Indirect and Compounded Effects of External Crises on Growth in Emerging Markets*

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Abstract

An attempt to quantify possible negative effects of external crises in emerging market economies is made in this paper. The direct and indirect effects of the external crises, here sudden stops in capital flows and currency crises, are estimated and compounded into composite overall effects. In addition, an alternative approach for the analysis of the dynamics is introduced. I find that a current account reversal has a negative effect, both direct and indirect, on economic growth introducing a slowdown exceeding two percentage points in the current year. On the other hand, the direct effect of currency crises is insignificant and unlike in the case of the reversal the indirect effect dominates and delivers a negative overall effect of 1.8 percentage points. The time necessary for the adjustment of actual growth back to its equilibrium rate is roughly 1.8 years after the current account reversal and 1.6 years after the currency crisis. The corresponding cumulative losses are four and 3.3 percentage points for the reversal and the currency crisis, respectively.

Keywords: External Crises, Economic Growth, Emerging Market Economies, Panel Data.

JEL Classification: C23, F32, O40, O52

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1 Introduction

A large number of developing and emerging market countries experienced considerable disturbances in their economic environment over the last few decades. The turbulent periods have mostly been brought about by a crisis or a combination of crises. The occurrence of a crisis is then perceived as a call for a new institutional and/or financial arrangement which should preserve the country from such events. Nevertheless, the choice of the arrangements is extensive, and the crisis evasion can be paid for by an arrangement unsuitable for other purposes (e.g. stabilization of business cycle fluctuations). Therefore, there is a need to distinguish among various types of crises and find whether all of them, or which in particular, are harmful before giving the recommendation for a change in the existing arrangement. In general, the crises can be approximately divided in two groups. These are namely "internal" crises (e.g. banking crises or defaults on sovereign debt) and "external" crises (e.g. currency crises and sudden stops in capital inflows). The latter are the focal point of this paper.

The theoretical literature on the possible effects of external crises on economic performance is wide-ranging. However, unlike in the case of sudden stops in capital flows that are deemed to have a negative influence on economic performance (see Calvo, 1998 and 2000, and Calvo and Reinhart, 1999) the effect of currency crises is ambiguous (Moreno (1999), Gupta et. al. (2000), Shankar (2001).

The objective of this paper is to analyze consequences of currency crises, sudden stops in capital flows (current account reversals)[1] and their concurrent occurrence for economic performance of emerging market economies. Conditioning upon sudden stops in capital flows and the joint crises is deemed to pin down the effect of currency crises

[1] The terms a sudden stop in capital flow and a current account reversal will be used interchangeably throughout the paper, since it is common to identify the former event by the latter based on the simplified national account identities.

on growth. The subsequent adjustment dynamics after such events is analyzed by introducing a possible alternative to the common analysis of the dynamics of the crises' effects.

The paper is organized as follows. Section 2 reviews recent empirical work dealing with the effect of external crises on growth. Section 3 provides estimates of the overall (compounded) effect of currency crises, current account reversals and their concurrent occurrence on economic growth. Furthermore, Section 3 explores the adjustment dynamics after the event under consideration, and Section 4 concludes.

2 Empirical Antecedents

Recent empirical research of the influences of external crises on economic performance is quite extensive in terms of approaches adopted and samples analyzed. This section summarizes the literature.

Aziz et al. (2000) search for common elements of currency crises in a broad sample of 50 industrial countries and emerging market economies over the 1975-97 period. They adopt a univariate approach and for each variable of interest (including growth), conduct a graphical "event study" to see whether its average pattern of movement before and after a crisis is different from its behavior during normal or tranquil periods. The differences in behavior between crisis and tranquil periods are then tested for statistical significance. They find that, on average, output growth returned to trend in about 1.5 years, and the cumulative loss in output growth per crisis was 4.5 percentage points relative to trend. Further, for approximately 40 percent of the currency crises, no significant output losses were identified using the applied technique.

Barro (2001) analyses the effect of currency and banking crises on growth and investment in 9 East Asian countries using a five-year grouped panel from 1980 to 2000 for 67 countries. He uses three stage least squares without country fixed effects as the estimation procedure and employs investment, initial GDP, male upper-level schooling, life expectancy, a total fertility rate, government consumption, a rule-of-law index, openness, inflation and a growth rate of terms of trade as control variables. He finds that a combined currency and banking crisis typically reduces economic growth over a five-year period by 2 % per year, compared with 3% per year for the 1997-98 crisis in East Asia. Further, he explores dynamics using lagged dummies and finds no evidence that financial crises had effects on growth that persisted beyond a five-year period. However, when analyzing the effect of banking and currency crises separately the estimates suggest that both may have a small positive effect on growth. Additionally, estimates of the lagged banking crisis' dummy in the investment equation suggest a small negative effect on investment.

Edwards (2001) analyses the circumstances surrounding major current account reversals. In particular, he investigates how frequent and how costly these reversals have been. The empirical analysis is based on a data set that covers over 120 countries over more than 25 years. He uses OLS with fixed effects and the Arellano-Bond procedure to estimate the effect of reversals on investment and feasible GLS to estimate the effect of reversals on economic growth. Regarding the growth equation he uses investment, government consumption, international trade and the initial level of GDP as a set of control variables. In his estimates of the investment equation the coefficients of the contemporaneous and lagged reversal dummies are significantly negative, with point estimates –2.06 and –0.84 percentage points, respectively. Although both private and public sector investments are negatively affected, he finds

that the impact is significantly higher on private investment. Concerning the estimates of the growth equation the results obtained support the hypothesis that current account reversals had a negative effect on GDP per capita growth, even after controlling for investment.

Hutchison and Neuberger (2001, 2002a and 2002b) analyze the impact of currency crises, currency and banking crises (twin crises) and current account reversals, currency crises and the so-called "sudden stops" on output growth. In all three papers they use a panel data set over the 1975-97 period covering 24 emerging market economies. Concerning the growth equation specification the authors use lagged real GDP, a change in budget surplus, credit growth, external growth rates, real exchange rate overvaluation and openness as control variables concurrently with the relevant impulse dummies. They employ Arellano and Bond, and Hausman and Taylor procedures for estimation, and explore the dynamics of the events under consideration by leading and lagging the crises' dummies. In the first paper they find that currency crises reduce output by about 5-8 percent over a two-three year period. Typically, growth tends to return to trend by the third year following the crisis. In the second paper they conclude that twin crises do not adversely impact on output over and above the independent effects associated with a currency and banking crisis taken together. They find that currency (banking) crises are very damaging, reducing output by about 5-8 (8-10) percent over a two-to-four year period. The cumulative output loss of both types of crises occurring at the same time is therefore very large, around 13-18 percent. The investigation undertaken in the third paper implies that sudden-stop crises have a large negative, but short-lived, impact on output growth over and above that found with currency crises. A currency crisis typically reduces output by about 2-3 percent, while a sudden stop reduces output by an additional 6-8 percent in the year

of the crisis. The cumulative output loss of a sudden stop is even larger, around 13-15 percent over a three-year period.

Milesi-Ferretti and Razin (1998) deal with a sample of 105 low and middle-income developing economies and analyze the current account reversals. They attempt to both explain the reversals and estimate the effects on output and exports resulting from sudden sharp reversals. In their "before-after" analysis they relate output growth after the reversal to its level before the reversal and to a set of explanatory variables. The latter are GDP per capita before the event, the current account deficit, interest payments, level of U.S. interest rates, the real exchange rate and the degree of openness. Estimating the cross-section sample by OLS they find that countries that had a less appreciated level of the exchange rate, higher investment and more trade openness before the event are likely to grow faster after the event. Moreover, the median change in growth between the period after and before the event is around zero; however, they detect very heterogeneous output performance.

Moreno (1999) investigates the deviation of output from its trend in the six East Asian economies around the episodes of sharp devaluation over the 1975-1996 period. He regress GDP growth, investment and consumption on the real exchange rate, nominal M2, real government expenditure, foreign output and the real Federal funds' rate (all the control variables are expressed as deviation from their trend values as well). He adds dummies identifying the banking and currency crises occurrence. The informal analysis suggests that episodes of sharp devaluation are associated with modest expansion and contraction cycles, with output above trend before a sharp depreciation episode and below trend after it. However, when estimating the growth, investment and consumption equations explicitly (using OLS and instrumental

variables) neither accounting for sharp depreciation episodes nor banking crises add to explanatory power over the period 1975–1996.

The review of some of the empirical antecedents illustrates indistinctness about the quantitative and occasionally qualitative effects of the external crises, especially those of currency crises. I am not aware of any work focusing on emerging market countries evenly across different regions that analyzes consequences of currency crises conditioning upon other external crises and considers the effect of those crises on the determinant of economic growth. Slight exceptions are papers by Barro (2001) and Edwards (2001) that estimate the effect of some external crises on investment. Nevertheless, the approach in this paper is far more complex since more than one indirect effect is considered. Moreover, the final results include composite effects of the crises on growth that compound both the direct and indirect impacts.

3 Empirical Analysis

The analysis is carried out using a broad sample of emerging market countries comprising regions of Latin America, East Asia and Central and Eastern Europe. African countries are not considered in the sample since most of them are less developed and significantly decrease homogeneity of the analyzed sample. Even though all countries of the regions mentioned cannot be considered given the data availability, I use the latter as a reasonable condition for identification of sufficiently developed countries within the regions in question. All the countries included in the sample are presented in Table A1 in the Appendix.

3.1 Identification of Currency Crises and Current Account Reversals

Currency Crises

To identify currency crises I follow the methodology proposed by Park and Lee (2001) which is based on the identification of currency crises introduced by Frankel and Rose (1996). They identified these kinds of crises with large nominal deprecations of a country's currency over a short period. The more rigorous identification of Park and Lee, recently applied by Barro (2001), defines a currency crisis as a situation in which the nominal depreciation of the currency was at least 25 percent during any quarter of the year and exceeded by at least 10 percentage points the depreciation of the currency in the previous quarter. I apply this kind of identification to the sample of emerging market countries and use, due to data-availability constraint, a month-to-month change as a measure of the necessary condition. Using such method 35 currency crises from 590 observations for the total of 59 EM countries have been identified; 17 of them in Central and Eastern Europe, 5 in East Asia and 13 in Latin America. The exact number of crises and the number of available observations for each particular country are presented in the Appendix in Table A1[2]. The time profile of currency crises, current account reversals and their joint occurrence (the crises) is portrayed in Figure 1 for the entire sample of EM countries.

Figure 1 Here

Current Account Reversals

So-called "sudden stops" in capital flows are viewed as more harmful for economic growth (at least in the short run) relative to currency crises (see e.g. Hutchison and

[2] Although only the provided identification is used throughout this paper, I have also include currency crises' dummies based on the sufficient condition only, i.e. 10% quarter-to-quarter devaluation, into the regression equation. Surprisingly, such optional dummy appeared to be more significant bearing a larger negative coefficient relative to the primary one.

Neuberger, 2002b). It is common practice to identify such "sudden stops" with current account reversals beyond certain threshold (see. e.g. Hutchison and Neuberger, 2002b; Edwards, 2001 or Milesi-Ferretti and Razin, 1998 and 1999). Initially, I consider two thresholds following in this respect Milesi-Ferretti and Razin. A current account reversal is thus defined as a positive change of the current account balance-to-GDP ratio of at least 3 % (alternately 5 %) in the particular year[3,4]. Applying this criteria 76 current account reversals have been identified using 453 observation on the change in current account-to-GDP ratios in the total of 59 EM countries during 1993-2001; 29 of them in Central and Eastern Europe, 23 in East Asia and 24 in Latin America. The exact number of the reversals for each country and the available observations are provided in the Appendix in Table A1.

Joint Occurrence of Currency Crises and Current Account Reversals[5]

The joint occurrence of a currency crisis and a current account reversal is expected to have an additional effect on economic performance of EM countries since both sets of transmission channels of negative effects associated with the two slightly different events are in force and combined together. I identify 12 joint occurrences of currency

[3] For instance, Edwards uses another alternative measure that is less restrictive and identifies currency crises with a positive change in the current account-to-GDP ratio of at least 3 % in three consecutive years. On the other hand, Hutchison and Neuberger impose, alternatively, an additional condition that the post-reversal current account deficit is higher than –1 % of GDP. This is motivated by the hypothesis that capital inflow reversals will be especially painful if they constitute an almost complete stop in capital inflows (or even capital outflows). In my robustness checks I also control for the size of the reversal (as a fraction of GDP). The approach applied here is therefore a mixture of the two since I use two thresholds of 3 % and 5 % but we are concerned with changes in the current account relative to GDP.

[4] The results provided further in this paper are associated with the 3% threshold only. The inclusion of dummy indicating the 5% reversal appeared to be of the similar significance and a somewhat higher magnitude proportional to the difference between the two thresholds.

[5] Only such joint occurrence of a currency crisis and a current account reversal is deemed to be the so-called "sudden stop" in Hutchison and Neuberger.

crises and current account reversals from 453 available observations for the total of 59 EM countries during 1993-2001; 4 of them were identified in Central and Eastern Europe, 3 in East Asia, and 5 in Latin America. The number of such events for each country is provided in Table A1 in the Appendix.

3.2 Methodology

In what follows I propose an approach for estimation of the overall (compounded) effects of currency crises, current account reversals and their joint occurrence on growth and perform such estimation subsequently. After that I examine the adjustment dynamics of the economic growth itself and all the explanatory variables found to be influenced by the events. Accordingly, a cumulative loss as a result of the events and the time necessary for the adjustment back to the equilibrium growth are estimated.

Why Bother with an Indirect Effect?

In general, an effect of a shock that hits an economy is usually pronounced through a number of variables. Therefore, in such a situation pitfalls arise if one attempts to model equilibrium behavior of variable y_t by regressing it on other variables x_t. Such pitfalls are even more obvious when an impact of the shock (assuming it can be identified) on the y_t variable is to be estimated. For illustration, consider the following regression: $y_t = \alpha x_t + \varepsilon_t$.

Plausible performance of the regression when both y_t and x_t are affected by the shock is described in Figure 2 below.

Figure 2 Here

Assume the equilibrium behavior of the y_t variable is described by the fitted values of the regression in tranquil periods, i.e. $\alpha_T x_t^*$. At time 0, when the economy is hit by the shock, $\alpha \neq \alpha_T$ and $x_t \neq x_t^*$. By including a dummy variable which identifies the shock only a portion of the impact on the y_t series is obtained. We can think of this portion as being a "direct" effect of the shock as it is labeled in crises literature. The direct effect is therefore equal to $y_t - \alpha x_t$. The value of αx_t would lie somewhere in between of $\alpha_1 x_{1t}$ and $\alpha_2 x_{2t}$, presumably closer to $\alpha_1 x_{1t}$. As it is apparent from Figure 2 when regressing y_t on x_t and the identification dummy one simply ignores the $\alpha_1 x_{1t} - \alpha_T x_t^*$ component. What will be referred to below as being an indirect effect is therefore the difference between the actual value of x_t and the value it would take if the shock did not occur, i.e. $x_t - x_t^*$ multiplied by α_T, i.e. how much of this effect is passed through to the y_t variable. In particular cases the importance of the indirect effect depends on how big is the impact of the shock on the explanatory variables and how much movements in these variables influence the dependent variable. It can therefore appear that the indirect effects may have, with respect to the direct effect, an opposite impact on the y_t variable and sometimes even dominate the direct effect. Given the discussion the correct model to assume, regarding the possible difference in slope coefficients, would be $y_t = \alpha x_t + (\alpha \times cd_t) x_t + \varepsilon_t$ where cd_t is a dummy variable that takes value one if the particular country experienced a crisis during the time span analyzed and zero otherwise. Nevertheless, the hypothesis that the slope coefficients for crises and non-crises countries are different has to be supported by an appropriate test.

Compounded Effect

The compounded (overall) effect of each crisis is defined here as a sum of the estimated direct and weighted indirect effects of the particular crisis, as described by equation (1):

$$event = event^{direct} + \hat{\boldsymbol{\alpha}}_T event^{indirect} \qquad (1)$$

where $event$ stands for the compounded effect of current account reversals, currency crises and their joint occurrence, respectively. $event^{direct}$ stands for the estimated direct effect and similarly $event^{indirect}$ for the indirect effects of the particular crisis. $\hat{\boldsymbol{\alpha}}_T$ is a vector of structural coefficients that characterize the impact of the particular control variable on growth. Hereafter I explain how all the three components used in equation (1) are defined and obtained.

Direct Effects

Consider a growth equation of the following form:

$$growth_{t,i} = \boldsymbol{\alpha}\, \boldsymbol{x}_{t,i} + \boldsymbol{\beta}\, \boldsymbol{z}_{t,i} + \boldsymbol{\delta}\, \boldsymbol{d}_{t,i} + \varepsilon_{t,i} \qquad (2)$$

where dependent variable is percentage change in real GDP and the first two RHS vectors are control variables and the third vector contains the crises dummies. $\boldsymbol{\alpha}$, $\boldsymbol{\beta}$, and $\boldsymbol{\delta}$, are the estimated coefficients; $\boldsymbol{\delta}$ being estimates of the direct effects. The attribute differentiating the first two vectors is whether the variables included in these vectors are affected by the crises themselves and whether such effect is not only tautological. The vectors are defined in a following way:

$$\boldsymbol{x}_{t,i} \equiv [invest_{t-1,i}, govcons_{t-1,i}, infl_{t-1,i}, ir_{t-1,i}]'$$

where *invest* is the ratio of fixed capital formation to GDP, *govcons*, the ratio of government expenditure to GDP, *infl*, the percentage change in CPI, and *ir* an

interest rate and it is assumed that a higher level of the latter two implies their higher volatility. All the x variables are lagged one period due to their possible endogeneity[6]. Similarly,

$$\boldsymbol{z}_{t,i} \equiv [rer_{t-1,i}, open_{t-1,i}, gdp_{t-1,i}]'$$

where *rer* is a bilateral real exchange rate with respect to the U.S. dollar, *OPEN*, the ratio that captures the degree of openness of the economy, calculated as a sum of imports and exports per GDP, *gdp* is the real GDP index (in levels) controlling for the influences of the business cycle still present in the data regarding their frequency and approximating the "short-run convergence" term[7]. Real exchange rate and measure of openness are again lagged one period due to their possible endogeneity. Moreover,

$$\boldsymbol{d}_{t,i} \equiv [cc_{t,i}, rev_{t,i}, cc{\times}rev_{t,i}]'$$

where *CC* and *REV* are impulse-dummy variables that take the value of one if the particular country has experienced a currency crises or current account reversal in the given period, respectively, and zero otherwise. A dummy that captures the effect of the joint occurrence of the two events and allows for non-linearity is considered as well.

Finally, i stands for individuals (countries)[8], t for the time period and $\boldsymbol{\varepsilon}$ is the residual term. All the data are from International Financial Statistics (IFS).

The error term of equation (2) is assumed to take the following form:

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[6] This can be seen as similar to IV procedure when the auxiliary model is assumed to be an AR(1) process

[7] Growth equations have on the right-hand side two vectors of variables: (a) determinants of potential output (capital stock, measure of education and institutional development, the convergence term, etc.) and (b) short-term shocks (inflation, terms of trade, etc.). The lagged value of *gdp* is applied due to the failure of including a sufficient number of short-run determinants. It is not a convergence term from the growth theory perspective. Intuitively, when the β_{gdp} coefficient is not different from 1 the *gdp* variable should be excluded from the regression (there is no business cycle influence).

[8] Here only crises countries are considered. Why it is so is explained in the next section when the hypothesis that $\boldsymbol{\alpha} \neq \boldsymbol{\alpha}_t$ it is that the slope coefficients for the crises countries are different from those for non-crises countries.

$$\varepsilon_{t,i} = \mu_i + \nu_{t,i} \qquad (3)$$

where $\boldsymbol{\varepsilon}_i$ is a country error term and $\boldsymbol{\mu}_{ti}$ is a standard disturbance term. Thus, I do not allow for time-specific effects and assume that there was no common event affecting all the countries in any particular year. Given the interest in EM countries, it is further assumed that the sample is complete and is not randomly taken out of some larger homogenous sample. The fixed effect specification is therefore appropriate.

$\boldsymbol{\alpha}_T$ *Coefficients*

Here the interest is in $\boldsymbol{\alpha}_T$ coefficients that would efficiently weigh (translate) the impact of the indirect effects passed through on growth, i.e. such $\boldsymbol{\alpha}_T$'s that describe an economy under standard circumstances when the economy is approximately growing at an equilibrium rate. In this respect, we can suspect that the link between growth and the explanatory variables is likely to be disrupted, if the country experienced a crisis, or is not behaving well if the country is about to experience a crisis. To support this premise the Wald test with H_0: $H_0 : \alpha - (\alpha \times cd) = 0$ is performed after running the regression[9]:

$$growth_{t,h} = \boldsymbol{\alpha}\, \boldsymbol{x}_{t,h} + (\boldsymbol{\alpha} \times cd)\, \boldsymbol{y}_{t,h} + \tau_{t,h} \qquad (4)$$

where j is the number of non-crises countries, $h = i + j$, cd_t is a dummy variable that takes value of one if the particular country experienced a crisis during the time span analyzed and zero otherwise and $\boldsymbol{y}_{t,h}$ is a vector obtained by concatenating vectors $\boldsymbol{x}_{t,h}$ and $\boldsymbol{z}_{t,h}$. $\tau_{t,h}$ bears the same properties as the error term in equation (2). The corresponding Wald test is $F(7,332) = 250.34[0.000]$ and rejects the $H_0 : \alpha = \alpha \times cd$ at 1 % significance level. This result supports the idea that only

[9] The regression estimates are not reported for brevity.

coefficients estimates for the sample of non-crises countries should be considered as the efficient weights.

To be able to apply those coefficient estimates for the entire sample of countries an assumption that the entire sample of countries is fairly homogenous has to be made. Such an assumption is commonly made when the General Evaluation Estimator (GEE) method is applied (see e.g. Goldstein and Montiel, 1986; Dicks-Mireaux, Mecagni and Schadler, 2000; and Hutchison, 2001). Thus, the following equation is estimated in order to evaluate the $\boldsymbol{\alpha}_T$ coefficients:

$$growth_{t,j} = \boldsymbol{\alpha_T}\, \boldsymbol{x}_{t,j} + \boldsymbol{\beta_T}\, \boldsymbol{z}_{t,j} + \varepsilon_{t,j} \qquad (5)$$

where j is the number of non-crises countries and the error term bears the same properties as the one in equation (2).

Indirect Effect

The third and last component necessary for the calculation of the compounded effect is an unbiased and consistent estimate of the indirect effect of the crises, i.e. an effect of the crises on control variables $\boldsymbol{x}_t$. For this purpose consider an equation of the following form:

$$x_{t,l} = \boldsymbol{\phi}\, \boldsymbol{x}_{t,l} + \boldsymbol{\varphi}\, \boldsymbol{w}_{t,l} + \boldsymbol{\gamma}\, \boldsymbol{d}_{t,l} + \upsilon_{t,l} \qquad (6)$$

where l is the number of countries considered and the error term is defined as in equation (3). $\boldsymbol{\phi}, \boldsymbol{\varphi}$ and $\boldsymbol{\gamma}$ are estimated coefficients; $\boldsymbol{\gamma}$ being estimates of the indirect effects. The vectors $\boldsymbol{x}_{t,l}$ and $\boldsymbol{d}_{t,l}$ are similar as in equation (2) and $\boldsymbol{w}_{t,l}$ is defined as follows:

$$\boldsymbol{w}_{t,i} \equiv [growth_{t-1,i}, rer_{t-1,i}, open_{t-1,i}]' .$$

When estimated the sample is truncated in such a way that it contains only observations prior to the periods when either of the crises occurred for the first time within the time period considered. Only those countries that provide at least three observations prior to the event are considered. This is done to exclude observations which are likely to be biased by either of the crises' occurrence. The periods in which either of the crises occurred for the first time are then added. This can be seen as additional identification to get unbiased estimates.

3.3 Estimations

Direct Effect

Following the proposed approach, equation (2) is estimated first by a method of maximum likelihood (ML).

Table 1 Here

The applied set of control variables seems to be on average significant and the estimation shows a reasonable fit. The reversals in current account appear to represent a significant damage for the economy decreasing the economic performance in the current period by almost two percentage points. This finding supports the idea that the foreign and domestic capitals are not substitutes and that the domestic economy is not capable to generate saving that would substitute the sudden stop in foreign capital inflows in the short run. The significant devaluations that characterize currency crises seem to hinder economic growth in the domestic country by 0.6 percentage points, however, this effect seems to be insignificant. Finally, the most detrimental effect on growth comes from the joint occurrence of currency crises and current account reversals according to the estimates. The combination of the sudden stop in the foreign capital inflows and large devaluations depresses growth in the domestic

economy by devastating seven percentage points. Nevertheless, the overall effect of the events can still be considerably different as shown in Figure 3.

$\boldsymbol{\alpha}_T$ *Coefficients*

The estimates of the structural coefficients of the control variables involved in the indirect effect using the sample of non-crises countries are reported in Table 2.

Table 2 Here

Starting with the investment coefficient, a 1 % increase in investment raises economic growth by 0.15 %. Similarly, an increase in government consumption appears to have, on average, a positive effect on short-run growth. The impact of inflation on growth is surprisingly positive and can illustrate the positive effect of mild inflation on innovation and quality improvement. Nevertheless, this estimate requires further investigation. The negative impact of interest rate volatility that arises at higher interest rates has been supported by the estimation results. Negative signing of the real exchange rate suggests that an excessive depreciation or undervaluation of the domestic currency hinders output growth in the domestic country. RER undervaluation has a negative effect, especially on EM countries in their early stage of development when they import technology and production capital[10]. The magnitude of the coefficient on the measure of openness suggests a positive impact of foreign trade on growth. However, this effect appears to be insignificant.

[10] It is well known from the literature on the dynamic of the current account that the trade balance is likely to follow the so-called U-shape during the catching-up process of emerging markets with industrial countries.

Indirect Effects

In the next step, the indirect effect of the crises on relevant explanatory variables[11] is estimated using the truncated sample as described in Section 3.2. The estimations of equation (3) are presented, in their parsimonious versions (following the general-to-specific approach), in Table 3:

Table 3 Here

All the estimations show a very good fit. The investment ratio shows moderate persistence that is highly significant. A significant negative effect of government consumption on fixed capital formation can be observed. As for growth the higher inflation associated with higher uncertainty appears to have significant negative impact on investment. Real depreciation of the domestic currency reduces the investment ratio by increasing the relative price of imported technology and other imports of capital goods. This finding is consistent with the estimation for growth. The impacts of both the current account reversal and the currency crisis are significantly negative and of a similar magnitude. The estimates for the joint crisis produce a non-linear positive effect on investment.

Government consumption shows average persistence that is highly significant. Investment seems to have mild positive effect on government consumption. Conversely, real exchange rate depreciation has a negative impact on government consumption. Both the current account reversals and currency crises have significant negative effects on government consumption. In addition, the joint crisis significantly magnifies the negative effect.

[11] These are those variables not affected by the events by definition. Therefore, the measure of openness and the real exchange rate with respect to the U.S. dollar are excluded.

Also inflation shows significant persistence of approximately 40 % according to the results. The other significant positive impacts on inflation come from investment, interest rate volatility and the pass-trough effect of the real exchange rate. Government consumption seems to have a mildly negative impact on inflation. The results suggest that the current account reversal has mild positive and the currency crisis negative effect on inflation movements. However, the joint occurrence of the reversal and the currency crisis raise inflation in the affected country by the large amount of 46 percentage points.

Interest rate movements exhibit significant persistence of a moderate magnitude. The effects of investment and inflation appear to be significant and positive, and those of government consumption and real exchange rate significantly negative. The current account reversals lower interest rate on average by 0.4 percentage point as opposed to currency crises which make interest rates increase by significant 5 percentage points. The joint crisis does not generate any additional effect on the top of the latter two.

Calculation of the Compounded Effects of the Crises

As described in equation (1) the compounded effects of the crises is calculated as a sum of their direct and weighted indirect effects. The weights applied are the estimated coefficients $\boldsymbol{\alpha}_T$ (see Table 2). By substituting the relevant estimated coefficients into equation (1) we obtain:

$$event = event^{direct} + 0.15event_{invest}^{indirect} + 0.20event_{govcons}^{indirect} + 0.24event_{infl}^{indirect} - 0.21event_{ir}^{indirect} \quad (6)$$

The compounded effects of the currency crises, current account reversals and their join occurrence are then calculated according to equation (6) by substituting in relevant estimates from Tables 1 and 3. The results are presented in Table 4:

Table 4 Here

The direct and indirect effects of current account reversals add up according to the result so that the compounded negative effect exceeds two percentage points. Since the direct effect of currency crises appeared to be insignificant the indirect effect determines the overall impact that is negative of about 1.8 percentage points. Finally, the joint crisis representing the non-linear fragment has controversially positive effect that is the outcome of the high coefficient on inflation. Exclusion of the latter effect would produce more plausible results.

3.4 Dynamics

This subsection focuses on the dynamics of the compounded effect of the crises on economic growth. It attempts to answer the following question: How fast or slow is the adjustment of output growth after a shock (a crisis) back to its equilibrium path. In other words, the time necessary to "get back on track" after the crises is estimated.

In the recent literature the dynamics of current account reversals and currency crises has been mostly analyzed using the leads and lags of identification dummies (see Section 2). Significance of such leads or lags should have then revealed whether the crisis had a long lasting or anticipation effect on growth. Such an approach is, however, likely associated with certain pitfalls. Regarding the implementation of the leads without leading other explanatory variables why would one believe that the dummies pick up just the information bit pertaining to the anticipation effect of the

crisis onset and not an effect pertaining to the anticipation of e.g. higher borrowing costs (interest rates) or a decline in investment.

Another issue may be incorporation of the lags for a similar purpose. Even though the economic intuition is clear in this case, the intended outcome may not be achievable. As discussed before if the crises affect the explanatory variables as well the dummies may not be capable to pick up the targeted impact of the event. In this case three concepts of economic growth have to be considered. These are the actual growth, the estimated growth and the growth that would have been present if the event had not occurred (equilibrium growth). More specifically, after the crisis occurred onwards, all the explanatory variables that have positive (negative) effect on growth and are negatively (positively) affected by the crisis themselves show lower (higher) values relative to what they would have showed if the crisis did not appear. It means one period after the crisis onwards there is a difference between the estimated growth and the equilibrium one. Since the estimated growth is fitted to the data on the actual growth and the equilibrium growth is likely to lie somewhere else the dummies would fail to be an effective tool for the analysis of the dynamics. Given the pitfalls discussed and the fact that the dummies may further pick up other effects, regardless whether they are associated with the event or not, an approach which seems to be more time consistent and explicit is followed here.

It is assumed that there exists equilibrium growth driven by fundamentals. Once the crisis occurred such shock makes the actual growth deviate from its equilibrium path. This deviation is further reinforced if the positive (negative) determinants are dampened (boosted) by the crisis itself. The convergence of the actual growth back to its equilibrium is then given by what I call "the compounded factor of adjustment" (CFA). The latter is obtained by compounding the speed of convergence in output

growth and all the explanatory variables carrying the indirect effect. The speed of convergence in variables of interest is estimated by running the following regression:

$$\Delta^2 x_{it} = \omega \Delta x_{i,t-1} + \eta_{it} \qquad (7)$$

where x stands for the variables of country i included in equation (2). $\boldsymbol{\omega}$s are estimated common, convergence coefficients to be used for calculation of the CFA as described in equation (8). $\boldsymbol{\eta_{it}}$ bears the same properties as the residual term in equation (2). As can be seen in equation (8) the convergence coefficients are compounded using the $\boldsymbol{\alpha}_T$ coefficients' estimates as weights:

$$CFA = \hat{\omega}_{growth} + \hat{\alpha}_{T,invest}\hat{\omega}_{invest} + \hat{\alpha}_{T,govcons}\hat{\omega}_{govcons} + \hat{\alpha}_{T,infl}\hat{\omega}_{infl} + \hat{\alpha}_{T,ir}\hat{\omega}_{ir} \qquad (8)$$

where, for example, $\hat{\alpha}_{T,invest}$ is 0.147 (see Table 2). The estimated common convergence coefficients and the calculated CFA are provided in Table 5:

Table 5 Here

We can infer from Table 5 that output growth shows quite strong convergence back to its equilibrium and rapidly eliminates any deviation from long-run trend[12]. Government consumption and inflation show moderate and investment and interest rates mild strength of convergence to their equilibrium paths. When using the formula described in equation (9) CFA amounts to -1.19, i.e. that the adjustments of the explanatory variables significantly contribute to the adjustment of the economic growth after a shock.

Since the compounded effect of the crises and the CFA are identified we can easily compute the *time* necessary for the full adjustment back to the equilibrium and the

[12] This may in fact demonstrate that the choice of yearly frequency is not far from being suitable for the analysis of economic growth.

resulting *cumulative loss* of economic performance. The intuition is captured in Figure 2 below which outlines all the main features of a stylized adjustment after a crisis.

Figure 2 Here

As outlined in Figure 2 the adjustment path is approximated by a trajectory equal to the hypotenuse of a triangle the other two sides of which are the overall size of the shock ("Size of the Shock" given by the Compounded Effect of a crisis) and the time necessary for the full adjustment (Adjustment Periods). The slope of the hypotenuse, which represents the overall strength of adjustment, is given by CFA. All the results are summarized in Table 6 below:

Table 6 Here

The intuition behind Table 6 is as follows. Assumed that the system is initially in equilibrium, i.e. economic growth is determined purely by the relevant long-run fundamentals. Then occurs a crisis period when the growth is forced to deviate from its long-run path. The "Size of the Shock" column gives the magnitude of deviation in this period zero for each event. The consequent time necessary for the full adjustment back to the long-run equilibrium is calculated in the next column "Length of Adjustment". For instance, given that the loss of output growth in the period zero when the current account reversal occurred is 1.88 percentage points the economy needs additional 1.8 years for the full adjustment. Thus the overall contraction period spans over 2.8 years (Period Zero + 1.8 years). Finally, the cumulative loss provided in the last column is calculated as a sum of the current compounded effect and losses in subsequent periods until the full adjustment. It is therefore a sum of the loss in period zero and the cumulative loss during the periods of adjustments. Both the *overall* cumulative loss and the cumulative loss *during the adjustment process* (provided in parentheses) are presented in Table 6.

We can infer from Table 6 that both reversals in current account and currency crises are associated with a significant loss in output growth of four and three percentage points, respectively and adjustment process that lasts 1.8 and 1.6 years, respectively. The effect of the combined crisis (the non-linear fragment) seems to last for three years.

4 Conclusions

This paper has estimated impacts of current account reversals and currency crises on economic growth. The former should have, according to theory, a negative effect on growth at least in the current period. The effect of the latter event is rather ambiguous regarding the plausible underlying theory.

The empirical findings were divided into four sections. In the first, the three crises, i.e. the current account reversal, the currency crisis and the joint crisis were identified and discussed with respect to the sample of countries considered. In the second, the definition of the compounded effect was introduced together with a discussion on importance of the indirect effect. Then the proposed approach is described and the whole system outlined.

In the third section, the direct effect of the crises was estimated using the standard growth equation with investment, government consumption, inflation, interest rates, the degree of openness, the real exchange rate and the convergence term as control variables. Significant negative impacts of current account reversals and the joint crisis on growth were found. The direct effect of currency crises is also negative but appeared to be insignificant.

The structural coefficients of the explanatory variables from the growth equation are estimated subsequently. These are needed for the calculation of the compounded

effect since they are used as weights when adding up the direct and indirect effects of a particular crisis. The indirect effect of the crises on all variables possibly affected is estimated, as it is the last item necessary for calculation of the compounded effect. The variables affected by definition are not considered in this respect. I find a negative influence of current account reversals and currency crises on investment, whereas their concurrent occurrence resulted in a positive non-linear impact. The indirect effect on government consumption coming from the three events is negative. The estimation of the inflation equation reveals a mild positive effect of the current account reversal, a negative effect of the currency crisis and a large positive effect of the joint crises. Concerning the indirect effects on the interest rate, current account reversals appear to have a mild negative impact whereas currency crises a considerable positive impact. The joint crisis turned up to be insignificant in this case.

Next the compounded effect of the crises was calculated. The current account reversal delivers a decline in output of 1.9 percentage points in the current period. The currency crisis causes even a larger drop in output growth since the direct effect was amplified by the indirect effect which dominates in the case of the currency crisis.

Finally, based on the estimated unconditional convergence factors I calculated the time necessary for the full adjustment of the actual growth to its equilibrium level after a shock. The calculations suggest that the affected country needs roughly 1.8 and 1.6 years to recover from the recession resulting from the current account reversal, and the currency crises, respectively. The estimated cumulative losses for current account reversals and the currency crisis are four and 3.3 percentage points respectively.

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Appendix

Table A1 Identification of Current Account Reversals, Currency Crises and Their Joint Occurrence in Emerging Markets 1992-2001

Country	Obs.	REV	%	Obs.	CC	%	Obs	REV×CC	%
Argentina	9	0	0.0	10	0	0.0	9	0	0.0
Bahamas	4	0	0.0	10	0	0.0	4	0	0.0
Barbados	7	1	14.3	10	0	0.0	7	0	0.0
Bolivia	9	1	11.1	10	0	0.0	9	0	0.0
Brazil	9	0	0.0	10	3	30.0	9	0	0.0
Colombia	9	1	11.1	10	0	0.0	9	0	0.0
Costa Rica	9	1	11.1	10	0	0.0	9	0	0.0
Ecuador	8	2	25.0	10	3	30.0	8	1	12.5
Grenada	9	2	22.2	10	0	0.0	9	0	0.0
Guatemala	9	0	0.0	10	0	0.0	9	0	0.0
Haiti	6	1	16.7	10	0	0.0	6	0	0.0
Honduras	8	1	12.5	10	0	0.0	8	0	0.0
Chile	8	1	12.5	10	0	0.0	8	0	0.0
Mexico	9	1	11.1	10	1	10.0	9	1	11.1
Nicaragua	8	4	50.0	10	1	10.0	8	1	12.5
Panama	8	2	25.0	10	0	0.0	8	0	0.0
Paraguay	9	1	11.1	10	0	0.0	9	0	0.0
Peru	8	0	0.0	10	0	0.0	8	0	0.0
Surinam	6	1	16.7	10	3	30.0	6	1	16.7
Uruguay	8	0	0.0	10	0	0.0	8	0	0.0
Venezuela	8	4	50.0	10	2	20.0	8	1	12.5
Latin America	168	24	14.3	210	13	6.2	168	5	3.0
Continues...									
Bangladesh	8	0	0.0	10	0	0.0	8	0	0.0
China, Hong Kong	4	1	25.0	10	0	0.0	4	0	0.0
China, Mainland	8	2	25.0	10	1	10.0	8	1	12.5
India	8	0	0.0	10	0	0.0	8	0	0.0
Indonesia	8	1	12.5	10	2	20.0	8	1	12.5
Korea	9	1	11.1	10	1	10.0	9	0	0.0
Laos	7	2	28.6	10	1	10.0	7	1	14.3
Malaysia	8	2	25.0	10	0	0.0	8	0	0.0
Nepal	8	1	12.5	10	0	0.0	8	0	0.0
Pakistan	8	1	12.5	10	0	0.0	8	0	0.0
Papua New Guinea	7	4	57.1	10	0	0.0	7	0	0.0
Philippines	9	2	22.2	10	0	0.0	9	0	0.0
Singapore	8	3	37.5	10	0	0.0	8	0	0.0
Sri Lanka	9	0	0.0	10	0	0.0	9	0	0.0
Thailand	9	2	22.2	10	0	0.0	9	0	0.0
Vietnam	8	1	12.5	10	0	0.0	8	0	0.0
East Asia	126	23	18.3	160	5	3.1	126	3	2.4

Continues...

Armenia	5	1	20.0	10	3	30.0	5	0	0.0
Belarus	1	0	0.0	10	1	10.0	1	0	0.0
Bulgaria	8	2	25.0	10	3	30.0	8	2	25.0
Croatia	7	3	42.9	10	1	10.0	7	0	0.0
Cyprus	8	2	25.0	10	0	0.0	8	0	0.0
Czech Republic	7	1	14.3	10	0	0.0	7	0	0.0
Estonia	9	2	22.2	10	0	0.0	9	0	0.0
Greece	6	0	0.0	10	0	0.0	6	0	0.0
Hungary	9	1	11.1	10	0	0.0	9	0	0.0
Ireland	6	0	0.0	10	0	0.0	6	0	0.0
Kazakhstan	9	2	22.2	10	2	20.0	9	1	11.1
Kyrgyz Republic	5	2	40.0	10	0	0.0	5	0	0.0
Latvia	9	1	11.1	10	0	0.0	9	0	0.0
Lithuania	7	1	14.3	10	0	0.0	7	0	0.0
Malta	9	2	22.2	10	0	0.0	9	0	0.0
Poland	8	1	12.5	10	0	0.0	8	0	0.0
Portugal	7	0	0.0	10	0	0.0	7	0	0.0
Romania	8	3	37.5	10	2	20.0	8	0	0.0
Slovak Republic	8	2	25.0	10	0	0.0	8	0	0.0
Slovenia	9	1	11.1	10	1	10.0	9	0	0.0
Turkey	8	1	12.5	10	2	20.0	8	1	12.5
Ukraine	6	1	16.7	10	2	20.0	6	0	0.0
CEE	159	29	18.2	220	17	7.7	159	4	2.5
Total	453	76	16.8	590	35	5.9	453	12	2.6

Table 1 Estimation of the Direct Effects on Growth

Variable	MLE
gdp(-1)	-0.098 (0.008)***
invest(-1)	-0.046 (0.024)*
govcons(-1)	-0.024 (0.070)
open(-1)	-0.003 (0.006)
rer(-1)	-0.007 (0.007)
infl(-1)	-0.043 (0.006)***
ir(-1)	-0.027 (0.018)
rev	-1.948 (0.168)***
cc	-0.604 (0.427)
cc×rev	-7.058 (0.777)***
R^2	0.439
#Observations	202
#Countries	30

The estimation method is ML using White heteroskedasticity consistent standard errors and covariance. The dependent variable is percentage GDP growth. The regression equation includes fixed effects (not reported for brevity). *, **, *** - stand for the significance of the particular variable at 5%, 10% and 1% level, respectively. S.E. are in parentheses.

Table 2 Estimation of the $\boldsymbol{\alpha_T}$ Coefficients

Variable	MLE
gdp(-1)	-0.067 (0.008)***
invest(-1)	0.147 (0.007)***
govcons(-1)	0.196 (0.031)***
infl(-1)	0.242 (0.004)***
ir(-1)	-0.205 (0.004)***
rer(-1)	-0.057 (0.010)***
open(-1)	0.049 (0.004)***
R^2	0.220
#Observations	93
#Countries	16

The estimation method is ML using White heteroskedasticity consistent standard errors and covariance. The dependent variable is percentage GDP growth. The regression equation includes fixed effects (not reported for brevity). *, **, *** - stand for the significance of the particular variable at 5%, 10% and 1% level, respectively. S.E. are in parentheses.

Table 3 Estimation of the Indirect Effects (parsimonious versions)

Variable	invest	govcons	infl	ir
invest(-1)	0.354 (0.041)***	0.098 (0.014)***	0.039 (0.003)***	0.158 (0.010)***
govcons(-1)	-0.444 (0.087)***	0.428 (0.087)***	-0.044 (0.014)***	-0.371 (0.031)***
infl(-1)	-0.018 (0.007)**	-----	0.391 (0.015)***	0.075 (0.001)***
ir(-1)	-----	-----	0.283 (0.013)***	0.326 (0.022)***
rer(-1)	-0.015 (0.006)***	-0.012 (0.005)**	0.086 (0.003)***	-0.045 (0.005)***
rev	-1.698 (0.033)***	-0.287 (0.046)***	0.106 (0.032)***	-0.430 (0.074)***
cc	-1.507 (0.040)***	-0.436 (0.120)***	-1.838 (0.051)***	5.324 (0.378)***
cc× rev	1.145 (0.106)***	-0.970 (0.124)***	46.374 (0.185)***	-----
R^2	0.963	0.951	0.873	0.862
#Observations.	188	189	210	205
#Countries	39	39	39	39

The estimation method is ML using White heteroskedasticity consistent standard errors and covariance. The dependent variables are *invest, concons, infl* and *ir*. The regression equations include fixed effects (not reported for brevity). *, **, *** - stand for the significance of the particular variable at 5%, 10% and 1% level, respectively. S.E. are in parentheses.

Table 4 Indirect and Compounded Growth Effects According to the Event

Type of the Event	Direct Effect	invest	govcons	infl	ir	Compounded Effect
Current Account Reversal (REV)	-1.948	-0.250	-0.056	0.026	0.088	-2.140
Currency Crises (CC)	NA	-0.223	-0.085	-0.445	-1.091	-1.844
Joint Occurrence of REV and CC	-7.408	0.168	-0.190	11.222	NA	4.142

The calculations follow equation (7) using result from Tables 1 and 3. The numbers are in percentage points for the current year. For instance the number characterizing the how much is passed from investment on growth given current account reversal (second row, second column) equals 0.147*(-1.698).

Table 5 Estimation of the Convergence Coefficients and Calculation of the CFA

Variable	Convergence Coefficient	#Countries	#Observations
growth	-0.864 (0.019)***	46	286
invest	-0.330 (0.034)***	46	330
govcons	-0.416 (0.033)***	46	332
infl	-0.558 (0.037)***	46	346
ir	-0.271 (0.027)***	46	290
CFA	-1.186 (0.069)***	NA	NA

Convergence coefficients are the estimates of ω's from equation (7). The estimation method is ML using White heteroskedasticity consistent standard errors and covariance. *, **, *** - stand for the significance of the particular variable at 10%, 5% and 1% level, respectively. Standard errors are in parentheses.

Table 6 Time Necessary for Full Adjustment and Cumulative Loss of Performance

Event	Size of Shock	Length of Adjustment	Cumulative Loss
rev	-2.140	1.804	4.070 (1.930)
cc	-1.844	1.555	3.278 (1.434)
rev×cc	4.142	3.492	-11.374 (-7.232)

The Size of the Shock (SS) is the Compounded Effect from Table 4 in percentage points. Length of Adjustment in years (LA) is calculated as corresponding SS divided by CFA. The cumulative loss (CL) in percentage points is given by $CL = \frac{1}{2}(SS \times LA) + SS$. The numbers in parentheses corresponds to the cumulative loss during the adjustment period only, i.e. $\frac{1}{2}(SS \times LA)$.

Figure 1 A Time Profile of Currency Crises Appearance During 1993-2001

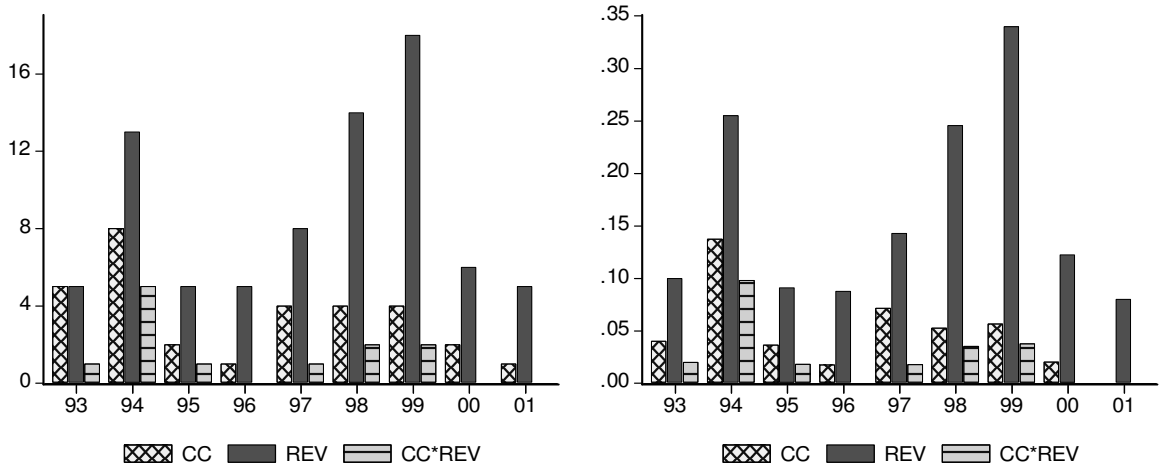

Figure 2 Stylized Response of $\boldsymbol{y}$ Regression to an Identified Shock

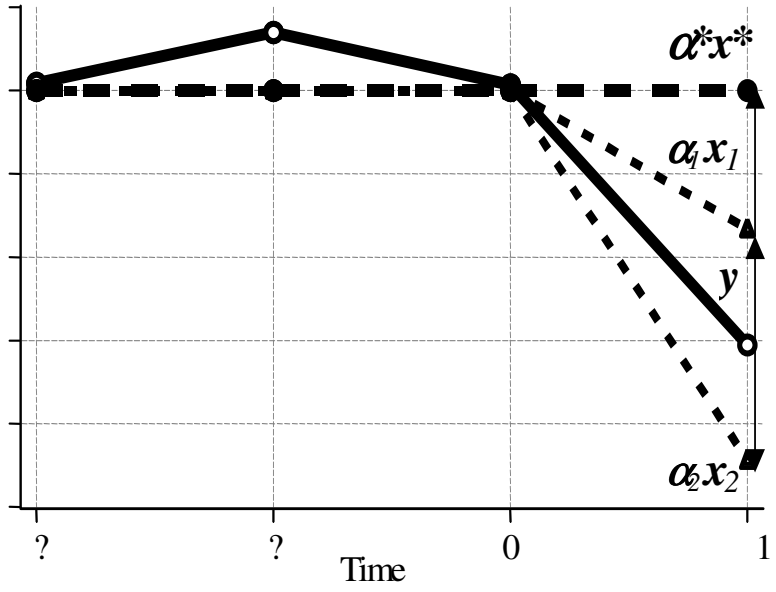

Figure 3 Stylised Adjustment Back to the Equilibrium Growth and Cumulative Loss