Mind the Break!
Accounting for Changing Patterns of Growth during Transition[∇]

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February 2009

Abstract

We argue that econometric analyses of growth in post-communist countries are vulnerable to structural breaks across time and/or countries. We demonstrate this by identifying structural breaks in growth for 25 countries and over 18 years. The method we use allows identification of structural breaks at a-priori unknown points in space or time. The only prior assumption is that breaks occur in relation to progress in implementing market-oriented reforms. We find robust evidence that the pattern of growth in transition has changed at least three times, yielding four different models of growth associated with different stages of reform. The speed with which individual countries progress through these stages differs considerably.

Keywords: Growth, reform, structural breaks, transition.
JEL codes: O47, P26, P27.

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1 Introduction

Transition is a process of structural change. Market-oriented reform, if implemented effectively, results dramatic change in the underlying regulatory and institutional environment, transfers ownership from the state to private agents and sets prices free in commodity and labor markets. State dirigisme is replaced by market economy and individual agents make their decisions so as to pursue their own best interest. Change is thus the quintessential characteristic, and indeed the objective, of the transition process in the post-communist countries of Central and Eastern Europe. The multifaceted process of change that is so central to transition, however, also implies that many fundamental relationships underlying the post-communist economies change as well. Few students of transition would doubt this simple and uncontroversial observation. Yet, most empirical studies of transition do not account for the changing nature of the relationships they analyze.

Failure to account for structural breaks during transition can have serious consequences. Such analyses are effectively based on data generated by two or more different underlying models. The resulting estimates then reflect only the average of pre- and post-break relationships rather than the two (or multiple) true patterns – and are therefore misleading. Adding new observations may change the resulting estimates considerably if the balance between pre- and post-break data is altered. As a consequence, studies addressing the same topic using the same but updated or extended data may find different or even widely diverging results.

The aim of this paper is to demonstrate the changing nature of economic processes during transition by testing for structural breaks in the post-communist countries' models of growth. There is already a large literature on the patterns of growth during transition, and in particular on the relationship between the progress in implementing market-oriented reform and growth. The discussion was spurred by the finding of De Melo et al. (1996) of a strong positive relationship in a cross section of 26 countries, with data covering the early 1990s. The defining characteristic of the ensuing debate was a general lack of consensus on the true nature of this relationship (see, for example, De Melo, Denizer and Gelb, 1996; Havrylyshyn, Izvorski and van Rooden, 1998; Krueger and Ciolko, 1998; Heybey and Murrell, 1999; Berg et al., 1999; Wolf, 1999; Fischer and Sahay, 2000; Popov, 2000; and surveys by Campos and Coricelli, 2002, and Babetskii and Campos, 2006). While several studies replicated the finding of a positive impact of reform policies on growth, others found a weak or insignificant relationship.

Most previous analyses do not consider the possibility of structural breaks and simply pool all available countries and years. Yet, economic growth is one of those processes where one should anticipate especially dramatic changes in the course of transition. The market-oriented reform was instigated by the economic stagnation and/or decline that afflicted most centrally planned economies during the 1980s. The main objective of the reform was to improve the allocation of resources and increase the efficiency of their use, thus helping deliver higher growth. If successful, the reform process should therefore fundamentally change the underlying economic systems and the process of growth.

Some studies attempted to account for the changing nature of the underlying relationship by splitting the data arbitrarily into groups of countries or sub-periods. Selowsky and Martin (1997) and Tichit (1999) analyze separately the Central and Eastern European countries and the former Soviet Union and find substantial differences between the two sub-groups. Fidrmuc (2003) and Rusinova (2007) estimate their regressions for different periods and, also, find substantial differences. The various post-communist countries implemented market-oriented reforms at different pace and with varying resolve, and some have experienced even temporary or sustained reform reversals. At any point in time, therefore, some countries will be closer to becoming market economies than others and may therefore belong to different models of growth. Therefore, while arbitrarily partitioning the data may be an improvement compared to regressions based on pooled data, one is unlikely to partition the data exactly at the true location of structural breaks.

We employ an analytical method that allows us to determine the presence of (potentially multiple) structural breaks in the data at ex-ante unknown locations in space and/or time. The method thus allows individual countries to follow different models of growth at any given point in time. In this manner, structural breaks are identified based on statistical inference about differences in patterns of growth rather than by our prior beliefs about which countries and/or which years should be lumped together. The only restriction that we impose on the analytical algorithm is the assumption that structural breaks occur in relation to the progress in implementing market-oriented reforms. We believe this to be reasonable: given that the very objective of transition is transforming the centrally-planned economies into market-based ones, one may expect those proceeding more rapidly to experience structural change earlier than those dragging their feet on reform.

A key element of our analysis is that we construct a new measure of progress in implementing market-oriented reforms (which is central to the analysis). Previous studies typically used a

simple average of the eight progress-in-transition indicators reported annually by the European Bank for Reconstruction and Development (EBRD). However, applying equal weights to these eight indexes is not necessarily justified. Therefore, we construct a weighted-average reform index with weights determined by factor analysis.

Our findings confirm considerable variation in patterns of transition across the different countries. In the baseline model, we find evidence of three structural breaks. Correspondingly, we identify four stable models of growth. As we expected, individual countries make their way through these models of growth with different speed: while some find themselves in the most advanced stage of growth already by mid 1990s, others remain in the first or second stage throughout the decade.

The rest of the paper is structured as follows. In the following section, we introduce the data used in our analysis and discuss the construction of the weighted reform index. Section 3 presents the results. Section 4, finally, summarizes our conclusions.

2   Measuring Progress in Transition

The communist countries possessed a number of characteristics that should have predestined them to grow at respectable rates: high investment rates, educated and skilled labor and relatively low income levels[1]. And indeed, most centrally planned economies grew at relatively high rates during the 1950s and 1960s. Yet, as has been documented elsewhere in the literature (Ofer, 1987; Easterly and Fischer, 1995), they failed to use the available resources efficiently and therefore, after the potential for extensive growth had been exhausted, their economic development eventually came to a halt during the 1980s. The subsequent reforms, however, fell short of delivering a universally-shared improvement. Instead, a great variety of outcomes ensued. While some countries resumed growth after a few years of a transformational recession, others experienced severe and protracted declines with little subsequent recovery. To demonstrate this variation, Figures 1 and 2 report cumulative growth rates for the periods 1989-1998 and 1989-2007, respectively. The graphs reveal an extraordinary variety of outcomes. During the first nine years of transition, most post-communist countries experienced sustained output contractions. This was especially severe in the former Soviet Union: output fell cumulatively by 50 to 70

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[1] A common finding in the growth literature is the so-called conditional convergence, i.e. poor countries tend to grow faster, after controlling for other determinants of growth, than rich countries (see Barro, 1991; Levine and Renelt, 1992; and Mankiw, Romer and Weil, 1992).

percent in Azerbaijan, Ukraine, Moldova, Tajikistan and Georgia. In contrast, in Central and Eastern European countries, the transformational recession was over by 1998, with Hungary, Czech Republic, Slovakia, Slovenia and Poland having attained or even exceeded the 1989 level by then. Another nine years later, by 2007, the countries of the latter group continue to do relatively well. Nevertheless, they are joined by some of the erstwhile laggards, especially resource rich countries such as Turkmenistan, Azerbaijan and Uzbekistan which benefited from high commodity prices in recent years.[2] Yes, while most post-communist countries have returned to or exceeded the 1989 level of economic activity by 2007, Tajikistan, Ukraine, Georgia and Moldova still fall short of the pre-transition level by 30 to 40 percent.

Figure 1 and 2 about here.

We can see a similarly high degree of variation in the progress in implementing market-oriented reform. The EBRD produces a set of diverse quantitative indicators to reflect the many facets of the transformation. Each year, it reports figures for eight indexes that measure each country's progress in the following fields: price liberalization, foreign exchange and trade liberalization, small scale privatization, large scale privatization, enterprise reform, competition policy, banking reform and non-banking financial institutions.[3] Figure 3 reports the simple average of these indexes for 2007, the last year in our data set. The index ranges between 1 (unchanged or little changed command economy) to 4.3 (modern market economy). We can see that the Central and Eastern European countries that ranked among the best growth performers are also the most ardent reformers. In contrast, adopting a cautious approach to market-oriented reforms tends to lead to a broad array of outcomes in terms of growth: Russia, Ukraine, Georgia and Armenia all have implemented similarly moderate reform (on average), yet their growth performance differs widely.

Figure 3 about here.

However, the simple average of the eight EBRD indicators is not necessarily a good measure of reform progress. It assigns the same weight to each of the sub-indexes, assuming that all eight are equally important in measuring progress towards building a market economy. This approach

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[2] Azerbaijan and Turkmenistan have been experiencing double digit growth rates since 2000.
[3] In addition, the EBRD also publishes an indicator of infrastructure reform. We do not use this indicator because it was only introduced recently and, where it is available for earlier years, we presume it has been constructed retrospectively, unlike the other indicators. Moreover, the infrastructure index appears, to a large extent, to measure the quality of infrastructure rather than government policies aimed at implementing market-oriented reforms. Last but not least, by using only the eight original sub-indexes, our results can be compared more easily with the previous literature.

has been followed in most previous studies analyzing the relationship between market-oriented reform and growth in post-communist countries. However, to the best of our knowledge, none of these studies tested whether assigning equal weights is in fact appropriate. Therefore, as the first step in our analysis, we perform a factor analysis to determine if all eight EBRD indicators measure the same phenomenon – progress towards the creation of a market economy – or if they reflect independent information. This method thus produces an aggregated weighted-average reform index with appropriate weights applied to the sub-indexes.

There are not one but several factor analysis models which differ in significant respects. A model most often applied is the so-called *principal component analysis*. Principal component analysis is concerned with identifying the patterns of common variation among a set of variables. Variation unique to a variable is ignored. In contrast, another factor model called *component factor analysis* is concerned with all patterns of variation in a set of variables, whether common or unique. We use the second method, as it allows us to determine the degree of unique variation for each indicator.

We thus try to find a good indicator or indicators of the degree of progress towards becoming full-fledged market economies. These indicators are unobserved. What we do observe is a set of indexes that measure the progress in different policies aimed at transforming the economy.[4] The component factor analysis pursues this objective by estimating the following equation system:

$$Y_1 = \alpha_{11}F_1 + \alpha_{12}F_2 + \ldots + \alpha_{1m}F_m + \varepsilon_1,$$
$$Y_2 = \alpha_{21}F_1 + \alpha_{22}F_2 + \ldots + \alpha_{2m}F_m + \varepsilon_2,$$
$$Y_3 = \alpha_{31}F_1 + \alpha_{32}F_2 + \ldots + \alpha_{3m}F_m + \varepsilon_3,$$
$$\ldots$$
$$\ldots$$
$$\ldots$$
$$Y_n = \alpha_{n1}F_1 + \alpha_{n2}F_2 + \ldots + \alpha_{nm}F_m + \varepsilon_n,$$

where Y_j, with j=1, 2, … n, are the observed variables (in our case, the eight EBRD indicators), α_{ij} are the so-called loadings, F_{ij} are the so-called factors, which in turn can be functions of some unknown variables and ε is the variation of Y that is independent of the factors. By application to the known data on the Y variables, factor analysis identifies the unknown F functions. The size of each loading for each factor measures how much that specific function is related to Y. We may find that some of the F functions are common to several variables. These are called *group factors*. To decide how many factors to retain, we use the common criterion that

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[4] The EBRD reports its indicators as ranging between 1 (unreformed centrally-planned economy) to 4.33 (fully liberalized market economy). For the purposes of our analysis, we rescaled them so that they range from 0 to 1.

we retain all factors with eigenvalues higher than 0.5. The eigenvalue of the first factor is 6.4 while that for the second one is 0.45. Therefore, we only retain the first factor. The results of the estimation are reported in Table 1.

Table 1 about here.

The first column shows the *factor loadings*, that is the coefficients of correlation between each EBRD sub-indicator and the first factor. We can see that all indicators are strongly positively correlated with the factor. This suggests that the factor clearly represents progress towards creating a market economy. The third column reports the percentage of variation of the indicator that is explained by the common factor.[5] All indicators display very high shares of common variation, reaching on average 80.1%. Finally, the last column shows the *uniqueness* of each variable, which depicts the percentage of the total variation that is autonomous. Of course, the sum of the last two columns must be equal to 100% for each row. The results indicate that the most independent indicator is price liberalization. Nevertheless, all the percentages of uniqueness are far less than 50%, implying that all the variables are highly correlated among themselves. It is interesting to note that principal-component analysis (which assumes that all the communalities are equal to 1) gives almost the same factor loadings as the component factor analysis (unreported results).

Using factor analysis, it is possible to endogenously determine the weight of each indicator in the aggregate index of progress towards creating a market economy (factor 1). The resulting scores are reported in the second column of Table 1. The highest weights are assigned to banking sector liberalization, enterprise reform and small scale privatization. Multiplying the scores and the values of the sub-indexes yields for each year and each country the weighted index of progress towards implementing a market economy. The aggregate index takes values from -1.617 (most of the countries at the beginning of transition) to +1.734 (Estonia since 2006).

The value of the index for each country in 2007 is reported in Figure 4. Comparing it with the simple average reform index in Figure 3, we see that, for the most part, the ranking of countries is similar. However, as our weighted-average index assigns different weights to different sub-indicators, a few differences can be found: Slovenia appears ahead of Romania according to the weighted-average index but not when reform is measured with the simple average, Russia and Ukraine similarly swap places, and Kyrgyzstan falls back a few places in Figure 4 compared to its position in Figure 3. In Table 2, we compare the two indexes further, by computing correlation

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[5] The communality for each variable is the square of the loading multiplied by 100.

coefficients between the weighted average, simple average and the individual sub-indexes. The two composite indexes are closely correlated with each other and with the sub-indexes as well, although again, there are differences across the individual sub-indexes.

Figure 4 about here.

Table 2 about here.

It is instructive to look also at the evolution of the index over time (see annex 2). Croatia, Macedonia, Slovenia and to a lesser extend Hungary and Poland began their transition with a relatively high degree of liberalization. In general, the FSU countries began with lower values of the indicator and progressed more slowly (except for the Baltics). Moreover, several FSU countries experienced reform reversals. For example, Belarus kept liberalizing up to 1995 but subsequently the index fell again. Russia experienced a similar albeit less dramatic reversal from 1997 until 2000 (and only in 2006 did the weighted-average index exceed the value attained in 1997). In 2007, the index is still lower than the 1995 performance. Turkmenistan, finally, lags furthermost behind in terms of implementing reform – and remains essentially unreformed. Overall, the evolution of the countries according to their progress towards a market economy is very heterogeneous and does not evolve monotonically over time, suggesting that the factors governing growth indeed may be sensitive to the progress in implementing reforms.

3   Structural Breaks in Growth during Transition

The conventional approach to finding structural breaks entails applying the Chow test (see Chow, 1960; and Greene, 1997, chapter 7.6) at a point determined with the help of theory, based on observing stylized facts such as an apparent change in trend, or otherwise based on one's prior beliefs and/or expert judgment. In our analysis, however, while we anticipate that transition will bring about a break in the underlying model of growth (and possibly multiple structural breaks), we do not have a clear-cut prior belief as to at which specific point in time or in space the break should occur. Or, more precisely, we have too many plausible break points such as CEE vs FSU (with the Baltic countries alternatively included with the former or the latter), EU accession-candidate countries vs the rest, the mid point of transition (alternatively measured in calendar or transition time, with the latter counting years since transition began in each particular country), etc. Therefore, we use the methodology developed by Bai (1997) and Bai and Perron (1998, 2003) that allows us to identify unknown structural breaks when the location of breaks and also

their number are unknown. In essence, this approach involves testing for structural breaks given all possible partitions of the data into two sub-samples. The point of partition that yields the highest value of the F-test statistic identifies the potential structural break. However, the resulting test statistic does not follow the conventional F-distribution. Bai and Perron (1998) therefore produce statistical tables and propose a dynamic algorithm in order to determinate the a priori unknown number of breaks. The first step is to determine whether there is at least one break. For that, we run UDmax and WDmax tests, which are the maxima of the different F-tests of no break versus a given number of breaks (with a maximum of five breaks and a minimum sub-sample size of 5% of the whole sample, that is about 22 observations). If the highest value of the UDmax and WDmax statistics is significant (according to the tables in Bai and Perron, 1998), we can conclude that there is at least one structural break. The second step is to determine the number of breaks. Therefore, we subsequently test the hypothesis of no break versus one, calculate the F-tests corresponding to all potential partitions and take the highest value. The partition corresponding to the maximum of the F-test identifies the location of a potential break. If the maximum is significant, we then test the hypothesis of two breaks vs one, three vs two, and so on, until the test is no longer significant. This identifies the number of breaks as well as their location.

As our data contain nearly 450 observations (25 countries over 18 years, with a few missing observations), the number of possible partitions is extremely large. Moreover, finding structural breaks based on random partitioning of the data would not be very illuminating as it would be difficult to ascertain what factors are responsible for the occurrence of the breaks. Therefore, we adopt a simplifying assumption, namely that the occurrence of breaks is related to the progress in implementing market-oriented reforms. Given that we are interested in identifying structural breaks that occur in the course of transition from central planning to market economy, this assumption seems justified. Accordingly, we order the data by the value of the weighted reform index (described above), and perform the partition and compute the test statistic for each distinct value of the index.

We estimate the following baseline model:

$$\Delta Y_{j,t} = f\left(RI_{j,t-1}, DI_{j,t}, LINFL_{j,t} WAR_{j,t}, INV_{i,t}\right)$$

where the dependent variable, $\Delta Y_{j,t}$, is the growth rate in country j in year t. The explanatory variables include the weighted-average reform index (*RI*), lagged by one year to allow for some time delay in the effect of reform on growth, democracy index, *DI*, which is the average value of

the indicators of political freedoms and civil liberties reported by the Freedom House and rescaled to range between zero (no democracy) and one (full democracy); the logarithm of CPI inflation, $LINFL_{j,t}$; a dummy indicating whether the country was involved in a military conflict (internal or external), $WAR_{j,t}$, and the investment rate (investment as percentage of GDP), $INV_{i,t}$. We tested whether fixed or random effects have to be included (with a Breusch-Pagan test). The test suggests that taking account of specific effects is necessary and the Hausman test provides evidence of endogeneity of the random effects with respect to the regressors. Consequently, we estimate the model with fixed effects. An advantage of estimating the model with fixed effects is that this framework allows us to account for the influence of initial conditions in the fullest possible way (previous studies frequently included explicit, and therefore necessarily incomplete, measures of initial conditions).

The reform index, inflation and the war dummy are variables that have been prominently used in the literature on growth during transition (see, for example, De Melo, Denizer and Gelb, 1996; Aslund, Boone and Johnson, 1996; Havrylyshyn, Izvorski and van Rooden, 1998; Berg et al., 1999; Wolf, 1999; Falcetti, Raiser and Sanfey, 2002 and Falcetti, Lysenko and Sanfey, 2006). Many earlier contributions controlled for both contemporaneous and lagged reform progress. However, this practice was criticized by Rzonca and Cizkowicz (2003) and Mickiewicz (2005) as producing biased estimates due to the fact that the index is bound from above and therefore the contemporaneous and lagged values tend to be strongly correlated during the later years of transition. Therefore, we only include the lagged value.

Our specification contains also the democracy index. This is to account for the dual nature of liberalization in post-communist countries, as most implemented both economic and political reforms more-or-less simultaneously.[6] This sets the post-communist countries apart from the previous liberalization episodes in countries such as Chile, South Korea and Taiwan, or the current reform in China, where economic reform was implemented before (or without) political liberalization. As a robustness check, nevertheless, we re-estimate our analysis also without democracy and the results do not change or change only little (see discussion below and additional results in the Annex).

The results are summarized in Table 3. The testing procedure indicates that there are three structural breaks at the 1% significance level: corresponding to the reform index taking values of

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[6] Moreover, as argued by Fidrmuc (2003), there may be important interactions between the two processes, whereby one type of liberalization reinforces the other.

–1.086518, 0.1116968 and 0.3626365. The regression results for the full sample and for the four sub-samples implied by these three breaks are reported in the top part of the table (panel A). Another break, at a value of the reform index equal to –0.8590747 is also found, but only at the 5% significance level. The results that include this fourth break are presented in panel B.[7]

Table 3 about here.

The analysis summarized in panel A thus yields four stable models of growth for the following reform index ranges: [-1.617, -1.086], (-1.086, 0.1117], (0.1117, 0.362] and (0.362, 1.734].[8] For simplicity, we refer to these intervals as the pre-reform, early reform, intermediate reform and advanced reform models of growth, respectively.[9] The first, pre-reform model thus captures the stage in transition before rigorous reforms were implemented. The early and intermediate reform models then comprise observations with low to moderate reform. The last model, accounting for nearly half of all observations, collects data points with more advanced reform progress. Note that countries can progress from one model to another at different points in time (or not at all) and can also revert back to a previously abandoned model if they reverse some of the reform measures implemented earlier. If we accept four structural breaks (panel B), then the early reform model is split into two models, the first of which only contains 21 observations (moreover, none of the variables appear significant and the F-statistic is not significant either). In the rest of our discussion, we focus on the case with three structural breaks presented in panel A.

Clearly, using a different regression specification, we could identify different structural breaks. Therefore, to test the robustness of our results, we repeated the analysis with four alternative regression specifications: adding the population growth, omitting the democracy index, omitting democracy index and adding population growth, and with both democracy index and population growth. In the first three cases, the analysis yielded four structural breaks located at precisely the same points as in the baseline model, except for the last one, which is located at 0.368 instead of 0.363 (only two observations are affected by this change). Therefore, changing the regression specification does not modify the main results or the location of the breaks. In the fourth case, with all the potential variables (democracy and the population growth) included, the last break is located as the same index value as in the baseline model and the third one is located

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[7] Because we are introducing an additional structural break, columns (A2), (A4) and (A5) are reproduced in panel B as columns (B1), (B4) and (B5), respectively, while the model in column (A3) is replaced with those in (B2) and (B3).

[8] -1.617 and 1.734 are the minimum and maximum value of the weighted-average reform index, respectively.

[9] It is very well possible that with further data, another model will be identified. Therefore, we leave the *post-reform model* label available for future research.

at 0.120 instead of 0.112 (3 observations concerned). The second break is close to the first one in the preserved model (-1.119 instead of -1.087, only one observation falls between these two values). The first break is located at -1.375503. Finally the four breaks are significant at the 1% significance level. The results of the model with democracy and population growth are presented in Annex 3. The remaining three other results are available from the authors on request. Importantly, the regression results obtained with the four alternative regression models are very similar to the one obtained with the baseline model. Given the overall similarity of the results, the discussion in the remainder of our paper centers on the baseline regression model reported in panel A of Table 3.

Table 4 reports the average values of growth, inflation and the corresponding ranges of the reform index for the four models. The pre-reform and early reform periods are associated with serious economic malaise: countries in these stages experience dramatic economic contractions along with very high inflation, even taking on hyperinflationary proportions. Compared to that, intermediate and advanced reform models present a marked improvement: growth becomes positive and inflation descends to low two digits.

Table 4 about here.

A question of great interest, of course, is which countries belong to which model of growth at which time. In principle, a country in transition should proceed through all four stages, although the *speed*, or the time spend at each stage, may differ. Table 5 presents a tabular representation of the distribution of countries across the four models over time. Hungary, Poland, Slovenia, Croatia and Macedonia are found in the second, early transition model, already in 1990. This does not imply that these countries never experienced central planning, rather, it reflects their progress in implementing partial reforms already in the course of the 1980s (and in case of the former Yugoslav republics, even before that). The remaining countries start the transition within the pre-reform model of growth. All proceed to the early and intermediate reform model, except Turkmenistan which remains in the pre-reform first stage even in 2007. Belarus, Tajikistan and Uzbekistan, in turn, move to the early reform model only and never reach the intermediate model. Most of them eventually progress to the fourth model, with the exception of Azerbaijan. Russia makes a temporary regression from fourth to second model in 1998, at a time coinciding with its financial crisis.

Table 5 about here.

Much of the discussion assessing transition countries' growth performance centered on the role of liberal policies in delivering efficiency improvements and, especially, higher growth and better economic performance. However, that discussion has so far been largely inconclusive: while some argue that progress in economic liberalization improves growth (see De Melo, Denizer and Gelb, 1996; Havrylyshyn, Izvorski and van Rooden, 1998; Berg et al., 1999; and Falcettin et al., 2002, 2006), others counter that initial conditions explain most of the differences in growth patterns or that progress in liberalization is in fact endogenous in economic performance (see Krueger and Ciolko, 1998; and Heybey and Murrell, 1999). Yet, essentially all of those studies were conducted using data pooled either across countries or time (or both), which, as our results show, are subject to multiple structural breaks. Since they fail to account for the changing nature of growth, it is not at all surprising that they often arrive at very different findings. In contrast to the earlier studies, the regressions reported in Table 3 are estimated with data that are free of structural breaks.

We find that market-oriented reform is conducive to growth in all four models. Moreover, its effect is especially large in the pre-reform model, where even modest reform effort seem to have a high payoff in terms of economic growth (or, rather, leads to less severe economic contraction). Inflation, which also measures reform progress in that it reflects the 'stabilize' aspect of the transition process,[10] also translates into lower growth in the pre-reform model (it is insignificant in the remaining three models). Hence, our results suggest that countries that implemented radical reforms early on and proceeded relatively aggressively in their implementation were in turn rewarded with better growth performance.

The results for the remaining variables are interesting as well. Not surprisingly, wars tend to depress growth. The negative effect of democracy in the early and intermediate models is more intriguing: it suggests that countries that implemented wide-ranging democratization in turn grew at lower rates.[11] The negative effect, however, disappears in the advanced reform period so that, even if democratization is costly initially, it does not have a permanent adverse effect. The effect of investment in physical capital, finally, also changes in the course of the reform. In the pre-reform period, counter-intuitively, investment appears to have a negative effect on growth. Later,

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[10] The three main premises of the so-called Washington consensus, named after the Washington institutions (IMF and the World Bank) were 'stabilize, privatize and liberalize'.

[11] However, Fidrmuc (2003) investigates the various relationships between economic reform, democratization and growth and argues that democratization fosters growth indirectly, because it encourages greater progress in implementing market-oriented reforms.

in the early and intermediate reform stages, it appears with insignificant coefficients, and eventually becomes positive in the advanced reform model. These changes can reflect the changing nature of the economic system in place in transition countries. Indeed, there is little reason to expect investment to foster growth in the pre-reform model as investment is not necessarily driven by economic considerations anyway. Finding it with a positive and significant effect on growth in the advanced stage, however, is reassuring.

We also explored the potential role of initial conditions by testing for presence of structural breaks in growth according to the initial conditions. For this, we used an index of initial conditions constructed by the EBRD.[12] This, in particular, would allow for the CEE and FSU countries to follow different models of growth, as asserted by Selowsky and Martin (1997) and others. We found only one structural break based on initial conditions, located at a value of -1.4 of the EBRD index of initial conditions. The break is significant at 1% and divides the sample between Azerbaijan, Tajikistan, Turkmenistan, Kazakhstan, Kyrgyzstan, Georgia, Ukraine and Uzbekistan, and the other countries. Besides all of the former being former Soviet Union republics, these countries stand out by having been relatively reluctant to implement reforms. An important draw-back of identifying structural breaks according to initial conditions, however, is that this approach does not allow countries to move from one model of growth to another – the exact opposite of what one would expect countries undergoing systemic transition to do. Therefore, we feel that our algorithm based on identifying structural breaks in growth according to progress in implementing reform is more promising.

4 Conclusion

As the various elements of the market environment are implemented in the post-communist countries, one should expect to see important changes concerning the way their economies work. Facilitating such changes, after all, is the very objective of the post-communist transition. This effectively implies that the reform process should result in (possibly multiple) structural breaks in fundamental economic relationship.

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[12] This index reflects macroeconomic distortions, time spent under communism, distance to the EU, dependence on CMEA for trade, and natural resource wealth. It is constructed as the first factor (out of two) resulting from principal component analysis of a number of initial conditions (see Box 2.1 in the EBRD Transition Report 1999, and Falcetti, Raiser and Sanfey, 2002). Falcetti et al. (2002) argue that the second factor is not robustly related to growth; in line with their argument, we only consider the first factor.

Failure to account for the changing nature of the underlying relationship would result in findings that can be misleading and outright incorrect. In our analysis of the relationship between reform-oriented policies and growth, we found evidence of at least three structural breaks. Moreover, different countries experience the breaks at different points in time. We locate the structural breaks in relation to the progress in implementing market-oriented reforms. Some countries made more progress in this respect and, correspondingly, move through the various stages of growth faster. Other countries, in contrast, may remain 'stuck' in a particular model of growth for extended periods.

Our analysis sheds new light on the much-disputed relationship between reform-minded policies and growth during transition. We find evidence of three breaks and thus four different models of growth, which we refer to as pre-reform, early, intermediate and advanced reform pattern of growth. The growth determinants are significantly different between the models. Therefore, the presence of structural break may account for the differences in findings reported by previous studies, which typically differed from each other in the number of countries included and even more often in the periods covered by the analysis. We find, nevertheless, that the effect of reform on growth is positive in all four models. It is particularly strong during the pre-reform stage; thereafter, it falls in size while it remains positive and significant.

In summary, we show that the pattern of growth changes in relation to progress in implementing market-oriented reforms. Nevertheless, we did not consider the issue of endogeneity of progress in reform, which has been raised in a number of recent studies, and the possibility of breaks in such a simultaneous relationship. This question still remains open for further research.

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Table 1: Factor Analysis Results

Variable	Factor 1 loading	Weight	Communality	Uniqueness
Price liberalization	0.8180	0.08118	66.91%	33.09%
Foreign exchange/trade lib.	0.9038	0.14742	81.69%	18.31%
Small privatization	0.9129	0.15495	83.34%	16.66%
Large privatization	0.9203	0.11934	84.70%	15.30%
Enterprise reform	0.9404	0.18810	88.44%	11.56%
Competition liberalization	0.8624	0.10872	74.37%	25.63%
Bank liberalization	0.9458	0.19199	89.45%	10.55%
Non bank liberalization	0.8477	0.08825	71.86%	28.14%

Table 2: Correlation Matrix of EBRD Indicators

	Weighted Average Index	Average Lib. Index	Price Lib	Forex & Trade Lib	Small Scale Priv	Large Scale Priv	Enterprise . Reform	Comp. Policy	Bank Reform	Non-bank. Fin. Inst.
Weighted Average Index	1.000									
Average Liberalization	0.998	1.000								
Price Liberalization	0.901	0.918	1.000							
Forex/Trade Liberalization	0.893	0.911	0.958	1.000						
Small Scale Privatization	0.888	0.898	0.861	0.855	1.000					
Large Scale Privatization	0.906	0.912	0.826	0.813	0.799	1.000				
Enterprise Reform	0.973	0.960	0.823	0.798	0.826	0.868	1.000			
Competition Policy	0.840	0.821	0.599	0.585	0.618	0.733	0.859	1.000		
Banking Reform	0.975	0.969	0.880	0.870	0.823	0.845	0.956	0.800	1.000	
Non-bank. Financial Inst.	0.849	0.832	0.606	0.593	0.646	0.706	0.860	0.895	0.840	1.000

Notes: Correlation coefficients calculated for the weighted average liberalization index produced by factor analysis (see Table 2), simple average of EBRD progress-in-transition indicators, and the EBRD indicators themselves, for 1989-2007.

Source: EBRD Transition Reports, various issues, own calculations.

Table 3 Structural Breaks in the Baseline Model of Growth with fixed effects

A. Index range:	Full sample		[Min;-1.086518]		(-1.086518; 0.1116968]		(0.1116968; 0.3626365]		(0.3626365; Max]	
	(A1)		(A2)		(A3)		(A4)		(A5)	
Reform index (lagged)	5.21***	(0.49)	28.07***	(7.10)	4.62**	(1.83)	8.177*	(4.49)	3.20***	(0.94)
Inflation (log)	-1.40***	(0.20)	-2.51***	(0.52)	-1.96	(0.56)	0.35	(0.80)	-0.06	(0.23)
Democracy	-5.65**	(2.54)	7.71	(8.18)	-17.58***	(6.37)	-20.78*	(11.43)	1.87	(2.80)
War Dummy	-11.98***	(1.36)	-13.32***	(4.90)	-15.16***	(2.93)	2.58	(6.99)	-7.23***	(2.55)
Investment	-0.06	(0.05)	-0.35**	(0.17)	0.04	(0.10)	-0.135	(0.25)	0.14**	(0.06)
Intercept	10.99***	(1.92)	55.58***	(11.64)	17.43***	(3.31)	15.96**	(6.42)	-2.11	(2.37)
R^2	0.657		0.569		0.591		0.181		0.298	
F-stat	152.34***		10.81***		24.53***		1.41***		14.34***	
N	428		65		114		55		194	
Stable/Unstable Model	Unstable		Stable		Stable		Stable		Stable	
B. Index range:	**[Min;-1.086518]**		**(-1.086518; -0.8590747]**		**(-0.8590747; 0.1116968]**		**(0.1116968; 0.3626365]**		**(0.3626365; Max]**	
	(B1)		(B2)		(B3)		(B4)		(B5)	
Reform index (lagged)	28.07***	(7.10)	17.29	(13.18)	3.05*	(1.80)	8.177*	(4.49)	3.20***	(0.94)
Inflation (log)	-2.51***	(0.52)	0.70	(3.59)	-2.48***	(0.57)	0.35	(0.80)	-0.06	(0.23)
Democracy	7.71	(8.18)	-65.34	(44.73)	-15.43*	(8.29)	-20.78*	(11.43)	1.87	(2.80)
War Dummy	-13.32***	(4.90)	-1.21	(14.60)	-21.31***	(4.65)	2.58	(6.99)	-7.23***	(2.55)
Investment	-0.35**	(0.17)	0.69	(0.85)	0.032	(0.09)	-0.135	(0.25)	0.14**	(0.06)
Intercept	55.58***	(11.64)	22.02	(11.70)	17.90***	(3.77)	15.96**	(6.42)	-2.11	(2.37)
R^2	0.569		0.859		0.620		0.181		0.298	
F-stat	10.81***		3.68		20.90***		1.41***		14.34***	
N	65		21		93		55		194	
Stable/Unstable Model	Stable		Stable		Stable		Stable		Stable	

Notes: Standard errors are in parentheses. Significance levels are indicated as 1% (***), 5% (**) and 10% (*). The WDmax and UDmax tests indicate presence of at least one break with 1% significance. The F-test statistic for the presence of one structural break versus no breaks is 111.28, significant at 1%. The F-test statistic for the presence of two breaks versus one break is 26.16, significant at 5%. The F-test statistic for the presence of three breaks versus two breaks is 201.93, significant at 1%. The third break is the global maximum for all the F tests, explaining this very high value of the F-test. The F-test statistic for the presence of four breaks versus three breaks is 74.77, significant at 1%. The F-test statistic for the presence of five breaks versus four breaks is 14.28, no significant.

Table 4 Descriptive Statistics

Model	Reform index range	MEANS		STANDARD DEVIATIONS	
		Growth	Inflation	Growth	Inflation
1 Pre-reform	[Min; -1.086518]	-7.499203	867.036	1.622278	265.5919
2 Early reform	] -1.086518; 0.1116968]	-1.224433	255.1978	0.9267362	41.00088
3 Intermediate reform	] 0.1116968; 0. 3626365]	3.855927	24.37936	1.049204	5.027257
4 Advanced reform	] 3626365, Max]	5.238468	14.38846	0.2404996	5.446702

Notes: Models 1, 2, 3 and 4 refer to the four stable models reported in Table 3 in columns (2), (3) (4) and (5), respectively.

Table 5 Patterns of Growth across Countries and Time

	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007
Albania	1	1	2	2	2	2	2	2	2	3	3	3	3	3	4	4	4	4
Armenia	1	1	1	1	1	2	2	2	2	3	3	3	4	4	4	4	4	4
Azerbaijan	1	1	1	1	1	2	2	2	2	2	2	2	2	2	2	3	3	3
Belarus	1	1	1	2	2	2	2	2	1	1	2	2	2	2	2	2	2	2
Bulgaria	1	2	2	2	2	2	2	4	4	4	4	4	4	4	4	4	4	4
Croatia	2	2	2	2	3	3	4	4	4	4	4	4	4	4	4	4	4	4
Czech Rep.	1	2	3	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4
Estonia	1	1	2	3	4	4	4	4	4	4	4	4	4	4	4	4	4	4
Georgia	1	1	1	1	1	2	2	3	3	3	4	4	4	4	4	4	4	4
Hungary	2	2	3	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4
Kazakhstan	1	1	1	1	2	2	3	3	3	3	3	4	4	4	4	4	4	4
Kyrgyzstan	1	1	1	2	2	3	3	4	4	3	3	3	3	3	4	4	4	4
Latvia	1	1	2	2	4	4	4	4	4	4	4	4	4	4	4	4	4	4
Lithuania	1	1	2	2	3	4	4	4	4	4	4	4	4	4	4	4	4	4
Macedonia	2	2	2	2	2	2	3	3	3	3	4	4	4	4	4	4	4	4
Moldova	1	1	1	2	2	3	3	3	3	3	3	3	3	3	3	4	4	4
Poland	2	2	2	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4
Romania	1	1	1	2	2	2	2	3	3	4	4	4	4	4	4	4	4	4
Russia	1	1	2	2	2	3	3	4	2	2	2	3	4	4	4	4	4	4
Slovakia	1	2	3	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4
Slovenia	2	2	2	3	4	4	4	4	4	4	4	4	4	4	4	4	4	4
Tajikistan	1	1	1	1	1	2	2	2	2	2	2	2	2	2	2	2	2	2
Turkmenistan	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
Ukraine	1	1	1	1	1	2	2	2	2	2	2	3	3	3	3	4	4	4
Uzbekistan	1	1	1	1	2	2	2	2	2	2	2	2	2	2	2	2	2	2

Notes: The table shows which model of growth a country belongs to in any given year between 1990 and 2007. The number within a cell indicates in which pattern of growth the country appears at which time.
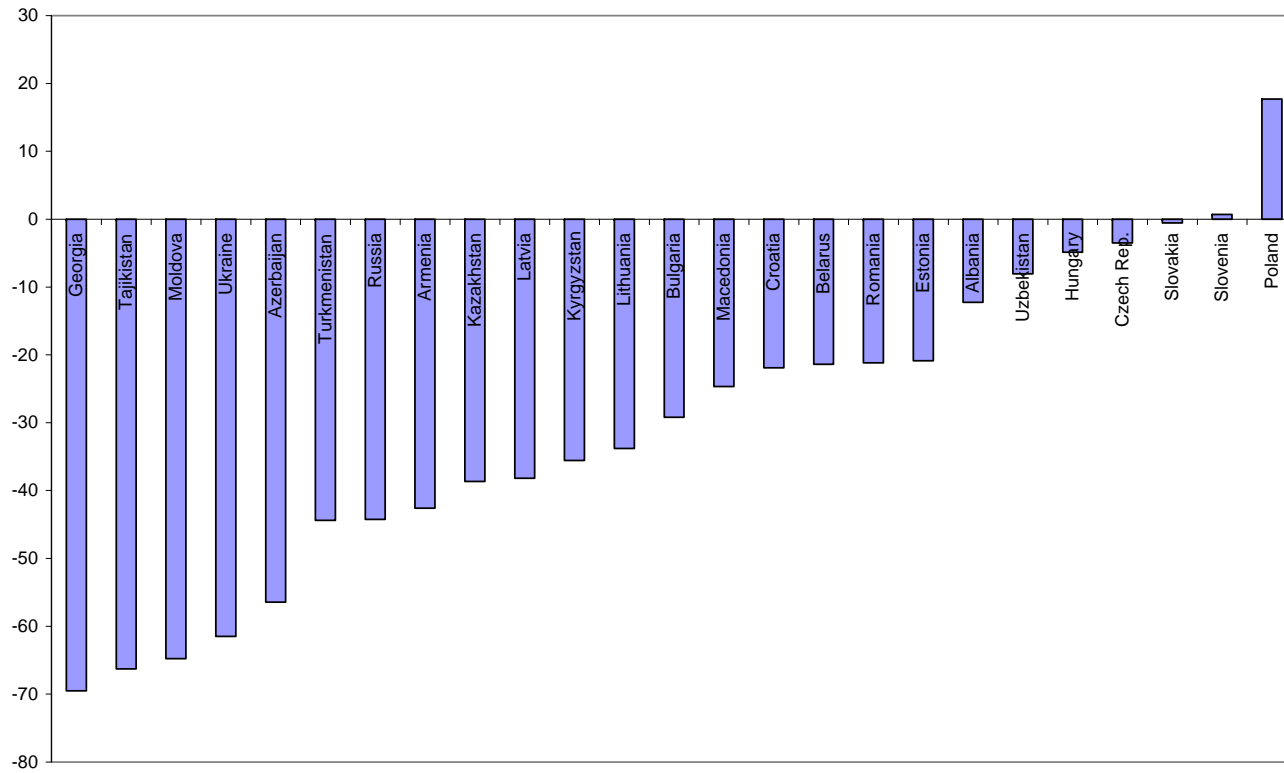
Figure 1 Cumulative Growth, 1989-1998
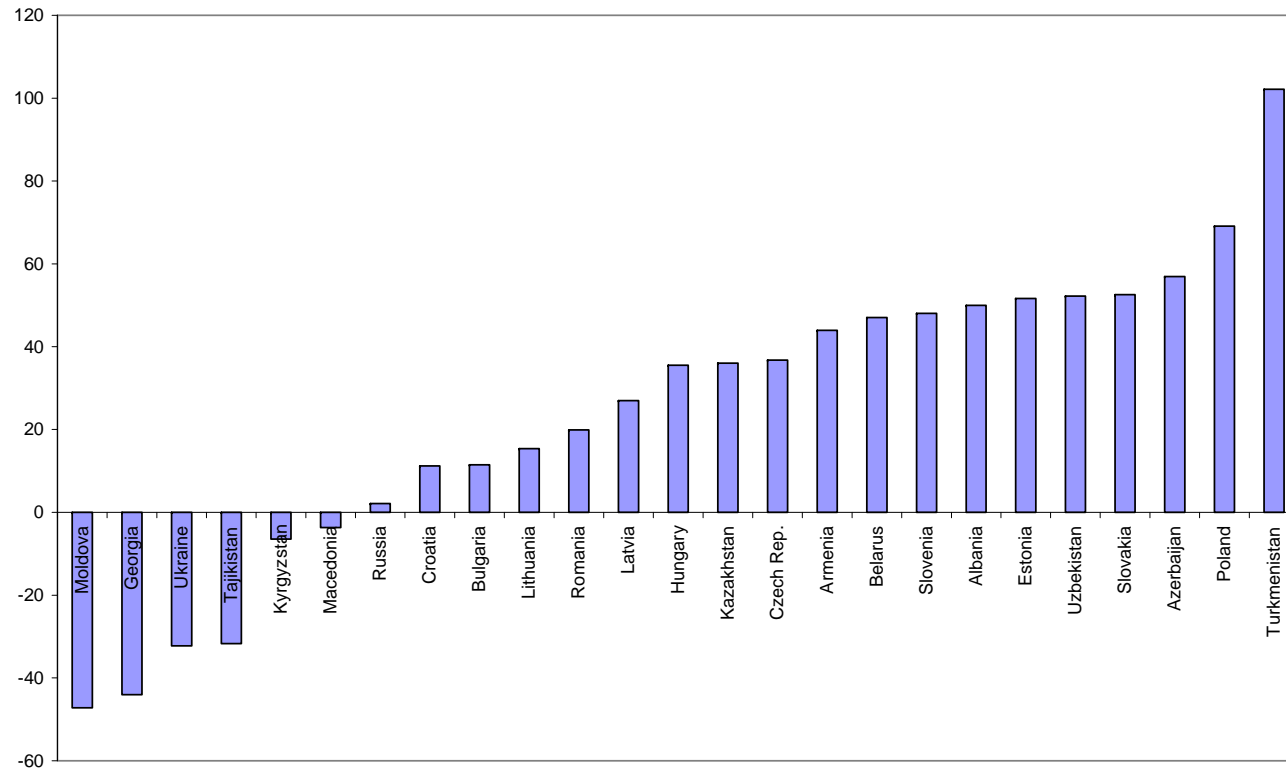
Figure 2 Cumulative Growth, 1989-2007
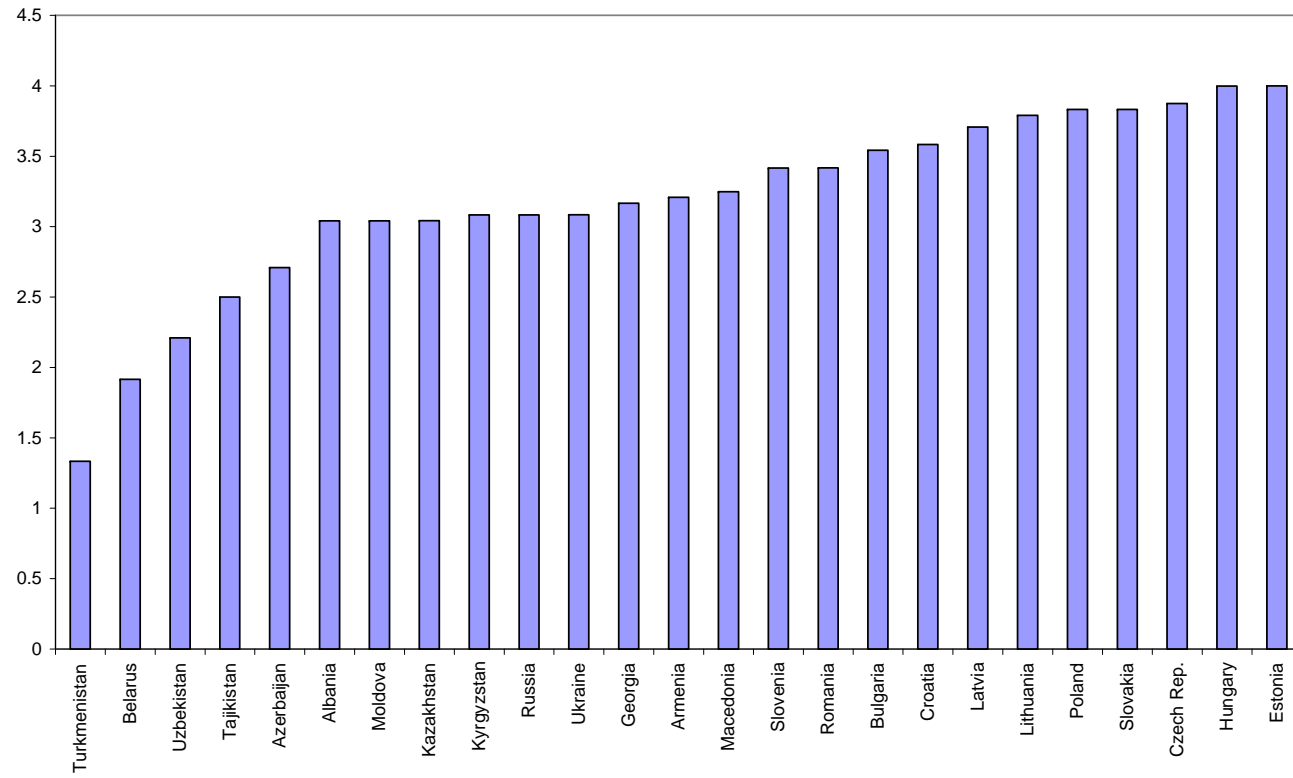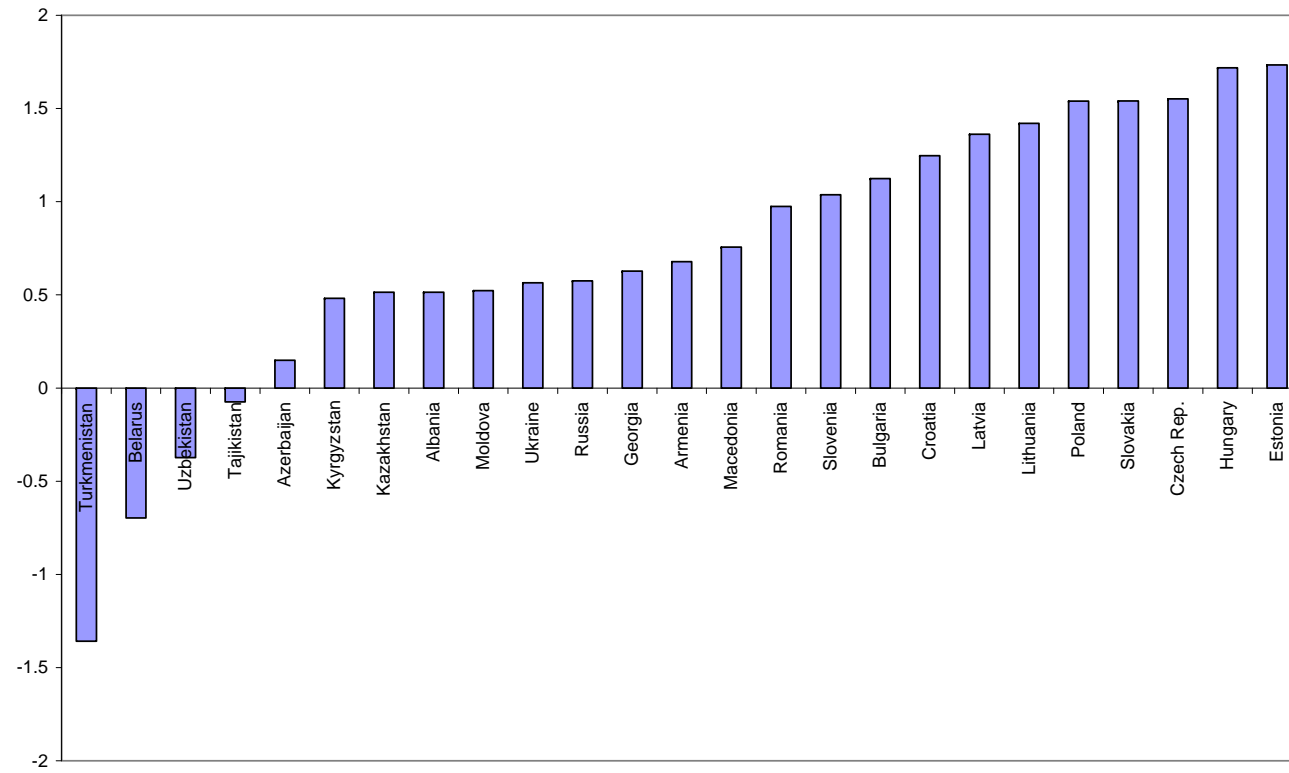
Figure 3 Average EBRD index in 2007

**Figure 4 Aggregate weighted-average index in 2007**

Annex 1: Percentage of common variation between EBRD indicators

	Price Lib		Forex/Trade Lib		Small Scale Priv		Large Scale Priv		Ent. Reform		Comp.Policy		Bank Reform	
	Min	Max	Min	Max	Min	Max	Min	Max	Min	Max	Min	Max	Min	Max
Price Lib														
Forex/Trade Liberalization	50.09 (1996)	94.35 (2005)												
Small Scale Privatization	50.46 (1993)	87.00 (2002)	66.63 (1992)	86.86 (2004)										
Large Scale Privatization	40.19 (1991)	84.08 (2006)	41.81 (1991)	80.53 (2005)	9.74 (1991)	85.98 (2003)								
Enterprise Reform	37.34 (1990)	73.29 (2006)	53.90 (1992)	85.45 (1994)	43.16 (1992)	87.03 (2000)	49.36 (1992)	85.27 (2000)						
Competition Policy	12.59 (1993)	64.46 (2007)	35.18 (1993)	67.59 (2007)	24.41 (1992)	74.36 (2003)	43.27 (1991)	75.87 (2003)	53.53 (1995)	100 (1990)				
Banking Reform	37.34 (1990)	75.04 (2006)	55.81 (1990)	87.89 (1994)	46.77 (1990)	84.14 (2006)	46.43 (1992)	83.57 (1998)	76.43 (1995)	100 (1990)	31.69 (1995)	100 (1990)		
Non-bank. Financial Inst.	5.04 (1992)	49.79 (2007)	8.14 (1992)	55.54 (1996)	11.14 (1992)	64.14 (2004)	1.53 (1992)	69.56 (2003)	6.02 (1990)	85.34 (2004)	6.02 (1990)	89.88 (2007)	6.02 (1990)	84.56 (2007)

Note: year when minimum and maximum occurs in parenthesis

Annex 2 : Evolution of the aggregate index by country and by year
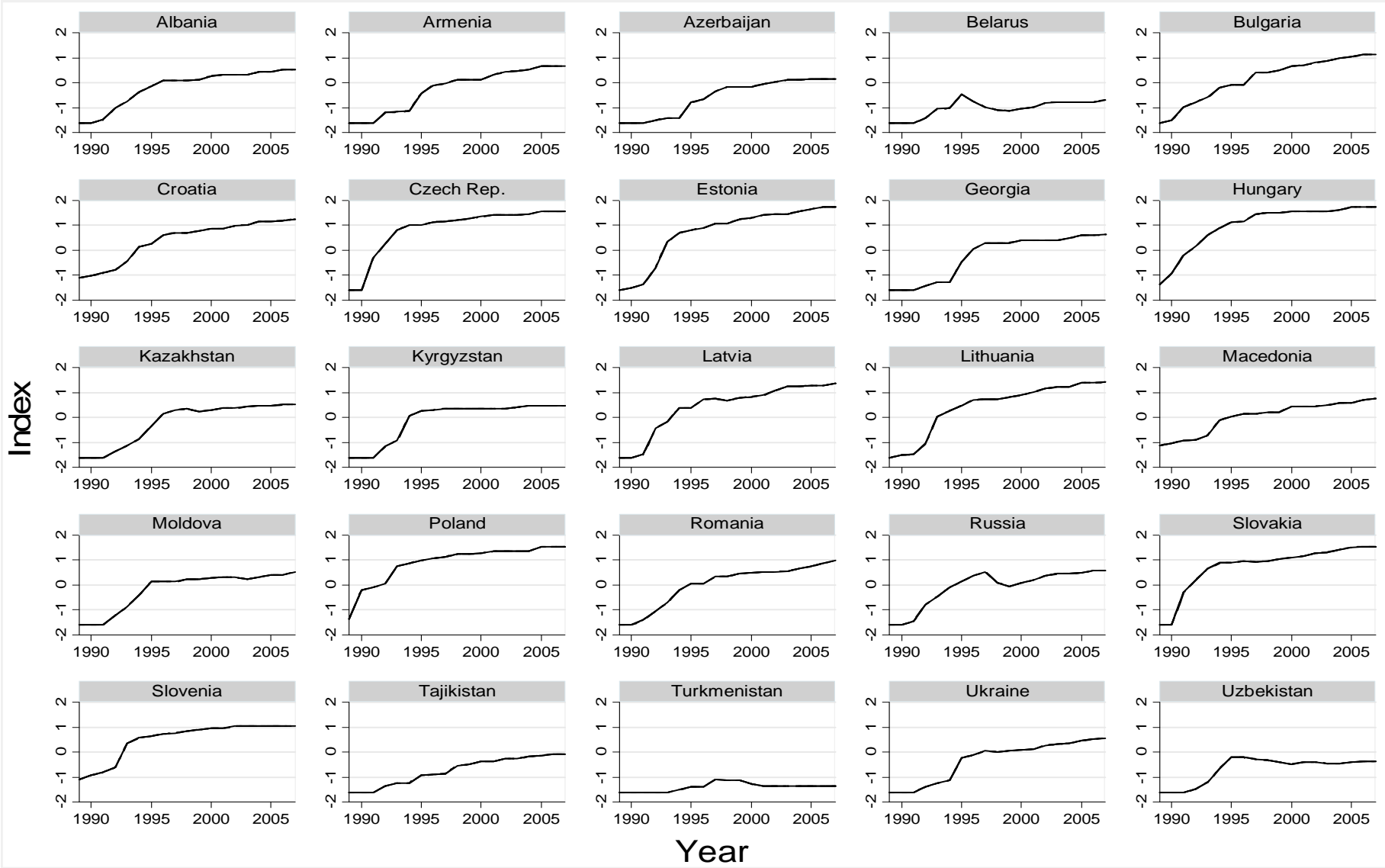
Annex 3: Robustness Check: Alternative Regression Model

Table A1 Structural Breaks in a Model with population growth

A. Index range:	Full sample		[Min;-1.375503]		(-1.375503; -1.118744]		(-1.118744; .1198719]		(0.1198719; 0.3626365[		(0.3626365; Max]	
	(A1)		(A2)		(A3)		(A4)		(A5)		(A6)	
Reform index (lagged)	5.22***	(0.49)	12.81***	(22.69)	97.31	(54.91)	3.61**	(1.87)	1.93	(5.63)	3.20***	(0.94)
Inflation (log)	-1.40***	(0.20)	-1.96***	(0.54)	4.17	(3.84)	-2.46***	(0.58)	0.33	(0.77)	-0.06	(0.23)
Democracy	-5.64**	(2.54)	9.66	(8.33)	-21.11	(73.59)	-14.6**	(6.26)	-32.26***	(11.62)	1.86	(2.81)
War Dummy	-12.00***	(1.36)	-10.43**	(4.58)	0.65	(13.66)	-13.98***	(2.92)	0.25	(6.84)	-7.25***	(2.56)
Investment	-0.065	(0.06)	-0.33	(0.26)	-1.15*	(0.53)	0.03	(0.10)	-0.19	(0.24)	0.14**	(0.06)
Population growth	0.16	(0.44)	3.30	(3.95)	32.17	32.78	1.12	(0.73)	6.67**	(3.19)	0.025	(0.38)
Intercept	11.12***	(1.95)	23.76	(39.63)	113.38	(75.00)	17.54***	(3.24)	26.37***	(7.63)	-2.07	(2.44)
R^2	0.657		0.707		0.653		0.613		0.3014		0.298	
F-stat	126.69***		6.03***		2.51		23.24***		2.01*		11.88***	
N	428		39		24		119		52		194	
Stable/Unstable Model	Unstable		Stable		Stable		Stable		Stable		Stable	

Notes: Standard errors are in parentheses. Significance levels are indicated as 1% (***), 5% (**) and 10% (*). The WDmax and UDmax tests indicate presence of at least one break. The F-test statistic for the presence of one structural break versus no breaks is 81.98, significant at 1%. The F-test statistic for the presence of two breaks versus one break is 97.85, significant at 1%. The F-test statistic for the presence of three breaks versus two breaks is 223.95, significant at 1%. The F-test statistic for the presence of four breaks versus three breaks is 59.36, significant at 1%. The F-test statistic for the presence of five breaks versus four breaks is 19.47, not significant.
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