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ABSTRACT

This paper examines the capital flow experience of transition economies who are also prospective EU members with a view to shedding light on the likely problems they might encounter with exchange rate policy in the run up to euro area membership. We show that they have been experiencing fairly sizeable capital flows since the early 1990s. We explain these flows using two separate models. The first explains the level of capital flows using panel data from the prospective EU members. The second concentrates specifically on estimating the probability of a country experiencing downward speculative pressure. In both cases, the contribution of domestic factors and contagion is explored. The results suggest that while domestic factors have some role to play, it is rather limited. Moreover there is clear evidence of contagion effects, suggesting that macroeconomic policy in the prospective EU members will be complicated by capital flows in the run up to euro area membership.

Keywords: capital flows, transition economies, accession countries and EU membership.
JEL Classification: F32, F36, P20

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1. Introduction

A key issue facing transition economies who are prospective EU members is what exchange rate policy they should pursue in the period between EU and euro area entry. It is anticipated that ERM II membership, which involves a commitment to a pegged exchange rate, will be necessary for a period of at least two years in line with the Maastricht Treaty and the obligations fulfilled by current euro area members[1]. An important factor determining the ease with which this commitment will be met is the extent to which the transition economies experience large and variable capital flows along with the determinants of these flows.

The purpose of this paper is to shed some light on this issue by examining the capital-flow experience of the prospective EU members. We show that they have been experiencing fairly sizeable capital flows since the early 1990s. The existing literature on these flows either focuses on individual economies or examines the determinants of FDI flows. Our contribution is to focus on private capital flows (excluding the more stable FDI flows), that is, flows which may complicate the conduct of macroeconomic policy; we test the sensitivity of our results to the exclusion of FDI flows. Furthermore, we use a panel of countries, allowing us to draw some broader conclusions about the nature of such flows rather than concentrating on the peculiarities of certain countries.

In order to explain capital flows, we estimate two separate models. The first attempts to explain the level of capital flows; the second model focuses specifically on speculative crises by estimating the probability of a country experiencing downward speculative pressure on the exchange rate. In both cases, we distinguish between the impact of what we refer to as "domestic factors", that is, macroeconomic aggregates that are largely under the control of the domestic authorities or at least are influenced directly by their policies and the effects of contagion, either through economic fundamentals or otherwise. If contagion from financial crises in other parts of the region/world is a feature, then this implies that in spite of successful domestic policies, the maintenance of the exchange rate peg could be complicated by developments in other countries which have spillover effects in the domestic economy. The results of both models suggest that, while domestic factors have a role to play in

[1] The Finnish Markkaa and the Italian Lira joined/rejoined the ERM in October and November 1996 respectively. Thus in June 1998, at the time when the decision to allow them to become euro area members was made, Finland and Italy had not completed the two-year period required to meet the Maastricht criteria. It could be argued, however, that, by the time that euro area membership would be effective, January 1999, the two-year requirement would have been met.

explaining capital flows and downward speculative pressure on the exchange rate, it is rather limited. Moreover, there is clear evidence of contagion effects. This suggests that macroeconomic policy in the prospective EU members will be complicated by capital flows in the run up to euro area membership.

The rest of the paper is organised as follows. In section 2, we provide some stylised facts about capital flows in the countries under consideration here. Section 3 discusses how capital flows and speculative attacks are modelled and considers the existing literature. In section 4 we present our empirical results before offering some concluding remarks in section 5.

2. Capital Flows: some stylised facts

The countries under consideration here include the transition economies which are already destined for EU membership in 2004 (Czech Republic, Estonia, Hungary, Latvia, Lithuania, Poland, Slovak Republic and Slovenia) and two transition economies, Bulgaria and Romania, whose EU membership is under consideration. We include Malta for completeness even through it is not a transition economy[2]. Figures 1a-1c show private capital flows (both including and excluding FDI) as a proportion of GDP. They suggest that capital flows are of a significant magnitude so as to make their analysis interesting. Indeed, they are at least as great as those experienced by the peripheral southern European countries in the run up to their membership of the euro area (Gibson and Tsakalotos, 2002). Such flows can complicate the conduct of monetary and exchange rate policies. Large inflows can undermine a tight monetary policy as a policy of sterilising the impact of the inflows on the domestic money supply becomes increasingly difficult or costly. Large outflows can put pressure on an exchange rate peg as reserves to defend the currency under attack can be rapidly depleted.

The prospective EU members have a variety of exchange rate systems which have not necessarily remained unchanged over time. Table 1 provides a summary. Two points are worthy of note. First, exchange rate pegs have involved a number of currencies and not just

[2] We consider the sensitivity of some of the results to the inclusion of Malta below. Cyprus, the other country joining in 2004, is excluded from the empirical analysis because of a lack of quarterly data. We do not examine the UK, Sweden and Denmark, the 3 EU members which are not also euro area members since we consider that the issues facing these countries are rather different – they have a history of macroeconomic stability and real *per capita* incomes are around the EU average. Their decision to remain outside the euro area is a political one which, in the case of the UK and Denmark is enshrined in an 'opt out' clause in the Maastricht Treaty. Such 'opt outs' are not available to acceding countries.

the euro[3]. More recently, however, some countries have adopted the euro as their sole reference currency. Second, if any trend in the late 1990s can be detected, then it is a tendency for countries to move towards more flexible systems. With respect to controls on capital movements, these have been extensive in all countries with the exception of the Baltic states which removed almost all controls quite early on (Table 2). Liberalisation, which is a requirement of EU membership, has been proceeding in the other countries over the last couple of years.

The vertical lines in figures 1a-1c represent changes in the exchange rate regime (either a move from a floating regime to some kind of peg or vice versa, something which can be gleaned from Table 1). Table 3 provides information on the average level of capital flows (both with and without FDI) and foreign exchange reserve changes and the correlation between them. Changes in reserves are at least as great as capital flows, possibly indicating problems for monetary policy. Changes in capital flows and reserves are usually positively correlated with the coefficients being even higher during periods of pegged exchange rate systems as we might expect. The low level of correlation in some cases may reflect the fact that the pegged arrangement was rather loose or simply that the flows were offset by countervailing movements in other parts of the balance of payments. There is no doubt from the figures, however, that at certain times movements in capital flows are closely reflected in movements in reserves. Indeed, Slovenia, the only country classified as floating for the whole period, has the highest correlation. Overall, the evidence suggests that inflows and outflows, including episodes of speculative crisis, have been important in the experience of these countries.

3. Modelling capital flows and speculative crises

An interesting question which arises in the light of the magnitude of these flows is whether we can explain them in terms of domestic factors and whether there is any role for the transmission of financial crises from one country to another. To this end, we initially focus on modelling the level of capital flows and we consider a number of possible determinants which have been employed in the literature. First, we might expect that domestic inflation or domestic monetary growth has a negative effect on capital inflows because it

[3] Before January 1999, either the ECU exchange rate was targeted or the target involved certain of the currencies included in the ECU.

depresses the real rate of return in the domestic country or leads to expectations of devaluation because of its effect on competitiveness. Higher domestic inflation causes real exchange rate appreciation and hence a loss of competitiveness if the nominal exchange rate is fairly fixed (Hermes *et al*, 1999). An alternative measure of competitiveness is given by developments in unit labour costs. Both higher inflation and higher unit labour cost growth are expected to reduce capital inflows.

Second, the nominal interest rate differential between the domestic and "foreign" countries is expected to have a positive impact on capital inflows (Durjasz and Kokoszczynski, 1998; Montiel and Reinhart, 1999; Cardenas and Barrera, 1997). We also experiment with the change in the interest rate differential in line with a portfolio approach to capital flows which allows flows to cease even if interest rate differentials persist. Of course, differential rates of return are also determined by exchange rate movements. In the absence of information on expected changes in the exchange rate or forward premia/discounts, we use the actual change in the exchange rate.

The third measure factor is economic activity. We use the rate of growth as a proxy for the health of the domestic economy and the investment opportunities which it is generating. The 1990s represented a period of rapid change in transition countries, often accompanied by greater uncertainty about future economic prospects. It might be expected that capital inflows responded positively to higher growth rates insofar as they reflected better economic conditions in general.

We include dummy variables to capture the possible effect of different exchange rate regimes on capital flows. Specifically, we identify those countries and periods with currency board arrangements as well as countries and periods with some form of pegged exchange rate relationship. The dummies are constructed based on the information in Table 1. Different exchange rate systems may impact on flows via their effect on credibility. Thus, for example, a pegged regime or a currency board may exert more monetary and fiscal discipline and hence be more credible in the eyes of the financial markets (Dickinson and Mullineux, 1999). In this case a positive coefficient on the regime dummies is expected. Alternatively, if the existence of a currency board or pegged regime makes a country more likely to be the target of an attack, then the expected sign of the coefficient on the dummy is negative.

In addition to the factors determined largely by domestic policy considerations, there are the effects of contagion. Contagion may come about through economic fundamentals. A

crisis in one country which leads to a devaluation of its currency has obvious implications for the competitive position of its trading partners. Alternatively, contagion may arise because a crisis in one country generates self-fulfilling crises in other countries. In particular, we examine the impact of both the financial crisis in SE Asia, which erupted in July 1997 with the devaluation of the Thai baht and the failure of a number of financial institutions, and the Russian crisis of August 1998. We anticipate that both crises might well have led to capital outflows as global financial institutions withdrew *en masse* from emerging markets. We test both for a general effect of the crises across all countries and also for effects specific to individual countries in the sample.

In the absence of adequate data on the stock of assets held abroad by residents of these countries or on the stock of assets held in these countries by nonresidents, we opt to model the short-run dynamics of capital flows[4]. In particular, we postulate the following relationship:

$$KF_{it} = \alpha_i + \beta CB_{it} + \gamma PER_{it} + \delta \Delta_4 P_{it} + \varepsilon \Delta_4 lny_{it} + \eta \Delta_1 rdiff_{it} + \zeta Russia_t + \kappa Asia_t \qquad (1)$$

where KF is private capital inflows into country i at time t; CB_{it} is a dummy capturing the existence of a currency board arrangement; PER_{it} is a dummy indicating some form of pegged exchange rate regime (excluding a currency board arrangement); $\Delta_4 P_{it}$ is inflation (the four-quarter change in the CPI); $\Delta_4 lny_{it}$ is the four-quarter rate of growth of real GDP (or industrial production); $\Delta_1 rdiff_{it}$ is the quarter-to-quarter change in the interest rate differential between the domestic and "foreign" countries adjusted for changes in the exchange rate; $Russia_t$ is a dummy capturing the potential effects of the Russian crisis of August 1998 (it takes a value of 1 during the third and/or fourth quarters of 1998); finally, $Asia_t$ is a dummy capturing the possible effects of the Asian financial crisis (it takes a value of 1 during the third and/or fourth quarters of 1997). As an alternative to inflation as a proxy of competitiveness, we use the four-quarter rate of growth of the money supply (both narrow and broad measures) and the four-quarter rate of growth of unit labour costs.

[4] Most countries have no stock data and those that do have data only from the mid-1990s onwards. The approach to modelling capital flows is similar to that taken in Gibson and Tsakalotos (1993). The time series properties of these series were explored using ADF tests and the Phillips-Perron test. *A priori*, it is anticipated that the variables in equation (1) are I(0). In practice, however, this is not entirely true. Capital flows are I(0) for each country except Poland. This implies that it is unlikely that we will get spurious regression results owing to both dependent and independent variables being highly trended.

The data periods covered for our sample of countries are listed in Appendix 1. We estimate the model using quarterly data and an unbalanced panel of all the countries listed in Table 1. As we noted above, the existing literature on capital flows in prospective EU members either adopts a single country approach (Hermes *et al*, 1999; Durjasz and Kokoszczynski, 1998; Oblath, 1998; Gomulka, 1998) or examines FDI flows only (Dickinson and Mullineux, 1999; Lankes and Stern, 1999; Kinoshita and Campos, 2003). Our panel approach is an improvement over the single country approach and allows broader conclusions to be drawn about the nature of private flows. Our main focus is on non-FDI flows as this reflects our concern with the kind of flows that are more likely to complicate the conduct of macroeconomic policy. However, in view of measurement problems arising from the fact that it is difficult in practice to distinguish FDI flows from portfolio flows, we also consider capital flows including FDI in order to test the sensitivity of our results.

Further evidence specifically on the impact of outflows can be gleaned from an analysis of the determinants of speculative crises in exchange rate regimes which involve some kind of nominal exchange rate fixity. Thus the second part of the empirical analysis focuses on estimating the probability of a speculative crisis. The literature on speculative crises identifies four main causes for crisis. First, it may arise from diverging fundamentals. Thus, for example, a country with a nominal exchange rate target and inflation which is higher than its trading partners will become increasingly uncompetitive leading to expectations of a realignment (Dornbusch, 1982; Flood and Garber, 1984). These models point to the dangers for the prospective EU members of trying to avoid convergence (unlikely if EMU membership is desired) or of trying to converge at a reasonably slow pace (more likely). Slower convergence can offer advantages in that it allows market expectations to adjust to the new regime and it is certainly the option which has been followed by most EU countries. The downside is that it introduces uncertainty into the minds of market participants and small deviations from the pre-announced convergence targets could trigger a speculative crisis.

A second reason why outflows may become unmanageable is because of perceived policy differences (Eichengreen, 1993; De Grauwe, 1994; Ozkan and Sutherland, 1995). In the case of ERM II membership, the prospective EU members could become susceptible to perceived (real or otherwise) policy differences between themselves and the centre (the euro area), which market participants consider to be unsustainable. One of the lessons of the 1992-

93 crises in the ERM was that if the exchange rate commitment implies that one country has to follow a policy which is unsuited to its economic conditions at that time, then this can call into question the credibility of exchange rate targets/central rates. Thus, if output is below trend and unemployment rising, then the costs of maintaining the peg may exceed the benefits and the authorities may decide to abandon it. Market participants realising this may put the peg under pressure, expecting a devaluation or abandonment of the peg.

Thirdly, exchange rate pressure can come about as a result of self-fulfilling attacks caused by multiple equilibria (Obstfeld, 1996). In this case the fundamentals do not suggest that the economy is doing badly with the targeting policy. However, if an attack occurs, what would have been sustainable in the absence of an attack is now unsustainable due, for example, to a weak banking system. Finally, there is the issue of contagion as disturbances in international markets spread over into other countries. Self-fulfilling attacks may be triggered by contagion. It should not be forgotten that the 1992 crisis in the old ERM began with problems specific to Sweden which caused financial markets to question the sustainability of other central rates which had not previously been in doubt (Cobham, 1994). We cannot exclude the possibility that in the future disturbances in one country will spread to others in the system. Contagion can also lead to speculative attack via its effect on fundamentals. Thus depreciation or a fall in demand in one country may lead to speculative attacks as the expected loss of competitiveness or reduced demand for exports (due, for example, to a depreciation of the currency of a competitor economy) lead markets to question the sustainability of the peg.

It is thus of interest to investigate not only the determinants of capital flows but also to focus explicitly on the determinants of the probability of a country experiencing a speculative attack. There are three common methodological approaches in the literature to modelling speculative attacks (see Gibson (2003) for a survey). The stylised facts approach simply examines the behaviour of certain macroeconomic variables around the speculative attack[5]. Such an approach provides useful descriptive evidence on the nature of speculative attacks, but cannot examine the interaction between factors which may contribute to increasing the probability of a speculative attack. The second approach adopts multivariate analysis and uses

[5] See, for example, Eichengreen, Rose and Wyplosz, 1995; Eichengreen and Wyplosz, 1993; Buiter, Corsetti and Pesenti, 1998; Jeanne, 1997.

either logit or probit estimations[6]. Finally, a time series approach uses interest rate differentials to estimate the probability of realignment for a country at each point in time and this estimated probability is then related to various macroeconomic variables which are hypothesised to affect the probability[7].

Here we adopt a rather different approach. We estimate the probability of speculative attack using a hazard function, that is, we estimate the instantaneous probability of a speculative attack occurring at time t, conditional on there having been no speculative attack up to t. We describe this methodology in some detail in Appendix II. Here we can note that this approach has a number of advantages over the other approaches adopted in the literature. First, it allows us to utilise the time dimension of our dataset. A problem with purely cross-sectional logic and probit models is that they require information on many countries, some of which have experienced a speculative attack and others which have not. Only with many countries will there be enough degrees of freedom to allow estimation of the model[8]. Estimation of the hazard function implies that we can work with a smaller number of countries and include a time series for each country. In this way, countries can experience any number of speculative attacks.

The second advantage of the hazard function approach is that it allows us to consider whether the probability of a speculative attack within an exchange rate regime depends, along with various macroeconomic factors and possible contagion effects, on the length of time that the country has been pursuing the policy of an exchange rate target. That is, we can investigate whether there are duration effects: controlling for all the other factors which might influence the probability of a speculative attack, the duration between speculative attacks might also play a role[9]. Thus, if a country can gain a reputation within an exchange-rate targeting regime, then this in itself may well work to lower the probability of a speculative attack. In this case we anticipate a negative duration effect: the longer the country goes

[6] See, for example, Edin and Vredin, 1993; Eichengreen, Rose and Wyplosz, 1995; 1996.
[7] Chen and Giovannini, 1997; Jeanne, 1997 and Ayuso and Perez-Jurado, 1997.
[8] Of course, one could estimate a panel logit or probit which includes both cross-section and time-series dimensions. However, such an estimate, while recognising that certain observations come from the same countries, does not take into account the fact that the observations for each country have a particular chronological order. We discuss these issues further in Dickerson, Gibson and Tsakalotos (2002).
[9] This is similar to duration effects in the unemployment literature. There the question is whether unemployment is characterised by hysteresis. If it is, then the probability of getting a job and moving out of the state of unemployment will depend not only on the individual's characteristics, the macro economy, etc, but also on the duration of the spell of unemployment. The longer a person has been unemployed, the lower his/her probability of getting a job. See, for example, Meyer (1990).

without experiencing a speculative attack, the lower the probability that it will experience one now (all other things equal)[10].

The dependent variable takes a value of 0 or 1 dependent on whether a speculative attack has occurred or not. We identify a speculative attack as being characterised by a large fall in foreign exchange reserves (more specifically, a fall greater than the mean change minus 1.5 times the standard error of the change in reserves). This approach is similar to that adopted by Moreno (1995).

The explanatory variables include those which have been identified in the literature to influence the probability of realignment or a speculative attack. Relative money supply growth rates (that is, the rate of growth of the money supply in the 'out' country relative to the 'foreign' country[11]), relative CPI inflation rates or unit labour cost growth are included to capture the idea that higher monetary expansion, inflation or unit labour cost growth will cause the exchange-rate targeting country to lose competitiveness and hence increase the probability of a speculative attack. The current account (as a percentage of GDP) might also capture this idea. That is, if exchange-rate targeting implies a continuous real appreciation of the domestic currency as it usually does when the exchange rate target is being used as a means of disinflation, then this is likely to be reflected in a growing current account deficit, bringing into question the sustainability of the targeting policy. The cyclical position of the economy (as represented by the rate of growth of GDP or industrial production) captures the political costs which might be associated with the exchange-rate targeting policy. Thus, if the policy is recessionary and growth falls or becomes negative, then the cost of continuing the peg increases (as unemployment rises), thus raising the probability of a speculative attack. Finally, we include three dummy variables. The first two capture the effects of the Asian and Russian crises and hence provide a measure of possible contagion effects (either of the self-fulfilling kind or through the effects of crisis in one country on the fundamentals of another). The final dummy variable in the hazard identifies those countries with currency boards in an attempt to determine whether the institutional structure of a currency board affects the probability of a speculative attack.

[10] Note that this reputation effect exists over and above improving fundamentals which are included in the equation. One can view it as the gains from establishing a reputation as a 'hard-nosed' government in resisting previous attacks.

[11] Where a basket of currencies is used as a peg, 'foreign' country variables are a weighted average of the various countries in the basket, the weights being those which each currency has in the peg.

4. Determinants of capital flows and speculative attacks: empirical results

The results of the equation for capital flows (equation 1) are presented in Table 4 where capital flows are defined to exclude FDI. The Hausman test does not reject a random effects GLS regression over a fixed-effects (within) regression and thus we present the results from the random effects model[12]. Model 1 in Table 4 reports the results of estimating equation (1)[13]. The impact of domestic factors on capital flows is weak. Only inflation and growth are significant. This suggests that increases in inflation have a negative impact on capital inflows. The elasticity evaluated at the mean reveals that a 10% increase in inflation leads to a 1.4% decline in capital flows[14]. Growth has a positive effect on capital inflows, although the elasticity (0.04 at the mean) is small. Interestingly, a currency board or pegged exchange rate system seem to attract capital inflows, perhaps because they are thought to eliminate exchange rate risk, increase credibility or lead to the belief that macroeconomic stability (and, in particular, low inflation) is a serious goal. The existence of either arrangement raises capital flows on average by over 2 percentage points of GDP.

Finally, the effects of contagion are clear with the dummy for the Russian crisis in 1998 being strongly negative and significant[15]. The size of the coefficient implies that the crisis led on average to a 6.8 percentage point fall, *ceteris paribus*, in capital flows/GDP in the third quarter of 1998. The dummies for the Asian crisis, by contrast, do not suggest the presence of contagion effects and are excluded from the final results. Model 2 investigates the contagion effect in more detail, by including a separate dummy for the Russian crisis for each country[16]. In this way we investigate whether the effects of the crisis were felt differently in

[12] A random effects model is reasonable when the individual country effects are viewed as randomly distributed across all the countries. This is appropriate if the countries are randomly drawn from a large population. On the other hand, where the model applies only to the countries in the study and not to those outside, then a fixed effects model is more appropriate. In our case, the capital flow model could apply to any country and hence we have a random sample of countries for that whole population. Thus the random effects model does not seem inappropriate. In any case the question is a statistical one. If the α_i (the individual country effects) are correlated with the various explanatory variables, then a random effects model produces estimates which are biased and inconsistent. However, if there is no significant correlation then it is better to report the more efficient random effects model results. The Hausman test offers a test of this and is reported in Table 4.

[13] We also experimented with money growth, differential money growth and differential inflation. Additionally, we tried specifications with lags of the various explanatory variables.

[14] Unit labour cost growth, included either by itself or along with inflation, does not appear to have a significant role to play. It should be noted that the number of observations falls significantly (to 201 from 289) when we include unit labour cost growth because of incomplete data.

[15] The effect of contagion could be even greater than suggested by the dummy. If economic fundamentals deteriorate as a consequence of contagion, then this could lead to a further increase in the probability of a speculative attack.

[16] A similar test for the effect of the Asian crisis did not reveal much except for a negative impact on Latvia.

each country. The results indicate that the crisis had a negative impact on all countries, but Estonia and Hungary were amongst the worst hit.

In order to test the sensitivity of the results to our measure of capital flows, we rerun the regression with total private capital flows (including FDI) as our dependent variable. The results are quantitatively similar. Interestingly the dummies for the existence of a currency board or a pegged exchange rate arrangement have a larger positive effect when FDI flows are included, perhaps indicating that such arrangements signal a country's commitment to macroeconomic stability. This is similar to Dickinson and Mullineux (1999) who find that macroeconomic uncertainty tends to reduce FDI flows to transition economies. The effect of the Russian crisis is smaller, reflecting the fact that contagion more strongly affects short-term capital flows. Finally, it is surprising that neither unit labour cost growth nor income growth as a proxy for the real opportunities in transition economies seem to affect capital flows (including FDI) significantly[17].

The results of the hazard model are presented in Table 5. We report four models depending on whether we include growth and the specification of the underlying baseline hazard (see Appendix II). Models 1 and 3 include growth which reduces the sample size significantly mainly because it removes Malta from our sample (there are no quarterly GDP or industrial production figures). This has the advantage that we remain only with transition countries in models 2 and 4 and a comparison between the results for models 1 and 3 and those for models 2 and 4 show that the inclusion of Malta does not alter the qualitative conclusions we draw.

Models 1 and 2 are a Weibull specification where the baseline hazard is assumed to be monotonically increasing or decreasing in duration. The results indicate that the underlying baseline hazard (the duration effects) is downward sloping in duration. That is, the longer a country goes without experiencing a speculative attack, the less likely it is to experience an attack. This may perhaps be interpreted as suggesting that reputation effects are indeed important. However, these results may be subject to unobserved heterogeneity bias which leads the underlying hazard to be estimated as downward sloping when in fact it is not.

[17] FDI is influenced by the degree of transition (as measured by the various indices produced by the EBRD). The correlation coefficient between annual FDI flows and an average of EBRD transition indices is 0.43 over the period 1990-2001. Since these indices are produced annually and do not change much over time, their inclusion in our quarterly regressions is not very revealing. See also Kinoshita and Campos (2003) on the importance of good institutions for attracting FDI.

Indeed, in Models 3 and 4 (Table 5) we estimate the more flexible non-parametric specification of the baseline hazard. This can help mitigate the negative duration bias (see discussion in Appendix II). Figure 2 shows that the non-parametrically specified baseline hazard (calculated at the mean of the explanatory variables) is slightly upward sloping, although it should be noted that it is not significantly so. This suggests that reputation effects are not important. Indeed, this is perhaps given some support by the fact that if a dummy variable indicating the presence of a currency board is included, it is not significant. If reputation were important and a currency board were seen as indicating that a country was tying its hands (Giavazzi and Pagano, 1988), then one might expect that its effect on the probability of speculative attack would be negative.

The current account (as a percentage of GDP), growth and inflation differentials seem to have some role to play. The sign on the current account indicates that an increasing surplus reduces the probability of speculative attack. The magnitude of the coefficient is such that a one standard deviation rise in the current account deficit will increase the probability of a speculative attack by around 40%. Growth has a bigger effect with a one standard deviation increase in the growth rate reducing the probability of a speculative attack by around 50%.

Differential inflation is significant at the 10% level in the models where growth is included. However, it does not have the expected sign – rather an increase in the inflation differential of the domestic country with the 'foreign' decreases the probability of a speculative crisis. This is in contrast to findings for ERM countries (Gibson, 2003) and perhaps results from the fact that in the early part of the period inflation was very high in most transition economies. The exchange rate peg quickly brought down inflation without generating a crisis. The crisis came later. This reading of the results is supported by two further pieces of evidence. Including Malta, a country which did not suffer from high inflation, causes the inflation differential to become insignificant (see models 2 and 4). Furthermore, if we run the models without very high inflation differentials, then the differential again becomes insignificant. The theoretical rationale for including inflation differentials stems from the fact that they provide some measure of competitiveness. An alternative proxy for competitiveness is unit labour cost growth. However, their inclusion does not help: either they are insignificant or have the wrong sign. The strong significance of the current account as a percentage of GDP in the models suggests that the impact of high inflation or excessive unit labour cost growth is only felt on the exchange rate peg once it

shows up in the current account. That is, the speculative attack comes with the deterioration in the current account; it is not anticipated by developments in inflation or unit labour costs

Finally, we can note the strong effect from the Russian crisis, providing evidence that contagion is a significant factor in determining the probability of speculative attacks. This is shown in Table 5 by the strongly significant effect of the dummy variable which takes a value in the third quarter of 1998 when the bulk of the effect was felt. The effect of the crisis is also shown in Figure 2 where we plot the baseline hazards evaluated at the mean of the explanatory variables for the case where there is no Russian crisis ("without Russia") and for the case with a Russian crisis ("with Russia"). It is clear that at the time of the Russian crisis a speculative attack was almost a certainty for those countries with some kind of exchange rate peg (the probability of realignment, as can be seen from Figure 2, is significantly higher) and this illustrates the vulnerability of these countries to economic events elsewhere in the region. By contrast, the dummies for the Asian crisis are not significant[18].

In the above discussion, no distinction was made between successful and unsuccessful attacks. It is interesting to see whether successful attacks have different characteristics from attacks in general. To this end, we define a successful attack as one which either led to a devaluation or a widening of the currency band[19]. The results are presented in Table 6 for the Weibull specification only[20]. They suggest that the main conclusions drawn above remain – the current account surplus has a negative effect on the probability of a successful speculative attack and the Russian crisis a positive impact.

5. Concluding Remarks

This paper has examined the determinants of both capital flows and instances of speculative attacks in various transition economics who are also prospective EU and euro area members. The results suggest that while what we called domestic factors play a role, contagion is also important, especially from other countries in the area. Contagion may come

[18] It is of course possible to estimate a hazard model for periods of upward speculative pressure, although since such inflows are more sustained in their nature, they are less amenable to a 0/1 categorisation. The results suggest that an increase in the current account surplus or a reduction in the inflation differential increase the probability of a country experiencing upward speculative pressure. This is in line with theoretical expectations. The other variables are not significant.

[19] One problem is that there are not many successful speculative attacks and hence the hazard cannot be estimated very precisely.

[20] There are too many durations for which there is no successful speculative attack to enable a meaningful semi-parametric specification.

about because of economic linkages within a region. However, it might also reflect the fact that transition economies are classified as emerging markets. Recent experience suggests that problems in one emerging market can spread quickly to others not least because international financial institutions tend to have targets for the proportion of their portfolio invested in emerging markets as a group. Problems in one emerging market can lead to a reduction in this targeted proportion as the risks of the whole group are reassessed and hence to a withdrawal of funds from other emerging markets. Additionally, funds can be withdrawn from other emerging markets as investors seek to cover their losses in one market by realising gains in another.

These results shed some light on the likely experience of transition economies in the run up to euro area membership. Exchange rate targeting within ERM II may well prove to be tricky as capital flows undermine either attempts at reducing inflation (or maintaining low inflation) or the exchange rate target itself. Both will complicate the conduct of macroeconomic policy. Simply ensuring sound domestic policies may be a necessary condition for satisfaction of the criteria for EMU membership but may not be a sufficient one. This suggests that prospective members might have been better advised to proceed cautiously with further liberalisation of capital movements (Begg *et al*, 1999; 2003) or that a stronger commitment by the euro area to intervene in foreign exchange markets within the framework of ERM II is required.

Appendix I: Countries and data sources

Country	data period	data sources
Bulgaria	1991Q1-2001Q3	**Private capital flows**: Financial Account, Foreign direct investment (abroad and in reporting country), other investments by monetary authorities (assets and liabilities) and other investments by general government (assets and liabilities) from IMF *Balance of Payments Statistics*. **changes in reserve assets**: Reserve Assets from IMF *Balance of Payments Statistics*. **Interest rates, money supplies and consumer price inflation** from IMF *International Financial Statistics*. **Economic Activity**: measured either by quarterly real GDP or industrial production taken from IMF *International Financial Statistics.* **Unit labour costs** are calculated using wages, industrial production and employment from IMF *International Financial Statistics* for Latvia and Lithuania and labour productivity in industry and wages and salaries in industry from the WIIW Monthly Database for Bulgaria, the Czech Republic, Hungary, Poland, Romania, Slovakia and Slovenia. Note: Cyprus is not included since it does not publish quarterly balance of payments statistics.
Czechoslovakia	1990Q1-1992Q4	
Czech Republic	1993Q1-2001Q3	
Estonia	1992Q1-2001Q4	
Hungary	1990Q1-2000Q4	
Latvia	1993Q1-2001Q4	
Lithuania	1993Q1-2001Q4	
Malta	1995Q1-2001Q4	
Poland	1990Q1-1995Q2	
Romania	1991Q1-2001Q3	
Slovak Republic	1993Q1-2000Q4	
Slovenia	1992Q1-2001Q4	

Appendix II: Hazard function models

The standard proportional continuous time hazard function (Cox, 1972) is given by:

$$g_{it} = g_{0t} \exp[X_{it}'\beta] \quad (1)$$

where g_{it} is the instantaneous probability of realignment for currency i conditional on survival to t. g_{0t} is the underlying or baseline hazard at t which can be estimated if it is parametrically specified with respect to duration. It is common to use the Weibull specification which implies a monotonic hazard (that is, the probability of realignment increases or decreases log-linearly with duration). In this case, the existence of reputation effects would imply a hazard which decreases with duration (negative duration dependence). X_{it} is a vector of potentially time-varying explanatory variables and β is the vector of parameters. The hazard is proportional in that the explanatory variables cause a proportional scaling of the underlying hazard rather than affecting its shape (we can note that it has been shown that the proportionality assumption is not that restrictive (Bergstrom and Edin, 1992)). Equation (1) can be estimated by using a panel of 'out' countries (that is, a cross-section of countries over time).

Alternatively, we can use the discrete time analogue of Cox's standard proportional continuous time hazard function (Prentice and Gloeckler, 1978), h_{it}, which is the probability that a realignment of currency i will occur between t and t+1 and is given by:

$$h_{it} = 1 - \exp\{-\exp[X_{it}'\beta + G_t]\} \quad (2)$$

where $G_t = \ln[\int_t^{t+1} g_0(v)dv]$

The instantaneous underlying or baseline hazard is given by g_0 and G_t yields the underlying hazard at each discrete duration t. Since we use quarterly data, each duration t is equivalent to a quarter in real time and a completed duration of t implies that a realignment occurred between quarter t and quarter t+1. It is worth noting that durations need not be of equal calendar time length. G_t gives us a measure of the duration effect and hence, if reputation effects are present, we anticipate that it has a negative slope. Estimation is by maximum likelihood and the underlying hazard can be estimated non-parametrically following Meyer (1990).

The hazard approach has a number of econometric advantages. First, we can incorporate time-varying explanatory variables (the X_{it}) which implies there is no need to omit useful data as often occurs in static probit or logit analyses. Second, estimation of equation (2), the discrete time version, rather than equation (1), the continuous time version, implies that we can estimate the duration effect (reputation effect) non-parametrically using a flexible baseline hazard. This, in combination with the inclusion of time-varying covariates, has the advantage that it can help to reduce the bias that arises from unobserved heterogeneity (Lancaster (1979), Lancaster and Nickell (1980) and Jenkins (1995)). Unobserved heterogeneity refers to factors which vary across countries and may well affect the probability of experiencing a speculative attack but which are unobservable or not easily measured and hence are not included in the model. It causes a negative duration dependence bias, that is, the

probability of a speculative attack occurring spuriously appears to decrease over time because the sample at longer durations becomes disproportionately dominated by countries with a lower probability of having a speculative attack.

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Table 1 Exchange rate arrangements in prospective EU member countries	
Bulgaria	Had a floating exchange rate from 1990 until end-June 1997. From 1 July 1997, a currency board has been in operation with the currency pegged to the DM and, since 1999, the Euro.
Czech Republic	From 1991 to 1993, as Czechoslovakia, the currency was pegged to a trade-weighted composite of currencies (including the Austrian schilling, the French Franc, the DM, the Swiss Franc and the US dollar). From the beginning of 1993 the basket was changed to two currencies, the DM and $. From end May 1997 the exchange rate has been floating with intervention from the central bank to smooth the Koruna/euro rate.
Estonia	Since mid-1992 a currency board has been in operation. Up until end-1998 it was a DM peg; since then it has become a euro peg.
Hungary	Since the beginning of the 1990s, Hungary has followed a strategy of pegging its currency to a basket which from 1991 to 1999 consisted of the ECU (euro) and the US$. Periodic devaluations occurred along with a preannounced crawling depreciation. From 2000, the crawl was switched to the euro only; from October 2001, the rate against the euro was fixed.
Latvia	Initially the exchange rate was floating. Since February 1994, it has been pegged to the SDR.
Lithuania	Initially the exchange rate was floating. Since April 1994, it has been pegged to the US$ via a currency board arrangement.
Malta	Has pegged to a basket of currencies (including £, $ and the ECU/Euro) determined by their importance in Maltese trade.
Poland	From 1990 until April 2000, the currency was pegged to a basket of currencies ($, DM, £, French Franc and Swiss Franc until end-1998; euro and $ thereafter). Periodic devaluations occurred and crawling depreciations were announced. Since April 2000, the exchange rate has been floating.
Romania	Pegged to a basket of 6 currencies dependent on trade during 1990. From 1991 to July 1997 it was floating independently. Since August 1997, it has followed a managed float.
Slovak Republic	From 1991 to 1993, as Czechoslovakia, the currency was pegged to a trade-weighted composite of currencies (including the Austrian schilling, the French Franc, the DM, the Swiss Franc and the US dollar). From the beginning of 1993 the peg to the basket of 5 currencies continued until July 1994 when a basket of two currencies (DM and $) was adopted. Since January 1999, the exchange rate has been managed with no preannounced path.
Slovenia	Managed floating with no preannounced path since December 1992.
Source: IMF *Annual Report on Exchange Arrangements and Exchange Restrictions*, various years.	

Table 2: Controls on Capital Movements

	Bulgaria	Czech Republic	Estonia	Hungary	Latvia	Lithuania
Controls on payments for invisible transactions and current transfers	yes	no	no	no	no	no
Repatriation requirements on proceeds from exports and invisible transactions	yes	yes	no	yes	no	no
Surrender requirements on proceeds from exports and invisible transactions	no	no	no	no	no	no
Capital transactions – controls on:						
- capital market securities	yes	yes (purchase of shares by nonresidents subject to direct investment regulation)	no	yes	no	no
- money market instruments	yes	no	no	yes	no	no
- collective investment securities	yes	no	no	yes	no	no
- Derivatives and other instruments	yes	no	no	yes	no	no
- commercial credits	no	no	no	no	no	no
- financial credits	yes	no	no	yes	no	no
- Guarantees, etc	yes	no	no	yes	no	no
- Direct investment	no	yes (in air transport only)	yes (in security sensitive areas)	yes	yes (in gambling, lotteries)	yes (in areas of defense, narcotics production and lotteries; additionally government can control purchase of privatised companies)
- Liquidation of direct investment	no	no	no	no	no	no
- Real estate transactions	yes	yes	yes	yes	yes	yes
- Personal capital movements	yes	no	yes (on real estate gifts)	yes	no	no

Table 2 continued

	Malta	Poland	Romania	Slovak Republic	Slovenia	
Controls on payments for invisible transactions and current transfers	yes	yes	yes	yes	no	
Repatriation requirements on proceeds from exports and invisible transactions	yes	yes	yes	yes	no	
Surrender requirements on proceeds from exports and invisible transactions	yes	no	no	no	no	
Capital transactions – controls on:						
- capital market securities	yes	yes	yes	yes	yes	
- money market instruments	yes	yes	yes	yes	yes	
- collective investment securities	yes	yes	yes	yes	yes	
- Derivatives and other instruments	yes	yes	yes	yes	yes	
- commercial credits	no	yes	yes	yes	no	
- financial credits	yes	yes	yes	no	no	
- Guarantees, etc	yes	yes	yes	no	no	
- Direct investment	yes	yes	yes	yes	yes (in sensitive areas)	
- Liquidation of direct investment	yes	no	no	no	no	
- Real estate transactions	yes	yes	yes	yes	yes	
- Personal capital movements	yes	yes	yes	no	no	

Notes:
Where the regulation relates only to a specific area (eg inward FDI into areas which might be sensitive for security reasons), further information is given.
Source: IMF *Annual Report on Exchange Arrangements and Exchange Restrictions*, 2001

Table 3: Private capital flows and changes in reserves (as a proportion of GDP)											
	Bulgaria	Czech Republic	Estonia	Hungary	Latvia	Lithuania	Malta	Poland	Romania	Slovak Republic	Slovenia
Private capital flows excluding FDI											
Average absolute private capital flows	0.071	0.057	0.070	0.058	0.059	0.042	0.144	0.034	0.033	0.074	0.045
- during periods of pegged exchange rates	0.030	0.078	0.070	0.058	0.060	0.044	0.144	0.034	0.030	0.074	-
Average absolute change in reserves	0.078	0.053	0.062	0.062	0.050	0.043	0.066	0.027	0.030	0.061	0.042
- during periods of pegged exchange rates	0.070	0.074	0.062	0.062	0.036	0.036	0.066	0.027	0.037	0.063	-
Correlation between capital flows and changes in reserves	0.154	0.630	0.278	0.287	-0.203	-0.352	-0.074	0.123	0.231	0.459	0.812
- during periods of pegged exchange rates	0.373	0.667	0.278	0.287	0.105	-0.194	-0.074	0.123	0.636	0.472	-
Private capital flows including FDI											
Average absolute private capital flows	0.085	0.079	0.099	0.081	0.089	0.067	0.080	0.036	0.041	0.081	0.049
- during periods of pegged exchange rates	0.064	0.099	0.099	0.081	0.097	0.073	0.080	0.036	0.042	0.079	-
Correlation between capital flows and changes in reserves	0.239	0.788	0.321	0.672	-0.288	-0.164	0.422	0.116	0.145	0.459	0.841
- during periods of pegged exchange rates	0.342	0.754	0.321	0.672	0.159	0.078	0.422	0.116	0.317	0.468	-
Source: own calculations from data from IMF *International Financial Statistics*											

Table 4: The determinants of capital flows

dependent variable: private capital flows (excluding FDI, government and monetary authority flows) as a proportion of GDP

	Model 1		Model 2	
	Coefficient	standard error	coefficient	standard error
Constant	0.015*	0.007	0.015*	0.007
rate of growth	0.067+	0.039	0.072+	0.039
Inflation	-0.009*	0.004	-0.009*	0.004
currency board	0.024**	0.008	0.024**	0.010
pegged exchange rate regime	0.023**	0.010	0.024**	0.008
Russia	-0.068**	0.022		
Russian effect on:				
- Czech Republic			-0.035	0.062
- Estonia			-0.192**	0.062
- Hungary			-0.148*	0.062
- Latvia			-0.003	0.062
- Lithuania			-0.028	0.062
- Romania			-0.014	0.062
- Slovak Republic			-0.047	0.062
- Slovenia			-0.079	0.062
number of observations	289		289	
Overall significance of model	$Chi^2(5)=36.80$ (prob=0.00)		$Chi^2(12)=45.37$ (prob=0.00)	
R^2	0.1152		0.1414	

Notes: + significant at 10% level; * significant at 5% level; ** significant at 1% level.

A Hausman test cannot reject a random effects model over a fixed effects model ($Chi^2(5) = 7.33$, prob=0.00). Hence the results above are for random effects models which are more efficient.

Table 5: Determinants of the probability of a speculative attack								
	Model 1 – Weibull hazard model		Model 2 – Weibull hazard model		Model 3 – Semi-parametric hazard model		Model 4 – Semi-parametric hazard model	
	coefficient	standard error	Coefficient	standard error	coefficient	standard error	Coefficient	standard error
Inflation (lagged one quarter)	-2.469+	1.459	-0.751	0.890	-3.102+	1.647	-0.934	0.962
Current account (%GDP, lagged one quarter)	-8.861*	3.467	-7.244**	2.396	-11.592*	4.579	-8.246**	2.663
Growth (lagged one quarter)	-5.227*	2.191			-6.899**	2.546		
Russian crisis	1.969**	0.586	1.719**	0.503	2.688**	0.950	2.173**	0.646
Constant	-2.442**	0.529	-2.402	0.412	-2.609**	0.737	-2.728**	0.591
Baseline hazard	Log(t)		Log(t)		Non-parametric		Non-parametric	
	-0.800**	0.230	-0.952**	0.177	$Chi^2(12)=10.87$ (prob=0.54)		$Chi^2(15)=9.18$ (prob=0.87)	
Country-specific effects	$Chi^2(8)=4.08$ (prob=0.85)		$Chi^2(10)=8.24$ (prob=0.60)		$Chi^2(8)=5.25$ (prob=0.73)		$Chi^2(10)=8.16$ (prob=0.61)	
LogL	-69.77		-108.63		-59.01		-96.05	
Specification test	-0.72 (prob=0.473)		-1.15 (prob=0.25)		1.55 (prob=0.12)		-0.24 (prob=0.81)	
Model Chi^2	$Chi^2(5)=23.63$ (prob=0.00)		$Chi^2(4)=21.17$ (prob=0.00)		$Chi^2(16)=34.1$ (prob=0.01)		$Chi^2(18)=31.98$ (prob=0.02)	
number of countries	10		11		10		11	
number of observations	204		297		179		261	

Notes: + significant at 10% level; * significant at 5% level; ** significant at 1% level.

The countries included are Bulgaria, Czech Republic, Czechoslovakia (until end-1992), Estonia, Hungary, Latvia, Lithuania, Malta, Poland, Romania, Slovak Republic. They are included for the periods when they had some kind of exchange rate peg. Slovenia did not have a peg over the period 1990-2000 and hence is excluded.

The specification test is due to Pregibon (1980). Similar to a standard RESET test, it is distributed as standard normal N(0,1) under the null hypothesis of no misspecification.

Table 6: Determinants of a successful speculative attack				
	Model 1		Model 2	
	coefficient	standard error	Coefficient	standard error
Inflation (lagged one quarter)	-0.808	2.521	-0.604	1.797
Current account (%GDP, lagged one quarter)	-14.836+	8.253	-13.686*	6.183
Growth (lagged one quarter)	0.910	5.416		
Russian crisis	1.960+	1.128	2.169*	1.131
Constant	-2.992**	1.386	-2.930**	1.118
Baseline hazard	Log(t)		Log(t)	
	-1.689**	0.436	-1.824**	0.430
Country-specific effects	$Chi^2(4)=4.81$ (prob=0.31)		$Chi^2(3)=3.42$ (prob=0.33)	
LogL	-23.65		-25.43	
Specification test	-0.38 (prob=0.702)		-0.70 (prob=0.49)	
Model Chi^2	$Chi^2(5)=6.84$ (prob=0.23)		$Chi^2(4)=7.83$ (prob=0.10)	
number of countries	10		11	
number of observations	204		297	
Notes: see Table 5				

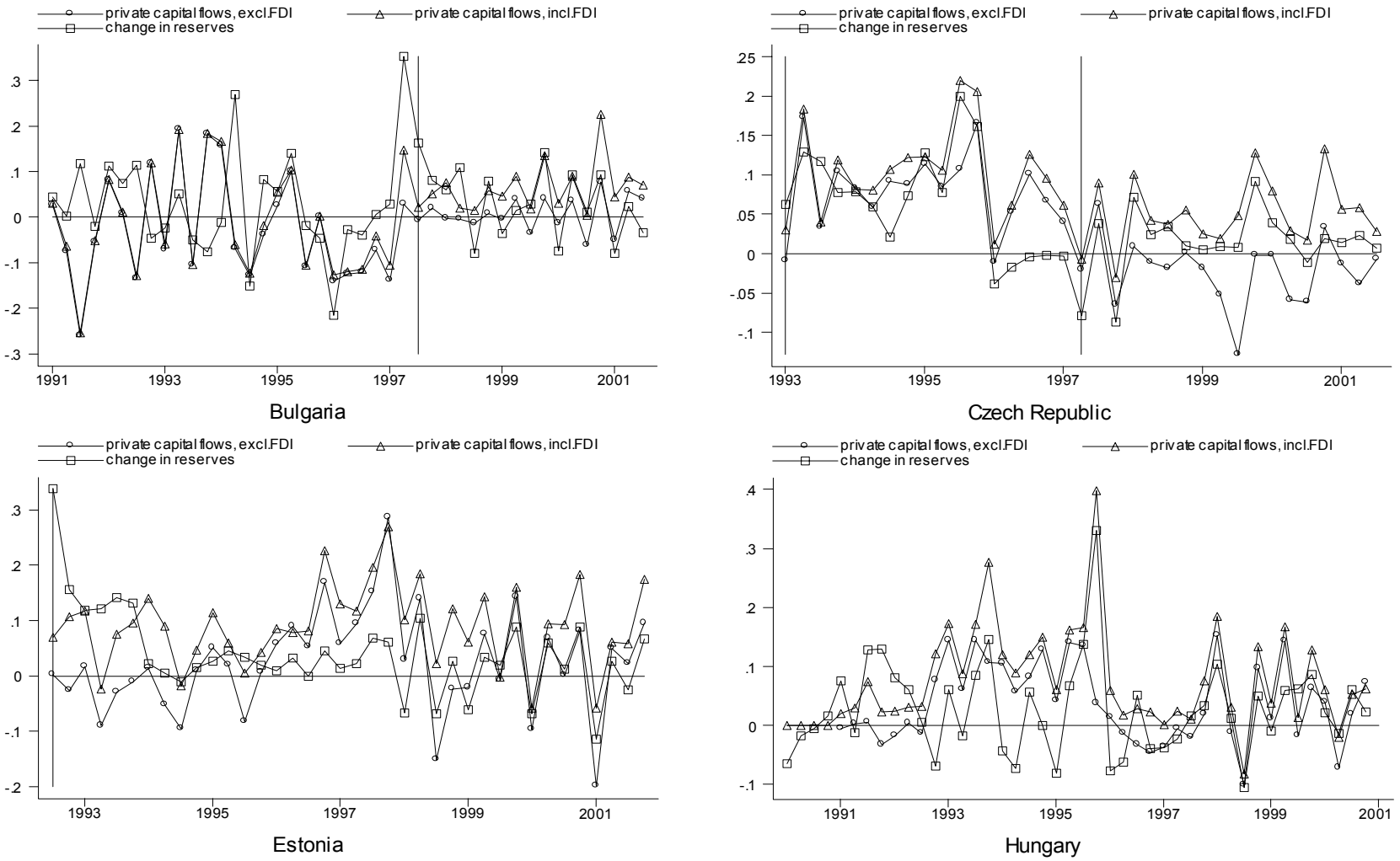


Figure 1a: Eastern European countries - capital flows and reserves

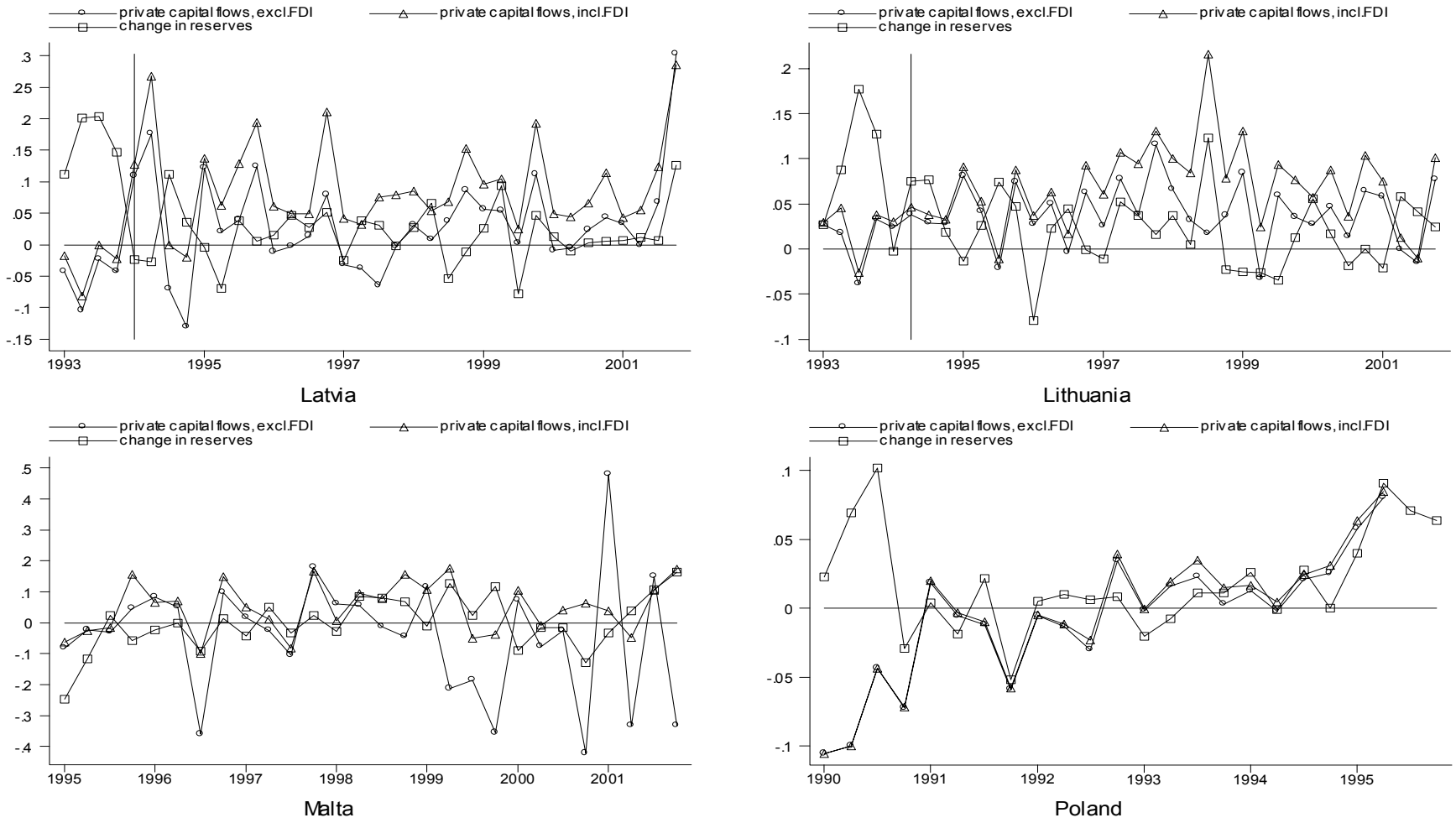
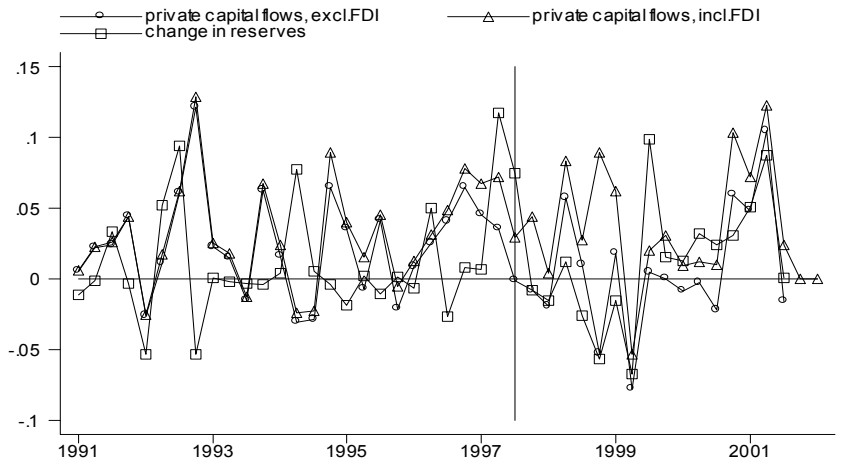
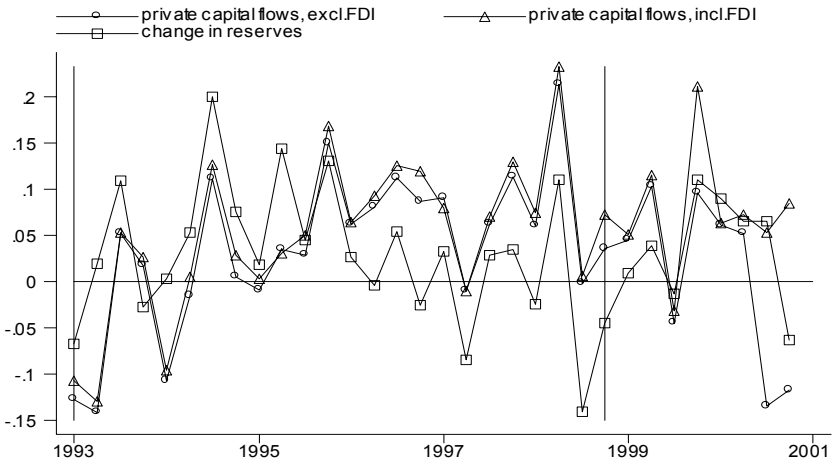


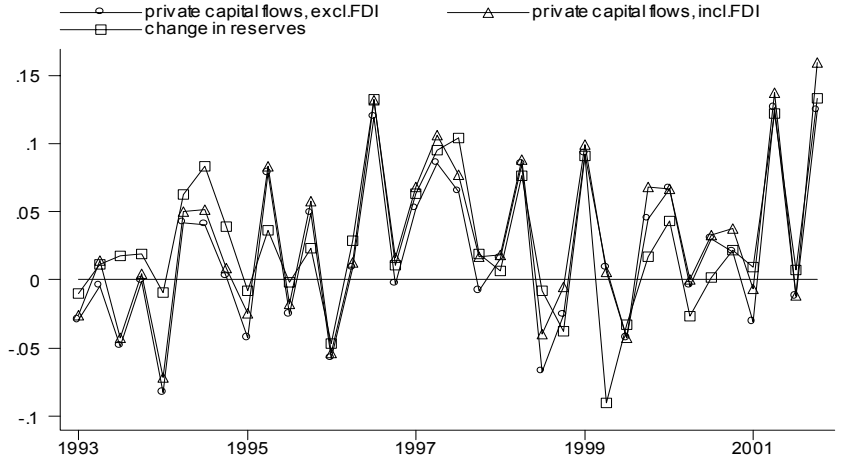
Figure 1b: Eastern European countries - capital flows and reserves



Romania

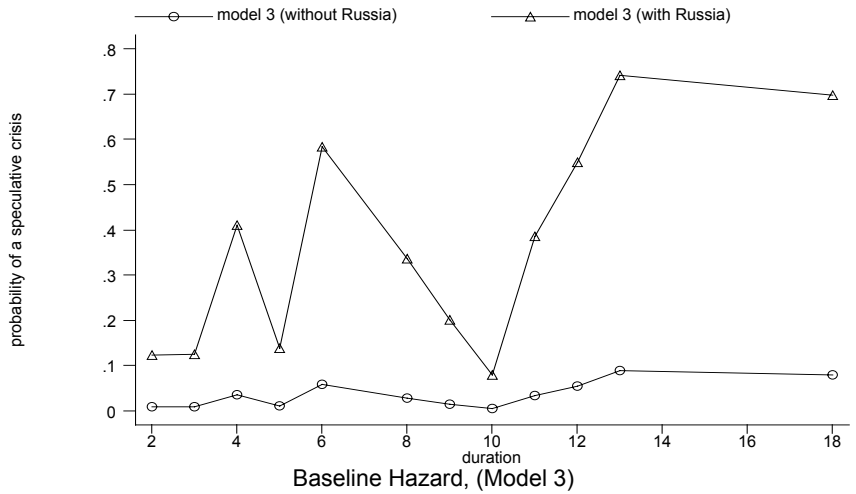


Slovak Republic



Slovenia

Figure 1c: Eastern European countries - capital flows and reserves



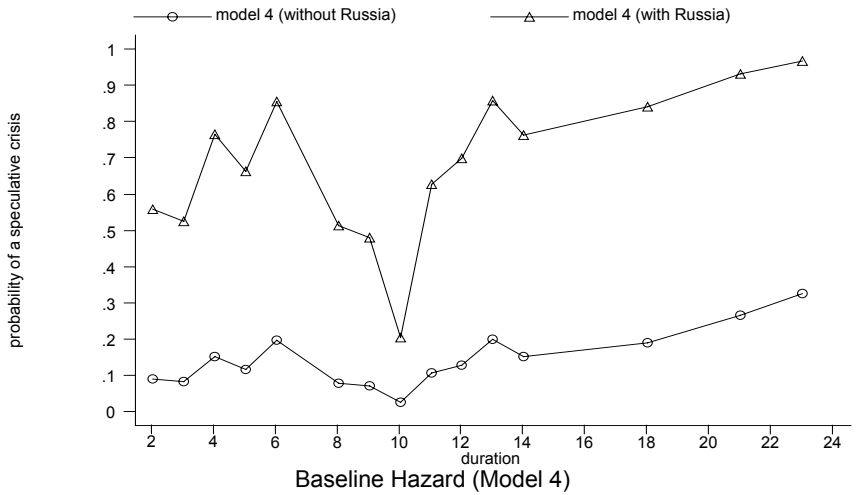


Figure 2: Baseline Hazards

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2. Lazaretou, S., "Greek Monetary Economics in Retrospect: The Adventures of the Drachma", April 2003.

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