Economic development and growth in transition countries

Rusinova, D.T.

Publication date
2010

CHAPTER 2

GROWTH IN TRANSITION: RE-EXAMINING THE ROLE OF FACTOR INPUTS AND GEOGRAPHY

2.1 Summary

In this chapter we reconsider the role of factor inputs in determining long-run growth for transition countries[1]. For this purpose, we estimate cross-sectional growth equations using spatial econometric models. Investments in physical and human capital are found to be significant growth factors for the period after 1994. The estimated coefficients are very similar to those obtained in the literature for developed market economies. We also find evidence for spatial autocorrelation of growth, due mostly to the wars and financial crises in the region. Correction for such correlation increases the significance of the explanatory variables.

2.2 Introduction

The pioneering studies in empirical growth analysis (Barro, 1991, Mankiw et al., 1992) identified a number of factors explaining cross-country differences in long-term growth. As predicted by the neoclassical growth models, an important role is played by the so-called factor inputs: the investments in physical and human capital.

A large empirical literature on the determinants of growth in transition countries appeared in the 1990s[2]. A broad agreement emerged that factor inputs do not play a role. Instead, cross-country differences in growth are explained by peculiarities of the transition process: initial conditions, reforms and institutions (Havrylyshin, 2001). As a consequence, all recent empirical studies of growth in transition have left factor inputs out of their attention and concentrated only on the transition-specific determinants. However, as the transition economies gradually transform into market economies, we can ask whether it is still justified to assume that factor inputs do not affect growth.

In this chapter we aim at contributing to the analysis of growth in transition by extending the existing empirical literature in two ways. First, we attempt to answer the question whether after more than a decade of transition, factor inputs are still not relevant for growth. In order to answer this question we return to the classical cross-sectional framework of studying empirical growth as introduced by Barro (1991) or Mankiw, Romer and Weil (1992). Second, the chapter addresses the so far neglected issue of possible spatial interdependence among countries, or the possibility that growth in an individual country depends on the growth of its neighbours. For this purpose we apply spatial econometric techniques which pay explicit attention to the spatial autocorrelation, and trace how

[1] This paper is based on Rusinova, Desislava (2007): Growth in Transition: Re-examining the roles of factor inputs and geography, Economic Systems, vol. 31, iss. 3, pp. 233 - 255, 2007

[2] An extensive description of works published in the 1990s is available in a comprehensive survey by Havrylyshyn (2001).

incorporating it into the analysis changes the inference from the growth regressions.

There are two major findings emerging from the analysis. The most important is that investments in physical and human capital do matter for per capita growth in transition, if we abstract from the initial period of "disorganization". This result is robust to changing control variables. In fact, apart from the lagged growth (and in some cases the FSU dummy), factor inputs are the only variables that have explanatory power for the cross-country differences in GDP growth per capita. The estimated coefficients are positive and similar in magnitude to the ones found in the general empirical growth literature. The result for human capital implies a 0.04 - 0.05 percentage points gain in per capita growth for every percent increase in enrolment. For physical capital we have 0.08 p. p. gain resulting from a one percent increase in the investment/GDP ratio.

Second, our analysis reveals some evidence for the presence of spatial dependence in the transition dataset which has been neglected in earlier works. The correction for it increases the significance of all explanatory variables including factor inputs. Moreover, for the early transition it does not suffice to consider a country's initial conditions and involvement in wars. Rather, these attributes for the neighbours have to also be accounted for. These results are important since the failure of the earlier literature to find significant factor inputs might lie in the absence of spatial dependence consideration.

The result of the significance of factor inputs is in fact very intuitive if we keep in mind the nature of the transition process. Transition is not a usual cyclical recession, but a profound change of the economic system involving the incentives faced by economic agents, the coordinating mechanisms and the structure of the economy. We can expect that over the relatively short period, while the initial distortions in the economies are not eliminated, efficiency- and allocation improving factors play a dominant role, concealing the effect of the long-run growth determinants (Fischer et al., 1996; Staehr, 2003). We can think of these factors as affecting the total factor productivity in the neoclassical growth model (Durlauf and Quah, 1998, Islam, 1995). However, as the transition process unfolds, it is natural that factor inputs come into action in explaining growth. The major result of the transition process is that the countries gradually turn into market economies. We can therefore expect the efficiency-enhancing factors to diminish their role, and the growth determinants of the transition countries to start resembling those of the established market economies. Moreover, gradually longer series of data on transition countries become available, which allows the effects of the long-run growth determinants to become discernible.

The rest of the chapter is organized as follows. The second section summarizes the conclusions of the cross-country growth studies on transition countries. The third section discusses in more detail the motivation for implementing spatial econometric techniques in this field. Section four and five contain correspondingly descriptions of the data and the estimation strategy, and section six describes the empirical results. The seventh section is devoted to a discussion of the robustness of the results with respect to several alternative setups. Conclusions follow. A brief theoretical review of the relevant spatial econometric models, spatial tests and spatial weighting matrices used in the present analysis can be found in Appendix A, and the intermediate results from the extreme bounds analysis are contained in Appendix B.

2.3 Literature review

This section provides an overview of the empirical literature on transition and the reasons why factor inputs have been neglected by the work in this area. For detailed comments of the findings of the empirical work from 1990s, the reader may refer to the detailed surveys of Havrylyshyn (2001), or Havrylyshyn et al. (1998).

There is broad agreement in the literature that traditional factor analysis plays no role for growth in transition since studies using long-term growth determinants (investment in physical and human capital, population growth) found that these were not significant (Campos, 2001; Staehr, 2003)[3]. For this reason, the majority of studies do not consider factor inputs at all[4].

Instead, growth in transition appears to be explained well by four clusters of transition-specific factors. The first relates to what is called "short-run macroeconomics" (Temple, 1999) or macroeconomic policies measured by inflation, fiscal deficits etc. The second cluster includes indicators of initial distortions like the degree of over-industrialization of the economy, repressed inflation or number of years under communism, first used in de Melo et al. (1997). The third cluster comprises economic reforms like internal or external liberalization, privatization and financial sector reform, measured usually by the EBRD reform indicators. In the fourth place, a relatively new strand of empirical literature has found significant institutional factors like economic freedom, protection of property rights, corruption etc. Further controls found to be significant are regional dummies, war dummies and geographical factors like distance from Western Europe (e.g. Aslund et al., 1996). Apart from these, more recent works have identified such factors as increase in oil prices for the oil-producing countries and the convergence to the country's potential output level (Falcetti et al., 2005).

2.4 The need for spatial economic models

A possible reason for the failure of the literature to find factor inputs significant is the absence of spatial dependence considerations. Put simply, the spatial autocorrelation (one of the forms of spatial dependence) means that the spatial units (in our case, countries) are not independent of each other (Abreu et al., 2005). Correction for spatial dependence is important since failure to consider it can result in serious model misspecification (Abreu et al., 2005; Anselin, 1992). Spatial econometrics provides us with rigorous tools to account for the spatial dependence between countries.

The composition and the characteristics of the transition sample give us ample reasons to expect the presence of spatial dependence. First, growth rates in neighbouring economies are correlated because of the natural links between them: trade, capital flows, labour mobility, technology diffusion (Abreu et al., 2005) etc. In addition, spatial correlation should be expected when the spatial units are affected by substantial common shocks (Anselin, 1988; Rey and Montouri, 1999). Examples of common shocks abound in the case of transition economies: in early transition, the collapse of the CMEA trading

[3]One exception is Fidrmuc (2001), who reports a significant positive coefficient of secondary school enrolment.

[4]Exceptions are Campos (2001), who includes investment and school enrolment and Havrylyshyn, Izvorski and van Rooden (1998), who consider only investment. However, in both cases the variables are found not to be significant.

Table 2.1: First year of official positive growth

Country	First year with positive growth
Albania	1993
Armenia	1994
Azerbaijan	1997
Belarus	1996
Bulgaria	1994
Croatia	1994
Czech Republic	1993
Estonia	1994
Georgia	1995
Hungary	1994
Kazakhstan	1996
Kyrgyz republic	1996
Latvia	1994
Lithuania	1995
FYR Macedonia	1996
Moldova	1997
Poland	1992
Russian Federation	1997
Romania	1993
Slovak Republic	1994
Slovenia	1993
Tajikistan	1998
Turkmenistan	1998
Ukraine	1999
Uzbekistan	1996
Yugoslavia (Serbia)	n.a.
Source: World Bank World Development Indicators, 2004	

block had strong negative consequences for both trade and production of all transition countries due to the heavy intra-bloc trade dependence. Later on, the Russian financial crisis of 1998 influenced also the neighboring countries with strong economic relations with Russia.

A similar cross-border shock effect can be exercised by wars and conflicts. A traditional way to handle these effects is through a war dummy. However, it is insufficient to describe the entire effect of wars, since it only distinguishes the countries immediately involved, while neighboring countries are likely to be affected as well via the collapse of trade, economic embargoes, etc. For instance, the economy of Bulgaria was adversely affected by the war in former Yugoslavia, although the country itself was not involved in it (Christoffersen and Doyle, 1998).

Second, since the data are gathered only at an aggregate scale, there may be a discrepancy between the spatial scope of an economic phenomenon and the formally drawn borders of spatial units. In this case, the measurement errors are likely to "spill over" the border of the units and give rise to a spatial residual autocorrelation (Anselin, 1988). In our sample, there are countries which were parts of a single country or federation, and the statistical data for them for this period has been artificially "split". Therefore, the measurement and aggregation errors of the new separate series are likely to be correlated since these activities were performed by the same institution with the same methodology. Examples are the former Soviet Union, former Yugoslavia, and Czechoslovakia. Some earlier works (e.g. de Melo et al., 1997) have corrected for this through including a categorical variable, indicating whether the country has been an independent state or a part of a larger formation at the beginning of the period. However, the spatial approach handles the issue in a substantially more advanced and theoretically sounder way.

Next to these reasons, there is increasing evidence in the literature that spatial interdependence exists among countries or regions (Abreu et al., 2005). More specifically, GDP levels or growth tend to exhibit clustering in space: if a country is experiencing strong growth, it is likely to be situated close to countries where growth performance is also strong (Cannon et al., 2000; Ramirez and Loboguerrero, 2002)[5]. Therefore, we can expect to find a similar effect in our case.

2.5 Data

The data are gathered from a variety of sources. Table 2.2 gives an overview of the variables used, the source, and period covered. The major data sources are the World Development Indicators, published annually by the World Bank.

In contrast to many transition studies, which take aggregate GDP growth as the dependent variable, we remain in the stream of traditional empirical growth and employ the growth of per capita GDP. This does not only ensure better comparability with the studies in general growth empirics, but also gives a better measure of the relative change in living standards than total GDP.

[5]Apart from spatial dependence, there is also another way in which the value of an economic indicator can depend on the location of a country – spatial heterogeneity. This comes when the economic characteristics of the countries vary systematically according to a characteristic with a spatial dimension like the geographical position (Abreu et al., 2004). In our case however, spatial dependence is more relevant than spatial heterogeneity. For details see appendix A.4.

Table 2.2: Overview of the original variables

Variable	Definition	Source	Period covered
Dependent variable			
GDP per capita	Average annual percentage growth of GDP per capita	World Bank	1990 – 2002
Independent variables: Factor inputs			
Population growth	Average annual percentage growth of population	World Bank	1990 – 2002
Investment	Gross domestic capital formation as % of GDP	World Bank	1990 – 2002
Schooling	Upper secondary school enrolment	UNICEF's Transmonee database	1990 – 2001
Initial income	GNP per capita, correspondingly in 1989 and 1994	De Melo et al. (1997), World Bank	1989, 1994
Macroeconomic stabilization			
Log inflation	Natural logarithm of the annual percentage growth of the GDP deflator	World Bank, EBRD	1990 – 2002
Measures of economic reforms			
Internal liberalization	Annual index of progress in price liberalization	EBRD	1991 – 2002
External liberalization	Annual index of trade and foreign exchange liberalization	EBRD	1991 – 2002
Small scale privatization	Index of progress in small-scale privatization	EBRD	1991 - 2002
Large scale priv.	Index of progress in large-scale privatization	EBRD	1991 - 2002
Enterprise restructuring	Index of enterprise restructuring and reform	EBRD	1991 - 2002
Initial conditions			
Over-industrialization	Difference between the actual share of industry in GDP and predicted share	De Melo et al. (1996)	1989
Suppressed inflation	Difference between growth in real wages and real GDP	De Melo et al. (1996)	1989
Years under communism	Number of years under communism	De Melo et al. (1996)	1989
Share of CMEA trade	Share of country's trade with CMEA countries	De Melo et al. (1996)	1989
Institutional variables			
Corruption	Index of corruption	Freedom House	1999 - 2002
Judiciary	Constitutional, legal and judicial framework	Freedom House	1997 – 2002
Governance	Governance and public administration	Freedom House	1997 – 2002
Average Freedom Index	Composite index of political and economic freedom	The Heritage Foundation	1995 – 2002
Additional controls			
War dummy	1 if the country suffered a major conflict or war	De Melo et al. (1996)	1990 – 2002
FSU dummy	1 if country belonged to the FSU		
ACC dummy	1 if the country becomes a member of EU in 2004 or 2007		

The choice of explanatory variables builds on both the general empirical growth literature and on transition-specific studies. As in Barro (1991) and Mankiw, Romer and Weil (1992), investment in physical capital is measured by fixed capital formation as a proportion of GDP and investment in human capital – by school enrolment (see below for details). Initial level of GDP per capita, population growth and the logarithm of the inflation rate are traditionally used in empirical growth analysis (Levine and Renelt, 1992; Barro, 1991; Mankiw, Romer and Weil, 1992).

We use four of the initial condition variables constructed by de Melo, Denizer and Gelb (1997) and broadly used in later works. These are the degree of over-industrialization, (the excessive industry share over its predicted share), the number of years under socialism, the repressed inflation in 1989 and the share of CMEA trade in total trade in 1989.

The reform variables are taken from EBRD and include measures of internal liberalization, external liberalization, small and large-scale privatization and enterprise restructuring. The backdated reform indicators are used (EBRD, 2000), which enables the use of time series starting in 1991.

There is criticism of the EBRD indicators in the literature. It mainly concerns their subjectivity (they are based on the opinion of country experts at the EBRD) as well as their ordinal nature, making it hard to interpret the coefficients in a quantitative analysis (Falcetti et al., 2002; Campos and Horvath, 2005). However, this is the only available comprehensive dataset on reforms in transition countries, with data collected using the same methodology for all countries[6]. Moreover, the present chapter does not concentrate explicitly on the effect of reforms on growth, but merely includes them as additional control variables. Therefore, we assume that they are acceptable as reform measures for the present purpose.

We consider "first generation" and "second generation" of reforms, where the first group comprises price liberalization, trade liberalization and small-scale privatization, and the slower second-generation reforms include large-scale privatization and enterprise restructuring. The reason is that the time needed to design and empower different types of reforms varies: some reforms like price liberalization were implemented by most countries early on, "with the stroke of a pen" (Gros and Steinherr, 2004), while the restructuring and privatization of the large state-owned enterprises requires substantially more time and effort. Indeed, later years do not witness a lot of cross–country variation in the two liberalization indexes and almost all countries obtain advanced "grades", while in the third index the variation is substantial even in 2002 (EBRD, 2003).

It is hard to find consistent data about investment in human capital. The most appropriate proxy for it is the average number of years of schooling (Temple, 1999). However, such data are not systematically available for transition countries. We use the upper secondary school enrolment from the UNICEF Transmonee database, since this specialized measure is most likely to reflect the availability in the economy of the human capital obtained through high levels of education, crucial for the success of restructuring and modernizing. Moreover, this human capital measure exhibits more variation across countries than alternative schooling measures.

The institutional variables come from two sources: the Freedom House publications

[6] A new reform indicator dataset has been created recently in Campos and Horvath (2005).

and a general index of economic and political freedom by the Heritage Foundation. Since the indexes of the Freedom House are only available for the years after 1997 and the Heritage foundation index after 1995, they are included only for the second period.

Finally, the variables include three additional controls – a war dummy, a dummy for the FSU countries and one for the EU accession countries. Wherever available, the data include observations until 2002 (World Bank, 2004).

The method of principal components is used several times in the chapter in order to handle groups of variables, which are heavily correlated, like the four institutional variables and the two groups of reform indicators. Only the first principal component is used out of each correlated group. In this way, the chapter only finds the relative weight of the institutional and reform factor groups, and does not disentangle the roles of individual factors within these groups.

Of course, any work dealing with data from transition countries should acknowledge the problems with data quality. The problem is most severe in the initial years of transition and in some FSU countries, where estimates from two different national sources differ by up to 50% (Gros and Steinherr, 2004). The measurement errors and initial underreporting of output, due to failure to capture the output of the new private sector are widely discussed in the literature. In addition, the task of statistical offices changed from measuring quantities towards measuring values. The targeted indicator had to change from net material product to GDP, which includes also the so-called non-material services (World Bank, 2002) and for some countries, this change took several years. There are further problems, like the difficulty to capture the substantial informal sector; to value goods produced under the old system, price distortions from high inflation etc. (World Bank, 1996). However, since these problems are less severe for later years, the analysis using newer data should provide more accurate results.

2.6 Estimation strategy

On the first step of model specification we split transition into two periods: early and late transition. The first period covers the years from 1990 until 1994, and the second – from 1995 onwards. The reason for such a division is our conjecture that different factors explain growth in the two periods of transition. Initial conditions and efficiency-improving reforms might play a stronger role in the beginning, while other factors might come into action later.

However, the time point when the first group of factors gives way to the second is not identifiable. To fix this problem, we can use the U-shaped output dynamics as a benchmark. According to this criterion, 1995 seems a reasonable choice: by 1995, 12 of the 25 countries in the sample, (almost all non-CIS states), have already witnessed at least one year of positive growth (Table 2.1). In the following years, the rest of the countries in our sample also experience growth turnarounds and positive growth in the whole region resumes by 1999 (Table 2.1).

Alternatively, we can use advances in reform and choose a cutoff point at the time when the quickest "first generation" reforms - price and trade liberalization, are close to completion for most countries. Inspection of the EBRD reform indicators series reveals that only by 1995 the majority of countries receive advanced "grades" in both areas of

3.7 or higher[7] (EBRD transition reports).

In addition, previous work has also adopted the division approach using the years 1994/1995 as a turning point (e.g. Fisher, Sahay and Vegh, 1996; Fidrmuc, 2001). Further we will refer shortly to the two sub-periods correspondingly as 'recession" and "recovery" periods. Section 2.7 discusses the implications of choosing two other division years and finds that the major results of the analysis are robust to such changes.

On the second step of model specification we choose the explanatory variables for the spatial regressions implementing extreme bounds analysis in the spirit of Levine and Renelt (1992). The aim of this approach is to overcome the arbitrariness in choosing variables by elimination of insignificant ones, since the path dependence in this approach is well-known in transition data: different sequences of elimination often lead to widely differing results (e.g. Berg et al., 1998). In addition, elimination of a seemingly insignificant variable often leads to change in sign and significance of the remaining ones (Falcetti et al., 2002).

The extreme bounds procedure consists in estimating regressions with all combinations of regressors and tracing the change in size and significance of the coefficients across specifications. We perform it in a two-step form: in the first stage any combination of three to six explanatory variables is allowed on the right-hand side, and if robust variables are found (robustness is defined below), the regressions are re-estimated with those variables always included. The two-step implementation is intended to avoid misspecified regressions due to omitted variables. Since from previous empirical work we can expect the explanatory variables to be rarely significant, the criteria for robustness of the variables are relatively modest. The robustness criterion of Sala-i-Martin (1997) is accepted: in order to be labeled robust, variables are expected to have the same sign in all specifications and to be significant at least in 95% of them. In addition, we take significance at the 10% level as a criterion.

As a third step in model specification we diagnose the presence of spatial dependence in growth, employing the Moran's I test for spatial autocorrelation (see Appendix A.3). The test shows whether the growth values are spatially clustered, as opposed to the null hypothesis that they are randomly scattered. A positive and significant z-value of this test indicates positive spatial autocorrelation, a negative and significant z-value means that there is negative spatial autocorrelation, i.e. no clustering.

On the fourth, final step of model specification we choose a spatial lag model for the first period and a spatial error model for the second, as suggested by appropriate diagnostic tests. In the spatial error model, the error term at one location is assumed to be correlated with the error term at other locations. The spatial lag model assumes correlation of the dependent variable at different locations (Anselin, 1988). In fact, the spatial error model can be regarded as a constrained form of the spatial lag model (more detail is provided in Appendix A.1). The spatial lag model is estimated by Maximum Likelihood, and the spatial error model – either through Maximum Likelihood or GMM[8]. All spatial specifications are implemented with the help of SpaceStat[9].

[7] In the scale of the EBRD reform indicators, a grade of 1 means an unreformed, planned economy and 4.3 is the highest grade relating to completed reforms in the corresponding area (EBRD).

[8] For a review of the main estimating methods, Maximum Likelihood and GMM, see Appendix A.2.

[9] Information and links on spatial econometric software and routines can be found on the webpage of

In order to quantify the interdependence between the spatial units, spatial weighting matrices are used. Each element of such a matrix describes the presence or absence and the intensity of the interdependence between two countries. In this chapter, three different weighting matrices are used: a simple first - order contiguity matrix (assuming that growth is only related in neighbouring countries), an inverse distance matrix (where the intensity of the dependence is proportional to the inverse distance between the capitals of the countries) and an inverse distance matrix with cutoff point at 1000 km. A detailed description of the matrices is contained in Appendix A.5.

2.7 Results

Following the estimation strategy described above, we have chosen the explanatory variables with the help of extreme bounds analysis. For the first period, we have the war dummy, the FSU dummy, the CMEA trade and the schooling variable. For the second period, the variables are temporally lagged growth, schooling, investment, FSU dummy and institutions. The choice criterion employed is the percent of all OLS regressions in which the variables are significant and have a constant sign. Detailed information about the intermediate and final results of the extreme bounds procedure is contained in Appendix B.

Having chosen the regressors, we test for presence of spatial dependence. To start with, the global Moran's I test statistic of the growth per capita has a positive value and is highly significant for both sub-periods (Table 2.3), meaning that countries with higher growth tend to be clustered in space together with other higher-growth countries and vice versa, lower-growth countries are surrounded by other lower-growth countries. The individual countries that contribute most to the value of the statistic for the first period are the war-torn Armenia, Georgia and Azerbaijan, as well as Bulgaria whose presence in the list might be due to the consequences from the war in former Yugoslavia. The countries are ordered according to the value of their local Moran's I statistic, which shows in which countries growth is most correlated with that of their neighbours. In recovery, the individual country with most significant statistic is Russia. This is very likely due to the repercussions of 1998 financial crisis in Russia throughout the region.

For the first period, we choose a spatial lag model since it performs better than both OLS and the spatial error specification in terms of R^2, log likelihood and AIC (Table 2.7), there is no heteroskedasticity, and the test statistic for the alternative spatial error model is insignificant. The spatial error model is considered as well since the robust LM-ERR test seems to provide some evidence in favour of such a specification[10] (see Table 2.6). However, this model is not chosen since the test statistic on the common factor hypothesis is highly significant, suggesting that the specification including spatial lag and spatially lagged explanatory variables is more appropriate (see Appendix A.1 for a discussion of the common factor hypothesis). Indeed, an inspection of the estimated coefficients reveals that although the coefficient of the spatially lagged growth ρ is not significant, the spatially lagged war dummy and in most cases the spatially lagged CMEA are highly significant

Raymond Florax: http://web.ics.purdue.edu/~rflorax/links.htm

[10] A short description of the specialized spatial dependence tests can also be found in Appendix A.3.

Table 2.3: Global and local Moran's I test for spatial autocorrelation of the GDP growth (normal approximation)

Matrix used	Value of Moran's I	z-statistics	Probability
Global Moran's I statistic			
Recession period			
Contiguity matrix	0.40	2.79	0.005
Inverse distance matrix	0.15	3.20	0.001
Inverse distance with cutoff at 1000	0.31	3.30	0.000
Recovery period			
Contiguity matrix	0.43	2.98	0.003
Inverse distance matrix	0.11	2.62	0.008
Inverse distance with cutoff at 1000	0.28	3.04	0.002
Local Moran's I statistic: most significant observations			
Recession period			
1. Armenia	4.17	6.34	0.000
2. Georgia	2.36	4.52	0.000
3. Azerbaijan	1.99	3.82	0.000
4. Bulgaria	1.51	2.34	0.020
5. Russia	0.90	2.10	0.030
Recovery period			
1. Russia	1.64	3.66	0.000
2. Moldova	2.72	2.80	0.005
3. Armenia	1.82	2.74	0.006
4. Bulgaria	1.80	2.70	0.006
5. Azerbaijan	0.97	1.86	0.063

Note: Only first-order contiguity matrix is used for brevity.

and they are the reason for rejecting the null of the common factor hypothesis.

Finally, we turn to the estimation results. In the first period the coefficients of the war dummy, the CMEA and the FSU dummy in the spatial regression are more significant as compared to the OLS (see specifications 5.1.b to 5.4.b in Table 2.6). Although the same holds for the investment and human capital variables, they remain insignificant. Hence, in the initial phase of transition, growth is explained well by war and spatially lagged war, as well as by initial conditions, in this case the percent of CMEA trade and its spatial lag.

The importance of wars in explaining growth in cross-section is familiar (e.g. Fidrmuc, 2001; Cornia and Popov, 1998). The same is true for initial conditions. Naturally, the more a country's economy was dependent on the economies of the former communist bloc, the more costly is the restructuring of the economy in order to make it viable under the changed conditions.

However, the importance of the spatially lagged war and CMEA trade suggests a new way to model the full impact of wars and international trade on a country. By nature, these variables reflect country inderdependence. The war dummy registers international wars and conflicts, and the CMEA variable measures the intensity of international trade with other countries from the same bloc. Considering the countries immediately involved in wars seems not sufficient to capture the entire effect of the conflicts on the country's economy. We should also allow for negative consequences from wars in the country's neighbours, expressed by a coefficient equal in magnitude to the coefficient of the country's own involvement in the war. Moreover, we see that the value of the OLS war coefficient

Table 2.4: Spatial diagnostics of the growth regression

First period	Value	Prob.	Value	Prob.	Value	Prob.
Weights matrix	Contiguity		Inverse distance		Inverse distance (1000)	
Moran's I (error)	-1.03	0.30	-0.87	0.38	-0.68	0.49
Lagrange Multiplier (error)	1.98	0.16	1.53	0.22	1.26	0.26
Robust LM (error)	7.39	0.01	4.46	0.03	4.22	0.04
Kelejian-Robinson (error)	2.19	0.53	2.27	0.52	2.79	0.43
Lagrange Multiplier (lag)	0.21	0.65	0.31	0.58	0.53	0.46
Robust LM (lag)	5.61	0.02	3.24	0.07	3.50	0.06
Lagrange Multiplier (SARMA)	7.59	0.02	4.77	0.09	4.76	0.09

Table 2.5: OLS and spatial error model for growth determinants in recession

Variables	OLS regression (heteroskedasticity-consistent)				Spatial error regressions		
	5.1.	5.2.	5.3.	5.4.	5.1a	5.2.a	5.3.a
Constant	-12.80 (-1.41)	-11.42 (-0.72)	-11.58 (-0.74)	-15.71 (-1.31)	-0.78 (-0.17)	6.10 (1.225)	6.33 (1.40)
War	-6.94** (-2.63)	-6.83** (-2.16)	-7.04** (-2.30)	-7.29** (-3.03)	-11.44** (-7.00)	-12.35** (-7.83)	-12.83** (-9.00)
Dummy	-	-3.69 (-0.82)	-1.06 (-0.20)	-	-	-6.8** (-5.76)	-3.96* (-1.92)
CMEA	-0.16 (-1.36)	-	-0.13 (-1.13)	-0.18* (-1.63)	-0.28** (-5.09)	-	-0.15* (-1.74)
Schooling	0.12 (1.14)	0.08 (0.40)	0.10 (0.50)	0.13 (1.15)	-0.02 (-0.31)	-0.14** (-2.15)	-0.12** (-1.96)
Log inflation	-	-	-	0.86 (0.53)	-	-	-
Lambda (z-statistic)	-	-	-		-0.60** (-2.94)	-0.70** (-3.81)	-0.78** (-4.92)
LR test statistic (prob)	-	-	-		2.72 (0.099)	3.85 (0.05)	2.58 (0.11)
Common factor hypothesis: LR (prob)	-	-	-		19.51 (0.000)	21.75 (0.000)	23.92 (0.000)
Wald (prob)	-	-	-		29.57 (0.000)	33.81 (0.000)	38.65 (0.000)
Log likelihood	-67.89	-68.39	-67.84	-67.79	-66.53	-66.48	-65.11
AIC	143.78	144.79	145.67	145.57	141.056	140.94	140.23
LR test for spatial lag (prob.)	-	-	-	-	6.99 (0.008)	5.27 (0.02)	4.68 (0.03)
Adj. R^2 (sq. corr. for spatial error)	0.52	0.50	0.50	0.50	0.53	0.49	0.52

Notes: t-values (for OLS) and z-values (for the spatial error model) in parentheses. Coefficients significant at the 10% and 5% level are marked correspondingly with one and two asterisks. The weighting matrix used is the first-order contiguity matrix.

Table 2.6: Spatial lag models for growth determinants in recession

Variables	Spatial lag regressions			
	5.1.b (1)	5.1.b (2)	5.2.b	5.4.b
Constant	-6.59 (-1.13)	-4.85 (-0.89)	-13.75 (-1.51)	-2.66 (-0.93)
War	-6.53** (-3.45)	-7.45** (-4.24)	-7.41** (-3.73)	-7.26** (-3.78)
Spatially lagged war	-6.91** (-2.73)	-9.00** (-3.41)	-8.02** (-3.04)	-7.49** (-3.06)
CMEA	-0.22** (-3.01)	-0.17** (-2.17)	-	-0.25** (-3.23)
Sp. lagged CMEA	-	-0.21** (-2.03)	-	-
Log inflation	-		-	-0.05 (-0.03)
Schooling	0.05 (0.72)	0.04 (0.59)	-0.05 (-0.59)	-
Dummy	-	-	-6.40** (-3.06)	-
Spatial lag coefficient ρ (z-statistic)	-0.04 (-0.21)	-0.33 (-1.45)	-0.18 (-0.90)	-0.07 (-0.39)
LR test for spatial error (prob.)	0.000 (0.98)	1.95 (0.16)	0.14 (0.70)	
Log likelihood	-63.78	-62.38	-64.07	-64.02
AIC	139.57	138.76	140.14	140.03
R2 (not adjusted)	0.70	0.72	0.69	0.69

Table 2.7: OLS and spatial error model for growth determinants in recovery

Variables	OLS regressions			Spatial error regressions					
	1.	2.	3.	1.e (ML)	1.e (GMM)	2.e (ML)	2.e (GMM)	3.e (ML)	3.e (GMM)
Constant	-3.22 (-1.58)	-4.91** (-2.25)	-4.79* (-1.86)	-3.69* (-1.61)	-3.32 (-1.63)	-4.94** (-2.47)	-4.88** (-2.57)	-4.88* (-1.92)	-4.76** (-1.98)
Lagged growth	-0.31** (-4.75)	-0.29** (-4.57)	-0.33** (-4.84)	-0.29** (-4.35)	-0.30** (-4.73)	-0.29** (-5.05)	-0.29** (-5.19)	-0.30** (-4.59)	-0.31** (-4.98)
Investment	0.09 (1.62)	0.08 (1.67)	0.09 (1.71)	0.08*(1.6)	0.08** (1.71)	0.08* (1.66)	0.08** (1.67)	0.08* (1.74)	0.09** (1.81)
Schooling	0.03* (1.72)	0.05** (2.78)	0.05* (1.89)	0.04** (2.24)	0.04** (2.04)	0.05** (2.73)	0.05** (2.77)	0.05** (2.38)	0.05** (2.22)
Institutions	-	-	-0.25 (-1.00)	-	-	-	-	-0.21** (-1.00)	-0.23 (-1.06)
FSU dummy	-	1.41 (1.71)	-	-	-	1.40* (1.86)	1.45* (2.04)	-	-
Spatial error coefficient λ (z-statistic)	-	-	-	0.38** (2.00)	0.18 (na)	0.03 (0.12)	-0.04 (na)	0.35** (1.81)	0.17 (na)
LR test statistic (prob)	-	-	-	1.408 (0.23)	-		-	1.18 (0.28)	-
Common factor hyp. Test (pr)	-	-	-	7.03 (0.07)	-	7.41 (0.12)	-	6.51 (0.16)	-
Spatial lag dependence	-	-	-	0.14 (0.71)	-	0.69 (0.40)	-	0.34 (0.56)	-
Log likelihood	-44.00	-42.23	-43.40	-43.29	na	-42.29	na	-41.81	Na
AIC	96.00	94.58	96.80	94.59	na	94.58	na	95.61	-na
Adj. R2 (not adj. for sp. error)	0.46	0.46	0.47	0.51	0.49	0.59	0.60	0.48	0.51

Table 2.8: Panel data estimations for both periods

Variables	1990 - 1995				1996 - 2002		
	7.1.	7.2.	7.3.	7.4.	7.5.	7.6.	7.7.
Constant	3.70 (0.68)	-6.06 (-0.87)	0.11 (0.02)	-4.94** (-6.37)	0.62 (0.35)	2.84 (1.45)	4.66 (2.13)
War	-5.77** (-1.86)	-5.99* (-1.98)	-7.24** (-2.69)	-6.01** (-2.98)	-	-	-
FSU dummy	-	-10.92** (-2.82)	-8.50** (-2.17)	-9.70** (-4.02)	-	-	-
Schooling	0.10 (0.57)	0.22 (1.20)	0.18 (1.02)	0.22 (1.27)	0.14** (5.08)	0.11** (3.00)	0.13** (4.17)
Investment	-	-	-0.20 (-1.30)	-	0.03 (0.67)	0.01 (0.26)	0.07 (1.24)
Time Lagged growth	-	-	-	-	-0.14** (-2.76)	-0.06 (-0.81)	-0.10* (-1.65)
Log inflation	-1.25 (-1.26)	-	-	-	-0.88** (-4.80)	-1.29** (-6.30)	-1.51** (-5.84)
Institutions	-	-	-	-	-	-	-1.55** (-2.78)
CMEA	-0.29* (-1.93)	-	-0.02 (-0.11)	-0.05 (-0.56)	-	-	-
Reforms 1. generation	-	-	-	-	-	-	-
R2 (adjusted)	0.29	0.37	0.39	0.37	0.83	0.77	0.81

Notes: All regressions are estimated using cross-sectional random effects and White heteroskedasticity-consistent variance estimates. In all cases the Hausman test does not reject the null hypothesis of uncorrelatedness of the random effects. t-values are in parentheses. Coefficients significant at the 10% and 5% level are marked correspondingly with one and two asterisks.

is not split between the two new coefficients; rather, the cumulative effect of a war on a country appears twice the effect from the ordinary war dummy(Table 2.7). In this way, it appears that a country loses 6-7 percentage points of average growth if involved in a conflict and twice this figure if its neighbours are also involved. This result seems intuitive, as the effect of war in neighbouring countries may be due to refugee streams, lower foreign investment and destruction of trade routes (Abreu et al., 2005).

A similar reasoning is valid for the CMEA trade, probably because a substantial part of the within-bloc trade of a country is with its close neighbours. The magnitude of this coefficient suggests that for each additional percent of within-bloc trade dependence[11], a country would lose 0.2 percentage points in growth.

The first generation of reforms (price and trade liberalization, small-scale privatization) appears to have a very weak explanatory power. In the first period, initial conditions and wars explain cross-country growth differences substantially better than advance in reforms. Possible explanations for this puzzling finding might be that the chosen reform measure is a poor proxy for the real reform process or that the effect of liberalization pertains only in the short run. In fact, the effect of reforms on growth remains controversial in the literature even after the substantial increase in the work on the link between reforms and growth in the last years (Falcetti et al., 2002).

Finally, the significance of the FSU dummy, even controlling for the difference in initial conditions and reforms, means that the variable might capture unobserved or unmeasured characteristics like difference in further initial conditions or the institutions of FSU and

[11] Within-bloc trade dependence is measured as the proportion of the country's total exports aimed at other countries belonging to the same bloc.

non-FSU countries during this first period.

For the second, recovery period, there is evidence for spatial error autocorrelation (the spatial error coefficient λ is significant in all specifications, see table 2.7). Here, the common factor hypothesis test does not reject the null, suggesting the appropriateness of the reduced spatial error model, and indicating that here are no omitted spatially lagged variables. Indeed, experimenting with inclusion of spatial lags of some variables (war, education, and lagged growth) reveals that these are not significant. Again, the spatial error models perform better than the corresponding OLS regressions by a row of conventional measures (Table 2.7).

The most important result for the recovery period is that investment and schooling affect growth, and this result is robust to changing the control variables. The estimated coefficients are in the range between 0.07 and 0.08 for investment and 0.04–0.05 for secondary schooling. This means that a country can earn 0.07 percentage points of growth for every one percent increase of the investment/GDP ratio and 0.05 percentage points for every percent increase in human capital in the form of secondary school enrolment.

It is interesting to compare the magnitude of these coefficients to those estimated in some earlier works on empirical growth. For instance, table 4 in Barro (1991) reports coefficients of secondary school enrolment between 0.02 and 0.03 and of physical investment between 0.06 and 0.07. Therefore, the estimated coefficients in transition countries for the period starting in the middle of the 1990s are similar to those obtained for the market economies using a world sample.

We also confirm the finding of Falcetti et al. (2005) and EBRD (2004) that the coefficient of temporally lagged growth is significant with a negative sign. This is evidence for a certain type of convergence. However, it is not conventional convergence since the initial income does not appear significant. Rather, it might reflect a tendency for the countries (mainly CIS countries) to return to certain output potential after the dramatic collapse in the 1990s (Falcetti et al., 2005).

Finally, the unexpected positive sign and significance of the FSU dummy coefficient in the second period suggests that it might capture some omitted factor like the increase in oil prices for oil-producing countries, which has contributed to their recent rapid growth (Falcetti et al., 2005).

2.8 Discussion

It was noted earlier that a limitation of the present work is a small number of degrees of freedom in the cross-sectional setup. The present chapter chooses a cross-sectional and not panel framework in order to capture the medium-run growth processes and not short-run factors. Moreover, due to the substantial methodological difficulties and the lack of theoretical agreement on combining the spatial econometrics with panel data (Abreu et al., 2005) the cross-sectional regression is the only feasible one which allows integration of spatial econometric techniques.

As a way of checking the robustness of the main results, two simple panel data regressions were estimated separately for the first and second sub-periods by using three-year averages, and the results of this panel analysis are compared to the ordinary OLS regression. The panel estimation increases the degrees of freedom twice, but a comparison of the cross-sectional results (specifications 5.1. to 5.3. and 6.1. to 6.3.) with the panel results (reported in table 2.9) shows that this increase does not substantially alter the main results. The only difference is that once the period of averaging is reduced to three years, inflation, which is a factor with shorter-run effect, is found to be significant as well. Therefore, we can argue that the cross-sectional model seems appropriate for our purpose.

The reason to consider three-year averages is that a panel using yearly data would fail to capture exactly the long-term growth pattern of most interest. In order to capture the long-term factors, data have to be averaged over 5 or 10-year periods (Temple, 1999; Durlauf and Quah, 1999). However, such averaging is not feasible with the short transition series. The three-year average seems a reasonable compromise in such circumstances.

Another important issue in the empirical design is that there might be arbitrariness in choosing the year 1995 as a turning point to outline periods of "early" and "late" transition, particularly when imposing the same turning point for all countries. In order to verify the appropriateness of this choice, we have experimented with the spatial regressions for the two sub-periods by using the following and the previous year (1996 and 1994) as turning points. The results remain very similar. However, if 1996 is adopted as a division year, the significance of factor inputs in the recovery period becomes even more pronounced while the results in the recession become less conclusive (for instance, the spatially lagged war loses significance). On the other hand, with 1994 as a division year the results for the first period are the same as with 1995, but the significance of the factor inputs in recovery decreases. Therefore, we can argue that the choice of 1995 as a schematic turning point seems appropriate since it allows us not to miss the features we are most interested in for every period. Apparently, other divisions lead to mixing together of years belonging to the two periods and this leads to the less conclusive results.

Finally, the significance of factor inputs increases when considering a later time period (1996-2002), which comes as a support for our conjecture that transition countries become more similar to the rest of the world with the progress of transition.

In this chapter we found that factor inputs play a role in determining growth in later transition and the magnitude of this effect is comparable to the one in the market economies. The efficiency-improving factors and the initial conditions, which determine cross-country differences in growth in the beginning, lose importance with the unfolding of the transition process. The growth pattern of the transition countries starts to resemble that of the established market economies. Hence, factor inputs should not be dismissed any more from the empirical analysis of growth determinants in the ex-communist countries.

Further, there is evidence for the presence of spatial dependence in the transition dataset, which has been neglected in earlier works. This confirms our conjecture that economic growth in individual countries is influenced by the growth performance of their neighbours.

The spatial econometric models appropriate for the periods of early and late transition are different (spatial lag in the former and spatial error in the latter). The spatial analysis revealed that the reason for this unexpected difference lies merely in the changing effect of the war and initial conditions variables. In early transition, the war dummy plays an important role and in order to capture its effect fully, we also have to consider the associated spatially lagged war variable. For this setting, we need a spatial lag model.

In contrast, for the second period, when the war variable (and the lagged war, connected to it) are not significant any more, we can switch to a spatial error model. We also see clearly that considering the spatial effects increases the significance of the explanatory variables. This might hint that our specification is better than OLS.

Certainly, in our case the reliability of the spatial analysis is limited by the small size of the sample since it is not entirely clear how the properties and power of the spatial dependence tests transfer to the small sample case (Anselin, 1999).

Future work might seek to answer the question whether the spatial interdependence among countries can be rigorously confirmed in a panel data setting. In addition, apart from growth, there are further variables of keen interest in the transition literature like foreign direct investment, where it is also relevant whether there are cross-country spillovers and dependencies and to what extent they can alter existing results.