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# Growth in Transition Countries: Big Bang versus Gradualism

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## Abstract

This paper analyses the impact of the speed of transition reforms on economic growth in transition countries in the context of the debate big-bang versus gradualist approach. It builds a new indicator for the speed of transition reforms based on a three-way principal component analysis. It shows that: (i) the speed of transition reforms Granger-causes economic growth and there is no reverse causation; (ii) the impact of contemporaneous speed of transition reforms on economic growth is negative but becomes positive in the longer horizon; and (iii) other factors, such as initial conditions and macroeconomic stabilization program, also drive economic growth. While the first two results are robust to different estimators, the impact of control variables depends on the econometric specification.

**Keywords:** speed of transition; economic growth; three-way principal components analysis.

**JEL Classification:** C33, C82, 057, P21, P24

## Introduction

Transition countries have experienced profound macroeconomic, political, social and cultural changes since the fall of the Berlin wall.1 And among them different transition and growth paths have occurred. According to Roland (2000, p. 1), 'controversies focused very quickly on the speed of transition'. Two main, and opposite, views prevail in the literature. The first, the so-called Washington consensus, advocates for a big bang or shock therapy approach to transition (Murphy et al., 1992; Berg et al., 1999, among others). According to this view, a quick and simultaneous introduction of all reforms (see Roland, 2000) delivers sure efficiency gains in introducing successful market economy. The second view, the so-called gradualist approach, proposes a gradual reform path, relying on the flexibility of experimentation with an adequate sequencing of reforms (for example Aghion and Blanchard, 1994; Roland, 2000). There are episodes of success and failure for both views: the Czech Republic successfully implemented a big bang policy, differently from Hungary and Russia (see Roland, 2000, for a detailed discussion); China successfully experienced a gradual reform path (Feltenstein and Nsouli, 2001). A third strand of literature focuses on big bang along certain dimensions and gradualism along other dimensions (Kornai, 1990; Blanchard et al., 1991; and Fischer and Gelb, 1991).

Economic growth is a complex phenomenon; therefore, focussing on a sole dimension, such as the speed of transition reforms, might lead to an incorrect conclusion. According to Falcetti et al. (2006) and De Melo et al. (2001), the link between reforms and economic growth in transition countries should be re-examined taking into account a variety of factors, such as initial conditions and macroeconomic stabilisation programmes.

This paper provides empirical evidence in order to contribute to the debate 'big bang versus gradualism' in transition countries and it makes three major contributions.

First, it builds a new indicator of the speed of transition reforms based on an innovative procedure, the three-way Principal Component Analysis (PCA), originally applied by Tucker (1966) in psychometrics and then used in other disciplines such as chemometrics and recently economics (e.g. Henrion, 1994; Barbieri et al., 1999; Pardo et al. 2004; Mourao, 2008). Roland (2000, p.12) emphasises that focusing on individual reforms might lead to a wrong picture of transition: ‘there are, for example, evident complementarities between privatization and price liberalization’. The composite index of transition built in this paper provides a single dimension for all transition indicators published by the European Bank for Reconstruction and Development (EBRD). The percentage change of this index over time is defined as the speed of transition reforms (speed of transition, henceforth).

Second, this paper builds on the analysis by Falcetti et al. (2006), focussing on the link between the speed of transition and economic growth at different time horizons. In a panel analysis of the Central and Eastern Europe (CEE) and the Commonwealth of Independent States (CIS) transition countries2 for the period 1990-2008, we study: (i) the influence of the speed of reforms on economic growth as well as the reverse link from economic growth to speed of transition; (ii) the dynamic effects of reforms; and (iii) the role of other factors in explaining economic growth in transition countries, such as initial conditions, macroeconomic stabilisation programmes, and external demand.

Third, this paper presents different econometric methodologies to test the nature of the relationship between the speed of transition and economic growth. Panel unit root tests, Granger causality and the optimal lag length between the reforms and their effects on economic growth are employed as a preliminary analysis. Then, the model specifications are substantially two: (i) a static panel model, examining the effect of contemporaneous speed of transition on economic growth; and (ii) a dynamic panel model, examining whether the speed of transition leads to better economic performances over time.

[1] Transition is “the widely accepted term for the thoroughgoing political and economic changes” in ex-communist countries in order to establish market-oriented economies (Murrell, 2006, p. 1).
[2] See Appendix A for the list of countries.

The main results are as follows. First, we show that the three-way PCA is more appropriate than traditional two-way PCA to build an overall index of speed of transition when three-dimensional dataset are used. Second, the speed of transition Granger-causes economic growth and there is no evidence of reverse causation. Third, the impact of contemporaneous speed of transition is negative but in the longer horizon it becomes positive, reaching the maximum benefit with a three-year lag. This result is robust to different estimators and model specifications. Fourth, when controlling for endogeneity by system GMM, the control variables such as country's external demand, macroeconomic stabilization programmes and the country's initial conditions have a lower, often insignificant, impact on economic growth.

The structure of the paper is as follows. Section 1 presents some data on economic growth in transition countries and discusses the main contributions of the empirical literature. Section 2 explains and builds the composite index of speed of transition computed with the three-way PCA. Section 3 presents the econometric methodology, the results and the robustness exercises. Section 4 draws the main conclusions on the relationship between economic growth and speed of transition.

## 1. Transition: stylised facts and empirical literature

The 29 countries where the EBRD operates have experienced different growth paths.3 In 2009, Tajikistan was the poorest country with a GDP per capita (PPP) of 1,791 constant 2005 international dollars while Slovenia was the richest, with a GDP per capita of 16,405 constant 2005 international dollars. In the period 1990-2009 the average GDP growth rates were negative in Kyrgyz Republic, Moldova, Serbia, Tajikistan and Ukraine and positive in the others. Many countries experienced negative growth rate in the years immediately following the independence, while in all the countries the average growth rates between 2000 and 2009 were positive, even taking into account the effects of the 2007-2009 crisis. There should be potential problems in the data for transition countries; for example, the initial decline in GDP could be over-estimated (Foster and Stehrer, 2007). However alternative measures of economic growth, based on estimates of electricity use, have their own problems (Falcetti et al., 2006). Bearing this caveat in mind and given the absence of alternative good indicators, official data are used.

Figure 1 reports the paths of weighted and unweighted indexes of the annual average of GDP per capita, PPP (constant 2005 international dollars) for 27 transition countries, with the exception of Bosnia and Herzegovina (BiH) and Montenegro because of missing values in the early 1990s. The index is normalized to 100 in 1990 for all countries. At the beginning of the transition process there has been a significant fall in real GDP, which started to recovery many years after. This path is robust to the size of the different economies, with the two indexes virtually coincident. Various reasons have been provided to explain the output fall, such as the credit crunch hypothesis, the role of network externalities and the monopoly behaviour by enterprises after liberalization (see Roland, 2000, for a detailed discussion).

[3] Economic growth is measured by the growth rate of real GDP, as standard, and data are taken from World Bank Development indicator database.

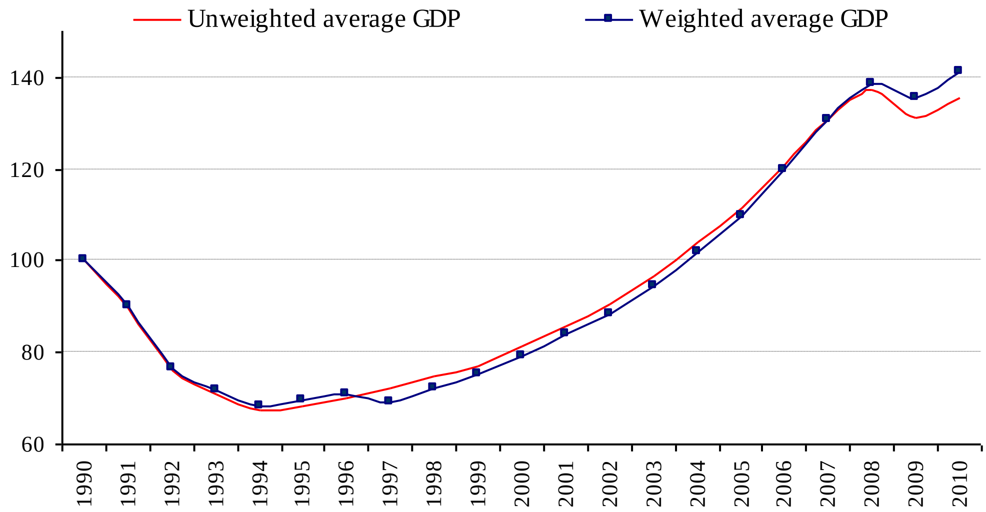


*Figure 1 - Weighted and unweighted indexes of the annual average of GDP per capita.*
*Source - Own elaboration from WB (27 transition countries with the exception of BiH and Montenegro)*

In the empirical literature the impact of reforms on economic growth can be summarised in the study of Falcetti et al. (2006). According to them, a consensus emerges on the three set of variables affecting economic growth in transition countries. First, macroeconomic stabilisation is essential for growth. Second, while initial conditions do matter, their influence on growth is declining steadily over time. And third, the impact of structural reforms is strong and robust. The relationship between different types of reforms and growth is discussed in Fidrmuc (2003), among many others. Fidrmuc uses five-year moving averages and estimates separate cross-section regressions for each period. The liberalisation index (an average of EBRD indicators), which is instrumented in the regressions, is positive and significant in the early period (1990-94, 1991-95), but not in the last period (1996-2000). Overall, the introduction of wide-ranging democracy did not in fact adversely affect economic growth in transition countries.

The relationship between the speed of transition and economic growth has been less explored in the empirical literature and results are mixed. Fischer and Sahay (2000) are in favour of the big bang approach. In a panel data of 25 transition countries from 1989 to 1998 they find that the faster is the speed of reforms, the higher is economic growth and the quicker is the recovery. In a panel of 25 transition countries from 1989 to 2001 Staehr (2005) finds that the effects from the speed of reforms on economic growth are mostly absent but early reforms leave the transition country a longer period in which to reap the benefits of reforms. Possible negative short-term effects of rapid reforms are likely to be modest, and could be balanced by possible positive medium-term effects. Therefore, in his study speed per se has no discernible impact on growth. Foster and Stehrer (2007) employ a logistic smooth transition regression in a sample of ten CEE countries with different sample periods for each country and use a dummy to indicate whether the country is a fast or gradual reformer. They find that differences in the speed of reforms have little impact on the depth and length of the transitional recession or on the response of long-term growth to reforms. Merlevede and Schoors (2007), in a panel of 25 transition countries using three-stage least squares estimators, find that new reforms affect economic growth negatively, while the level of past reforms leads to higher growth and attracts FDI. Fidrmuc and Tichit (2009) use a component factor analysis to construct an index for the measure of progress in implementing market-oriented reforms. They find evidence of three breaks and, thus, four different models of growth; overall, the effect of reform on growth is positive.

## 2. Creating an overall index of the speed of transition

This section proposes an overall index of transition process over the period 1989-2010. In establishing the proxy variable for the speed of transition, a broad aggregate indicator of institutional change in transition is constructed from the EBRD indices of structural and institutional reforms. These indices rank institutions in transition relative to the standards of the industrialized market economies (see Raiser et al., 2001; Di Tommaso et al., 2007, among many others). All transition countries and transition indicators published by EBRD are included, with the exception of Turkey and 'Railway' respectively for which missing values are present. Details on sources and definitions of all variables are provided in Appendix A. When a country reaches 4+, it has achieved the standards in this dimension of a typical advanced industrial economy, and no further advances in reform along this dimension are reflected in the transition score. A higher score means more progress in that dimension than a lower score, but there should be no presumption that the difference between a score of 1 and 2, for example, is the same as between 2 and 3. In fact, many countries have found it relatively easy to make the first steps (1 to 2) but much harder to complete the process.
Subsection 3.1 explains the three-way PCA which is a special case of Multiple Principal Component Analysis (MPCA), the econometric methodology used to build the index in Subsection 3.2.

### 2.1 Three-way principal component analysis

According to Russell et al. (2000), MPCA is a dimensionality reduction technique and allows a much easier interpretation of the information present in the data set since it directly takes into account its three-way structure.[4] In particular, Tucker3 model is the most common model for performing three-way PCA (Pardo et al., 2004). For a comprehensive analysis of this approach see Kroonenberg (1983, 2008).
Tucker3 method is an extension of two-way PCA which preserves the original 3-way structure of the data during model development. It decomposes data arrays X into three orthonormal loading matrices, denoted by A (I×P), B (T×Q), C (K×R) and the core matrix G (P×Q×R), which can be interpreted as a loading matrix in the classical two-way. The Tucker3 model for a 3-way array X with elements $x_{itk}$ has the form:

$$x_{itk} = \sum_{p=1}^{P}\sum_{q=1}^{Q}\sum_{r=1}^{R} a_{ip} b_{tq} c_{kr} g_{pqr} + e_{itk} \qquad (1)$$

where the values $a_{ip}$, $b_{tq}$ and $c_{kr}$ are the elements of the component matrices A, B, and C, respectively and $g_{pqr}$ denotes the elements (p, q, r) of the three way core matrix G (Kroonenberg, 1992). This method allows for extraction of different numbers of factors in each of the dimensions (e.g. countries, time, and variables) and the number of factors in each mode is not necessarily the same. The core array $g_{pqr}$ is another relevant difference between two-way and three-way PCA. While in standard two-way PCA, there are no interactions among PCs, the three-way PCA allows such interactions. All loading vectors in one mode (can) interact with all loading vectors in the other modes, and the strengths of these interactions are given in the core array. The squared element $g^2_{pqr}$ reflects the amount of variation explained by factor p, from the first mode, factor q from the second mode and factor r from the third mode. The largest squared elements of G indicate the most important factors that describe X.

[4] Although PCA could be applied also to three dimensional data set (e.g. Countries x Time x Variables) by transforming data, results could be difficult to interpret because the information of the three modes can be mixed (Pardo et al., 2004).

The number of factors chosen for the three-way PCA model determines the dimension of the core. The dimensionality is optimal when the increase in the complexity of the model no longer increases the fit of the model significantly. Figure 2 shows that the suitable dimensions of the three-way PCA may be (1, 1, 1). The numbers in the brackets represent a suitable number of factors in each mode.[5]

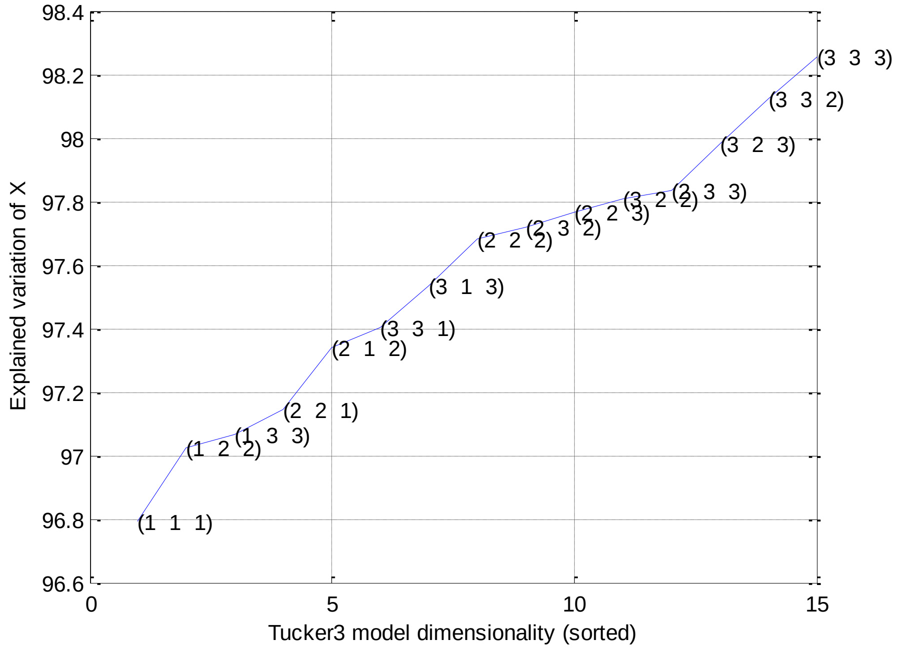


*Figure 2 - Explained variation of X as a function of Tucker3 model dimensionality.*

Table 1 shows the explained variation (sum of squares) of the core for the models (1,1,1) and (2,1,2). It confirms that the first component (1,1,1) is sufficient to explain the largest part of variation of X (96.8 percent as reported in Table 2). The core entry (2,1,2) is a rather small part of the total structural information. Figure 2 shows that it supplies the models with additional 0.55 percent of the total explained variation (97.35 percent). According with these results the smallest dimension of core matrix (1, 1, 1) is chosen. This implies the estimation of a matrix of loading vector for 'country' dimension A (29 x 1), for the 'time' dimension B (22x1) and for 'variables' dimension C (9 x 1).

Since there is a single core entry, G is a scalar instead of a matrix. This has two relevant implications. First, it makes it unnecessary to apply orthogonal core rotations in order to estimate a new solution. Second, it makes it possible to use the simplest three-way model: the PARAFAC model. Estimating PARAFAC with three, two and one dimension provides empirical support to apply Tucker3 method.[6]

[5] The empirical analysis of this research is performed by using N-ways toolbox for MATLAB (downloadable at http://www.models.life.ku.dk/~pih/parafac/chap0contents.htm).

[6] PARAFAC with three and two dimensions are not computable because of the extremely high correlation between factors. PARAFAC with one dimension produces the same results of Tucker3 (1,1,1).

| | G (1, 1, 1) | | | G (2, 2, 2) | | |
|---|---|---|---|---|---|---|
| | **Index to elements $g_{pqr}$** | **Explained var. of the core (percent)** | **Core entry** | **Index to elements $g_{pqr}$** | **Explained var. of the core (percent)** | **Core entry** |
| 1 | 1 1 1 | 100 | 204.91 | 1 1 1 | 99.086 | -204.91 |
| 2 | | | | 2 1 2 | 0.516 | -14.79 |
| 3 | | | | 2 2 1 | 0.205 | -9.32 |
| 4 | | | | 1 2 2 | 0.187 | 8.91 |

*Table 1 - Core matrix with dimensionality (1,1,1) and (2,2,2)*

The estimated coefficients and the fitting of alternative models are very similar. Therefore the Tuker3 (1,1,1) is chosen because is the most parsimonious. Since the squares of factor loadings represent the proportion of the total unit variance of the indicator which is explained by the factor, Table 2 reports the estimated squared of loadings of the matrixes A, B and C estimated by Tucker3 (1, 1, 1). The most relevant variables of reform toward market oriented economy are those for which $c_{kr} > 0.11$.[7] Table 2 reveals that the EBRD's indicators most relevant to explain the variability of overall index of transition process are: Price liberalisation, Trade and Forex system and Small scale privatisation.

| | | **Tucker3 C1** | **PCA** |
|---|---|---|---|
| BR | Banking reform & interest rate liberalisation | 0.089 | **0.123** |
| CP | Competition Policy | 0.062 | 0.113 |
| ER | Enterprise restructuring | 0.069 | **0.115** |
| LSP | Large scale privatisation | 0.108 | **0.121** |
| **PL** | Price liberalisation | **0.200** | 0.112 |
| SM | Securities markets & non-bank financial institutions | 0.063 | 0.108 |
| **SSP** | Small scale privatisation | **0.172** | 0.112 |
| **TS** | Trade & Forex system | **0.173** | 0.091 |
| OIR | Overall infrastructure reform | 0.064 | 0.105 |
| | **Explained Variation of X (%)** | **96.80%** | **84.06%** |

*Table 2 - Squared loadings of Matrix C estimated by Tucker3 (1,1,1)*

The choice of three-way PCA versus a simpler two-way PCA can be explained on the basis of two main factors. First, three-way PCA is more efficient at maximizing the explained variance of three dimensional dataset (97 percent versus 84 percent). Second, two-way PCA makes it harder to interpret the leading factors of transition reforms. In particular, the greatest variation in transition occurred in the first five years and it occurred mainly in the speed of price liberalization, foreign trade liberalization and small scale privatization. The variables have the highest factor loadings under Tucker3, differently from PCA. In order to compare three-way PCA with the most known two-way PCA, the last two rows of Table 3 show overall

[7] By considering that each variable explains the same quota of variability of the index, the loading should be *1/9 = 0.111*. Therefore the transition indicators with higher loadings imply that they have a major role in the index of overall transition reform.

indexes of transition estimated by two-way PCA and arithmetic average.[8] According to these results three-way PCA is a more appropriate methodology compared to two-way PCA because the former better identifies trend, explains a larger portion of the variance and provides a clear interpretation of leading factors of transition reforms.

## 2.2 The overall index of the speed of transition

In this section the loadings of the Tucker3 (1,1,1) are employed to calculate an index of the speed of transition. This index can be derived in two steps.
Analogously to two-way PCA, the factor loadings are the correlation coefficients between the 9 proxies of the transition index and the latent factors. Therefore, the first step consists in estimating the overall transition reform index according to the following formula:

$$TI_{it} = 0.089BR_{it} + 0.062CP_{it} + ... + 0.064OIR_{it} \, , \qquad (2)$$

where i = 1, 2,…, 29 (countries) and t = 1989, 1990,…, 2010. Table 3 reports the estimated index of transition reforms.

| Countries | 1989 | 1990 | 1991 | 1992 | 1993 | 1994 | 1995 | 1996 | 1997 | 1998 | 1999 | 2000 | 2001 | 2002 | 2003 | 2004 | 2005 | 2006 | 2007 | 2008 | 2009 | 2010 | Max | Min | Gap |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Albania | 1.00 | 1.00 | 1.17 | 2.03 | 2.43 | 2.56 | 2.86 | 2.98 | 2.98 | 2.98 | 3.01 | 3.28 | 3.31 | 3.31 | 3.31 | 3.36 | 3.36 | 3.38 | 3.41 | 3.47 | 3.51 | 3.51 | **3.51** | **1.00** | **2.51** |
| Armenia | 1.00 | 1.00 | 1.00 | 1.81 | 1.88 | 1.96 | 2.48 | 2.95 | 3.00 | 3.12 | 3.14 | 3.14 | 3.26 | 3.32 | 3.37 | 3.43 | 3.52 | 3.52 | 3.52 | 3.56 | 3.56 | 3.56 | **3.56** | **1.00** | **2.56** |
| Azerbaijan | 1.00 | 1.00 | 1.00 | 1.33 | 1.54 | 1.54 | 1.90 | 2.10 | 2.50 | 2.72 | 2.74 | 2.76 | 2.82 | 2.94 | 2.96 | 2.99 | 3.04 | 3.04 | 3.04 | 3.04 | 3.04 | 3.04 | **3.04** | **1.00** | **2.04** |
| Belarus | 1.00 | 1.00 | 1.00 | 1.33 | 1.64 | 1.70 | 2.21 | 2.05 | 1.90 | 1.63 | 1.58 | 1.70 | 1.83 | 1.94 | 2.00 | 2.00 | 2.00 | 2.00 | 2.03 | 2.15 | 2.24 | 2.31 | **2.31** | **1.00** | **1.31** |
| Bosnia and Herz. | 1.85 | 2.05 | 2.05 | 1.35 | 1.35 | 1.17 | 1.17 | 1.59 | 1.94 | 2.41 | 2.41 | 2.51 | 2.61 | 2.73 | 2.87 | 2.90 | 2.93 | 2.97 | 3.03 | 3.12 | 3.12 | 3.14 | **3.14** | **1.17** | **1.97** |
| Bulgaria | 1.00 | 1.17 | 2.07 | 2.21 | 2.41 | 2.64 | 2.61 | 2.63 | 3.13 | 3.13 | 3.29 | 3.45 | 3.53 | 3.58 | 3.61 | 3.67 | 3.69 | 3.77 | 3.77 | 3.81 | 3.81 | 3.81 | **3.81** | **1.00** | **2.81** |
| Croatia | 1.87 | 2.07 | 2.25 | 2.42 | 2.68 | 3.07 | 3.18 | 3.36 | 3.40 | 3.40 | 3.45 | 3.54 | 3.56 | 3.61 | 3.67 | 3.72 | 3.72 | 3.74 | 3.76 | 3.76 | 3.78 | 3.78 | **3.78** | **1.87** | **1.91** |
| Czech Republic | 1.00 | 1.00 | 2.51 | 3.10 | 3.40 | 3.57 | 3.57 | 3.68 | 3.76 | 3.78 | 3.83 | 3.85 | 3.88 | 3.90 | 3.92 | 3.94 | 3.99 | 3.99 | 3.99 | 3.99 | 3.99 | 3.99 | **3.99** | **1.00** | **2.99** |
| Estonia | 1.00 | 1.29 | 1.55 | 2.07 | 2.97 | 3.42 | 3.53 | 3.61 | 3.70 | 3.74 | 3.82 | 3.89 | 3.94 | 3.96 | 3.96 | 4.01 | 4.03 | 4.07 | 4.07 | 4.07 | 4.07 | 4.07 | **4.07** | **1.00** | **3.07** |
| Macedonia | 1.85 | 2.07 | 2.25 | 2.31 | 2.45 | 2.92 | 2.98 | 3.11 | 3.11 | 3.16 | 3.16 | 3.26 | 3.26 | 3.26 | 3.32 | 3.46 | 3.46 | 3.51 | 3.53 | 3.56 | 3.60 | 3.60 | **3.60** | **1.85** | **1.75** |
| Georgia | 1.00 | 1.00 | 1.00 | 1.47 | 1.71 | 1.71 | 2.32 | 2.90 | 3.18 | 3.27 | 3.29 | 3.39 | 3.39 | 3.39 | 3.39 | 3.42 | 3.48 | 3.48 | 3.54 | 3.54 | 3.54 | 3.54 | **3.54** | **1.00** | **2.54** |
| Hungary | 1.53 | 2.14 | 2.64 | 2.90 | 3.27 | 3.53 | 3.72 | 3.78 | 3.94 | 3.99 | 4.01 | 4.03 | 4.03 | 4.03 | 4.03 | 4.05 | 4.09 | 4.09 | 4.09 | 4.09 | 4.09 | 4.07 | **4.09** | **1.53** | **2.57** |
| Kazakhstan | 1.00 | 1.00 | 1.00 | 1.51 | 1.79 | 1.95 | 2.64 | 3.06 | 3.21 | 3.23 | 3.11 | 3.13 | 3.19 | 3.19 | 3.21 | 3.27 | 3.27 | 3.32 | 3.32 | 3.32 | 3.29 | 3.29 | **3.32** | **1.00** | **2.32** |
| Kyrgyz Republic | 1.00 | 1.00 | 1.00 | 1.72 | 2.16 | 2.99 | 3.20 | 3.22 | 3.25 | 3.25 | 3.28 | 3.28 | 3.28 | 3.30 | 3.33 | 3.40 | 3.40 | 3.40 | 3.40 | 3.40 | 3.40 | 3.40 | **3.40** | **1.00** | **2.40** |
| Latvia | 1.00 | 1.00 | 1.33 | 2.27 | 2.69 | 3.25 | 3.25 | 3.44 | 3.46 | 3.46 | 3.54 | 3.60 | 3.65 | 3.76 | 3.84 | 3.84 | 3.86 | 3.86 | 3.89 | 3.89 | 3.88 | 3.88 | **3.89** | **1.00** | **2.89** |
| Lithuania | 1.00 | 1.27 | 1.33 | 1.90 | 2.83 | 3.14 | 3.27 | 3.36 | 3.40 | 3.40 | 3.47 | 3.54 | 3.65 | 3.78 | 3.81 | 3.81 | 3.89 | 3.91 | 3.93 | 3.93 | 3.93 | 3.93 | **3.93** | **1.00** | **2.93** |
| Moldova | 1.00 | 1.00 | 1.00 | 1.68 | 1.95 | 2.25 | 2.90 | 2.92 | 2.96 | 3.05 | 3.05 | 3.13 | 3.18 | 3.18 | 3.14 | 3.17 | 3.28 | 3.28 | 3.33 | 3.39 | 3.39 | 3.39 | **3.39** | **1.00** | **2.39** |
| Mongolia | 1.00 | 1.00 | 1.50 | 1.76 | 2.17 | 2.17 | 2.19 | 2.42 | 2.87 | 2.91 | 3.02 | 3.09 | 3.14 | 3.17 | 3.30 | 3.33 | 3.35 | 3.35 | 3.44 | 3.48 | 3.48 | 3.48 | **3.48** | **1.00** | **2.48** |
| Montenegro | 1.85 | 2.05 | 2.05 | 2.07 | 2.07 | 1.70 | 1.70 | 1.70 | 1.72 | 1.33 | 1.89 | 2.09 | 2.22 | 2.67 | 2.75 | 2.80 | 3.07 | 3.10 | 3.20 | 3.23 | 3.23 | 3.27 | **3.27** | **1.33** | **1.93** |
| Poland | 1.44 | 2.60 | 2.68 | 2.92 | 3.29 | 3.40 | 3.48 | 3.62 | 3.67 | 3.79 | 3.79 | 3.83 | 3.88 | 3.88 | 3.88 | 3.88 | 3.95 | 3.97 | 3.97 | 3.97 | 3.97 | 4.03 | **4.03** | **1.44** | **2.59** |
| Romania | 1.00 | 1.00 | 1.41 | 1.93 | 2.23 | 2.68 | 2.83 | 2.78 | 3.11 | 3.26 | 3.35 | 3.41 | 3.45 | 3.45 | 3.47 | 3.55 | 3.58 | 3.62 | 3.67 | 3.69 | 3.69 | 3.71 | **3.71** | **1.00** | **2.71** |
| Russian Feder. | 1.00 | 1.00 | 1.06 | 2.24 | 2.57 | 2.72 | 2.94 | 3.20 | 3.28 | 2.81 | 2.78 | 2.94 | 3.02 | 3.15 | 3.23 | 3.25 | 3.24 | 3.29 | 3.29 | 3.29 | 3.29 | 3.29 | **3.29** | **1.00** | **2.29** |
| Serbia | 1.85 | 2.05 | 2.05 | 2.07 | 2.07 | 1.70 | 1.70 | 1.70 | 1.72 | 1.65 | 1.65 | 1.68 | 2.30 | 2.69 | 2.75 | 2.81 | 2.95 | 3.05 | 3.07 | 3.18 | 3.24 | 3.26 | **3.26** | **1.65** | **1.61** |
| Slovak Republic | 1.00 | 1.00 | 2.51 | 3.02 | 3.26 | 3.37 | 3.41 | 3.52 | 3.53 | 3.59 | 3.63 | 3.66 | 3.71 | 3.82 | 3.87 | 3.92 | 3.94 | 3.96 | 3.96 | 3.96 | 3.98 | 3.96 | **3.98** | **1.00** | **2.98** |
| Slovenia | 1.85 | 2.12 | 2.31 | 2.42 | 3.09 | 3.18 | 3.25 | 3.39 | 3.42 | 3.55 | 3.58 | 3.60 | 3.63 | 3.65 | 3.65 | 3.65 | 3.65 | 3.65 | 3.65 | 3.67 | 3.67 | 3.67 | **3.67** | **1.85** | **1.82** |
| Tajikistan | 1.00 | 1.00 | 1.00 | 1.51 | 1.50 | 1.50 | 1.98 | 2.05 | 2.11 | 2.38 | 2.42 | 2.59 | 2.63 | 2.69 | 2.69 | 2.74 | 2.80 | 2.83 | 2.83 | 2.83 | 2.85 | 2.94 | **2.94** | **1.00** | **1.94** |
| Turkmenistan | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.27 | 1.45 | 1.45 | 1.66 | 1.63 | 1.63 | 1.58 | 1.51 | 1.51 | 1.51 | 1.51 | 1.51 | 1.51 | 1.51 | 1.74 | 1.74 | 1.74 | **1.74** | **1.00** | **0.74** |
| Ukraine | 1.00 | 1.00 | 1.00 | 1.10 | 1.28 | 1.61 | 2.44 | 2.62 | 2.84 | 2.78 | 2.84 | 2.90 | 2.93 | 3.08 | 3.13 | 3.15 | 3.24 | 3.27 | 3.32 | 3.43 | 3.39 | 3.39 | **3.43** | **1.00** | **2.43** |
| Uzbekistan | 1.00 | 1.00 | 1.00 | 1.33 | 1.57 | 2.29 | 2.49 | 2.49 | 2.36 | 2.25 | 2.13 | 2.11 | 2.25 | 2.25 | 2.23 | 2.23 | 2.29 | 2.34 | 2.34 | 2.34 | 2.34 | 2.34 | **2.49** | **1.00** | **1.49** |
| **Average 3PCA** | **1.21** | **1.34** | **1.58** | **1.96** | **2.25** | **2.45** | **2.68** | **2.82** | **2.94** | **2.95** | **3.00** | **3.07** | **3.14** | **3.21** | **3.25** | **3.28** | **3.33** | **3.35** | **3.38** | **3.41** | **3.42** | **3.43** | **3.43** | **1.21** | **2.22** |
| **Average PCA** | **1.13** | **1.22** | **1.39** | **1.66** | **1.93** | **2.13** | **2.34** | **2.47** | **2.58** | **2.61** | **2.66** | **2.72** | **2.78** | **2.87** | **2.90** | **2.95** | **3.00** | **3.03** | **3.06** | **3.10** | **3.11** | **3.12** | **3.12** | **1.13** | **1.99** |
| **Arith. Average** | **1.13** | **1.22** | **1.40** | **1.68** | **1.94** | **2.14** | **2.35** | **2.48** | **2.59** | **2.62** | **2.67** | **2.74** | **2.80** | **2.88** | **2.91** | **2.96** | **3.01** | **3.04** | **3.07** | **3.11** | **3.12** | **3.13** | **3.13** | **1.13** | **2.00** |

*Table 3 - Overall index of transition reforms*

Figure 3 shows the trend of transition index calculated as annual (unweighted and weighted for the GDP per capita at PPP)[9] average for the 29 countries of the sample. The dot line represents the hypothetical gradualist trend to fill the gap between the average of minimum and maximum values in 21 years. The graphical analysis reveals a non linear concave progress of transition reforms towards decentralised economy.

[8]Details on two-way PCA are available from the authors upon request.
[9] Missing values in GDP per capita at PPP make it impossible to estimate 24 weights over 638. These missing weights are replaced with the estimated weights of the year after.

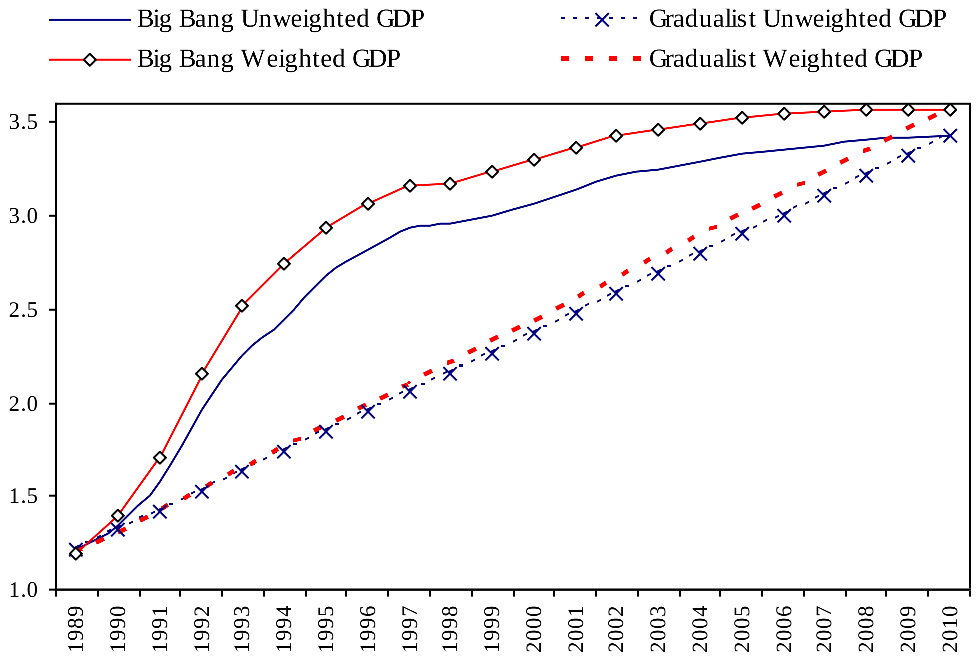


*Figure 3 - Weighted and unweighted overall indexes of transition reforms*

The second step is to calculate the growth rates of the (unweighted) overall index of transition; this variable is defined throughout the paper as speed of transition (ST). According to this index, the 1992 is the year with the highest acceleration to reform transition countries.
Data on ST are used to investigate the relationship with the growth rates of real GDP per capita; the dynamics of speed of transition reforms provide some insights on the controversy big bang versus gradualism. The index of ST is greater than 80 for Poland, the Czech Republic and Russia. No other country experiences such high levels. Croatia and Macedonia are the sole countries which display an index with a value lower than 20, suggesting a gradual path, while Estonia is an active reformer country in particular in the years immediately following independence. Serbia and Montenegro experienced acceleration in reforms later than other countries, around 2000. These patterns are consistent with the general interpretation of Croatia's path as more gradual than Poland's and with Russia's as one of the most radical but not persistent in the former Soviet Union. In the latest years the index is close to zero if not negative for most countries.

## 3. Econometric background and model specifications

This section presents the econometric analysis of the relationship between speed of transition and economic growth.[10]
Before beginning any econometric estimation, it is important to test the reliability of the series in order to get consistent results. It is well established that the non-stationarity of the variables can lead to a spurious regression. As a result, unit root tests are carried out on variables as a first step. Testing for the unit root in panel framework is more powerful compared to performing a separate unit root test for each individual time series (Levin and Lin, 1993). In Appendix B, Table B.1 shows several unit root tests for the panel data. According to the results, the speed of transitions and economic growth are stationary. This result implies that these two variables cannot be cointegrated.

[10] Compared to the 29 countries listed in Table 3, due to the presence of missing values, the following countries are excluded: Azerbaijan, Bosnia and Herzegovina, Montenegro, and Turkmenistan.

The second step of the analysis is to detect short run Granger causality running from economic growth – the growth rate of real GDP per capita (Ggdp) – to speed of transition and/or vice versa.[11] This analysis is also useful to specify an appropriate dynamic structure to the multivariate panel models presented in Subsection 4.1. The standard causality test developed by Granger (1969) is widely used to test whether past changes in one variable help to explain current changes in other variables. The following bivariate regressions are run:

$$Ggdp_{ij} = \alpha_0 + \alpha_1 Ggdp_{ij-1} + ... + \alpha_l Ggdp_{ij-l} + \beta_1 ST_{ij-1} + ... + \beta_l ST_{ij-l} + u_{ij} \quad (3)$$

$$ST_{ij} = \alpha_0 + \alpha_1 ST_{ij-1} + ... + \alpha_l ST_{ij-l} + \beta_1 Ggdp_{ij-1} + ... + \beta_l Ggdp_{ij-l} + u_{ij} \quad (4)$$

The $\chi^2$- and F- statistics for the joint hypothesis: $H_0 : \beta_1 = \beta_2 = ... = \beta_l$ are reported in Table 4. Two sets of Granger causality tests are shown according to different information; in particular, Schwartz and Hanan-Quinn information criteria suggest to use 2 lags, while Akaike and Final Predictor error information criteria suggest to include up to eight lags.

| | | **$H_0$:ST does not Granger causality Ggdp** | | **$H_0$: Ggdp does not Granger causality ST** | |
|---|---|---|---|---|---|
| Lags | Obs | Chi-sq<br>(F-stat) | p-value<br>(p-value) | Chi-sq<br>(F-stat) | p-value<br>(p-value) |
| 2# | 415 | 1.993<br>(0.997) | 0.369<br>(0.370) | 81.281<br>(40.640) | 0.000***<br>(0.000***) |
| 8□ | 265 | 10.360<br>(1.295) | 0.240<br>(0.247) | 38.389<br>(4.799) | 0.000***<br>(0.000***) |

*Table 4 - Granger Causality Test Statistics*

*#Optimum lag length according to Schwartz and Hanan-Quinn information criteria; □Optimum lag length according to Akaike information criterion and Final Predictor error. See Lütkepohl (1991) for details on lag length criteria. Tests performed with Eviews 7.1*

Table 4 shows robust empirical evidence rejecting the hypothesis that speed of transition does not Granger cause growth rate of real GDP. Therefore Granger causality runs one-way from *ST* to *Ggdp* and not the other way.

The third step of the empirical analysis aims at examining the relationship between the speed of transition and the economic growth. In the light of previous results, the hints about which should be the panel model specification are: (i) *ST* should be considered as a cause of economic growth instead of vice versa; (ii) *ST* can be treated as exogenous variable; and (iii) to preserve an adequate sample size, the dynamic panel specification should include at least two lags. We employ a variety of econometric specifications to test the robustness of the results: a static model using the least squares dummy variable (LSDV) estimator, a dynamic model using LSDV, LSDVC and the system generalised method of moment (GMM) estimators.

## 3.1 Panel Data Analysis

This section presents a panel data analysis that covers 25 countries with a maximum of 368 annual observations corresponding to the period 1990-2008. As standard in literature, a set

[11] An interesting avenue of research would be to investigate the relationship between the persistence of reform (i.e. the variance of the index of transition) and economic growth. In the econometric estimation we find some preliminary results that the persistence of reforms also exerts a positive effect on economic growth. However we prefer to focus the analysis on the speed of transition to provide results comparable with the literature on the optimal speed of transition presented in Section 2.

of control variables are added to take into account further potential causes of the economic growth and reduce the potential omitted-variables bias.
The basic static model is as follow (model I):

$$Ggdp_{it} = \delta_i + \lambda_t + \beta_1 ST_{it} + \beta_2 IC_i t + \beta_3 Infl_{it} + \beta_4 Sch2_{it} + \beta_5 ExGr_{it} + \beta_6 PR_{it} + \beta_7 CL_{it} + \varepsilon_{it}, \quad (5)$$

where $\delta_i$ are cross-sectional dummies; $\lambda_t$ are time dummies. In some regressions this variable is substituted with a time trend variable. The variable *ST* is the speed of transition. As control variables some of the most common sources of economic growth proposed in this strand of literature are included: *IC* is the initial condition index for each country. 'Initial condition' is a proxy variable to control for the potential impact of different starting positions on later economic performance, similarly to De Melo et al. (2001), Falcetti et al. (2002, 2006) and Fischer and Sahay (2000), among others. The proxy presented in this paper consists of a composite index computed on the basis of PCA. The full list of variables used and details on how to build this composite index are provided in Appendix C. *Infl* is the annual inflation rate and it is included to take into account the macroeconomic stabilization policies. In the main literature, two alternative variables are used to test the impact of sound macroeconomic policies in transition countries: annual inflation rate and fiscal balance over GDP. The former is considered here following Radulescu and Barlow (2002), who using extreme bound analysis find that the only robust determinant of growth is inflation. The gross enrolment rate of secondary school (Sch2) is considered to control for human capital. Following Falcetti et al. (2006), we consider: (i) a weighted average of real GDP growth in partner trading countries, where the weights are the share of total exports to each country (*ExGr*); and (ii) a proxy of civil liberties and rule of law (*CL*)[12] published by Freedom House. To control for the role of political reforms that also happened in the period under study (i.e., democratization, political competition), an additional proxy of institutional quality is included in the regressions. Following Pavletic and Sattler (2009), we use the political right index (*PR*)[13] published by Freedom House.
This empirical literature usually includes the foreign direct investments as share of GDP, as control variable, to examine the effects on a host country’s development effort. However, since it is not statistical significant, it is dropped from the regressions to save degree of freedoms.
According to Hausman (1978) tests for correlated random effects, the least squares dummy variable (LSDV) estimator is consistent. Therefore it is always preferable to random effects in the model specification. Anyway, as a robustness check, the estimates obtained by a regression with random effects (model II and IIa) are also reported in order to compare with the corresponding model estimated by LSDV (model III and IIIa).
To test the significance of which kind of fixed effects should be included in the regressions, the unrestricted specification including the dummies of interest (cross-section and/or period effects) are estimated firstly. Subsequently the joint significance of all the effects as well as the joint significance of the cross-section effects and the period effects are tested separately. The results suggest that the cross sections and time periods effects are statistically significant for models I and Ia (Table 5) and model IV, V, VI and VII (Table 6), while cross sections effects are usually not significant when lagged value of economic growth is included as explanatory variable in the panel specification. LSDV models are specified by including two-way, one-way and one-way with time trend instead of period dummies. The main

[12] Civil liberties allow for the freedoms of expression and belief, associational and organizational rights, rule of law, and personal autonomy without interference from the state (*Freedom in the World*, 2012, http://www.freedomhouse.org/report/freedom-world-2012/methodology.)
[13] Political rights enable people to participate freely in the political process, including the right to vote freely for distinct alternatives in legitimate elections, compete for public office, join political parties and organizations, and elect representatives who have a decisive impact on public policies and are accountable to the electorate (*Freedom in the World* , 2012).

findings are: (i) previous alternative models generate qualitatively similar results; and (ii) the findings change strongly by moving from static (models from I to IIIa) to panel data dynamic specifications with lagged value of dependent variable.

From residual diagnostic, there is evidence that both random and fixed panel models exhibit heteroskedasticity and, in the static regressions, also serial correlation. To take this into account two estimators are computed: (i) the 'White Period', which accommodates both arbitrary heteroskedasticity and within cross-section serial correlation (Arellano, 1987; White, 1980); and (ii) the 'White Diagonal', which computes White coefficient covariance estimates that are robust to observation specific heteroskedasticity in the disturbances, but not to serial correlation. Table 5 shows estimation results from the static specification.

| Model | LSDV (I) | LSDV (Ia) | Random (II) | Random (IIa) | LSDV (III) | LSDV (IIIa) |
|---|---|---|---|---|---|---|
| ST | -0.076** (-1.98) | -0.079** (-2.12) | -0.178*** (-3.85) | -0.181*** (-3.09) | -0.154*** (-3.09) | -0.160*** (-3.32) |
| IC*t | -0.005 (-1.52) | -0.006 (-1.58) | -0.001 (-0.52) | -0.001 (-0.91) | -0.004* (-1.80) | -0.005* (-1.82) |
| Inflation | -0.002*** (-4.40) | -0.002*** (-3.79) | -0.002*** (-3.84) | -0.002*** (-3.71) | -0.002*** (-3.52) | -0.001*** (-2.84) |
| 2nd school enr. rate | -0.210** (-2.44) | -0.224** (-2.51) | -0.112** (-2.07) | -0.100** (-1.97) | -0.282*** (-2.95) | -0.274*** (-2.96) |
| ExGr | 0.766*** (2.57) | 0.781*** (2.72) | 0.747*** (3.47) | 0.724*** (3.27) | 0.747*** (3.74) | 0.755*** (4.03) |
| Political Rights | -- | -0.422 (-0.63) | -- | -0.216 (-0.37) | -- | -0.920 (-1.27) |
| Civil Liberties | -- | -0.328 (-0.39) | -- | 0.021 (0.03) | -- | 0.315 (0.42) |
| Time Trend | -- | -- | 0.602*** (5.78) | 0.614*** (5.23) | 0.904*** (4.34) | 0.897*** (4.62) |
| Cross-Effect | Fixed | Fixed | Random | Random | Fixed | Fixed |
| Time Effect | Fixed | Fixed | -- | -- | -- | -- |
| Robust St.Errors | White period | White period | White period | White period | White period | White period |
| Adj-$R^2$ | 0.660 | 0.659 | 0.571 | 0.568 | 0.606 | 0.606 |
| Durbin-Wats. | 1.241 | 1.243 | 1.156 | 1.160 | 1.286 | 1.309 |
| Obs. (N/T) | 368 (25/19) | 366 (25/19) | 368 (25/19) | 366 (25/19) | 368 (25/19) | 366 (25/19) |

*Table 5 - Dependent Variable: Growth rate of real GDP – static model*

****, ** and * denote significant at 1%, 5% and 10% level respectively; constant and dummies variables are not reported. The numbers in parenthesis are the t-ratios. Robust Covariance method known as 'White Period' is applied to LSDV and random models as they have autocorrelated residuals.*

In models I and Ia, the coefficient on *ST* is negative and statistically significant, indicating that the speed of transition has a negative contemporaneous impact on the growth rate of real GDP. Adjustment costs of the reforms have been explored in the literature (Nsouli et al., 2005, among others): in real world the reallocation of resources cannot occur simultaneously without incurring costs among different sectors of the economy. Moreover, the adjustment to policy changes and price signals can differ among markets. Therefore, rapid reforms could result in temporary contraction in economic activity as evident from the coefficient on *ST*. As far as control variables are concerned, the coefficient on initial conditions multiplied by time is negative but statistically not significant; the negative coefficient implies that the impact of initial condition on growth is falling over time, as in Falcetti et al. (2006).[14] The coefficient on

[14] The *IC* index takes a positive value the worse the initial condition. The negative coefficient on the term $IC_i\,t$ indicates that the direct negative effect of bad initial conditions declines as transition time goes by.

inflation is negative and significant. This suggests that macroeconomic stabilisation in the form of lower inflation rate has a positive impact on the growth rate of real GDP. The variable enrolment in secondary education is meant to capture human capital. Its coefficient is negative and significant in the three models. Even if the mainstream literature supports a positive sign, for transition countries there are two main reasons for this result. First, since the fall of the Berlin wall, several transition countries have experienced a decreasing trend in the enrolment rates. This path diverges from the well-known J-curve trend of real GDP observed in transition counties (see Figure 1). Second, as Murphy et al. (2005, p.8) point out, although under the communist system the universal education was a priority, the type of education in the transition countries 'with emphases on memorization at the expense of analytical and critical thinking, and perhaps premature specialization if not over-specialization may be ill-suited for the needs of a market economy'. Although Murphy et al. (2005) findings may support an insignificant effect of the enrolment rate on the economic growth for transition countries, the first reason may motivate the estimated negative sign due to the divergence between the paths of GDP and enrolment rate.

The coefficient on the control variable *ExGr* is positive, highlighting the importance of external demand; this variable broadly captures the positive effect of openness on growth.

The proxies of institutional context (*PR* and *CL*) are not statistical significant (both jointly and separately). This result is also in line with previous empirical literature: Falcetti et al. (2002) assume that civil liberties affect reforms but not growth. Fidrmuc (2003) finds that democracy is highly correlated with liberalization but it has an ambiguous effect on growth.

In models II, IIa, III and IIIa the time trend has been added following Falcetti et al. (2006). The positive and significant coefficient captures the general increase in the GDP growth rate, after the initial fall shown in Figure 1. The results of models I and Ia are confirmed in models II, IIa, III and IIIa; the negative coefficient on initial condition becomes significant in the latter model, where cross-effects are fixed. In line with dynamic properties of Ggdp and ST, dynamic versions of the previous regression (models from IV to XII) are also estimated.[15] Following Falcetti et al. (2006), from models VI to IX current value of ST as explanatory variable for growth is excluded. Differently from their analysis, in these models a longer lag structure for the variable of ST is included. This model specification implies the assumption that the structural reforms have not (only) short effect on the economic growth. In particular, lagging up to five years implies a sufficient time to take into account almost all the effects of reforms on economic system. The benchmark dynamic specification is an autoregressive distributed lag (ADL) model, (model VII):

$$Ggdp_{it} = \lambda_t + \beta_1 Ggdp_{it-1} + \beta_2 ST_{it} + \beta_3 ST_{it-1} + ... + \beta_7 ST_{it-5} + + \beta_8 IC_i t + \beta_9 Infl_{it} + \beta_{10} Sch2_{it} + \beta_{11} ExGr_{it} + \varepsilon_{it} \quad (6)$$

As Nickell (1981) demonstrates, the LSDV estimator for autoregressive panel data models is not consistent for finite T. Kiviet (1995) suggests an alternative estimator (LSDVC) to correct downward biased estimates in the LSDV estimator with lagged dependent variable. LSDV (model X) and LSDVC (model XI) estimates are compared in order to have evidence of the size and consequences of this bias. Even though LSDVC estimates may be unreliable for a misspecification of fixed effect, these estimates are useful to verify that downbiased coefficients of LSDV estimator do not have a relevant effect on the findings. Table 6 shows the estimation results for the dynamic specification.

Models IV-VI includes different lags of ST. Model IV includes two lags of ST in addition to the contemporaneous value; the coefficients on one-year and two-year lags are not statistically significant while the speed of transition has (still) a negative contemporaneous impact on the GDP growth rate. Therefore, with few lags the negative effect prevails. The signs of the control variables are unchanged, confirming the previous results. Model V introduces lagged ST at time t-2, t-3 and t-4: the coefficient on the two-year lag is negative as in model IV, while

[15] As Civil Liberties and Political Rights are not statistical significant also in dynamic specification, to save degree of freedoms, they are dropped from the regressions.

the coefficients on the three-year and four-year lags are positive and statistically significant. This dynamic specification further supports the results of the static specification on the trade-off between short-run costs and long-term benefits of the speed of reforms. The other models test the robustness of the previous results. In particular, model VI includes lags 0-3 of ST and the lagged growth rate of real GDP. Model VII and VIII and IX includes up to five lags of ST. In model VII the coefficients on ST from t to t-2 are not statistically significant while the lagged terms from three up to five years have positive effects on the economic growth. With respect to model VI, the coefficient not only on the third lag of ST is positive and significant but also on the fourth and fifth lags, suggesting that the benefits of past level of reforms last some years. The signs of coefficient on the control variables are unchanged, the variable initial condition returns significant, while the proxy on human capital is not statistically significant. Same conclusions apply to models VIII and IX, which respectively do not include contemporaneous value of ST and lag from 0 to 1 of ST.

| | **LSDV (IV)** | **LSDV (V)** | **LSDV (VI)** | **LSDV (VII)** | **LSDV (VIII)** | **LSDV (IX)** | **LSDV (X)** | **LSDVC (XI)** |
|---|---|---|---|---|---|---|---|---|
| ST | -0.109** (-2.45) | -- | -0.006 (-0.11) | 0.038 (0.61) | -- | -- | -- | -- |
| $ST_{t-1}$ | -0.041 (-1.43) | -- | 0.029 (0.70) | -0.017 (-0.35) | -0.017 (-0.35) | -- | -0.022 (-0.38) | -0.022 (-0.38) |
| $ST_{t-2}$ | -0.035 (-1.48) | -0.023 (-0.52) | -0.008 (-0.40) | 0.063 (1.61) | 0.057* (1.52) | 0.035 (1.00) | 0.073* (1.82) | 0.074** (1.83) |
| $ST_{t-3}$ | -- | 0.051** (2.06) | 0.052*** (2.78) | 0.049* (1.72) | 0.051* (1.81) | 0.051* (1.76) | 0.038 (1.39) | 0.047 (1.33) |
| $ST_{t-4}$ | -- | 0.045** (2.55) | -- | 0.026** (2.09) | 0.022** (2.21) | 0.022** (2.24) | 0.013 (1.32) | 0.011 (0.62) |
| $ST_{t-5}$ | -- | -- | -- | 0.024** (2.15) | 0.023** (2.09) | 0.024** (2.09) | 0.014 (1.33) | 0.013 (0.02) |
| $Ggdp_{t-1}$ | -- | -- | 0.275*** (2.83) | 0.439*** (6.93) | 0.430*** (6.71) | 0.412*** (6.45) | 0.295*** (4.65) | 0.376*** (4.22) |
| IC*t | -0.006* (-1.66) | -0.005 (-1.13) | -0.003* (-1.77) | -0.002*** (-4.42) | -0.002*** (-4.55) | -0.002*** (-4.74) | -0.001 (-0.32) | 0.000 (0.01) |
| Inflation | -0.002*** (-4.08) | -0.002* (-1.83) | -0.001*** (-3.66) | -0.009** (-2.04) | -0.001** (-2.13) | -0.009** (-2.03) | -0.013** (-2.13) | -0.012*** (-2.77) |
| $2^{nd}$ sch. enrol. | -0.208** (-2.24) | -0.120 (-1.58) | -0.088 (-1.59) | 0.028 (1.25) | -0.003 (1.21) | 0.028 (1.20) | 0.031 (0.71) | 0.030 (0.40) |
| ExGr | 0.746** (2.22) | 1.136*** (2.76) | 0.686** (2.24) | -0.018 (-0.13) | -0.028 (-0.20) | -- | 0.505*** (2.81) | 0.433 (0.08) |
| Time Trend | -- | -- | -- | -- | -- | -- | 0.264* (1.85) | 0.199 (0.353) |
| Cross-Effect | Fixed | Fixed | Fixed | -- | -- | -- | Fixed | Fixed |
| Time Effect | Fixed | Fixed | Fixed | Fixed | Fixed | Fixed | -- | -- |
| Robust St.Errors | White period | White period | White diagonal | White diagonal | White diagonal | White diagonal | White diagonal | Kiviet |
| Adj-$R^2$ | 0.449 | 0.536 | 0.640 | 0.506 | 0.506 | 0.493 | 0.467 | -- |
| Durbin-Wats. | 1.249 | 1.050 | 1.602 | 1.629 | 1.628 | 1.748 | 1.603 | -- |
| Obs. (N/T) | 293 (25/14) | 317 (25/15) | 338 (25/16) | 293 (25/14) | 293 (25/14) | 297 (25/14) | 293 (25/14) | 293 (25/14) |

*Table 6: Dependent Variable: Growth rate of real GDP – dynamic model (LSDV/LSDVC)*

****, ** and * denote significant at 1%, 5% and 10% level respectively; constant and dummies variables are not reported. The numbers in parenthesis are the t-ratios. Robust Covariance method known as 'White Period' is applied to LSDV and random model IV as they have autocorrelated residuals. For model with lagged dependent value (from V to IX) computed standard error are robust to observation specific heteroskedasticity in the disturbances, but not to correlation between residuals for different observations. For LSDVC is applied Kiviet (1995) correction estimator. The consistent estimator chosen to initialize the bias correction is Anderson and Hsiao estimator (1982).*

Models X and XI include time trend instead of time dummies effects among the regressors. This is an indirect test of the size of downward bias in the estimates of LSDV estimator with lagged dependent variable. Comparing the estimates of LSDV estimator (model X) to LSDVC16 estimates (model XI) there is evidence that the downward bias has not relevant effect on statistical significance and estimates of the main findings. For sake of brevity, Table 6 omits regressions with lagged value of enrolment in secondary education and inflation able to smooth out concerns about reverse causation. These estimates confirm previous analysis with the exclusion of the annual inflation rate that becomes insignificant. According to this result, the system GMM estimator proposed by Arellano and Bover (1995) and Blundell and Bond (1998) is considered appropriate to account for the potential endogeneity of the explanatory variables.17 Bond et al. (2001) recommend the use of the system GMM estimator for growth empirics. This is due to the fact that the number of periods used in the standard growth literature is usually small18 and the variables considered are generally persistent. Some literature on transition reforms and growth also investigates the effectiveness of system GMM (e.g. De Melo et al. 2001; Falcetti et al. 2006).

To implement this GMM approach lagged dependent variable (growth rate of real GDP) and inflation rate are treated as endogenous; index of speed of transition and gross enrolment rate of secondary school are handled as predetermined; initial conditions and external demand are strictly exogenous.

Following Roodman (2009a, b) one of the main drawback in implementing GMM system is that that too many instruments can overfit endogenous variables and fail to remove their endogenous components. Roodman (2009a) suggests two main techniques to overcome this issue: first, to use only certain lags instead of all available lags for instruments; second, to combine instruments through addition into smaller sets (so-called instruments collapsing). We apply both of them: lags 2 (lag 1) through 4 (3) are included for the equation in differences, and lag 1 (lag 0) through 4 (3) for the level equation for endogenous (predetermined) variables.[19]

To verify the reliability of the GMM estimates, the robust version of Sargan's (1958) test (Hansen J-statistic) is applied to check for the validity of instrumental variables. As we have an unbalanced panel with gaps, the sample is maximized by using the forward orthogonal deviation (Arellano and Bover 1995) instead of the first-difference approach. Finally, we report standard error estimates computed by Windmeijer’s (2005) finite-sample correction for the two-step covariance matrix.

[16] This change in the model specification is due to unavailability of LSDVC estimator for model with two-way fixed effects.

[17] Blundell and Bond (2000) argue that the first-difference GMM (Arellano and Bond, 1991) using persistent series has poor performances due to weak instruments because lagged levels are only weakly correlated with subsequent first differences.

[18] The number of instruments tends to explode with T in panel GMM estimations. This makes the GMM estimator only applicable when T is small.

[19] Roodman (2009a) suggests to include time dummies in order to make the hypothesis of no correlation across countries in the idiosyncratic disturbances more likely to hold. When time dummies are introduced in our sample the “rule of thumb” of preserving estimates by severe consequences of the inclusion of too many instruments is not met (number of instruments should not exceeds the number of countries). Since the risk of overfitting endogenous variables are very high for system GMM we do not include time dummies in the estimated regressions. This choice is also supported by the empirical evidence that time dummies are both jointly and separately insignificantly different from zero at the usual significance levels.

| Model | GMM (XII) | GMM (XIII) | GMM (XIV) | GMM (XV) | GMM (XVI) | GMM (XVII) | GMM (XVIII) | GMM (XIX) |
|---|---|---|---|---|---|---|---|---|
| **ST** | -0.188*** | -0.175*** | -0.191*** | -0.188*** | -0.190*** | -0.165*** | -0.025 | -0.002 |
| | (-2.93) | (-2.87) | (-2.92) | (-2.87) | (-3.04) | (-2.48) | (-0.44) | (-0.03) |
| **$ST_{t-1}$** | -- | -- | 0.015 | 0.006 | -0.015 | -0.010 | 0.037 | 0.018 |
| | | | (0.18) | (0.11) | (-0.30) | (-0.20) | (1.21) | (0.40) |
| **$ST_{t-2}$** | -- | -- | -- | -- | -- | 0.007 | -0.007 | -0.039 |
| | | | | | | (0.22) | (-0.27) | (-0.85) |
| **$ST_{t-3}$** | -- | -- | -- | -- | -- | -- | 0.043* | 0.052** |
| | | | | | | | (1.79) | (2.11) |
| **$ST_{t-4}$** | -- | -- | -- | -- | -- | -- | -- | 0.002 |
| | | | | | | | | (0.18) |
| **$Ggdp_{t-1}$** | 0.467*** | 0.477** | 0.471** | 0.442*** | 0.425*** | 0.508*** | 0.585*** | 0.578*** |
| | (3.20) | (2.69) | (2.72) | (3.21) | (3.33) | (4.04) | (6.55) | (6.99) |
| **IC*t** | -0.001 | -0.001** | -0.001* | 0.002 | -0.001 | -0.001 | 0.000 | -0.001 |
| | (0.76) | (-2.34) | (-1.94) | (1.01) | (-0.76) | (-1.62) | (0.16) | (-0.59) |
| **Inflation** | -0.001 | -0.001 | -0.001 | -0.001 | -- | -- | -- | -- |
| | (-0.46) | (-0.46) | (-0.53) | (-0.59) | | | | |
| **2nd sch. enr.** | -0.104 | 0.019 | 0.020 | -0.173 | 0.026 | 0.029* | 0.002 | 0.009 |
| | (-1.22) | (0.84) | (0.76) | (-1.69) | (1.59) | (1.92) | (0.19) | (0.58) |
| **ExGr** | 0.443* | 0.245 | 0.249 | 0.505* | 0.651* | 0.539* | 0.664** | 0.683* |
| | (1.91) | (0.93) | (0.88) | (1.86) | (1.87) | (1.86) | (2.46) | (2.02) |
| **Time Trend** | -- | 0.142 | 0.138 | -- | -- | -- | -- | -- |
| | | (0.331) | (0.95) | | | | | |
| **Constant** | 10.63 | -- | -- | 16.26* | -- | -- | -- | -- |
| | (1.49) | | | (1.92) | | | | |
| **# instruments** | 23 | 23 | 24 | 24 | 18 | 19 | 20 | 21 |
| **Hansen (p-v.)** | 0.175 | 0.146 | 0.114 | 0.171 | 0.413 | 0.335 | 0.696 | 0.696 |
| **GMM instruments for levels[a]: (p-value)** | | | | | | | | |
| **Exclud. Gr.[b]** | 0.313 | 0.070 | 0.042 | 0.337 | 0.084 | 0.168 | 0.812 | 0.935 |
| **Difference[c]** | 0.122 | 0.730 | 0.843 | 0.101 | 0.954 | 0.898 | 0.281 | 0.083 |
| **IV[a]: (p-value)** | | | | | | | | |
| **Exclud. Gr.[b]** | 0.104 | 0.358 | 0.311 | 0.086 | 0.188 | 0.265 | 0.663 | 0.644 |
| **Difference[c]** | 0.909 | 0.053 | 0.057 | 0.846 | 0.371 | 0.482 | 0.534 | 0.418 |
| **Obs.(# count.)** | 361 (25) | 361 (25) | 361 (25) | 361 (25) | 361 (25) | 356 (25) | 338 (25) | 317 (25) |

*Table 7: Dependent Variable: Growth rate of real GDP – dynamic model (system GMM)*

****, ** and * denote significant at 1%, 5% and 10% level respectively; constant and dummies variables are not reported. The numbers in parenthesis are the t-ratios. [a]Difference-in-Hansen tests of exogeneity of instrument subsets. P-values greater than usual significance levels imply that we can not reject null that the instruments used in GMM and IV parts are valid. [b] Hansen test excluding group. The null hypothesis is that excluded instruments, as a group, are not correlated with independent variables (those which were assumed to be endogenous); [c] the null hypothesis is that the instruments are exogenous.*

First, Table 7 provides additional evidence in favour of previous results. In particular, Models XII and XIII include contemporaneous value of *ST*. These regressions reveal that *ST* has a negative impact on the GDP growth rate. Models XIV-XIX introduce lagged values of *ST*. The coefficients on *ST* at different lags confirm that the speed of transition has a not significant impact on growth in the short horizon, while in the third year the impact becomes positive and significant. Similarly to Staehr (2005), the coefficient on lagged GDP growth rate is positive and statistically significant, reflecting that it tracks its past trends and, on annual basis, there are no strong divergences in GDP from its long-run path. Similarly to previous estimates, when the specification includes a larger time horizon of *ST* (models XVIII and XIX), the impact of *ST* on economic growth becomes positive. Therefore, the speed of transition exerts an immediate negative, and not significant, impact on growth since the adjustment costs prevail in the years immediately following the transition. Similarly to previous literature (e.g. of Selowsky and Martin 1997; Merlevede, 2003), in a longer horizon

– after three years – the relationship flips and the speed of transition positively affects the growth rate of real GDP.

The signs of the control variables are similar to LSDV but often become statistically insignificant. As long as initial conditions and secondary enrolment ratio are concerned, the results coming from GMM estimation are in line with the findings of Murphy et al. (2005).

Since the estimates of speed of transition are not robust between dynamic and static model, dynamic regression is the best choice to examine the effect of ST on economic growth for a variety of reasons: (i) the statistically significant coefficients on Ggdpt-1 and STt-i; (ii) the Granger causality test performed in the previous section; (iii) the reduction of the autocorrelation in the residuals shown by the Durbin-Watson statistics; and (iv) the robustness of main results throughout estimators LSDV, LSDVC and system GMM.

According to these findings, there is adequate empirical support that big bang approach to transition reforms has better consequences for economic performances. These effects become observable only after a time lag of (at least) three years. Thus empirical analysis reveals that reform transition process cannot be evaluated in a (very) short run but this process causes an increase of rate of GDP only after three-five years.

## 4. Conclusions

This paper examines the effects of the speed of transition on the growth rate of real GDP in a sample of transition countries in the period 1990-2008. It first introduces a new methodological approach in order to estimate an overall index of transition reforms using three-way PCA (Tucker3). This methodology is more appropriate than the two-way PCA or simple average generally used in this strand of literature (e.g. Fidrmuc, 2003; Falcetti et al. 2006). This result may be itself a valuable contribution for the existing literature. Then, we test if the new index of transition reforms corroborates the main results of literature on the link between the speed of transition and economic growth. Our analysis benefits from a wider sample size (18 years), which allows a lag structure more complex than that employed in the previous literature, more sophisticated approaches to estimate the index of transition reform and several estimation approaches to investigate the relationship between growth and speed of transition reforms.

The main results are as follows. First, Granger causality analysis reveals that the growth rate of real GDP does not cause speed of transition since Granger causality runs one-way only from speed of transition to economic growth. Second, in the static specification the speed of reforms has a contemporaneous negative impact on economic growth. In the dynamic specification, the past level of reforms leads to higher economic growth and this effect reaches its greatest value with a lag of three years. Therefore, the speed of transition has a J-curve effect on GDP growth: a negative contemporaneous effect which is more than compensated by subsequent gains. In this respect, a big bang approach to transition delivers benefits in the longer horizon which offset the initial adjustment costs. This result is robust to different models' specifications and econometric approaches. Third, other factors affect economic growth in transition countries; however their impacts are not robust to different estimators. While external demand seems to drive economic growth for any estimator, the statistically significance of initial conditions and macroeconomic stabilisation programmes is not robust when controlling for endogeneity by system GMM.

The results presented in this paper can offer some avenues for future research. The reduced form model used in the estimations cannot capture all the mechanism through which the speed of reforms affects economic outcomes or the role that government can play in reaching the optimal speed of transition. From a theoretical point of view, a general equilibrium model would be an appropriate framework to analyse these issues. Another interesting extension in this empirical literature may be to investigate the relationship between the persistence of transition reforms and economic growth. This topic, partially missing in this strand of literature, is in the agenda of our future research.

## Appendix A – Database

The dataset cover the period from 1989 to 2010 and include the following 29 Transition countries: Albania, Armenia, Azerbaijan, Belarus, Bosnia And Herzegovina, Bulgaria, Croatia, Czech Repubblic, Estonia, Georgia, Hungary, Kazakhstan, Kyrgyz Republic, Latvia, Lithuania, Macedonia, Moldova, Mongolia, Montenegro, Poland, Romania, Russian Federation, Serbia, Slovak Republic, Slovenia, Tajikistan, Turkmenistan, Ukraine, Uzbekistan.

With reference to the EBRD database, Turkey is excluded for the presence of many missing values. For Czech Republic, EBRD indexes are available up to 2007. It has graduated within EBRD in 2007 and gained the status of the only ex-communist country that has become a shareholder within EBRD and not a borrower any more. To replace missing values, it is assumed that from 2008 to 2010 the EBRD indicators have the same values as those reported for 2007. EBRD data sets are freely available from: http://www.ebrd.com/downloads/research/economics/macrodata/tic.xls.

The measurement scale for the indicators ranges from 1 to 4.33, where 1 represents little or no change from a rigid centrally planned economy and 4.33 represents the standards of an industrialised market economy. The reform scores reflect the assessments of EBRD economists using the criteria described in the methodological notes.

| Var. | Description | Source | Mean | Min | Max | Obs |
|---|---|---|---|---|---|---|
| **Database to estimate the overall index of sped of transition (ST)** | | | | | | |
| **BR** | Banking reform & interest rate liberalisation | EBRD – Transition Indicators | 2.25 | 1.00 | 4.00 | 638 |
| **CP** | Competition Policy | EBRD – Transition Indicators | 1.92 | 1.00 | 3.67 | 638 |
| **ER** | Enterprise restructuring | EBRD – Transition Indicators | 2.49 | 1.00 | 4.00 | 638 |
| **LSP** | Large scale privatisation | EBRD – Transition Indicators | 3.56 | 1.00 | 4.33 | 638 |
| **PL** | Price liberalisation | EBRD – Transition Indicators | 1.92 | 1.00 | 4.00 | 638 |
| **SM** | Securities markets & non-bank financial inst. | EBRD – Transition Indicators | 3.19 | 1.00 | 4.33 | 638 |
| **SSP** | Small scale privatisation | EBRD – Transition Indicators | 1.93 | 1.00 | 3.67 | 638 |
| **TS** | Trade & Forex system | EBRD – Transition Indicators | 1.92 | 1.00 | 3.67 | 638 |
| **OIR** | Overall infrastructure reform | EBRD – Transition Indicators | 2.49 | 1.00 | 4.00 | 638 |
| **Database for Granger causality Tests and Panel Data analysis** | | | | | | |
| **Ggdp** | Growth rates of GDP (constant 2000 US$) | World Bank [NY.GDP.MKTP.KD] | 1.49 | -44.9 | 12.00 | 465 |
| **ST** | Speed of Transition | Our elaborations from EBRD | 7.09 | -18.0 | 151.11 | 475 |
| **Infl** | Inflation, GDP deflator (annual %) | World Bank[NY.GDP.DEFL.KD.ZG] | 167.88 | -5.18 | 15442 | 458 |
| **Sch2** | Gross School Enrolment ratio secondary | World Bank [SE.SEC.ENRR] | 89.70 | 60.64 | 108.25 | 399 |
| **ExGr** | External demand | Our elaborations from IMF and WB | 1.97 | -5.44 | 10.98 | 433 |
| **PR** | Political Rights | Freedom House - Freedom in the World | 3.30 | 1 | 7 | 459 |
| **CL** | Civil Liberties | Freedom House - Freedom in the World | 3.40 | 1 | 7 | 459 |
| **Database to estimate (IC) initial condition by PCA** | | | | | | |
| **GDP** | GDP per capita PPP in 1990 | World Bank[NY.GDP.MKTP.PP.KD] | 8193 | 2003 | 16405 | 26 |
| **URB** | Urbanization (% of pop. in 1990) | World Bank [SP.IRB.TOTL.IN.ZS] | 57.22 | 31.70 | 75.20 | 26 |
| **DIST** | Geographical distance from EU (km) | Falcetti et al. (2006) | 2416 | 722 | 6815 | 26 |
| **TRADE** | trade (% GDP) in 1990 | World Bank [NE.TRD.GNFS.ZS] | 74.76 | 11.90 | 169.29 | 26 |
| **Y_SOC** | years under socialism | Falcetti et al. (2006) | 56.58 | 41.00 | 74.00 | 26 |
| **EM_AG** | Employment share in agriculture (1990) | World Bank [SL.AGR.EMPL.ZS] | 22.96 | 5.00 | 44.00 | 26 |
| **IC** | Initial conditions | Own calculations | 49.11 | 0.02 | 100 | 26 |

*Table A.1 - The dataset*

## Appendix B – Panel unit root analysis

In this appendix the univariate unit root analysis and panel cointegration tests for the variables included in the model are summarised. The small sample size is a major limitation for unit root testing and also for cointegration analysis. EViews 7.1 is used.
The Levin-Lin-Chu (LLC) test (Levin et al., 2002), the Im-Pesaran-Shin test (Im et al., 2003), the Fisher-ADF test and the Fisher-PP test (Maddala and Wu, 1999; and Choi, 2001) are employed.

| Variable | ST | ST | G_GDP | G_GDP |
|---|---|---|---|---|
| **Lag length** (test specification) | 0 to 3 (None) | 0 to 3 (Intercept) | 0 to 3 (None) | 0 to 3 (Intercept) |
| **Null Hypothesis:** Unit root (assumes common unit root process) | | | | |
| **Levin, Lin & Chu t-stat** | -48.02*** (0.00) | -48.02*** (0.00) | -7.84*** (0.00) | -7.04*** (0.00) |
| **Null Hypothesis:** Unit root (assumes individual unit root process) | | | | |
| **Im, Pesaran, Shin W-stat** | -- | -33.03*** (0.00) | -- | -4.69*** (0.00) |
| **ADF - Fisher Chi-square** | 315.96*** (0.00) | 763.90*** (0.00) | 123.09*** (0.00) | 109.75*** (0.00) |
| **PP - Fisher Chi-square** | 256.86*** (0.00) | 472.62*** (0.00) | 130.17*** (0.00) | 241.18*** (0.00) |

*Table B.1: Panel Unit Root Tests – Variable in levels with intercept and linear trend*

****Denotes significant at 1% level; **Denotes significant at 5% level; *Denotes significant at 10% level. P-values are in parenthesis. The lag length is based on Akaike information criterion. Newey-West automatic bandwidth selection and Bartlett kernel are applied.*

Table B.1 shows robust evidence that speed of transition reform and growth rate of real GDP are stationary in levels both without ('None') and with intercept ('intercept'). These findings imply that the ST and economic growth cannot be cointegrated. Therefore there is no long-term co-movement between these two variables.

## Appendix C - PCA analysis of initial conditions

Following Falcetti et al. (2006), Principal Component Analysis (PCA) is applied to build a synthetic index of initial condition for each transition country. To give an unambiguous meaning of the score of the index, all the values of variables are converted as deviations from the overall means, according to the following equations:

$GDP_i^* = GDP_i - \overline{GDP}$; $Urban_i^* = Urban_i - \overline{Urban}$; $Dist_i^* = \overline{Dist} - Dist_i$; $Trade_i^* = Trade_i - \overline{Trade}$; $Y\_soc_i^* = \overline{Y\_soc} - Y\_soc$; $Em\_Agr_i^* = \overline{Em\_Agr} - Em\_Agr_i$.

This procedure implies that a higher index reveals a better initial condition for the economy. On this data set (two-way) principal component analysis is applied. Table C.1 shows estimated eigenvectors.

| *Variable* | *PC 1* | *PC 2* | *PC 3* | *PC 4* | *PC 5* | *PC 6* |
|---|---|---|---|---|---|---|
| **GDP** | 0.507 | 0.094 | -0.018 | 0.137 | -0.763 | 0.363 |
| **URB** | 0.367 | -0.341 | 0.584 | 0.360 | 0.410 | 0.332 |
| **DIST** | 0.485 | -0.121 | -0.296 | 0.431 | 0.065 | -0.688 |
| **TRADE** | 0.127 | 0.916 | 0.071 | 0.241 | 0.275 | 0.075 |
| **Y_SOC** | 0.384 | -0.086 | -0.645 | -0.285 | 0.410 | 0.424 |
| **EM_AG** | 0.457 | 0.115 | 0.388 | -0.726 | 0.028 | -0.316 |
| % of Expl. Variance $(\lambda_j)$ | 0.540 | 0.181 | 0.170 | 0.043 | 0.037 | 0.029 |

*Table C.1: Eigenvectors (loadings) of initial conditions*

Then weighted averages (WA) of the six principal components are computed according to the following formula: $WA_i = \sum_{j=1}^{6} \lambda_j PC_{ij}$. The index of initial conditions (IC) used in the empirical analysis ranges from 0.02 to 100 according with the following equation:

$$IC_i = 100 * \left( \frac{WA_i - WA_{MIN} + 1}{WA_i + WA_{MAX} - WA_{MIN} + 1} \right) \qquad \text{(C.1)}$$

As IC-index is multiplied for the time trend in the regressions, a unit is added to both numerator and denominator in order to avoid that the index of IC is equal to 0 for the country with the worst initial condition. The rational for this is that, without this adjustment, only for the worst country the variable 'IC*time trend' would be always equals to zero.

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