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## ABSTRACT

### Mind the Break! Accounting for Changing Patterns of Growth during Transition\*

We argue that econometric analyses based on transition countries' data can be vulnerable to structural breaks across time and/or countries. We demonstrate this argument by identifying structural breaks in growth regressions estimated with data for 25 countries and 16 years. Our method 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 two times, yielding thus three different models of growth associated with different stages of reform. The speed with which individual countries progress through these stages differs considerably.

JEL Classification: O47, P26 and P27

Keywords: growth, reform, structural breaks and transition

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# 1 Introduction

Transition is a process of structural change. Market-oriented reform, if implemented effectively, results in rapid and dramatic changes in the regulatory and institutional environment, transfers ownership from the state to private agents and sets free prices 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, 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 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.

A good example of this is the analysis of the impact of market-oriented reform policies on growth. We use this relationship to demonstrate the fragility of analytical results obtained with data spanning a large number of years and/or countries. There is already a sizeable literature on whether progress in implementing market-oriented reform delivers higher 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. Consequently, successful reform should improve the allocation of resources and increase the efficiency of their use, thus helping deliver higher 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) estimates his regressions for different periods and, also, finds 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 of the data may be an improvement compared to regressions estimated with 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 or which years should be lumped together. The only *prior belief* 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 assumption 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 side product of our analysis is that we construct a new measure of progress in implementing market-oriented reforms (which is central to our 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 our baseline model, we find evidence of two structural breaks. Correspondingly, we identify three stable models of growth. As we expected, individual countries make their way through the three 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 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 Data

The communist countries displayed 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<sup>1</sup>. 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 was 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, Figure 1 reports cumulative growth between 1989 and 2004 for the 25 post-communist countries for which data are available. On the one hand, Poland saw its GDP rise by 44 percent, with further eleven countries also reporting positive cumulative growth. On the other hand, more than half of the transition economies report negative cumulative growth and some of the former Soviet Republics even found themselves at output levels close to or even below one half of the level they attained before the transition began. In general, the Central and Eastern European Countries

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<sup>1</sup> 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).

(CEECs) performed better, returning to positive growth 2 or 3 years after the beginning of transition, whereas the former Soviet Union (FSU) countries experienced prolonged periods of economic decline (lasting 4-5 years or even longer).

Figure 1 about here.

As the aim of this paper is to test whether the post-communist transition countries follow different models of growth depending on the degree of progress towards building a market economy, the first problem to settle is to find an accurate measure of this progress. The EBRD produces a set of diverse quantitative indicators to reflect the many facets of the transformation. Each year, it reports figures for 8 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. If these different indicators measure the same phenomenon – the progress towards the market economy – they must be closely related. Table 1, listing the coefficients of correlation between the country averages of the eight EBRD indexes, clearly shows that there is a high degree of dependency between them. In particular, the following pairs of sub-indexes show very high correlation: enterprise and banking reforms (93.2%), large scale privatization and enterprise reforms (87.6%), the foreign exchange\trade liberalization with banking reform (85.6%) and with price liberalization (83%). In general, competition policy is less correlated with the other indicators. Those results reflect between-countries correlations, as they are calculated with average values for the period 1989-2004. While carrying out the same exercise year by year, some variation appears (see annex 1), but the main conclusions do not change.

Table 1 about here.

Because of the high correlation between the various sub-indexes, previous studies typically used their simple average so that the eight measures were reduced to one. However, to the best of our knowledge, none of these studies tested whether assigning equal weights to all eight sub-indexes is in fact appropriate. Therefore, as the first step in our analysis, we perform a factor analysis to determine if all the eight EBRD indicators measure the same phenomenon – the creation of a market economy – or if they reflect independent information contained in some of the sub-indexes. Moreover, while computing a general aggregated index, this method ensures that we apply appropriate weights for the sub-indexes in a composite weighted-average reform index.

There are not one but several factor analysis models which differ in significant respects. A model most often applied is the so-called *common factor analysis (or principal component analysis)*. Common factor 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 patterning all the variation in a set of variables, whether common or unique. We use the second method, as it allows 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.<sup>2</sup> The component factor analysis pursues this objective by estimating the following equation system:

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

where  $Y_j$ , with  $j=1, 2, \dots, n$ , are the observed variables (in our case, the eight EBRD indicators),  $\alpha_{ij}$  are the so-called loadings,  $F_{ij}$  are the so-called factors, which in turn can be functions of some unknown variables and  $\varepsilon$  is the variation of  $Y$  that is independent of the factors.

In understanding factor analysis, it is crucial to remember that  $F$  stands for a function of variables and is not a variable. By application to the known data on the  $Y$  variables, factor analysis defines the unknown  $F$  functions. The factors are the  $F$  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 we retain all factors with eigenvalues higher than 0.5. The eigenvalue of the first factor is 6.12 while that for the second one is 0.39. Therefore, we only retain the first factor. The results of the estimation are reported in Table 2.

The first column shows the *factor loadings*, that is the coefficients of correlation between each EBRD indicator and the factor. We can see that all indicators are strongly positively related

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<sup>2</sup> 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.

to the factor. This suggests that the factor clearly represents progress towards creating a market economy. The second column reports the percentage of variation of the indicator that it is explained by the common factor.<sup>3</sup> All indicators display very high shares of common variation, reaching on average 76.5% of the total variation. 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. Computing a common factor analysis (which assumes that all the communalities are equal to 1) indeed gives almost the same loadings as the component factor analysis (unreported results).

Table 2 about here.

Using factor analysis, it is possible to endogenously determine the weight for each indicator in the aggregate index of the progress towards a market economy (Factor 1). The resulting scores are reported in the last column of Table 2. The highest weights are assigned to enterprise reform, small scale privatization and banking sector liberalization. Multiplying the scores and the values of the sub-indexes yields for each year and each country the index of progress towards a market economy. The aggregate index takes the values from -1.44 (most of the countries at the beginning of transition) to +1.80 (Hungary since 2000). The average level of the index for each country over the period 1989-2004 is reported in Figure 2.

Figure 2 about here.

The former Republics of the USSR progressed more slowly in liberalization of their economies: almost all these countries have a negative average index. Only the Baltic Republics report positive average values of the indicator. Turkmenistan lags furthest behind. If we look at the evolution of the index over time (see annex 2), it is interesting to note that Croatia, Macedonia, Slovenia and to a lesser extent 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 improved them more slowly (except for the Baltics). Moreover, several FSU countries experienced reversals in the index's evolution. For example, Belarus improved its index up to 1995 but subsequently the index fell again. In 2004 the index is still lower than the 1995 performance. Overall thus, the evolution of the countries according to their progress towards a market economy is very heterogeneous and does not evolve monotonically over time, suggesting

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<sup>3</sup> The communality for each variable is the square of the loading multiplied by 100.

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 or based on observation of stylized facts such as an apparent change in trend. In this analysis, 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 that the break should occur at a specific point in time or in space. Or, to be precise, 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 for 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. The main problem is, as it is now well documented, that the max of the F-tests does not follow a Fisher's law. Therefore, Bai and Perron (1998) propose a dynamic algorithm and tests of significance in order to determine the a priori unknown number of breaks. The first question is to infer if 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). If the highest value of the UDmax and WDmax statistics is significant (according to the Bai and Perron (1998) tables), we can conclude that there is at least one structural break. The second question 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 and we stop when the test is no longer significant. This gives the number of breaks, as well as their location.

As our data contain 400 observations (25 countries over 16 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 test statistic for each value of the index.

We estimate the following baseline model:

$$\Delta Y_{j,t} = f(RI_{j,t-1}, DI_{j,t}, IC_j, LINFL_{j,t}, WAR_{j,t})$$

where the dependent variable,  $\Delta Y_{j,t}$ , is the growth rate in country  $j$  in year  $t$ . The explanatory variables include: the reform index ( $RI$ ), lagged by one year to allow for some time delay in the effect of reform on growth; a 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);  $IC_j$ , a composite index of initial conditions constructed by the EBRD, (measuring macroeconomic distortions, time spent under communism, distance to the EU, dependence on CMEA for trade and natural resource wealth)<sup>4</sup>; the logarithm of CPI inflation,  $LINFL_{j,t}$ ; and a dummy indicating whether the country was involved in a military conflict (internal or external),  $WAR_{j,t}$ . We tested whether fixed or random effects have to be included and found that we can estimate the model as a pooled cross section. The reform index, initial conditions, 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

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<sup>4</sup> This measure is 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). We follow Falcetti et al. (2002) who argue that the second factor is not robustly related to growth and only use the first one.

above and therefore the contemporaneous and lagged values tend to be strongly correlated during the later years. Therefore, we only include the lagged value.<sup>5</sup>

The results are summarized in Table 3. The testing procedure indicates that there are two structural breaks significant at the 5% significance level. There is also a potential third break but it is only significant at the 10% level. Panel A of Table 3 reports the regression results obtained if we accept only two structural breaks and Panel B reports the corresponding results for three breaks. The first column (A1/B1) reports the regression results obtained with the full sample. This model, however, is found to be unstable in that it contains a structural break at a value of the reform index equal to -1.269 and another at -1.042. Hence, the observations follow (at least) three different models of growth. The resulting regressions are reported in columns A2, A3 and A4. The first two regressions both collect relatively few observations, 38 and 22, respectively. Reform has a strong negative effect on growth in the first regression: an increase in the value of our weighted reform index by 1 (the index ranges from approximately -1.4 to 1.8) would lower growth by 80 percentage points per year! This large (and counter intuitive) effect is presumably due to the fact that the first regression is estimated with data from the least reformed countries, many of which experienced dramatic economic declines at the onset of transition. Reform appears insignificant in the second regression. Inflation depresses growth but the effect is only significant in the second regression. Being involved in a military conflict has a strong negative effect on growth in both models of growth. Initial conditions do not appear to have a significant impact on subsequent growth.

Most data points follow the third model of growth (column A4). Here, progress in reform has a positive effect on growth, although this is counter-balanced by the negative effect of democracy (given that the range of the reform index is more than three times greater than the range of the democracy index, a full economic liberalization accompanied by full democratization would have essentially a zero effect on growth<sup>6</sup>). Inflation again depresses growth. War now has no impact on growth (this may be because military conflicts occurred predominantly during the early stages of transition). Initial conditions remain insignificant.

This third model of growth, however, may itself be subject to a further structural break, although the break is only significant at the 10% level. This would yield another two models of

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<sup>5</sup> Our specification contains also the democracy index. As a robustness check, we reestimated the model without democracy (see the Annex).

<sup>6</sup> However, this statement ignores the fact that democratization may have a positive feedback effect on economic liberalization, as argued by Fidrmuc (2003).

growth. The corresponding regression results are reported in columns B4 and B5. These models differ from each other in several ways. Reform is insignificant in column B4 whereas it is positive in column B5. Inflation and democracy have both stronger (and both negative) effects on growth in B4. Finally, initial conditions are significant in both regressions but with opposite signs. Since higher values of the initial-conditions variable indicate lower extent of pre-transition imbalances, this suggests, somewhat counter-intuitively, that countries with less favorable initial conditions improved their growth performance in the latest part of transition.<sup>7</sup>

Table 3 about here.

The analysis thus yields three stable models of growth for the following reform index intervals: [-1.441, -1.269], [-1.269, -1.042] and [-1.042, 1.803]. For simplicity, we refer to these intervals as the early reform, intermediate reform and late reform models of growth, respectively.<sup>8</sup> The first, early-reform model thus depicts the stage in transition before rigorous reforms were implemented. The second and third models then comprise observations with intermediate and advanced progress in reform. Note that countries can progress from one model to another at different points in time (if ever) and can also revert back to a previously abandoned model if they reverse some of the implemented reform measures.

Clearly, using a different regression specification could lead us to identify different structural breaks. Therefore, to test the robustness of our results, we repeated the analysis with four alternative regression specifications: omitting the democracy index, adding pre-transition secondary school enrollment (as a measure of human-capital endowment) or population growth and adding both schooling and population growth. In all four cases, the analysis yielded only two structural breaks located at precisely the same points as in the baseline model (the model without democracy is reported in the Annex, the remaining 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. Omitting the democratization index weakens the significance of the reform index, which confirms that the two variables are closely correlated. The remaining variables appear with similar coefficients as in the baseline model,

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<sup>7</sup> This may be due to two factors. First, these countries have experienced protracted economic declines so that the positive coefficient on initial conditions captures the eventual rebound of growth and subsequent catch-up. Second, these countries depend to a greater extent on exports of oil and gas and therefore benefited from the recent high prices of these commodities (Falcetti et al., 2006, formally account for the effect of high oil prices on growth and find that it helps explain the recent rapid recoveries across the FSU).

<sup>8</sup> 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.

except for the initial-conditions measure which is significant in the last two models of growth (the coefficient estimate is negative, which again suggests that countries with relatively adverse initial conditions grow more dynamically). Given the overall similarity of the results, the discussion in the remainder of our paper centers on the baseline regression model reported in Table 3.

Table 4 reports the average values of growth, inflation and the corresponding ranges of the reform index for the three models. The early and intermediate reform periods are associated with serious economic malaise: countries in these stages experience dramatic economic contractions along with very high inflation, taking on hyperinflationary proportions in the intermediate-reform stage. Compared to that, the third model presents a marked improvement: growth becomes positive and inflation, while still high on average, slows down again.

Table 4 about here.

A question of great interest, of course, is knowing which countries belong to each model of growth at which time. In principle, a country in transition should proceed through all three 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 three models over time. Hungary, Poland, Slovenia and the former Yugoslavia are found in the third, late 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 Yugoslavia, even before that). All other countries start the transition within the first model of growth. All proceed to the second and third model, or often directly to the third model, during the first half of the 1990s. Most countries eventually progress to the fourth model (if we accept the third structural break), with the exception of Belarus, Tajikistan and Uzbekistan. Turkmenistan, furthermore, recedes from the third model back to the second. Russia and Macedonia make a similar, though temporary, regression from fourth to third model during the late 1990s.

Table 5 about here.

Much of the discussion assessing transition countries' growth performance centered on the role of liberal policies in delivering efficiency improvements that lead to higher growth. However, that discussion has so far been largely inconclusive: while some argue that progress in 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 these studies were conducted using data pooled either across countries or time (or both). Hence, they fail to account for the changing nature of growth and therefore it is not at all surprising that they often arrive at very different findings. In contrast, the regressions reported in Table 3 are estimated with data that are free of structural breaks. Therefore, it is instructive to compare the impact of liberal policies on growth in the three stages of reform.

The regression results suggest that reform has a positive effect on growth during the last stage of transition (whether we accept two or three structural breaks). During the early stages, reform appears to have had no effect, or may even have had a negative effect. Again, this probably reflects the extraordinary economic (and political) turbulence at the outset of reform when most countries experienced dramatic economic contractions.

The EBRD indicator of initial conditions is only significant in the early-reform stage when countries with a greater extent of macroeconomic imbalance grew less dynamically (or, as was typically the case, declined more rapidly). The lack of a significant impact of initial conditions on growth in the first model is surprising, considering the attention that this relationship has received in the literature (see Aslund et al., 1996; Krueger and Ciolko, 1998; and Heybey and Murrell, 1999). For the late reform stage, our finding of no effect parallels those of Berg et al. (1998) and Falcetti et al. (2002). We further explored the potential role of initial conditions by testing for presence of structural breaks in growth according to the initial conditions. 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. However, we found no structural breaks based on the differences in initial conditions. Hence, while the occurrence of structural breaks is related to the progress in implementing economic reforms, the patterns of growth during transition do not appear to differ across countries with different historical legacies.

## 4 Conclusion

In this paper, we use the heterogeneous growth experiences of post-communist countries to demonstrate the changing nature of fundamental economic relationships during transition. As the various elements of the market environment are implemented, one can see, indeed one should

expect to see, important changes concerning the way the transition economies work. Facilitating such changes, after all, is the very objective of reform.

Presence of structural breaks, however, implies that empirical analyses of transition must account for the changing nature of the underlying relationship, otherwise the findings can be misleading. In our analysis of the relationship between reform-oriented policies and growth, we found evidence of at least two structural breaks. Moreover, different countries experience the breaks at different points in time. In particular, 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, moved through the various stages of growth faster.

While we demonstrate the fragility of econometric results using a specific relationship that has generated much interest in the transition literature, our argument is valid more generally. Therefore, this paper constitutes a cautionary tale for any empirical analyst studying multiple countries and/or longer time periods, and especially during a period of dramatic systemic changes such as the post-communist transition: structural breaks are possible, indeed very likely, and may occur in time and in space alike.

Our analysis also sheds new light on the much-disputed relationship between reform-minded policies and growth during transition. For our base model, we find evidence of two breaks and thus three different models of growth, which we refer to as early, intermediate and late 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 period covered by the analysis. The reform-minded policies had no effect or even a negative effect on growth during the early and intermediate stage of growth. The relationship becomes positive during the late stage, nevertheless. As the previous studies used different periods and did not account for possible structural breaks, they inevitably mixed data from more than one model of growth. Consequently, different studies obtained often very different results.

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: 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	0.996	1.000								
Price Liberalization	0.810	0.849	1.000							
Forex/Trade Liberalization	0.914	0.929	0.830	1.000						
Small Scale Privatization	0.904	0.921	0.808	0.855	1.000					
Large Scale Privatization	0.934	0.931	0.728	0.831	0.836	1.000				
Enterprise Reform	0.956	0.933	0.692	0.822	0.808	0.876	1.000			
Competition Policy	0.848	0.836	0.606	0.678	0.702	0.787	0.819	1.000		
Banking Reform	0.953	0.936	0.712	0.856	0.810	0.863	0.932	0.768	1.000	
Non-bank. Financial Inst.	0.856	0.838	0.562	0.679	0.704	0.779	0.835	0.825	0.823	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 1989-2004.

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

**Table 2: Factor Analysis Results**

Variable	Factor 1 loading	Uniqueness	Weight
Price liberalization	0.7993	0.3611	0.08116
Foreign exchange/trade lib.	0.9036	0.1836	0.15028
Small privatization	0.8927	0.2031	0.13332
Large privatization	0.9227	0.1486	0.13579
Enterprise reform	0.9447	0.1075	0.21431
Competition liberalization	0.8375	0.2986	0.09703
Bank liberalization	0.9415	0.1135	0.18238
Non bank liberalization	0.8458	0.2846	0.08908

**Table 3 Structural Breaks in the Baseline Model of Growth**

<b>A. Index range:</b>	<b>Full sample</b>		<b>[Min; -1.269]</b>		<b>]-1.269 -1.042]</b>		<b>]-1.042, Max]</b>			
	(A1)	(A2)	(A3)	(A4)	(A5)	(A6)	(A7)	(A8)		
Reform index (lagged)	3.86***	(0.56)	-79.83***	(26.39)	9.80	(19.62)	3.26***	(0.88)		
Inflation (log)	-2.01***	(0.21)	-0.83	(0.78)	-2.43***	(0.69)	-2.00***	(0.26)		
Democracy	-11.80***	(2.04)	11.94	(7.73)	-10.98	(7.93)	-11.05	(2.30)		
War Dummy	-8.28***	(1.37)	-8.76***	(2.96)	-19.30***	(2.86)	-2.42	(1.90)		
EBRD IC1 measure	0.97	(0.22)	-0.85	(0.84)	-2.64*	(1.41)	0.08	(0.22)		
Intercept	12.99***	(1.33)	-122.14***	(39.48)	19.26	(23.69)	12.79***	(1.35)		
R <sup>2</sup>	0.56		0.51		0.89		0.47			
F-stat	86.33***		6.69***		25.52***		49.45***			
N	341		38		22		281			
Stable/Unstable Model	Unstable		Stable		Stable		Stable <sup>1</sup>			
<b>B. Index range:</b>	<b>Full sample</b>		<b>[Min; -1.269]</b>		<b>(-1.269 -1.042]</b>		<b>(-1.042, 0.272]</b>		<b>(0.272, Max]</b>	
	(B1)	(B2)	(B3)	(B4)	(B5)	(B6)	(B7)	(B8)	(B9)	(B10)
Reform index (lagged)	3.86***	(0.56)	-79.83***	(26.39)	9.80	(19.62)	0.01	(2.20)	3.01***	(0.99)
Inflation (log)	-2.01***	(0.21)	-0.83	(0.78)	-2.43***	(0.69)	-3.27***	(0.55)	-1.05***	(0.23)
Democracy	-11.80***	(2.04)	11.94	(7.73)	-10.98	(7.93)	-19.33***	(4.61)	-4.15**	(2.10)
War Dummy	-8.28***	(1.37)	-8.76***	(2.96)	-19.30***	(2.86)	-2.06	(2.77)	-0.86	(2.68)
EBRD IC1 measure	0.97	(0.22)	-0.85	(0.84)	-2.64*	(1.41)	1.05**	(0.49)	-0.47***	(0.18)
Intercept	12.99***	(1.33)	-122.14***	(39.48)	19.26	(23.69)	21.49***	(2.70)	6.63***	(1.21)
R <sup>2</sup>	0.56		0.51		0.89		0.51		0.25	
F-stat	86.33***		6.69***		25.52***		21.05***		10.89***	
N	341		38		22		108		173	
Stable/Unstable Model	Unstable		Stable		Stable		Stable		Stable	

Notes: Standard errors are in parentheses. Significance levels are indicated as 1% (\*\*\*), 5% (\*\*) and 10% (\*). The F-test statistic for the presence of one structural break versus no breaks is 26.90, significant at 5%. The F-test statistic for the presence of two breaks versus one break is 32.09, significant at 5%. The F-test statistic for the presence of three break versus two breaks is 23.89, significant only at 10%. Panel A presents the results with only two breaks (i.e. those significant at 5% or higher) while Panel B presents results with three breaks (with the third break significant only at 10%).

<sup>1</sup> Stable at 5% significance level but unstable at 10%.

**Table 4 Descriptive Statistics**

<b>Model</b>	<b>Reform index range</b>	<b>MEANS</b>		<b>STANDARD DEVIATIONS</b>	
		<b>Growth</b>	<b>Inflation</b>	<b>Growth</b>	<b>Inflation</b>
1 Early reform	[Min; -1.269]	-8.36032	255.0237	9.226079	586.9099
2 Intermediate reform	]-1.269 -1.042]	-10.9371	1776.923	14.75498	3285.673
3 Late reform	]-1.042, Max]	1.120313	157.7065	7.668501	450.7436
3a Late reform 1	]-1.042, 0.272]	-3.02004	375.7919	9.914021	665.0116
4 Late reform 2	]0.272, Max]	3.705039	21.56062	4.13556	84.37616

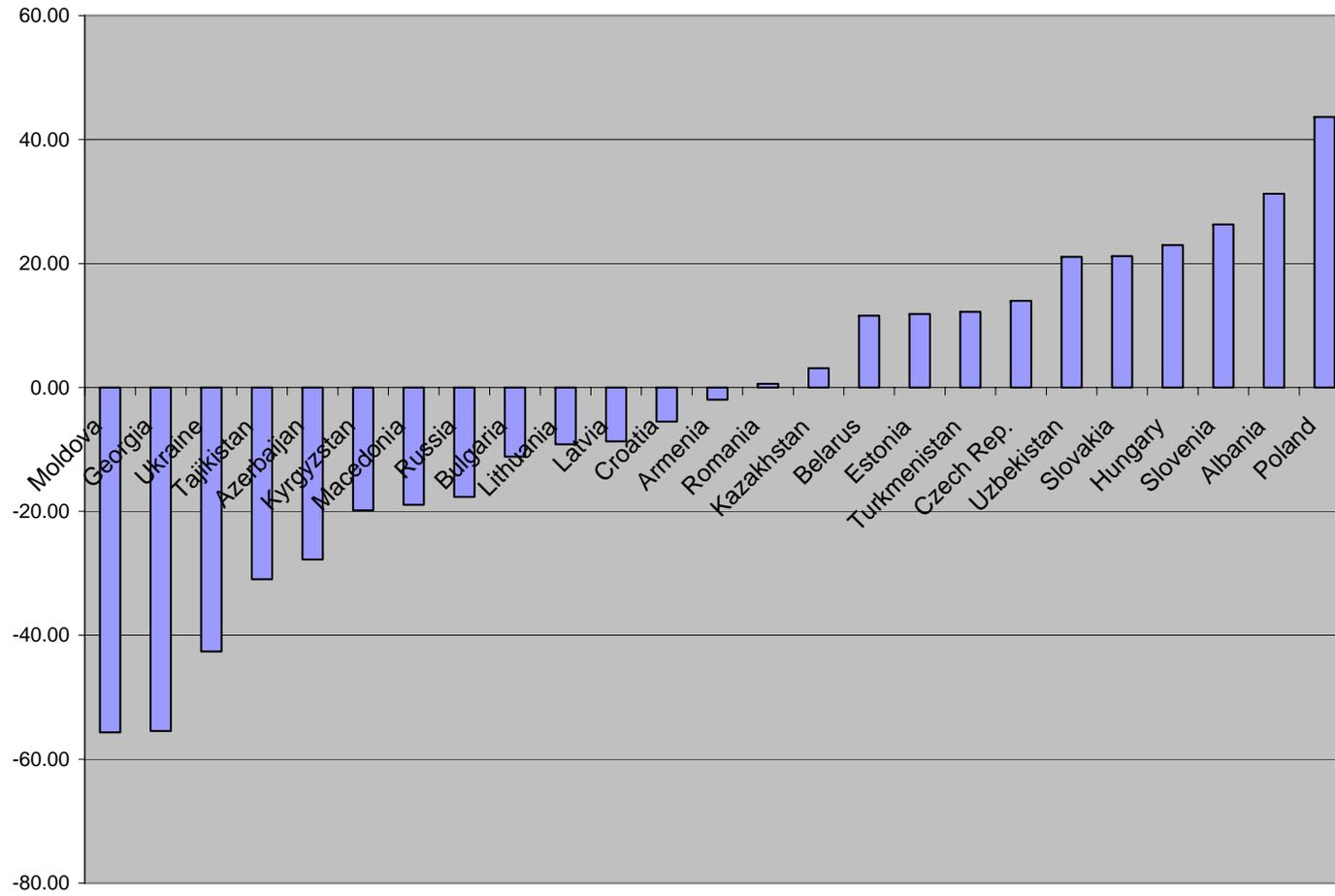
Notes: Models 1, 2 and 3 refer to the three stable models reported in Table 1 in columns (2), (4) and (5), respectively.

**Table 5 Patterns of Growth across Countries and Time**

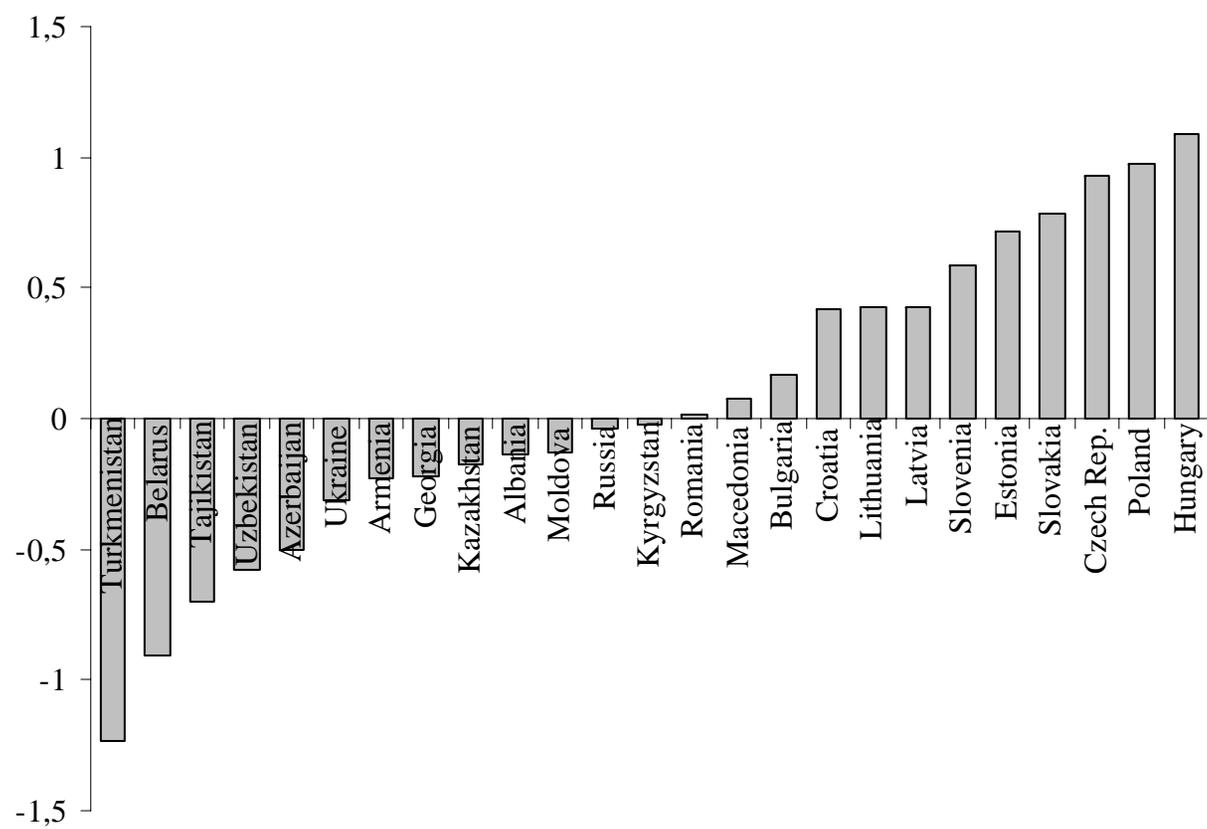
	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004
Albania	1	1	3	3	3	3	3	3/4	3/4	3/4	3/4	3/4	3/4	3/4	3/4
Armenia	1	1	2	3	3	3	3	3	3/4	3/4	3	3/4	3/4	3/4	3/4
Azerbaijan	1	1	1	2	2	3	3	3	3	3	3	3	3/4	3/4	3/4
Belarus	1	1	2	3	3	3	3	3	3	3	3	3	3	3	3
Bulgaria	1	3	3	3	3	3	3	3	3	3/4	3/4	3/4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

Notes: The Table shows which model of growth a country belongs to in any given year between 1990 and 2003. The number within a cell indicates in which pattern of growth the country appears at which time. Cells denoted with 3/4 are those observations that occur after the third break that is only significant at 10%.

**Figure 1 Cumulative Growth, 1989-2004**



**Figure 2 Average level of aggregate index for each country**



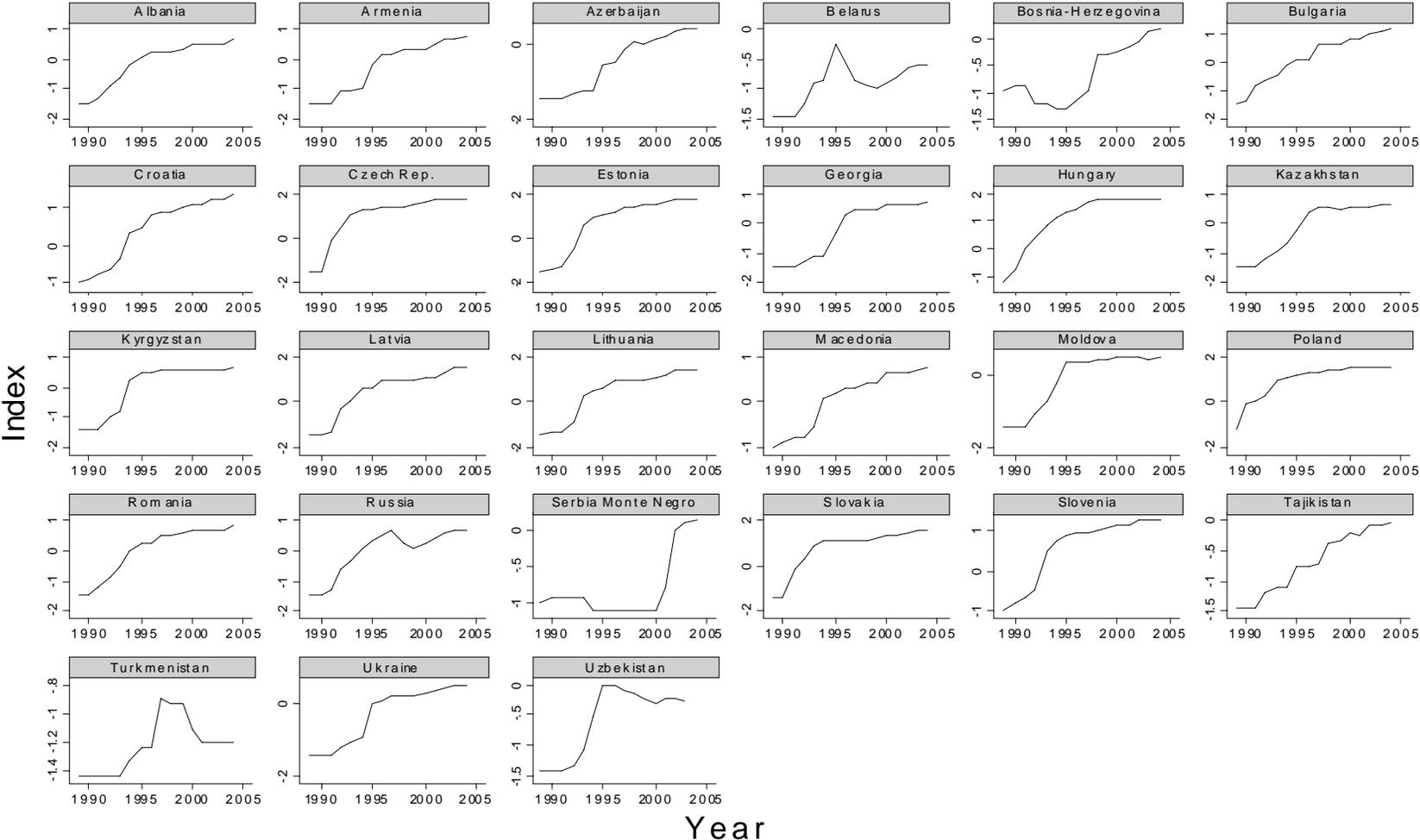
Note: The figure reports country averages over 1989-2004.

### 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	59.57	93.66												
	(1992)	(1989)												
Small Scale Privatization	50.12	89.01	64.29	84.62										
	(1992)	(1989)	(1992)	(2001)										
Large Scale Privatization	35.44	87.53	40.74	81.69	4.57	86.67								
	(1991)	(2004)	(1991)	(2004)	(1991)	(2003)								
Enterprise Reform	30.90	72.62	51.75	86.78	36.69	85.36	50.82	88.20						
	(1990)	(2000)	(1990)	(1994)	(1990)	(2000)	(1992)	(1997)						
Competition Policy	19.18	57.23	37	60.47	21.12	77.73	44.05	77.54	58.81	100				
	(1993)	(1997)	(1993)	(1991)	(1992)	(2003)	(1991)	(2001)	(1992)	(1990)				
Banking Reform	30.90	77.39	51.75	89.04	36.69	84.50	48.43	86.24	77.67	100	43.32	100		
	(1990)	(1998)	(1990)	(1994)	(1990)	(1997)	(1992)	(1997)	(1992)	(1990)	(1995)	(1990)		
Non-bank. Financial Inst.	7.35	50.19	9.11	63.32	9.25	66.82	4.55	70.57	5.55	84.52	5.55	88.97	5.55	83.31
	(1992)	(2004)	(1992)	(1996)	(1992)	(2000)	(1992)	(1991)	(1990)	(2001)	(1990)	(2001)	(1990)	(2003)

*Note: year when minimum and maximum occurs in parenthesis*

**Annex 2 : Evolution of the aggregate index by country and by year**



### Annex 3: Robustness Checks: Alternative Regression Models

**Table A1 Structural Breaks in a Model without Democracy**

Index range:	Full sample (1)	[Min; -1.269] (2)	(-1.269 -1.042] (4)	(-1.042, Max] (3)
Reform index (lagged)	2.44*** (0.53)	-72.34*** (26.49)	12.36 (20.05)	0.73 (0.88)
Inflation (log)	-2.12*** (0.22)	-1.16 (0.76)	-2.82*** (0.65)	-2.42*** (0.26)
War Dummy	-8.02*** (1.43)	-7.75*** (2.95)	-18.81*** (2.92)	-1.13 (1.90)
EBRD IC1 measure	0.72*** (0.18)	-0.17 (0.73)	-4.04*** (1.02)	-0.60*** (0.22)
Intercept	6.80*** (0.83)	-104.56*** (38.59)	18.68 (24.32)	8.58*** (1.35)
R <sup>2</sup>	0.52	0.47	0.88	0.43
F-stat	90.74***	7.46***	29.82***	51.52***
N	341	38	22	281
Stable/Unstable Model	Unstable	Stable	Stable	Stable

Notes: Standard errors are in parentheses. Significance levels are indicated as 1% (\*\*\*), 5% (\*\*) and 10% (\*). The F-test statistic for the presence of one structural break versus no breaks is 27.46, significant at 5%. The F-test statistic for the presence of two breaks versus one break is 36.33, significant at 5%. The F-test statistic for the presence of three break versus two breaks is 22.57, not significant.