Current Account Reversals and Long Term Imbalances: Application to the Central and Eastern European Countries

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Abstract

In our study we investigate the evolution of short-term and long-term external positions in the CEECs and make an attempt at predicting their future paths. First, we analyze the long term relationship between net foreign assets and a set of explanatory variables and construct a measure of imbalances which equals the deviation of net foreign assets from their equilibrium level. Later we incorporate this measure in our prediction of current account reversals and compare the forecasts of this model with the baseline model that does not account for long-term disequilibria. We show that the inclusion of stock disequilibrium measures improves the model's performance in and out-of-sample. By doing this, we fill the gap in the literature on external sustainability, which despite the recent emphasis on stock adjustment (Calderon et al., 2000, Lane and Milesi-Ferretti, 2001), has not yet assessed the effectiveness of stocks in predicting sudden current account reversals. Finally, we apply this methodology to the CEECs. We find that net foreign assets lie below their long-term equilibrium level in allcountries except Slovenia and Baltic States, but we predict current account reversals only for Hungary, Estonia and the Czech Republic.

Keywords: current account deficits, current account reversals, net foreign assets
JEL Classification: F21, F32

1. Introduction

In the last few years, the current account deficits in the Central and Eastern European Countries (CEECs) have been widening and reached, on average, 7.4% of GDP in 2004. It is comparable to the deficit of Mexico in 1994 (7%) and Thailand's in 1996 (8%), just before they suffered a sudden stop in capital flows. Even bigger current account imbalances are experienced currently by Estonia and Latvia, whose deficits exceeded 13%. As a consequence, net foreign liabilities have also been growing, reaching on average 52% of GDP in 2004. Again, Estonia arouses particular concern since its net foreign liabilities reach almost 106% of GDP. The aim of this paper is to define excessive net foreign liabilities in developing countries and to assess whether an excess of indebtedness can lead to unsustainable current account and drive a reversal of capital flows. By doing this, we fill the gap in the literature on external sustainability, which despite the late emphasis on stock adjustment (Calderon and alii, 2000, Lane and Milesi-Ferretti, 2001), has not yet assessed the effectiveness of stocks in predicting sudden stop crises.

Not surprisingly, a number of researches have analyzed the structure and dynamics of capital flows to the CEECs. Lipschitz et al. (2002) highlight the importance of the real exchange rate history and factor intensity of production in attracting capital flows. Begg et al. (2003) examine the experience of the old EU states (Italy, Ireland, Spain, Greece and Portugal) to cope with capital flows and draw policy conclusions for new EU member states. Buiter and Taci (2003) study benefits and costs of cross-border capital flows for financial sector development and stability in the CEECs. Bussière et al. (2004) extend the standard intertemporal model by introducing habit formation and non-ricardian consumers to account for current account behavior in OECD and EU acceding countries. This model is then used as a basis for an empirical estimation of the determinants of the current account. CEECs do not appear as outliers in this framework. Zanghieri (2004) extends this analysis by projecting the future level of debt using the forecasts of current account minus FDI flows. Depending on the assumed share of FDI in the current account deficit, CEECs' debt will be stabilized (high share of FDI) or will continue to grow (low share of FDI).

The above flow approaches have a major drawback, because they ignore valuation effects of stocks of foreign assets and liabilities and assume that the current level of net foreign assets (NFA) is sustainable. However, a country running persistent current account deficits might be at the same time improving its NFA position if capital gains on its foreign assets exceed those on its foreign liabilities (Lane and Milesi-Ferretti, 2006). Additionally, if the country is located away from its

equilibrium level of NFA, the current account deficit can be sustained precisely because the economy is adjusting to a higher level of long-term liabilities. Edwards (2001) shows that this adjustment process can lead to quite substantial current account deficits. This drawback is especially meaningful for the CEECs, since these economies are in transition. Indeed, from having the highest ratio of net foreign assets to GDP in 1995, the CEEC have rapidly accumulated foreign liabilities and caught up with South American countries. As a consequence, in our view, a stock approach can cope with this problem. Stocks are also less volatile and can provide long term relationships which are easier to estimate. The stock approach has recently been used by several authors thanks to the development of an external wealth database by Lane and Milesi-Ferretti (2006). They use their own estimates of external positions to study the determinants of NFA in developing and industrial countries and they find that public debt, GDP per capita and a set of demographic variables give a good account of the patterns of external holdings (Lane and Milesi-Ferretti, 2001). Calderon et al. (2000) use a dataset constructed by Kraay et al. (2000) to test a portfolio model on a set of developing and industrial countries. Gourinchas and Rey (2005) use monthly data and an intertemporal budget constraint view to measure external imbalances in the United States.

External imbalances should be especially disruptive in developing markets. IMF (2005) uses a methodology close to Gourinchas and Rey (2005) to show the different roles played by valuation effects in emerging and industrial countries. The idea behind this is that valuation effects are destabilizing in developing countries because of liability dollarization (see for example Obstfeld, 2004). The more an economy is dollarized, the worse will be a reaction of its net foreign assets position to a depreciation. And since the reaction of the exchange rate to excess external liabilities will be to depreciate, a dollarized indebted country should become even more indebted, unless it runs substantial trade surpluses. On the other hand, if these surpluses are not accompanied by a surge in productivity, it should take place thanks to a shift in demand from tradables to nontradables, and this is possible only through a further real exchange rate depreciation. This mechanism initiates a vicious circle that badly affects firms' balance sheets and their capacity to invest, thus leading to an output collapse. Indeed, IMF (2005) finds that valuation effects play a stabilizing role in industrial countries but not in developing countries.

Although stock imbalance measures proved useful at predicting future flows (see Lane and Milesi-Ferretti 2001, IMF, 2005 and Gourinchas and Rey, 2005), no attempt has been made at using them to predict the particular phenomenon of sudden stops in capital flows, which can be defined as a

sharp, disruptive reversal in the current account. The literature on the determinants of sudden stops is very extensive. This strand of literature was initiated by Milesi-Ferretti and Razin (1998). Similar to earlier empirical literature on currency crises, the literature on sharp current account reversals relied massively on event study analysis and non-linear econometric methods, especially binary probit and logit analysis, which was used by Milesi-Ferretti and Razin (1998 and 2000), Edwards (2001), Eichengreen and Adalet (2005) among others. We adopt this kind of approach since sudden stops are exceptional events and cannot be understood in the framework of the day-to-day economic life. Besides, Berg et al. (2004) show that model-based forecasts can perform better than non-model-based forecasts, such as agency ratings and private analysts' risk scoring, in predicting currency crises.

In our study we put together the above two strands of literature: the stock approach to external equilibrium and the analysis the determinants of sudden capital stops. In the first step, we analyze the long term relationship between net foreign assets and a set of measures of productivity, demographic structure, wealth variables and fixed effects. After running unit root and cointegration tests, we use a DOLS methodology to estimate the long run cointegrating relationship. We compute whether the stocks of net foreign assets lie above or below their long-term equilibrium levels and construct a measure of imbalances which is a deviation of country's NFA from their long-term trend. In the second step, we incorporate this measure in our predictions of current account reversals and compare it with a baseline model which does not account for disequilibria in the external stock position.

In order to predict the behavior of current account (CA) balances in the CEECs, we estimate a model of CA reversals for middle-income developing and transition countries, and later use the estimated coefficients to predict reversals for the CEECs. We choose this approach because we lack historical data about the relationship between CA and economic indicators for our countries of interest, and therefore we assume that CA dynamics in the CEECs should not differ significantly from those in Asia, Latin America, or other developing regions. Of course, given the uniqueness of the experience of the CEECs, such method is not perfect, but in our opinion, it will only bias probabilities of reversals upward, which will still allow us to spot vulnerabilities of the external positions.

Our results show that Hungary, Poland, Czech and Slovak Republics have net foreign liabilities significantly above levels predicted by our model. However, there is a high probability of a sharp current account reversal only for Hungary, Estonia, and Czech Republic.

The paper is structured in the following way. Section 2 presents data and descriptive statistics. In Section 3 we estimate our measures of long-term imbalances and in Section 4 we use these measures in the logit model of current account reversals. In Section 5 we apply our model to the CEECs and in Section 6 we conclude.

2. The data and descriptive statistics

The data for our study comes mainly from the World Bank. One of the most important variables in our research is NFA. Since country reports about their international investment positions are often incomplete, we take the data from Lane and Milesi-Ferretti (2006). In this study they construct estimates of the foreign assets and liabilities for 145 advanced, emerging, and developing countries for the period of 1970-2004[1].

Given the lack of historical data for the CEECs, our research idea is to construct models of current account reversals and net foreign assets position for a group of countries, and later apply these estimates to evaluate the current long term external position and predict current account reversals for the CEECs[2]. To do so, it is essential to choose a correct set of countries which would serve as a benchmark to their Central and Eastern European peers. For our baseline estimations, we decided to include only middle income developing countries. The list of middle income countries is provided by the World Bank. It is defined on a per capita income basis. We additionally exclude small countries with the population below 1 million people. In all, our sample includes 63 countries among which 58 can be used in the logistic analysis and 52 in the cointegration analysis. The time span covers approximately the period from the late seventies to 2003 for the logit and the period from 1975 to 2004 for the cointegration analysis.[3]

[1] See Lane and Milesi-Ferretti (2006) for details about data construction.
[2] We analyze the following CEECs: Bulgaria, Czech Republic, Estonia, Hungary, Latvia, Lithuania, Poland, Romania, Slovak Republic, Slovenia.
[3] The complete information about variable definitions, construction, and sources is given in Appendix 2. The list of countries and time spans in our sample is given in Appendix 3.

Table 1. Current account balances as percentage of GDP

	2000	2001	2002	2003	**2004**
Bulgaria	-5.6	-7.2	-5.3	-9.3	**-8.5**
Romania	-3.7	-5.5	-3.3	-5.8	**-7.6**
Hungary	-8.6	-6.2	-7.2	-8.7	**-8.9**
Poland	-6.0	-2.9	-2.6	-2.2	**-4.3**
Czech Republic	-4.8	-5.4	-5.8	-6.4	**-5.2**
Slovak Republic	-3.4	-9.0	-8.1	-0.9	**-3.5**
Slovenia	-2.9	0.2	1.5	-0.3	**-2.1**
Estonia	-5.4	-5.7	-10.2	-12.3	**-13.2**
Latvia	-4.8	-7.6	-6.8	-8.2	**-13.0**
Lithuania	-5.9	-4.7	-5.1	-7.0	**-7.7**
Mean	**-5.1**	**-5.4**	**-5.3**	**-6.1**	**-7.4**

Source: World Bank

Table 1 provides descriptive statistics of current account positions in the CEECs. We can see that current account deficits have been widening for a few years. On average, they reached 7.4% of GDP in 2004. It is comparable to the deficit of Mexico in 1994 (7%) and Thailand's in 1996 (8%), just before they suffered a sudden stop in capital flows. The biggest deficits are experienced by the Baltic countries (especially Estonia and Latvia), Balkan countries (Bulgaria and Romania) and Hungary. Slovenia seems to follow a different pattern from the rest of Eastern Europe with a deficit of only 2%.

Table 2. Net foreign assets as percentage of GDP

	2000	2001	2002	2003	**2004**
Bulgaria	-40.0	-32.7	-35.1	-40.9	**-47.0**
Romania	-20.5	-21.3	-23.4	-33.0	**-34.0**
Hungary	-71.4	-69.0	-76.2	-84.2	**-96.5**
Poland	-33.6	-31.5	-38.8	-45.4	**-53.4**
Czech Republic	-9.3	-11.3	-18.1	-22.9	**-34.6**
Slovak Republic	-19.4	-25.5	-26.0	-30.0	**-37.5**
Slovenia	-12.6	-6.9	-4.5	-14.0	**-18.3**
Estonia	-50.9	-51.9	-62.7	-80.3	**-105.6**
Latvia	-31.0	-37.8	-44.0	-47.2	**-55.1**
Lithuania	-35.7	-35.2	-37.1	-37.8	**-38.7**
Mean	**-32.4**	**-32.3**	**-36.6**	**-43.6**	**-52.1**

Source: Lane and Milesi-Ferretti (2006)

As a consequence, net foreign liabilities (presented in Table 2), have also been growing, reaching 52% of GDP in 2004. Remember that Thailand and Mexico had respectively 60% and 40% of net liabilities before they hit a crisis. Among the Baltic countries, Estonia arouses particular concern since its net foreign liabilities reach almost 106% of GDP. Hungary is also by far one of the most

indebted Central European country with 96% of liabilities. Consistently, Slovenia has little foreign liabilities.

As a comparison, Asian and Latin American countries have improved their current account deficit since the crises of the nineties (see Figure 1). Asia's current accounts has even remained positive since the 1997 crisis. Therefore, Asian countries' net foreign asset position is now positive on average. It is also noteworthy that CEEC's negative position, despite its consequent widening, has only reached Latin America's position.

According to Figures 1 and 2, this surge in foreign financing in the CEECs has been recent. In particular, net foreign liabilities have almost doubled in the last 5 years. It is also well known that the CEECs have been opened only recently to capital inflows and that they have gone through a wave of liberalization. We can therefore hypothesize that their current account deficits are the result of their net foreign assets catching-up process.

Figures 7-10 present some variables which are important long term determinants of net foreign assets, such as GDP per capita in PPP dollars, demographic structure and productivity. The variables are graphed for different groups of countries: industrial, Asian, Latin American, the CEECs and other Europe (New Independent States and other Central and Eastern European countries).

To construct a productivity measure, we calculate an index as the principal components of 4 productivity indicators: literacy rate, life expectancy, financial depth, measured by bank credit over GDP, and trade openness, measured by the sum of exports and imports over GDP. Figures 3-6 present the above indicators separately, and Figure 7 shows the calculated productivity indicator for groups of countries in our sample.

In comparison to other developing regions, the CEECs are endowed with the highest literacy rate, which is of the same order of magnitude as industrial countries. As to life expectancy and trade, they score among the best, just after Asian countries. However, they have much less financial depth than the latter. On the whole, their productivity index is the same as Asian countries.

Figures 9 and 10 present respectively the share of population above 60 and below 24. We document that CEEC societies are older than the other developing countries. Their age structure seems to fit

more that of industrial countries. In Figure 10 we report GDP per capita in PPP dollars, and the CEECs appear to be as rich as Asian countries.

On the whole, apart from the demographic structure and literacy rate, the CEECs show the same features as Asian economies and are closer to other middle-income countries than to industrial countries. Therefore, we feel confident in our choice of the sample.

Figure 1.

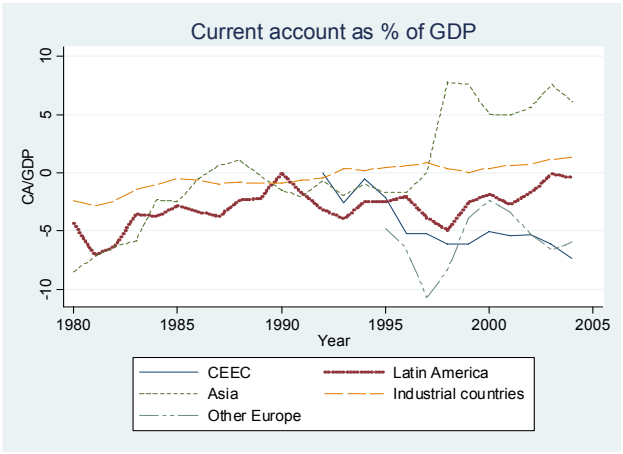


Figure 2.

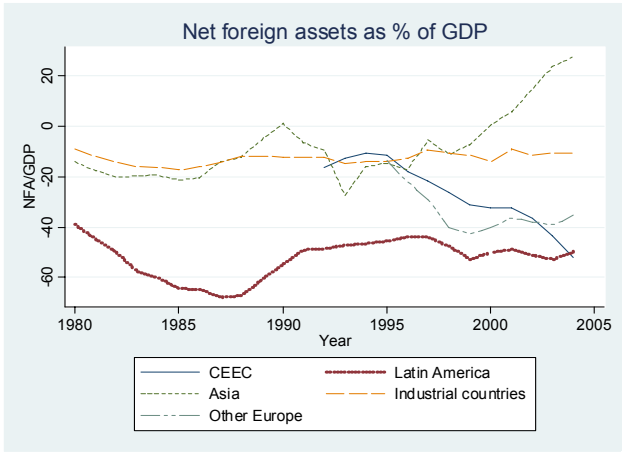
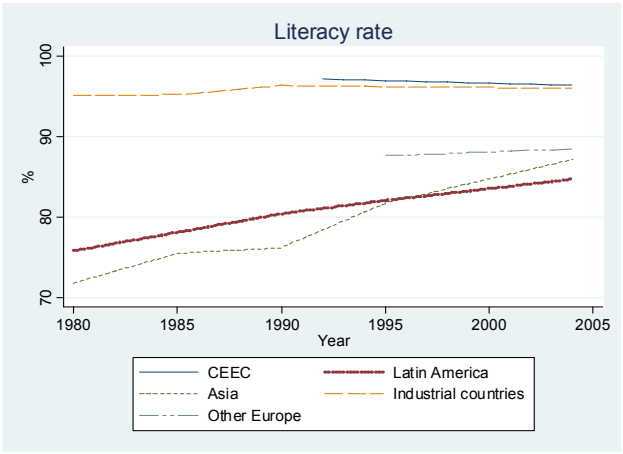


Figure 3.



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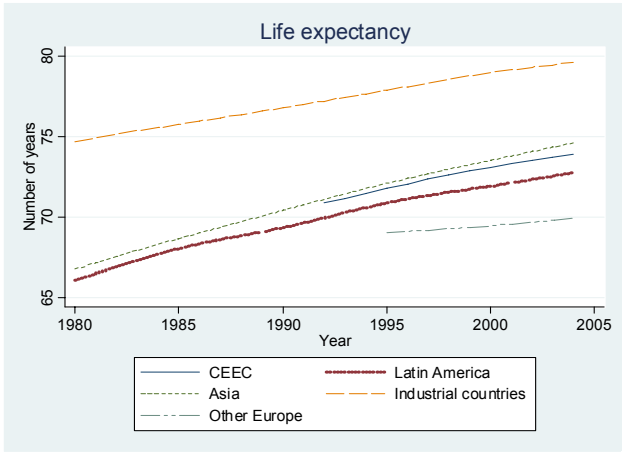
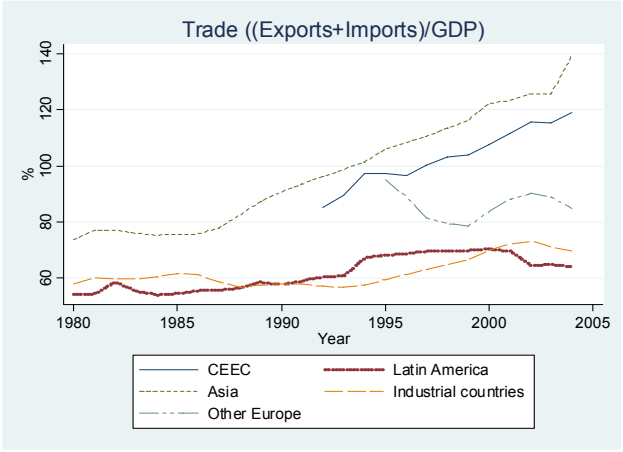


Figure 5.



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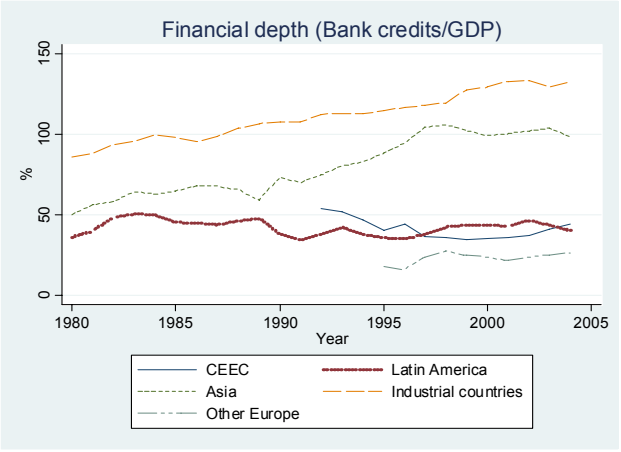

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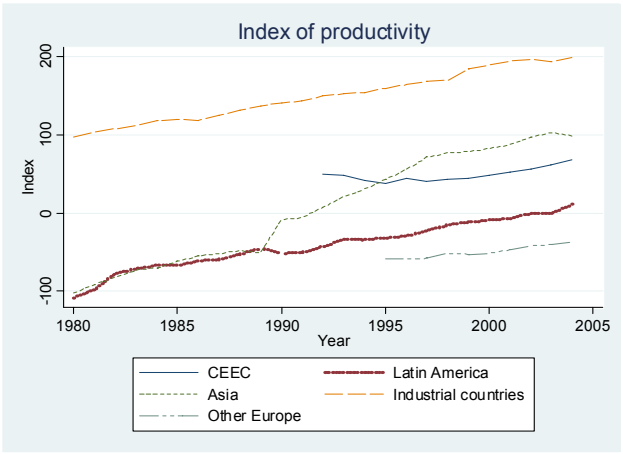

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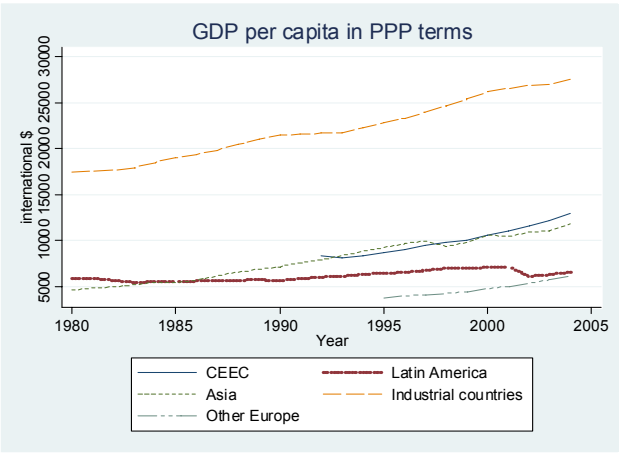


Figure 9.

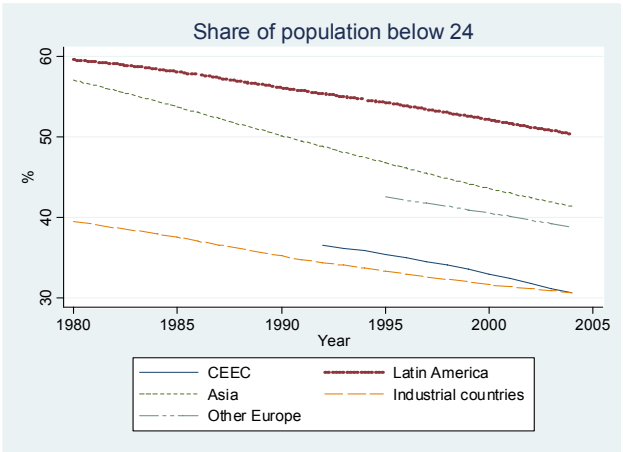
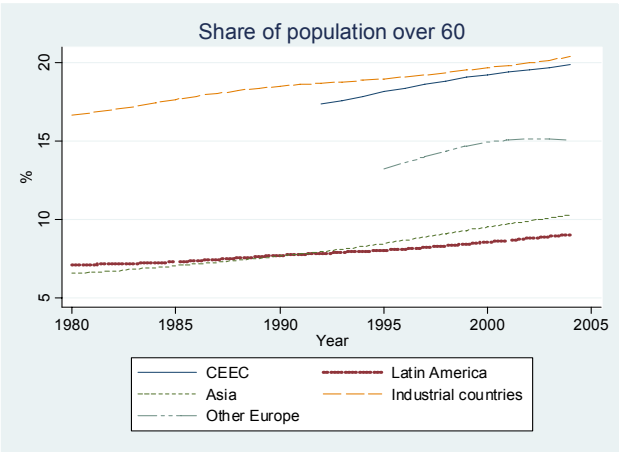


Figure 10.



3. Long Term Determinants of Net Foreign Assets

Choice of variables

In this section we follow Lane and Milesi–Ferretti (2001) and Calderon et al. (2000) and estimate a long-term model of NFA determinants. The above papers adopt a portfolio choice approach while Gourinchas and Rey (2005) and IMF (2005) rely on a loglinearized intertemporal budget constraint. We follow the first approach because it seems more adapted to our sample of developing countries: the intertemporal budget constraint loglinearization is based on strong stationarity assumptions which in our view does not correspond to developing countries, especially the CEECs. Later we calculate deviations of NFA from their long-run equilibria for each country, which we use as an additional explanatory variable in our predictions of current account reversals. Our model of long-term NFA determinants takes the following form:

$$NFA_{it} = \beta Z_{it} + \varepsilon_{it}, \qquad (1)$$

where NFA_{it} - net foreign assets as a share of GDP, and Z_{it} is a set of explanatory variables. In our study we define three important long-term determinants of net foreign asset position: output per capita, demographic structure, and our measure of productivity[4].

One of the most important factors in explaining net foreign assets is the output per capita which can affect the external position through different channels. In the standard classical growth model, individuals save less in lower income and thus faster growing economies, because their permanent income is higher than their current one. This positive link between income and savings is even greater when we depart from some standard assumptions. For example, Rebelo (1992) introduces Stone-Geary preferences: utility depends on a subsistence level which affects the intertemporal elasticity of substitution. Agents want to save only when their level of consumption gets away from this subsistence level and thus only when they get richer. At the same time, countries with low income can attract capital flows which they will repay at the later stage of their development, and therefore the positive association between income and net foreign assets can be used to support the "stages of the balance of payment" hypothesis (Cairnes, 1874, Crowther, 1957). Alternatively, Lane and Milesi-Ferretti (2001) find a negative correlation between output per capita and net foreign

[4] Data sources are available in Appendix 2.

assets position for developing countries, explaining this phenomenon by credit constraints. In their opinion, improvement in net worth or cash flows relaxes financial constraints, and therefore an increase in production may lead to a greater recourse to foreign investment. Thus, we can expect the sign of output per capita to be either positive (stages of the balance of payments hypothesis) or negative (financial constraints hypothesis).

Second, the demographic structure of the population plays an important role in determining external position. For instance, a society with a high share of the young population may require heavy investment in education, housing and other social infrastructure. A high youth dependency ratio would also lead to low savings as households try to smooth their consumption (Higgins, 1998). As a result, one can expect a negative impact of a high share of young population on net foreign assets. At the other end of the demographic distribution, a high share of retired people might lead to a depletion of savings and foreign assets accumulated in the past. This is the so-called "running down of assets" hypothesis, and we might also expect that a higher share of old population has a negative impact on net foreign assets. Furthermore, the age structure of the working population is also very important, as people who just started working tend to borrow more, whereas the older labor force tries to save before retirement. Lane and Milesi-Ferretti (2001) find a significant impact of the age structure on net foreign assets position. Following them, we use the methodology of Fair and Dominguez (1991) and Higgins (1998) to account for the whole age structure divided in twelve cohorts: to capture the demographic structure of the population we construct variables *dem1 dem2* and *dem3* by using a low-order polynomial to represent 12 population age shares: 0-14, 15-20, ... , 60-64 and over 65. This technique for incorporating demographic information into macroeconomic equations has the advantage of capturing the information contained in the entire age distribution while maintaining a parsimonious parameterization[5]. Afterwards we can reconstruct the coefficients for each age cohort.

Third, we look at the measure of productivity or return on capital. This variable is inspired by the model of Calderon et al. (2000) which is based on a standard Markowitz-Tobin model of portfolio diversification and in which net foreign assets is a negative function of investment return in a country relative to the rest of the world. The negative sign of the coefficient would indicate that capital flows to the regions with the highest productivity. Productivity is measured as a weighted average of variables reflecting human capital (life expectancy and literacy rate), financial transaction costs and financial development (bank credit as a percentage of GDP), access to foreign

technology and competitiveness (trade openness)[6]. It should be noted that such measures, as productivity or demographic structure make the the stock approach original when compared to the flow approach of the current account. It allows us to take into account very smooth variables such as human capital, which are nonetheless important determinants of the capacity to attract capital in developing countries.

Stationarity tests

Before turning to the regression analysis, we analyze the univariate time series properties of our data. We test for non-stationarity for net foreign assets, demographic variables (dem1, dem2, dem3), log of GDP per capita in PPP dollars, and productivity. To do so we rely on panel unit root tests of Levin, Lin and Chia-Shang (2002), Im, Pesaran and Shin (2003), Maddala and Wu (1999) and Hadri (2000). The null hypotheses of the first three tests is the existence of the unit root, whereas Hadri (2000) tests the null hypotheses of stationarity of time series. More precisely, the tests can be represented as follows:

$$y_{it} = \alpha_i + \rho_i y_{it-1} + u_{it}, \quad i = 1,...,N, \quad t = 1,...T$$

With $-1 < \rho_i \leq 1$ and the noise processes u_{it} are stationary ARMA processes. The null hypothesis of the Levin, Lin and Chia-Shang (2002), Im, Pesaran and Shin (2003) and Maddala and Wu (1999) tests is $H_0 : \rho_i = 1$ for i = 1, . . . , N, against the *homogenous* alternative $H_1 : -1 < \rho_i = \rho < 1$ for i = 1, . . . , N in Levin, Lin and Chia-Shang (2002), and the *heterogeneous* alternative $H1 : -1 < \rho_i < 1$ for at least one i = 1, . . . , N in the Im, Pesaran and Shin (2003) and Maddala and Wu (1999) tests. In Hadri (2000), the null hypothesis is stationarity in all units against the alternative of a unit root in all units.

The results of the above tests are presented in Table 3 and show a somewhat mixed evidence. Im, Pesaran and Shin (2003) test does not reject the null hypothesis of non-stationarity, whereas the results of the Levin, Lin and Chia-Shang (2002) test allow us to reject the hypothesis of unit root for net foreign assets and productivity, and Maddala and Wu (1999) test rejects the null hypotheses for productivity, dem3, and GDP per capita. The Hadri test rejects the null hypothesis of stationarity for all variables. To decide which results to keep, we must consider which is the most accurate for our specification. Hloukovska and Wagner (2005) show through their simulation study

[5] See Appendix 1 for more details.

that the panel stationarity test of Hadri (2000) performs very poorly. The null of stationarity is rejected as soon as sizeable serial correlation of either the autoregressive or the moving average type is present. In our specification, the best power behavior is displayed in general by the Levin, Lin and Chu (2002) test. However, for values of time and individual dimensions comparable to ours (respectively 25 and 50), the tests of Im, Pesaran and Shin (2003) and Maddala and Wu (1999) have a comparable power to that of Levin, Lin and Chia-Shang (2002) when there is no serial correlation in the residual. When the residual presents some autocorrelation, the Im, Pesaran and Shin (2003) test performs even better than the Levin, Lin and Chu (2002) test. We thus rely on the results of the Im, Pesaran and Shin (2003) test, which concludes that all series are non-stationary.

Table 3. Unit root tests for variables of the long term model of net foreign assets

LLC (2002)	LLC (2002)	IPS (2003)	WM (1999)	HD (2000)
Net foreign assets/GDP	-3.2404***	-1.672	57.354	28.88***
Productivity	-3.0844***	-1.192	67.0881**	79.47***
Dem1	2.7662	-0.381	0.5164	84.646***
Dem2	4.5456	-0.573	20.3969	82.012***
Dem3	6.78413	-1.442	79.1792***	80.202***
Log of GDP per capita in PPP $	-0.71270	-1.456	152.219***	81.662***

The null hypothesis of LLC (Levin, Lin and Chia-Shang, 2002), IPS (Im, Pesaran and Shin, 2003), and MW (Maddala and Wu, 1999) is non-stationarity and of HD (Hadri, 2000) is stationarity of time series. IPS and MW assume individual unit root process for each time series, whereas LLC and HD assume a common unit root process.

Table 4. Kao (1999) and Pedroni (1995) cointegration tests

	t-statistic	Prob.
Kao (1999) DF_Rho Test	-45.8024	0.0000
Kao (1999) DF_t_Rho Test	-25.7478	0.0000
Kao (1999) DF_Rho_Star Test	-7.1835	0.0000
Kao (1999) DF_t_Rho_Star Test	-12.9796	0.0000
Kao (1997) ADF Test	-13.8003	0.0000
Pedroni (1995) rho_NT_minus_1 Test	-0.7033	0.0000
Pedroni (1995) t_rho_NT Test	-773.4757	0.0000
Pedroni (1995) TN1_rho Test	-73.0865	0.0000

The null hypothesis of all cointegration tests is no cointegration.

Since we have evidence on the presence of unit roots in our time series, we test for the panel cointegration among our variables using tests suggested by Kao (1999) and Pedroni (1995) with the null hypothesis that the estimated equation is not cointegrated. The results of both tests are

[6] Data sources are available in Appendix 2.

provided in Table 4 and our findings strongly point to the existence of a cointegrating relationship between net foreign assets and other variables.

Estimation

Having ascertained the cointegrating relationship between our variables, we estimate the model using dynamic ordinary least squares specification with one lag and one lead (DOLS [-1, 1])[7]. The leads and lags of the first differences of our explanatory variables eliminate the effect of regressor endogeneity on the distribution of the OLS estimator. We include country fixed effects in order to capture unobservable country characteristics that might lead to permanent differences in measured net foreign asset positions across countries. To control for common global movements we include time fixed effects.

The estimated relationship takes the following form:

$$NFA_{it} = \beta Z_{it} + \beta_{-1}\Delta Z_{it-1} + \beta_0 \Delta Z_{it} + \beta_{+1}\Delta Z_{it+1} + u_i + v_t + \eta_{it}, \quad (2)$$

where NFA is the ratio of net foreign assets over GDP, and Z includes: *gdp* - logarithm of GDP per capita in PPP dollars, *dem1-dem3* - demographic variables, *prod* - productivity measure.

The results of our estimations are presented in Table 5. The results differ with respect to the specification of the output per capita. In the first three columns we assume linear relationship between NFA and output per capita, whereas in columns 4-6 we test for the non-linearity by adding a squared term. We also split our period in two time samples: before and after 1990. If we look at the whole sample, we find a non-linear relationship between NFA and output per capita. Considering the value of the coefficients and the span of our output per capita data, this implies that there is a positive comovement of NFA and output per capita but this relationship is less strong for higher levels of output. The positive correlation is consistent with the "stages of development hypothesis", however we also find that this effect disappears after 1990, when the relationship between the two variables is negative and linear. This is an evidence that after 1990, developing

[7] A DOLS [-2, 2] specification gives similar results, but relying on the Bayesian information criteria we prefer DOLS [-1, 1]

countries became credit constrained. This may be a consequence of the debt crises of the eighties that made creditors more demanding in terms of collateral requirements during the next period.

Table 5. Determinants of NFA

	NFA	Before 1990	After 1990	NFA	Before 1990	After 1990
prod	-0.12***	-0.10*	-0.02	-0.14***	-0.15**	-0.06
	(0.03)	(0.06)	(0.04)	(0.02)	(0.06)	(0.04)
dem1	-5.21***	1.43	-4.34**	-4.09***	1.52	-5.37**
	(1.47)	(3.25)	(2.15)	(1.45)	(3.17)	(2.38)
dem2	1.19***	0.38	1.32***	0.89***	0.23	1.59***
	(0.31)	(0.70)	(0.46)	(0.31)	(0.69)	(0.52)
dem3	-0.07***	-0.05	-0.09***	-0.05***	-0.03	-0.10***
	(0.02)	(0.04)	(0.03)	(0.02)	(0.04)	(0.03)
GDP	0.02	0.13	-0.48***	3.16***	4.08***	-0.24
	(0.06)	(0.10)	(0.12)	(0.55)	(0.86)	(1.62)
GDP squared				-0.19***	-0.23***	-0.01
				(0.03)	(0.05)	(0.09)
Constant	-0.97	0.12	4.74***	-13.96***	-17.08***	3.54
	(0.65)	(1.24)	(1.17)	(2.37)	(3.92)	(6.96)
Observations	1102	503	599	1102	503	564
Number of groups	52	39	52	52	39	52
R-squared	0.310	0.674	0.264	0.341	0.695	0.248

Dependent variable is NFA/GDP
Estimation by DOLS(1,-1) using country fixed effects and time fixed effects.
Standard errors in parentheses.
* significant at 10%; ** significant at 5%; *** significant at 1%

To be able to study the impact of the demographic structure on NFA, we reconstruct coefficients for 12 age groups from the estimated equation[8]. Results are reported in Figures 11 and 12. We find that NFA decrease when the share of the working age population younger than 25 or older than 50 expands, whereas the population between those ages has a positive impact on NFA. This is consistent with the life-cycle model since there is a stage of investment in human capital and infrastructure, followed by an accumulation and finally a running down of assets. Our findings are mostly in line with our theoretical conjectures and are consistent in spirit with Lane and Milesi-Ferretti (2001) even though the exact age group definitions differ.

[8] See Appendix 1 for the estimation of age effects.

Figure 11.

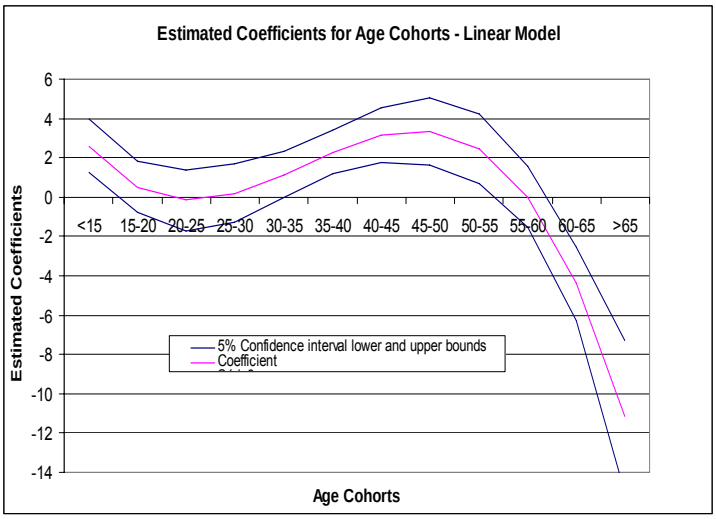
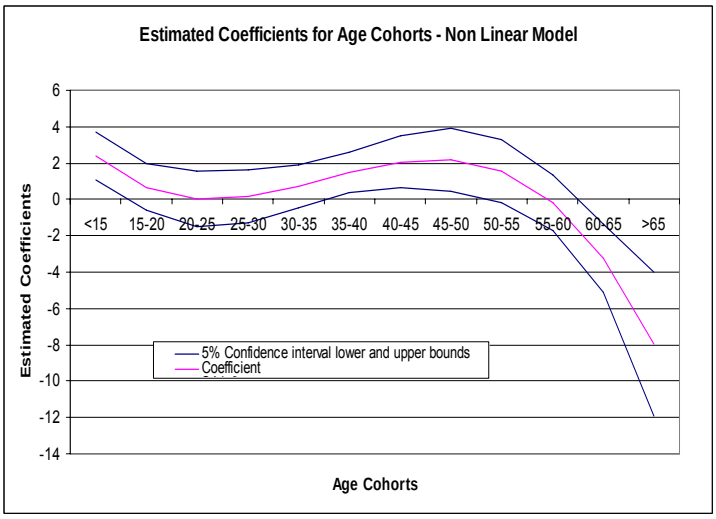


Figure 12.



4. Explaining current account reversals

Definition of reversals

In this section we use multivariate logit models to examine which macroeconomic, financial and structural variables help to predict sharp current account reversals. Following Milesi-Ferretti and Razin (1998), we define current account reversals as a combination of the following two conditions:

1. The average current account balance as a percentage of GDP during the last three years must be inferior by at least 3% to the average current account balance during the following three years.
2. The maximum current account balance as a percentage of GDP during the last three years must be inferior to the minimum current account balance during the following three years.

The first condition stipulates that a reversal was really sharp since it is likely to be more disruptive for the economy, and the second condition ensures the persistence in the current account reversal.

The model

Further we estimate a logit model with *reversal* as a dependent variable:

$$reversal_{ijt} = \begin{cases} 1 & with \quad probability \quad \Pr(reversal_{itt} = 1) = P \\ 0 & with \quad probability \quad \Pr(reversal_{itt} = 0) = 1 - P \end{cases} \tag{3}$$

We use a logistic distribution to define the logit model:

$$\Pr(reversal_{it} = 1) = \Lambda(\alpha' x_{it-1}) = \frac{e^{\alpha' xit-1}}{1 + e^{\alpha' xit-1}} \tag{4}$$

with x_{it-1} denoting the vector of (lagged) explanatory variables and α the vector of coefficients.

The explanatory variables used in the model are the following: *ca* - the average current account balance during the last three years, *g* - GDP growth, *govcons* - government consumption to GDP ratio, *GDP* - logarithm of GDP per capita in PPP dollars, *inv* - investment to GDP ratio, *trade* - the ratio of imports and exports to GDP, *fdi* - the ratio of net foreign direct investment to net foreign assets, *reserves* - the ratio of foreign exchange reserves to GDP and *g_oecd* - GDP growth in OECD countries[9]. The choice of variables in the baseline model is based on previous literature about determinants of sudden stops, especially on Milesi-Ferretti and Razin (1998).

The baseline model does not take into account the long term imbalances that we calculated in the last section. Therefore, we extend it by adding additional explanatory variables that should capture the long term external position: *NFA*, *Deviation 1* and *Deviation 2*, which are the residuals from the long term models of NFA, estimated according to the linear and nonlinear specifications.

$$Deviation_{it} = NFA_{it} - \hat{\beta} Z_{it} \tag{6}$$

Estimation results

The results of our estimations are reported in Table 6. We report coefficients with their standard errors. The first model reports the baseline specification, whereas the following 3 models include

[9] The complete information about variable definitions, construction, and sources is given in Appendix 2.

respectively NFA, Deviation 1 and Deviation 2. The two last models distinguish between positive and negative imbalances ("Deviation 1 NL" and "Deviation 2 NL", NL referring to "non-linear").

The empirical analysis identifies a number of predictors of current account reversals. First of all, the most economically important variable is the persistence of the current account deficits in the last three years. This is consistent with solvency and willingness to lend considerations, and this is what Milesi-Ferretti and Razin (1998, 2000) and Edwards (2006) find using similar definitions for current account reversals. Calvo et al. (2003) and Eichengreen and Adalet (2005), despite they do not include the current account deficit in their models of sudden stops, consider the effect of similar variables, respectively the ratio of current account deficit on the supply of tradables (which is supposed to account for the percentage fall in the absorption of tradables needed to close the current account gap) and trade balance. Their results are also consistent with ours. However, it can be argued that the average current accounts from t-1 to t-3 must be endogenous since it is used in the construction of our sudden stop measure. We test for this endogeneity by using CA_{t-4} as an instrument and by performing a Hausman test for the equality of coefficients of the instrumented and non-instrumented regressions. The test detects no significant differences (p-value of 0.76), which means that we can consider that the estimators we provide are unbiaised.

Second, countries with larger GDP per capita are more prone to reversals. This reflects the theory of stages in the balance of payment, according to which countries with low income can attract capital flows which they will repay at the later stage of their development. Per capita income might also be a proxy for financial openness that makes countries more vulnerable to capital flow reversals. These results are consistent with the findings of Milesi-Ferretti and Razin (1998, 2000). Edwards (2006) and Eichengreen and Adalet (2005) find that reversals are more likely in relatively small countries, but their sample includes high-income countries. In their sample, country size might rather proxy for institutional quality.

Table 6. Determinants of current account reversals

	Baseline	NFA	Deviation 1	Deviation 2	Deviation 1 NL	Deviation 2 NL
	(1)	(2)	(3)	(4)	(5)	(6)
ca	-25.01***	-25.03***	-34.96***	-34.59***	-35.44***	-35.04***
	(2.86)	(2.89)	(4.56)	(4.55)	(4.61)	(4.59)
g	-1.77	-1.96	0.27	0.33	0.22	0.14
	(3.25)	(3.29)	(4.44)	(4.43)	(4.42)	(4.40)
govcons	-0.04*	-0.04	0.01	0.01	-0.00	-0.00
	(0.02)	(0.02)	(0.03)	(0.03)	(0.03)	(0.03)
inv	-2.78	-2.96	-8.59***	-8.36***	-8.65***	-8.20***
	(2.03)	(2.05)	(2.82)	(2.80)	(2.81)	(2.79)
GDP	0.90***	1.22***	1.60***	1.65***	1.68***	1.74***
	(0.24)	(0.28)	(0.34)	(0.34)	(0.35)	(0.35)
trade	0.42	0.01	-0.25	-0.23	-0.33	-0.29
	(0.40)	(0.45)	(0.50)	(0.50)	(0.51)	(0.51)
fdi	0.00	0.00	0.00	0.00	0.00	0.00
	(0.00)	(0.00)	(0.01)	(0.01)	(0.01)	(0.01)
reserves	-2.48	-1.21	-1.44	-1.33	-1.77	-1.71
	(1.70)	(1.77)	(2.10)	(2.08)	(2.12)	(2.10)
g_oecd	11.59	12.69	16.47	18.15	16.86	18.66
	(15.60)	(15.63)	(18.66)	(18.69)	(18.71)	(18.81)
Constant	-8.93***	-11.84***	-14.32***	-14.80***	-15.05***	-15.63***
	(2.02)	(2.33)	(2.74)	(2.77)	(2.80)	(2.81)
Long-term Imbalances						
NFA		-0.77***				
		(0.29)				
Deviation 1			-1.94***			
			(0.53)			
Deviation 2				-1.85***		
				(0.52)		
Deviation 1 < 0					-2.55***	
					(0.64)	
Deviation 1 > 0					1.42	
					(1.95)	
Deviation 2 < 0						-2.58***
						(0.63)
Deviation 2 > 0						1.78
						(1.78)
Pseudo-Rsquared	0.1588	0.1677	0.2131	0.2116	0.2175	0.2180
Observations	1066	1066	893	893	893	893

Dependent variable takes value 1 if a reversal takes place and 0 otherwise.
Explanatory variables are lagged.
Standard errors in parentheses.
* significant at 10%; ** significant at 5%; *** significant at 1%

Third, higher investment makes the probability of reversals less likely in models including deviation measures. In theory, the impact of investments on current account is ambiguous. On the one hand, high investment should increase the ability of a country to sustain current account deficits through productivity gains, but on the other hand, high investment might increase future exports, contributing to narrowing the current account imbalances (Milesi-Ferretti and Razin, 1998). In our sample the first effect dominates and has a very significant impact on the probability of current account reversals, especially when we control for the level of NFA imbalances.

Fourth, in the baseline model we see that the probability of a reversal is higher, the lower government consumption. This surprising result may be due to fiscal retrenchment before the crisis. Milesi-Ferretti and Razin (1998) also report a negative coefficient for fiscal balance. The decrease in government consumption may also reflect the government debt burden that provokes the crisis. The coefficient becomes not significant in the other specifications.

Table 7. Marginal effects (in percentage points)

	Baseline	**NFA**	**Deviation 1**	**Deviation 2**
	$dy/dx.\sigma_x/2$	$dy/dx.\sigma_x/2$	$dy/dx.\sigma_x/2$	$dy/dx.\sigma_x/2$
X				
ca	-4,4***	-4,2***	-4,5***	-4,5***
	(0,4)	(0,4)	(0,6)	(0,6)
NFA		-0,7***		
		(0,3)		
Deviation 1			-1,2***	
			(0,4)	
Deviation 2				-1,2***
				(0,3)
inv	-0,4	-0,4	-1,0***	-1,0***
	(0,3)	(0,3)	(0,3)	(0,3)
GDP	0,5***	0,7***	0,7***	0,7***
	(0,1)	(0,1)	(0,1)	(0,1)

y=P(reversal=1)
Standard errors in parentheses.
* significant at 10%; ** significant at 5%; *** significant at 1%

Finally, variables that measure the external position turn out to be highly statistically and economically significant. Lower levels of NFA, and deviations from the equilibrium level of NFA are likely to lead to current account reversals. The explanatory power of the model is improved when we add NFA as an additional predictor, and it is even better when we use our estimated deviations from the long-term NFA equilibrium. Both deviation measures perform equally well.

Importantly, these three variables are very significant economically. Table 7 reports the marginal effects of average values of the significant variables of the above models, namely the percentage change in probability following an increase of the explanatory variable equal to half of its standard deviation[10]. A half-standard-error rise in the NFA deviation leads to a 1.2% increase in the probability of reversal, which is only smaller to the impact of the persistence of the current account deficit, which increases the probability of the reversal by 4%. It should be noted that NFA are less volatile than current account balances and therefore it is better to compare the impact of NFA deviations with the effect of such variables as investment/GDP or GDP per capita. In this case, we see that predictive power of NFA deviations is higher than of either of the above measures. It is also important that deviation from equilibrium NFA is superior in forecasting current account reversals to a simple NFA to GDP ratio.

It is also interesting to observe which variables are not significant in predicting current account reversals. We do not find any evidence that the structure of capital inflows, measured by the share of FDI, contribute to explaining reversals. Moreover, low foreign exchange reserves should make it hard to sustain current account deficits and eventually lead to reversals, but its impact is not significant. It is noteworthy that reserves are assets themselves and that they have no impact on the probability of a reversal, whereas NFA and the deviation measures are very significant. It seems that the whole amount of a country's assets, and not their composition, is relevant for the current account sustainability. Surprisingly, trade does not turn out to be a predictor of current account reversals. In theory, more open economies have less difficulties in servicing their foreign liabilities due to foreign exchange earnings through exports (Frankel and Cavallo, 2004). Besides, more open economies have less incentives to default on their debt since they have more to loose from being cut off from international capital and goods markets (Rose, 2002). But openness can also make the country more vulnerable to external shocks. The conclusion of other papers on the effect of trade openness on reversal probability is mixed: Milesi-Ferretti and Razin (1998) and Frankel and Cavallo (2004) find it negative, Milesi-Ferretti and Razin (2000) report non-significant results while Eichengreen and Adalet (2005) find that reversals are more likely in more open economies. We also do not find significant links between GDP growth in OECD countries and reversals.

We also decide to investigate whether the impact of deviations from the equilibrium level of NFA is linear, or whether it could be different for countries that have negative and positive deviations (actual level of NFA below or above equilibrium level). The findings are presented in columns 5

[10] Of course, these are rough numbers: they only reflect the slope of the probability function.

and 6 of Table 6. Negative and positive deviations really have a different impact on current account reversals, while leaving the impact of the other variables unchanged. As expected, the impact of negative imbalances is stronger in this specification, and larger negative deviations from equilibrium level of NFA perform well in predicting current account reversals. At the same time, we document that the deviation has no impact on the probability of sudden stop in countries with actual NFA above their equilibria. This confirms that our deviation measure is a relevant warning indicator for current account reversals.

Predictive power and models' evaluation

In Table 8 we report results of the in-sample and out-of-sample goodness-of-fit of our logit model. To determine a threshold probability for an alarm we chose to minimize a "loss function" that is equal to the sum of false alarms (as a share of total tranquil periods) and missed reversals (as a share of total reversals). For each model, we apply this procedure on the whole available sample (1978-2003). But in-sample goodness of fit comparison is not enough to assess the predictive power of the models. To do this, we perform out-of-sample predictions by running rolling regressions: we estimate the model on the period 1978-1989 and predict crises for the year 1990, then we extend the sample year by year and repeat the procedure until 2004.

Our models have goodness-of-fit comparable to other studies (see for example Berg et al, 2004 for the evaluation of early warning systems of currency crises). In the baseline model the value of the loss function is 67 in-sample and 76 out-of-sample. The probability of reversal given a signal equals 18% for in-sample and 13% for out-of-sample forecasts, which represents respectively 3,5 and 2,5 times the probability of reversal given no signal. The results are similar in the model that incorporates NFA. However, when we include our estimated deviations from the long term NFA equilibrium, the fit of the model strikingly improves ("Deviation 1" and "Deviation 2"): the loss function is a little above 50 for in-sample forecasts. The probability of reversal given a signal is around 7 times higher than the probability of reversal given no signal in-sample and around 3 out-of-sample. The models accounting for the sign of imbalances, "Deviation 1 NL" and "Deviation 2 NL", are even better out-of-sample: when a signal is extracted, the probability of crisis is respectively 4,5 times and 6 times the probability of crisis when there is no signal. Including the measure of countries' departures from their long term NFA improves the traditional model's performances both in and out of sample in terms of loss function and odds ratio.

However, considering the percentage of crises and tranquil periods correctly called, the assessment of the different models depend on whether one favors reversal periods or tranquil ones. With the models including deviation measures, we miss more crises than with the baseline. The loss function is smaller because those models are better to detect tranquil periods. This can be understood if we remember that our aim was not to excessively call for crises in countries with a high current account deficit but with still catching-up foreign liabilities by introducing a measure of NFA deviation. As a result, we report less false alarms.

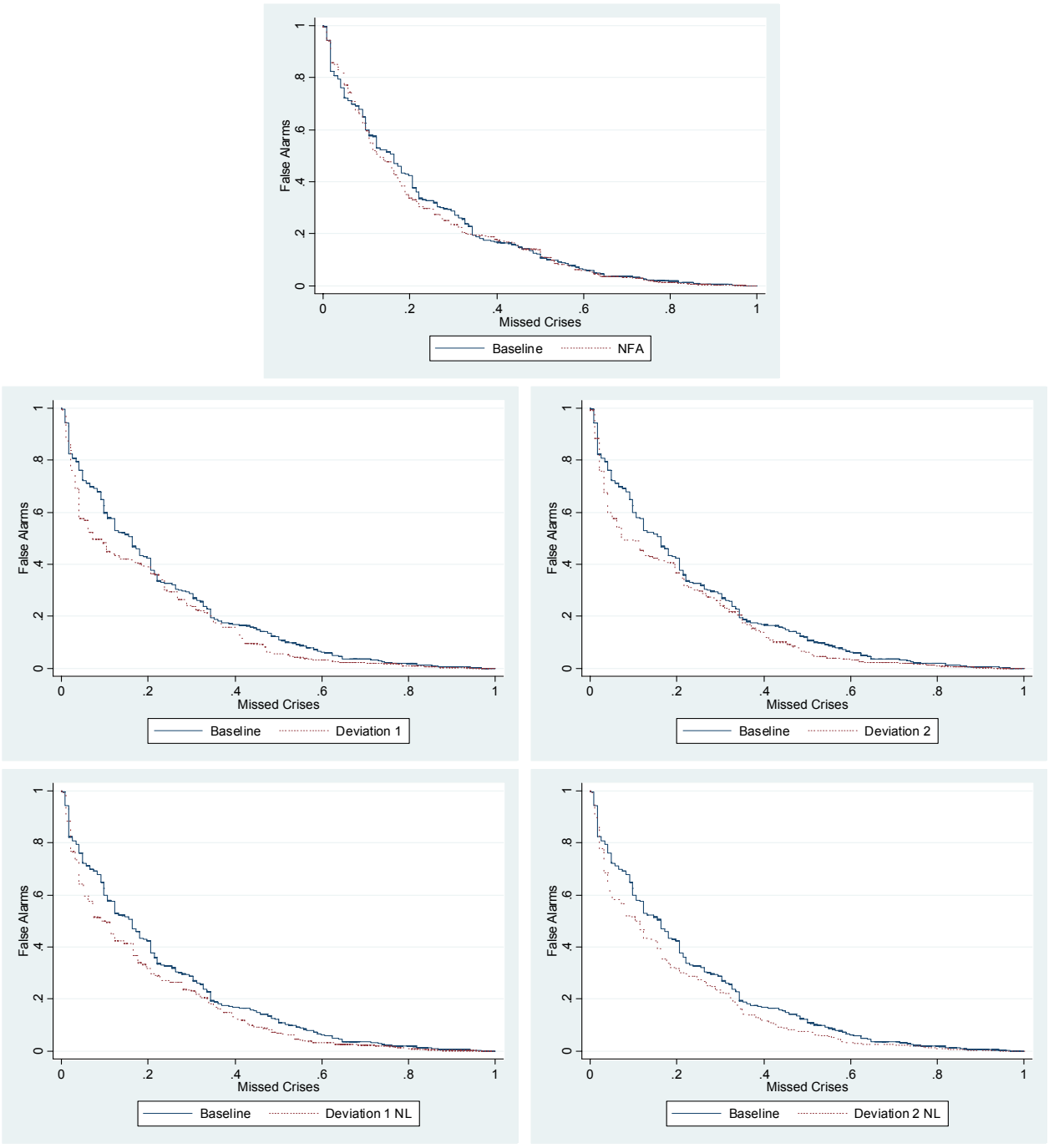
Figure 13 gives a more complete picture of the models' relative performances. Until now, we have chosen for each model the optimal cut-off with regards to a predefined loss function. It provided a particular trade-off between missed crises and false alarms. Figure 12 plots for each cut-off between 0 and 1 these shares for the 5 models that include NFA and deviations from equilibrium NFA over the whole sample. Each model is compared to the baseline. Points that are further towards the lower left are unambiguously preferred for any loss function, in that both the percent of missed crises and the percent of false alarms are lower. As shown in the figure, models including deviation measures dominate the baseline model for all cut-off definitions, in that their curves lie to the left and below the baseline model's curve. For any given percent of crises correctly called, models including NFA deviations call as many or fewer false alarms.

Table 8. Goodness of fit of the model of current account reversals

	Baseline		NFA		Deviation 1		Deviation 2		Deviation 1 NL		Deviation 2 NL	
	Whole Sample*	Out of Sample**	Whole Sample*	Out of Sample**	Whole Sample*	Out of Sample**	Whole Sample*	Out of Sample**	Whole Sample*	Out of Sample**	Whole Sample*	Out of Sample**
Cut-off[1]	15		14		21		20		11		17	
Value of loss function[2]	67	76	68	76	53	68	53	76	51	63	50	56
Percent of reversals correctly called [3]	73	57	76	68	57	56	58	42	76	58	64	61
Percent of tranquil correctly called[4]	60	67	57	56	90	77	89	82	73	79	86	83
False alarms as percent of total alarms[5]	82	87	83	88	58	84	60	84	75	82	64	78
Probability of reversal given a signal[6]	18	13	17	12	42	16	40	16	25	18	36	22
Probability of reversal given no signal[7]	5	5	5	5	6	4	5	5	4	4	5	4
Odds ratio[8]	3,6	2,5	3,5	2,5	7,6	3,6	7,3	2,9	6,7	4,5	7,3	6,0

Goodness-of-fit results are based on current account reversal models with different specifications. Out of sample results are based on rolling regression.
*: 1978-2003.
**: 1990-2004.
1. This is the cutoff probability above which a forecast is considered to signal a reversal.
2. The loss function is equal to the sum of false alarms as a share of total tranquil periods and missed reversals as a share of total reversal periods.
3. This is a number of reversals correctly called as a share of total reversal periods.
4. This is a number of tranquil periods correctly called as a share of total tranquil periods.
5. A false alarm is an observation with estimated probability of crisis above the cutoff which is not followed by a reversal.
6. This is the number of periods where a reversal was predicted and it eventually took place as a share of total predicted reversal periods.
7. This is the number of periods where tranquility was predicted and a reversal took place as a share of total predicted tranquil periods.
8. This is the ratio of the probability of reversal given a signal over the probability of reversal given no signal.

Figure 13. Trade-Off of false alarms and missed crises (In-sample forecasts) New



Missed crises: fraction of missed crises among all crises periods.
False alarms: fraction of false alarms among all tranquil periods.

5. Application to the CEECs

Our next step is to apply the methodology that we developed above to the CEECs data and see if it predicts reversals for any country in the region.

In Figure 14 we plot actual and predicted long-term equilibrium NFA, using both the linear and non-linear specification. It is easy to spot visually large negative deviations from long-term equilibrium NFA for Czech and Slovak Republics, Bulgaria, Poland and Hungary. Interestingly, our model explains rather well the direction in which NFA move in these countries. However, the observed deviation from the equilibrium is rather persistent and does not narrow during the analyzed period. All in all, the picture is rather contrasted in CEECs in terms of NFA deviations.

Figure 14. Actual and predicted NFA (linear specification: PredictedL, non-linear specification: PredictedNL)

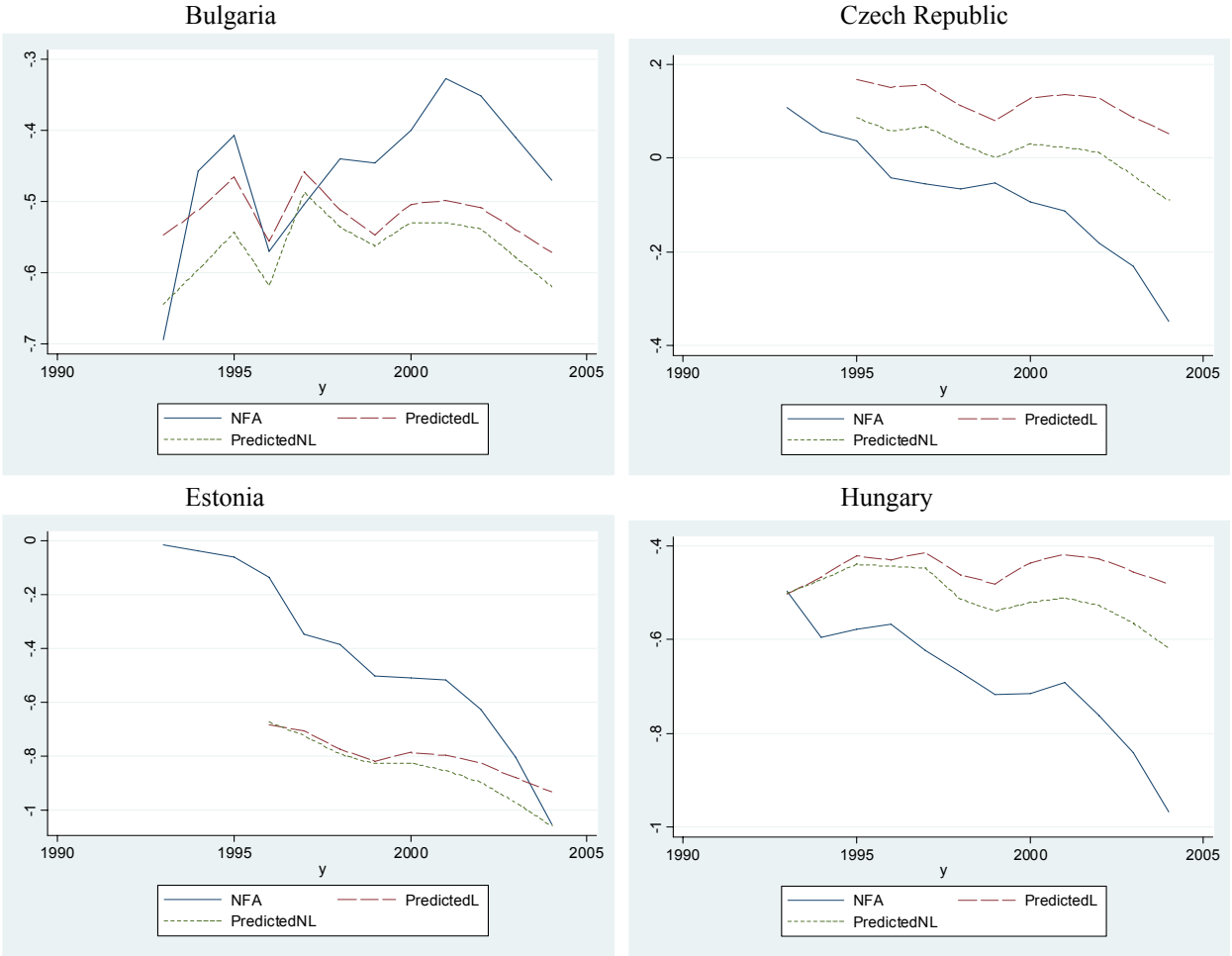


Figure 14. Actual and predicted NFA (linear specification: PredictedL, non-linear specification: PredictedNL) - Continued

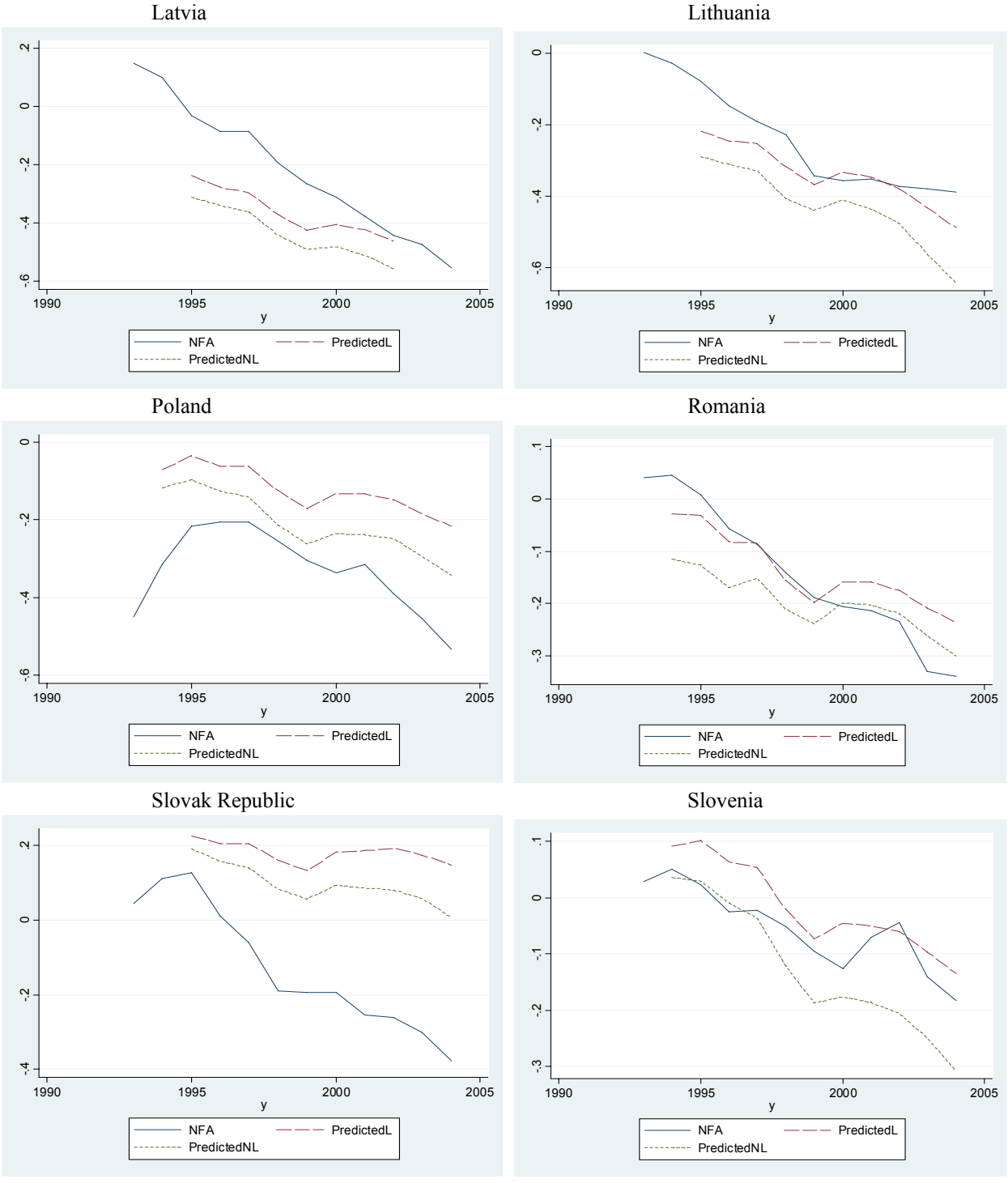


Table 9 reports the results of our forecasting exercise. In the first column we present the average current account balance in 2002-2004. In column 2 we report the ratio of NFA to GDP, and in column 3-4, we present our estimated deviations from the equilibrium NFA. Deviation 1 and Deviation 2 correspond to deviations calculated accordingly to linear and non-linear models. Then,

we present fixed effects from the cointegrating equations. Finally, we present probabilities of reversals based on the baseline model and models including NFA, Deviation 1 and Deviation 2. The probabilities of reversals that exceed the cut-off, above which we decide that a country is likely to experience a reversal, are highlighted.

Our baseline model allows us to predict reversals of current account for Estonia, Latvia and Hungary. Lithuania also appears to be under threat of reversal in the model that incorporates NFA. Our forecasts change again when we use the models that rely on our estimated deviations of NFA from their equilibria. According to those specifications, Latvia and Lithuania, which have positive deviations from their long-term NFA and thus are still catching up to higher level of foreign liabilities, do not have a positive signal anymore. On the opposite, Czech Republic, which has a negative deviation measure, is now under alarm. Other countries with high excessive net liabilities, Poland and Slovak Republic, substantially increase their probability to undergo a crisis, even though their other macroeconomic characteristics prevents them from hitting the threshold. On the whole, all models point to a high average risk of current account reversals in the CEECs compared to other regions (17-18% against 8%).

Table 9. Probabilities of current account reversals in the CEECs

						Probability of reversal			
						Baseline	NFA	Dev. 1	Dev. 2
Country	CA/ GDP	NFA/ GDP	FDI/ GDP	Dev. 1	Dev. 2				
Bulgaria	-8.5	-47.0	86.2	10.3	14.9	7.6	9.3	6.6	6.9
Czech Republic	-5.2	-34.6	143.9	-39.8	-25.6	10.3	12.7	**22.4**	20.3
Estonia	-13.2	-105.6	75.8	-12.0	0.5	**38.1**	**48.6**	**42.7**	**40.3**
Hungary	-8.9	-96.5	58.2	-48.2	-34.7	**31.2**	**42.4**	**48.2**	**44.5**
Latvia	-13.0	-55.1	58.0	3.8	16.0	**19.5**	**22.7**	17.7	16.2
Lithuania	-7.7	-38.7	69.2	10.3	25.6	14.1	**14.8**	11.6	10.2
Poland	-4.3	-53.4	63.9	-31.6	-19.1	6.1	8.3	11.6	10.2
Romania	-7.6	-34.0	73.3	-10.3	-3.9	8.2	8.5	7.2	7.0
Slovak Republic	-3.5	-37.5	95.8	-52.1	-38.2	5.6	6.6	10.7	9.6
Slovenia	-2.1	-18.3	76.8	-4.7	12.5	3.2	3.9	2.5	2.2
CEEC mean	**-7.4**	**-52.1**	**80.1**	**-17.4**	**-5.2**	**14.4**	**17.8**	**18.1**	**16.7**
Sample mean	**-1.2**	**-36.4**	**42.3**	**-13.2**	**-5.9**	**7.9**	**9.0**	**8.4**	**7.8**
Cut-off						**14.6**	**14.1**	**21.0**	**20.4**

CA/GDP, NFA/GDP and FDI/GDP represent descriptive statistics: current account balance in the last three years, net foreign assets and stock of net foreign direct investment ratios to GDP. Dev. 1 and Dev. 2 represent deviations of NFA from their long term equilibrium estimated according to linear and non-linear models, respectively. The last four columns present the probability of reversals according to the four models: baseline, including NFA, Deviation 1 and 2 (see Table 6.). The cut-off probabilities are reported in the last line and probabilities that exceed the cut-off threshold are highlighted in bold.

Taking into account the stock equilibrium of transition economies has thus an impact on the diagnosis on the countries' chances to suffer a current account reversal and the decision to signal an alarm. In the CEECs, the inclusion of measures of excess liabilities does not change the overall picture (the average risk is around 17% while it is 14% with the baseline model), but it highlights the role of catching-up in some countries and, on the opposite, pinpoints some new alarms in other cases.

6. Conclusions

In our study we investigate the evolution of external positions in the CEECs and make an attempt at predicting their future path. First of all, we analyze the long term relationship between net foreign assets and a set of variables and construct a measure of imbalances which equals to deviation of net foreign assets from their equilibrium level. Later we incorporate this measure in our predictions of current account reversals to see whether we can improve the predictive power of the baseline model which does not account for long-term disequilibria. We have shown that models including these deviations performed better than the baseline in and out-of-sample.

We apply our model to analyze short term and long term external positions of the CEECs. Based on our estimations, we predict sharp current account reversals for Estonia, which has the highest current account deficit, Hungary, which runs high and persistent deficits and has large foreign liabilities. In addition, there is a high probability of reversals in the Czech Republic, whose NFA lie below their equilibrium level.

From a methodological point of view, our paper contributes to the literature by showing that in predictions of current account reversals it is important to account for the long-term equilibrium of NFA. In our sample, Latvia has been running large current account deficits and would be under the threat of reversal if we did not take into account that it is moving to a lower level of its equilibrium NFA.

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Appendix 1. Representing the impact of the age structure on NFA

Let p_{kit}, k=1,..12, i=1,…N, t=1,…T represent the share of population of age k in country i and year t. The 12 age cohorts are the following :0-14, 15-19, 20-24,…, 60-64 and over 65. Let δ_k the coefficient associated the population share p_k:

$$NFA_{it} = \alpha + \theta X_{it} + \sum_{k=1}^{12} \delta_k p_{kit} + \varepsilon_{it}, \quad i = 1,...,N, \quad t = 1,...T \tag{*}$$

Instead of estimating all the δ_k coefficients, we impose a cubic polynomial structure on them:

$$\delta_k = \alpha_0 + \alpha_1 k + \alpha_2 k^2 + \alpha_3 k^3, \quad k = 1,...12 \tag{**}$$

Replacing δ_k, k=1,..12 in (*) using constraints (**), we obtain the following equation to estimate:

$$NFA_{it} = \alpha + \theta X_{it} + \sum_{j=0}^{3} \alpha_j dem_{jit} + \varepsilon_{it}, \quad i = 1,...,N, \quad t = 1,...T \tag{***}$$

where $dem_{jit} = \sum_{k=1}^{12} k^j p_{kit}, \quad i = 1,...,N, \quad t = 1,...T$

Moreover, since the population shares sum to 1, the vector $\left(dem_j\right)_{j=0,1,2,3}$ is collinear with the intercept and the coefficients α, α_0, α_1, α_2 and α_3. We thus impose the identifying constraint on the coefficients : $\sum_{j=0}^{3} \alpha_j = 0$ and transforming again (***), we obtain:

$$NFA_{it} = \alpha + \theta X_{it} + \sum_{j=1}^{3} \alpha_j (dem_{jit} - 1) + \varepsilon_{it}, \quad i = 1,...,N, \quad t = 1,...T$$

Using the transformed variables $(dem_{jit} - 1)$, we can restrict the number of coefficients associated to the age structure to 3. The original coefficients δ_k can be reconstructed using (**).

Appendix 2. Variable definitions and sources

Variable	Definition and source
NFA	Lane and Milesi-Ferretti (2006) measure of net foreign assets over GDP.
GDP	Log of GDP per capita in 2000 constant international dollar (World Bank).
Dem1, Dem2 and Dem3	Demographic variables constructed out of the population shares of 12 cohorts (0 to 14, above 65 and all the 5-year cohorts between them). The coefficients of these 12 shares are restricted so that they must lie along a cubic polynomial (4 parameters) and sum to zero. Following these assumptions, the number of parameters to estimate falls down to 3. We follow Lane and Milesi-Ferretti (2001) to construct the underlying 3 age variables that should be introduced to estimates those parameters. The data come from the United Nations.
Prod	index calculated as a weighted average of the principal components of 4 indicators, where the weights are given by the share of the indicators' overall variance explained by each principal component.: Literacy rate (Barro and Lee 2002), Life expectancy (United Nations), Bank credits as a percentage of GDP (World Bank), Trade : exports plus imports over GDP (World Bank).
ca	Average current account as percentage of GDP over three preceding years (World Bank).
g	Average GDP growth rate over three preceding years (World Bank).
GovCons	Government consumption over GDP (World Bank).
Inv	Investment as a percentage of GDP (World Bank).
Trade	Exports plus imports over GDP (World Bank).
FDI	Net FDI over net foreign assets (Lane and Milesi Ferretti, 2006).
Reserves	Reserves as a percentage of imports (World Bank).
g_oecd	Average growth rate in OECD countries (World Bank).

Appendix 3. Countries included in the sample

Countries	Time span		Countries	Time span	
	Cointegration	Logit		Cointegration	Logit
Albania		1993-2003	Romania	1992-2004	1993-2003
Algeria	1975-2004	1979-1991	Russian Federation	1993-2004	1993-2003
Argentina	1975-2004	1987-2004	Slovak Republic	1993-2004	1995-2003
Armenia		1997-2003	Slovenia	1992-2004	
Azerbaijan		1997-2003	South Africa	1975-2004	1994-2003
Belarus		1995-2003	Sri Lanka	1975-2004	1978-2003
Bolivia	1975-2004	1978-2003	Syrian Arab Republic	1975-2003	1978-2003
Bosnia Herzegovina		2001-2003	Thailand	1975-2004	1978-2003
Botswana	1976-2004	1978-2003	Trinidad and Tobago	1975-2004	1978-2003
Brazil	1975-2004	1978-2003	Tunisia	1975-2004	1978-2003
Bulgaria	1991-2004	1995-2003	Turkey	1975-2004	1978-2003
Chile	1975-2004	1978-2003	Ukraine		1996-2003
China	1981-2004	1984-2003	United Arab Emirates	1975-1998	
Colombia	1975-2004	1978-2003	Uruguay	1975-2004	1978-2003
Costa Rica	1975-2004	1979-2003	Venezuela	1975-2004	1978-2003
Croatia	1997-2004	1997-2003			
Czech Republic	1993-2004	1995-2003			
Dominican Republic	1975-2004	1978-2003			
Ecuador	1975-2004	1978-2003			
Egypt	1975-2004	1979-2003			
El Salvador	1975-2004	1978-2003			
Estonia	1994-2004	1994-2003			
Gabon		1980-2000			
Georgia		1999-2003			
Guatemala	1975-2004	1979-2003			
Honduras	1975-2003	1978-2003			
Hong Kong	1990-2004				
Hungary	1982-2004	1984-2003			
Indonesia	1975-2004	1983-2003			
Iran	1976-2004	1980-2000			
Jamaica	1975-2003	1978-2003			
Jordan	1978-2004	1978-2003			
Kazakhstan	1994-2004	1997-2003			
Korea	1975-2003				
Kuwait	1975-2003				
Latvia	1993-2003	1994-2003			
Lithuania	1993-2004	1995-2003			
Macedonia		1998-2003			
Malaysia	1975-2004	1978-2003			
Mauritius	1982-2004	1983-2003			
Mexico	1975-2004	1981-2003			
Morocco		1978-2003			
Oman		1978-2003			
Panama	1982-2004	1982-2003			
Paraguay	1975-2004	1978-2003			
Peru	1975-2004	1979-2003			
Philippines	1975-2004	1980-2003			
Poland	1992-2004	1993-2003			