is used. Constant not reported.*

In general, replacing official regimes by either de facto counterparts does not lead to substantial changes in the conclusions on the non-linear influence of exchange rate regime on capital control intensity, although differences in the two sets of results are still visible. Based on our own de facto regime classifications (Table 2), the coefficients of the variables related to exchange rate regimes are qualitatively the same as in Table 1, but some of them lose significance. The peak intensity of capital controls is again associated with intermediate de

facto regimes.[28] In contrast, the results based on the LYS classifications (Table 3) show a significant influence of both observed and intended ERR choices. The hump-shaped relation is less prominent, since the peak of control intensity is close to flexible regimes, and both intermediate and flexible regimes have very high intensity of capital controls.

An interesting result from Table 2 and Table 3 is that countries with inconclusive de facto regimes tend to have significantly less capital controls than flexible, intermediate, and, to a lesser extent, fixed de facto regimes. Since inconclusive regimes characterized by low volatility in both exchange rates and international reserves are identified only in tranquil periods without major shocks, our results suggest that countries suffering shocks resort to capital controls to help manage the economy. If larger shocks require both higher flexibility in exchange rate policies and more intensive capital controls, a positive association between the latter two is expected, which is born out by our evidence.

For the remaining determinants, the results are very similar to those listed in Table 1. The only obvious change is the strengthening of the effects of INCOMTAX when the LYS data are used. Its significant negative coefficients confirm our expectation that countries with more efficient tax system tend to have less capital controls. The dummies for the EU candidates become insignificant in Table 3, but they still indicate that EU-accession countries maintain significantly less capital controls than the CIS countries. Moreover, the period dummies also point to the conclusion that in the most recent period capital controls has been intensified.

## 5    Conclusions

In this paper we examine the role of exchange rate regime choices in the determination of capital controls in transition economies. We devise an empirical model which allows hump-shaped relationship between exchange rate regime choices and capital control intensity. The results provide some evidence for a non-linear relationship between capital controls intensity and exchange rate regime choices. The overall evidence suggests that intermediate regimes are typically associated with the most intensive capital controls, and hard pegs are associated with the most liberal capital accounts. This hump-shaped relationship is detected with both official and de facto exchange rate regimes.

Among the other determinants of capital controls, the results show that strong central bank independence and current account liberalization are associated with substantially lower

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[28] If we repeat the exercise of note 27, we have $Z^* = 2.1$ for our own classification, corresponding to intermediate de facto regimes. For the LYS data, $Z^* = 2.7$, close to flexible regimes.

intensity of capital controls. On the contrary, large government size, current account surplus, and heavy burden of external debt are associated with more tightened capital controls in transition economies. Among country groups, the EU accession candidates, especially those advanced in this process, maintain much more open capital accounts than the non-accession countries, most of them being the CIS member states. There are also evidences that the crises-ridden late 1990s witnesses a slight tightening of capital controls in many transition countries.

## Appendix: Definitions of Variables and Data Sources

### I.    Capital Controls

The index of capital controls is defined as the ratio of the number of capital transactions subject to controls to the total number of capital controls, transformed using the formula $x^* = \log[x/(1-x)]$ after replacing 0 with 0.01 and 1 with 0.99 in the original data series $(x)$. Data on capital controls are from IMF, Annual Report on Exchange Arrangements and Exchange Restrictions (various issues).

### II.    Explanatory Variables

*Exchange Rate Regimes (ERR)*

The official exchange rate regime classifications are based on the new eight-regime classification scheme of the IMF. The eight regimes are: (1) currency unions, (2) currency board arrangements, (3) conventional pegs, (4) horizontal bands, (5) crawling pegs, (6) crawling bands, (7) managed floats, and (8) free floats. The first regime type is not applicable to the transition economies. For the estimation of ERR*, a classification of three broad regimes are used, where the fixed group contains regime (2) and (3), the intermediate group regime (4), (5), and (6), and the floating group regime (7) and (8). The explanatory variables are selected based on the analysis of von Hagen and Zhou (2002a). Data on official exchange rate regimes are from the following sources: IMF, International Financial Statistics (various issues), Annual Report on Exchange Arrangements and Exchange Restrictions (various issues), and Exchange Rate Arrangements and Currency Convertibility: Developments and Issues (1999).

The Author's classification for de facto exchange rate regimes is discussed in von Hagen and Zhou (2002b). The LYS de facto exchange rate regime classification is extracted from Levy-Yeyati and Sturzenegger (2000). Both classifications have (1) inconclusive, (2) fixed, (3) intermediate, and (4) flexible regimes. The estimation of ERR* is based on a three-

regime classification, with the fixed group including regime (1) and (2), the intermediate and the flexible groups including regime (2) and (3) respectively. The explanatory variables come from von Hagen and Zhou (2002b).

*Other Variables*

ART8: Dummy for the acceptance of the obligations under Article VIII of the IMF's Articles of Agreement. For each country it takes the value of zero when it does not accept the obligations under Article VIII. If the acceptance is effected in the first half of a year, the dummy assumes the value of unity for this year and after. If accepted in the second half of a year, the dummy will begin to assume the value of unity in the next year. Data source is IMF, International Financial Statistics (various issues).

CBINDEP: Index for the legal independence of central banks. Data are from Cukierman, Miller, and Neyapti (2000).

CIS: Dummy for the member countries of the Commonwealth of Independent States, including Armenia, Azerbaijan, Belarus, Georgia, Kazakhstan, Kyrgyz Republic, Moldova, Russia, Tajikistan, Turkmenistan, Ukraine, and Uzbekistan.

CURRACCT: Current account surplus(+) or deficit (-) as a ratio of GDP. Data source is IMF, International Financial Statistics (various issues).

DEBT: External debt stock, normalized by GDP. Data are taken from EBRD, Transition Report (1999) and IMF, Country Report (various issues).

EUCAND1: Dummy for the first-round EU accession candidates, including Czech Republic, Estonia, Hungary, Poland, and Slovenia.

EUCAND2: Dummy for the second-round EU accession candidates, including Bulgaria, Latvia, Lithuania, Romania, and Slovak Republic.

FINQUAL: Index of the quality of financial institution, measured by the average of the EBRD indices for banking reform and for non-banking financial institutions reform. Data source is EBRD, Transition Report (2000).

GOVEXP: General government expenditures, normalized by GDP. Data are taken from EBRD, Transition Report (1999) and IMF, Country Report (various issues).

INCOMTAX: Share of tax on income, profits, and capital gains in total tax revenue. Data are from IMF, Government Finance Statistics Yearbook (2000) and IMF, Country Report (various issues).

PERIOD1: Dummy for the period 1990-1993.

PERIOD2: Dummy for the period 1994-1996.

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