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Trade, Foreign Direct Investment, and Growth: Evidence from Transition Economies

HIRANYA K. NATH

Department of Economics and International Business, Sam Houston State University, Huntsville, TX 77341-2118, USA. E-mail: eco_hkn@shsu.edu

Using a fixed effects panel data approach, this paper empirically examines the effects of trade and foreign direct investment (FDI) on growth of per capita real GDP in 13 transition economies of Central and Eastern Europe, and the Baltic region from 1991 to 2005. A significant positive effect of trade on growth is a robust result for transition economies of this region. In addition, domestic investment appears to be an important determinant of growth. In general, FDI does not have any significant impact on growth in these transition economies. However, when we control for the effects of domestic investment and trade on FDI, it appears to be a significant determinant of growth for the period after 1995.
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INTRODUCTION

The experiences of economic transition from a centrally planned to a market-based system in Central and Eastern Europe (CEE) and the former Soviet Union raise two pertinent questions. First, what triggered growth that ended the 'transition recession' experienced by these transition economies in the early 1990s? Second, what would sustain growth in subsequent periods? This paper is primarily concerned with the second question and examines the role of trade and foreign direct investment (FDI) in growth in 13 transition economies of Central and Eastern Europe, and the Baltic Region

(CEEB).[1] Because these countries have substantially liberalised international trade and have attracted large FDI inflows in the last few years, it is important to examine the significance of these factors in the growth of these economies.

The volume of trade in these countries has increased: total exports from and imports into these countries have more than quadrupled between 1990 and 2005.[2] FDI inflows into these 13 countries increased steadily from less than a billion US dollar (USD) in 1990 to about 43 billion USD in 2005, or from 0.31% to about 6% of real GDP during the period. There is, however, wide variation across the recipient countries. For example, Czech Republic, Hungary, and Poland received about 67% of total FDI inflows into the region. Six countries, Albania, Estonia, Latvia, Lithuania, Macedonia, and Slovenia, together received less than 10%.

Figure 1 displays trends in growth of per capita real GDP, FDI-to-GDP ratio, and volume of trade (exports *plus* imports) as a share of real GDP, also used as a measure of trade openness, all averaged across the cross-section of 13 transition economies and expressed in percentages between 1991 and 2005. As we can see, the average growth rate was negative until 1993. Then it fluctuated and has been steadily rising since 2001. The growth rates have averaged over 5% in the last 3 years of this period. The volume of trade appears to have a clear upward trend. The FDI share has been increasing steadily with some slow down in 2003.

The transition economies of CEEB experienced a substantial decline in output in the initial phase of transition, a phenomenon often referred to as the transition recession. Fischer *et al*. (1996a) argue that restrictive macroeconomic policies and restructuring of the economy caused such decline in economic activities. However, the extent and the speed of recovery varied across countries. There is a substantial amount of literature that addresses various aspects of the transition recession and attempts to identify the factors that triggered the recovery. Some notable works include de Melo *et al*. (1996), Fischer *et al*. (1996a, b), Sachs (1996), de Melo *et al*. (1997), Hernandez-Cata (1997), Havrylyshyn *et al*. (1998), Berg *et al*. (1999), Polanec (2004), and Popov (2007). These studies examine one or more of four different sets of variables to understand the growth experiences of the early transition years.

[1] These countries are Albania, Bulgaria, Croatia, Czech Republic, Estonia, Hungary, Latvia, Lithuania, Macedonia FYR, Poland, Romania, Slovak Republic, and Slovenia. Ideally one would like to include all transition economies in this investigation. But for some of the countries in the former Soviet Union, reliable data are not available for a significant part of the sample period considered in this paper.

[2] The numbers discussed and reported in this paragraph and the next are based on the author's calculation.

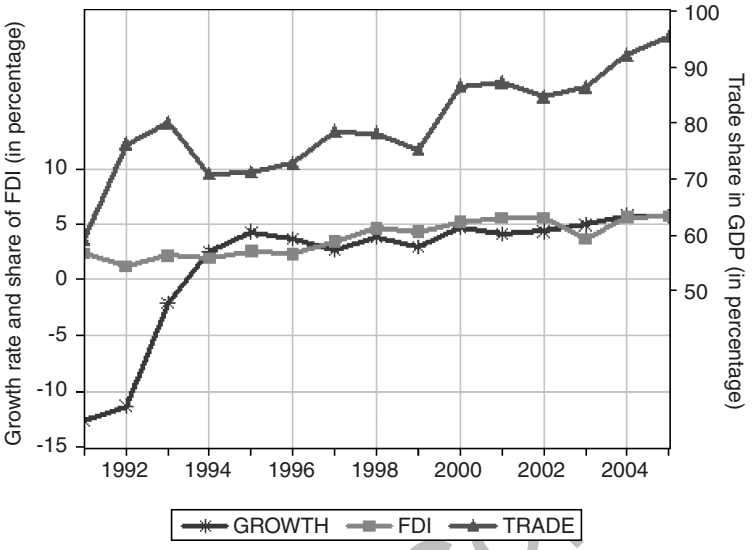

Figure 1: Average per capita real GDP growth, FDI–GDP ratio, and trade–GDP ratio in CEEB transition economies: 1991–2005

These four categories of factors are macroeconomic variables, structural reform variables, initial conditions, and institutional factors.

The recovery and growth since the transition recession was over leave us with only a few data points, not enough to conduct any meaningful time series analysis of the growth experiences of transition countries. Pooling time series and cross-section data may, however, provide a useful way of studying growth in those countries.[3] There have been attempts in recent years to use a panel data approach to evaluate the contribution of various factors to growth in transition economies. For example, in a study very similar in spirit to the current research, Cernat and Vranceanu (2002) use a panel data analysis of 10 CEE countries to assess the impact of globalisation on output performance. Their results indicate that increased EU integration and trade liberalisation are conducive to development. Furthermore, increased FDI inflows seem to be associated with better output performance.[4]

[3] To our knowledge, Islam (1995) is the first study to implement panel data approach to cross-country growth data.

[4] In a related study, drawing on the insights provided by a production function with a low elasticity of substitution between capital and labour, for short-run growth dynamics in the transition economies, Lee and Tcha (2004) empirically show that the marginal contribution of FDI to growth is greater than that of domestic investment. In another study, Sohinger (2005) shows, in a less formal way, that FDI, with its growth-enhancing effects, has played a significant role in setting the transition economies in the CEEB region onto the path of convergence with their more affluent neighbours.

In this paper we examine empirically the role of FDI and trade in the process of economic growth in 13 transition economies of the CEEB region. The empirical work is motivated primarily by an extension of the growth theory that includes trade and FDI as additional determinants of growth. Using fixed effects panel data estimation methods applied to data from 1991 to 2005, this paper examines the effects of trade and FDI on growth after controlling for gross domestic investment (GDI) and other macroeconomic variables such as inflation, fiscal balance, size of the government, real money growth, the lending rate, and foreign exchange reserves; and structural variables such as tariff revenue and infrastructure reform index.

This paper improves upon some previous work on growth in transition economies by explicitly addressing three methodological issues. First, in order to deal with the problem of omitted variables, a very general specification of the model including the largest possible number of variables is estimated and *F*-tests are conducted to implement a 'general-to-specific' approach of selecting the most parsimonious specification. Second, we conduct panel unit root tests to determine the stochastic trend properties of the variables. Nonstationary variables are included in the regression equation in their stationary forms. Furthermore, we formally test for groupwise heteroscedasticity and cross-sectional correlation. The test results help us choose the appropriate estimation technique. Third, by including the lagged dependent variable (LDV), we estimate a dynamic version of the model to mitigate the problem of serial correlation.

Our analysis suggests that a significant positive effect of trade on growth is a robust result for transition economies of the CEEB region. Additionally, domestic investment is an important determinant of growth. In general, FDI does not appear to have any significant effect on growth. When we control for the effects of domestic investment and trade on FDI, however, it is found to have a significant positive effect on growth, but only after 1995. Among other findings, macroeconomic stabilisation through fiscal and monetary policies as reflected in fiscal balance, size of the government, and real money growth plays a significant role. That the real lending rate turns out to be an important determinant of growth underlines the importance of the development of the financial sector in transition economies. These results have important policy implications.

The rest of the paper is organised as follows. The next section discusses theoretical background of the linkages between trade, FDI, and growth. In the subsequent section, we describe the data and the methodology. The subsequent section presents the empirical results and analysis. In the last section, we summarise and include a few concluding remarks.

LINKAGES BETWEEN TRADE, FDI, AND GROWTH: A THEORETICAL BACKGROUND

The importance of trade and FDI for the growth of developing countries has been emphasised in both theoretical and empirical literature. Apart from the traditional Ricardian argument of efficiency gain from specialisation, there have been several other hypotheses put forward to argue how trade may affect growth in developing countries. In early works (eg Rosenstein-Rodan, 1943, Nurkse, 1953, Scitovsky, 1954, Fleming, 1955, Hirschman, 1958), exports were seen as providing the big push to break away from the vicious cycle of low-level equilibrium in which developing countries are often caught. Later, exports were thought to fill in the foreign exchange gap that prevented imports of machinery needed to be competitive in the market (see McKinnon, 1964). More recently, Coe and Helpman (1995) argue that trade enhances the spillover effects of foreign R&D on domestic productivity. Another strand of the recent literature uses new growth theory framework to link trade policy to growth. Externalities associated with liberal trade policies are seen as leading to higher levels of GDP or higher growth.[5]

The importance of FDI for growth is emphasised for its role in augmenting domestic capital stock and as a conduit for technology transfer, two essential elements in the modern growth literature.[6] Studies that use the new growth theory paradigm to examine the effects of FDI on growth take two different routes. For example, extending a hypothesis advanced by Jagdish Bhagwati (1973), Balasubramanyam *et al*. (1996) were able to show that the growth-enhancing effects of FDI were stronger in countries with a more liberal trade regime. They argue that a liberal trade regime is likely to provide an appropriate environment conducive to learning that must go along with the human capital and new technology infused by FDI. Others (eg Borensztein *et al*., 1998) rely on the absorptive capability of the recipient country in the form of stock of human capital for technological progress that is assumed to take place through a process of capital deepening in the form of new varieties of capital goods introduced by FDI.

There are two dimensions to the hypothesis that FDI interacts with trade to have a positive effect on growth. First, a more liberal trade environment with export orientation attracts larger FDI inflows because it not only allows foreign capital to take advantage of low cost of labour in the host country but also provides access to a larger market. Second, the neutrality of incentives

[5] See Grossman and Helpman (1992) for a comprehensive discussion of a class of such models.

[6] In the literature, the role of FDI in transferring technology has received much attention and spurred intense debate. For a recent survey, see Saggi (2002).

associated with export orientation allows exploitation of economies of scale, better capacity utilisation, and a lower capital-output ratio, thus making foreign capital more productive. Moreover, exports also promote technical innovation and dynamic learning from abroad and thereby create a more favourable environment for externalities and learning from technology spillovers associated with FDI.

Some of the recent theoretical work (Helpman *et al.*, 2004; Antras and Helpman, 2004) has explored the relationship between trade and FDI. Under certain conditions, trade and FDI have been shown to be substitutes. As this line of research highlights the role of within-sector productivity differences for determining the patterns of international trade and FDI, it seems to have implications for growth in countries receiving the benefits of trade and/or FDI. For the purpose of our empirical study, the theoretical expositions of the linkages between trade, FDI, and growth translate into an extended growth equation with trade and FDI as additional variables alongside domestic investment.

DATA AND METHODOLOGY

Data

The main sources of data for this study are the United Nations' *Statistical Database*, the *Foreign Direct Investment Database* compiled by the United Nations Conference on Trade and Development (UNCTAD), and the *Transition Reports* for various years prepared by the European Bank for Reconstruction and Development (EBRD).

We obtain national accounts data on GDP per capita, gross fixed investment, government consumption expenditures, exports and imports of goods and services from the *UN Statistical Database*. These data are available both in national currency and in USD; and both at current prices and at 1990 constant prices. We use constant 1990 USD data. We obtain the net FDI inflows data in current USD for CEEB countries from the UNCTAD.[7] Our sample covers a period from 1990 to 2005.[8]

[7] FDI inflows in the recipient economy 'comprise capital provided (either directly or through other related enterprises) by a foreign direct investor to an enterprise resident in the economy. FDI flows are recorded on a net basis (capital account credits less debits between direct investors and their foreign affiliates) in a particular year' (UNCTAD).

[8] Although transition began in 1989 in most countries, data are either not available or too noisy for this initial year of the process. When we calculate growth rates of per capita real GDP, we lose one year's data. Therefore, we use the sample period 1991–2005 in our estimation.

It may be noted that the national accounts data on the transition economies have serious problems, which have been emphasised by Fischer *et al*. (1996a) and others. The GDP data for years immediately after transition are likely to overstate the decline of output and the increases in prices because the pre-transition prices were used to measure output, which was of extremely poor quality. Moreover, statistical agencies had been collecting and publishing data on output mainly from the state sector and, therefore, they may have underreported the expansion of the private sector during the initial years of transition.

We construct the following variables for the empirical analysis. The growth rate of per capita real GDP is calculated as 100 times first log differences of per capita real GDP and is used as the dependent variable (*GROWTH*) in the growth equation.[9] Percentage share of exports plus imports in GDP is taken as a measure of the trade variable (*TRADE*). FDI inflow as a percentage share of GDP (in constant 1990 USD) is taken as the FDI variable (*FDI*). Note that FDI current price series has been converted into constant 1990 USD by using an implicit deflator calculated from the series on gross

[9] There have been studies that use per capita real GDP, mostly in logarithms, as the dependent variable. For example, see Berg *et al*. (1999) and Cernat and Vranceanu (2002). Polanec (2004) argues in favour of using growth rate of average labour productivity. There are others (eg Fischer *et al*., 1996a, b; Sachs, 1996; de Melo *et al*., 1997) who use the growth rate of aggregate real GDP as the dependent variable. There are some concerns, however, about the use of the growth rate of per capita real GDP measured in 1990 constant USD. For example, the differences in the movements of exchange rates over time across countries may introduce some systematic bias in the estimation of the coefficients in our regression model when we use the growth rate of per capita real GDP measured in constant USD instead of constant national currency as the dependent variable. Furthermore, because of the differences in domestic prices across countries, there may have been important differences even with growth rate of per capita real GDP measured in international purchasing power parity (PPP) dollar. Ideally, one would like to use per capita real GDP in PPP dollar, but data for all relevant variables measured in PPP dollars and for the sample period considered are not readily available. To have a sense of the extent of possible biases, we examine growth of per capita real GDP in 1990 constant national currency and growth of per capita real GDP in international PPP dollar. We observe that growth rates of per capita real GDP in both US dollars and in national currency track each other very closely, and for most countries they are perfectly correlated. The correlation coefficient is the lowest with a value of 0.98 for Bulgaria. Thus, the bias introduced by differences in movements of exchange rate should be negligible. We further obtain growth rates of per capita real GDP measured in PPP dollar from Heston *et al*. (2006) for 1991–2004 (for some countries data are not available for all the years), plot them alongside growth rates of per capita real GDP in 1990 USD, and calculate the correlation coefficients. The correlation ranges between 0.825 (for Bulgaria) and 0.992 (for Croatia). For Albania, Bulgaria, Hungary, and Lithuania the correlation coefficients are less than 0.90. Most of the deviations in these two sets of growth rates are in the early years of transition. Interested readers can obtain the data and graphs from the author. As mentioned above, these deviations are likely to introduce some biases in coefficient estimates. However, the results do not seem to change qualitatively. The growth rates of per capita real GDP are almost perfectly correlated with the growth rates of aggregate real GDP for all countries.

fixed investment. FDI inflows are subtracted from gross fixed investment to calculate GDI. The percentage share of GDI in GDP is taken as the domestic investment variable (*GDI*).

Additionally, data on CPI inflation, fiscal balance, nominal exchange rate, employment growth, money growth, domestic credit growth, lending rate, gross foreign exchange reserves, share of private sector in GDP, share of industry in employment, tariff revenues, budgetary subsidies and current transfers, and infrastructure reform index, the variables that are deemed important for growth, are obtained from various issues of EBRD's *Transition Reports*.[10] The Appendix includes a description of the variables along with availability and sources of the data.

The summary statistics of the variables of interest (*GROWTH, GDI, FDI,* and *TRADE*) are presented in Table 1. Per capita real GDP in the CEEB countries grew at an average rate of 1.63% during 1991–2005. The average growth rate, however, varies widely across countries and so does its variance over time. Among the CEEB countries, Poland has recorded the highest average annual rate of per capita real GDP growth, 3.43%, during this period, followed by Estonia, 3.08%. In Former Yugoslav Republic (FYR) of Macedonia, the average annual growth rate has been negative. On an average, these countries have invested 18% of their GDP in building domestic stock of fixed capital during this period. Seven countries, Albania, Czech Republic, Lithuania, Poland, Romania, Slovak Republic, and Slovenia, have exceeded this average. FDI inflows have accounted for about 4% of real GDP, on average. This share is about 6% in the Czech Republic and above 8% in Hungary. Average trade volume among these countries has been about 80% of GDP, with Estonia and Slovak Republic over 100%. In most countries, the increase in this ratio over the sample period has been substantial.

Methodology

We use panel data estimation techniques for our empirical analysis. As discussed above, extension of basic growth theory suggests that alongside domestic investment, trade, and FDI are important determinants of growth. We therefore consider *GDI, FDI,* and *TRADE* to be the main right-hand side variables in our growth equation. Although time invariant initial conditions have been shown to be important for subsequent growth in general (see, eg, Barro, 1991) and for transition economies in particular (see de Melo *et al.*,

[10] Data on other variables that may affect growth are also reported in the *Transition Reports*. They are not included in our set of potentially relevant variables for one of two reasons: (i) incomplete data with data missing for a significant part of our sample period; (ii) they represent the same aspects of the economy as the ones that are included.

Table 1: Summary statistics of the variables of interest: 1991–2005

Country	Per capita real GDP growth rate	GDI-to-GDP ratio	FDI-to-GDP ratio	Trade-to-GDP ratio
	1	2	3	4
Albania				
Mean	2.94	18.72	2.14	42.74
Standard dev	11.62	7.26	0.87	15.78
(Max, Min)	(12.69, −32.23)	(29.21, 4.37)	(3.77, 0.69)	(95.30, 34.70)
Bulgaria				
Mean	1.31	10.06	4.65	86.52
Standard dev	5.51	2.71	4.19	10.57
(Max, Min)	(6.20, −8.86)	(15.66, 4.94)	(14.56, 0.31)	(108.40, 68.80)
Croatia				
Mean	0.36	16.97	3.60	65.44
Standard dev	8.96	3.30	2.32	8.11
(Max, Min)	(7.35, −24.37)	(22.97, 12.83)	(7.17, 0.13)	(78.20, 39.20)
Czech Republic				
Mean	1.43	22.55	5.95	94.17
Standard dev	4.39	3.46	3.74	18.39
(Max, Min)	(5.93, −12.37)	(28.55, 17.08)	(12.35, 1.51)	(124.80, 63.10)
Estonia				
Mean	3.08	14.40	4.94	112.71
Standard dev	8.75	2.67	3.47	9.92
(Max, Min)	(11.70, −22.16)	(19.63, 7.73)	(15.54, 1.21)	(131.30, 93.10)
Hungary				
Mean	2.11	17.18	8.17	90.18
Standard dev	4.68	5.16	2.61	28.28
(Max, Min)	(5.33, −12.48)	(25.21, 7.05)	(14.38, 3.29)	(128.80, 45.40)
Latvia				
Mean	0.68	14.53	3.46	72.91
Standard dev	13.69	6.28	1.81	8.10
(Max, Min)	(10.66, −41.61)	(26.40, 7.09)	(7.14, 0.49)	(87.30, 58.00)
Lithuania				
Mean	0.71	18.30	2.82	96.45
Standard dev	10.34	2.95	2.13	19.43
(Max, Min)	(10.21, −23.68)	(22.52, 14.19)	(7.77, 0.12)	(157.70, 71.00)
Macedonia, FYR				
Mean	−0.04	14.00	2.13	80.16
Standard dev	3.88	3.97	2.91	11.70
(Max, Min)	(4.08, −9.10)	(19.23, 1.80)	(11.64, 0.00)	(103.80, 58.80)
Poland				
Mean	3.43	22.29	3.76	47.15
Standard dev	3.50	2.96	1.94	9.90
(Max, Min)	(6.90, −7.63)	(27.10, 17.86)	(7.39, 0.38)	(67.10, 34.50)

Table 1: (*continued*)

Country	Per capita real GDP growth rate	GDI-to-GDP ratio	FDI-to-GDP ratio	Trade-to-GDP ratio
	1	2	3	4
Romania				
Mean	1.18	20.64	3.63	54.41
Standard dev	6.51	2.34	3.14	10.79
(Max, Min)	(8.57, −13.68)	(23.76, 15.24)	(11.32, 0.15)	(71.10, 33.40)
Slovak Republic				
Mean	1.94	21.68	3.76	112.56
Standard dev	5.98	4.86	3.83	18.19
(Max, Min)	(5.93, −16.16)	(28.20, 9.56)	(14.84, 0.92)	(140.10, 86.10)
Slovenia				
Mean	2.12	23.20	1.86	90.83
Standard dev	4.20	4.37	2.10	11.71
(Max, Min)	(5.11, −9.74)	(29.32, 16.000)	(9.03, 0.56)	(108.70, 63.10) 63.1095)
Full sample				
Mean	1.63	18.04	3.93	80.43
Standard dev	7.58	5.77	3.31	26.56
(Max, Min)	(12.69, −41.61)	(29.32, 1.80)	(15.54, 0.00)	(157.70, 33.40)

1997, and Berg *et al.*, 1999), we leave them out in favour of country-specific fixed effects for two reasons. First, previous studies (eg Berg *et al.*, 1999) have shown that more than one initial condition may be important for growth and macroeconomic performance in transition economies.[11] Inclusion of too many initial conditions may lead to imprecise estimation of the coefficients. Moreover, there may be country-specific factors other than initial conditions that contribute to variations in growth experiences in transition economies. Therefore, our choice of a fixed effects model is dictated by the desire for a parsimonious specification and a concern for the omitted variable problem. Second, the objective of the study is to examine the contribution of trade and FDI to growth in transition economies, and the role of initial condition or relative importance of different initial conditions for growth is not of particular interest. However, for completeness and to facilitate comparison with previous studies (eg de Melo *et al.*, 1997; Polanec, 2004), we also examine, as a part of the sensitivity analysis, whether the results of our

[11] However, they have argued that the effects of these initial conditions taper off as time passes. This is another reason why they may be excluded in investigating growth over an extended period of time.

empirical analysis are robust enough to include the initial conditions in the growth equation.

Although growth theory provides some guidance, growth in countries that are going through economic and political transition could just be a black box. Therefore, choosing appropriate control variables is a difficult task. As shown by previous works, growth in transition economies may well be affected by, in addition to initial conditions, macro variables, structural reform variables, and institutional factors. Based on suggestions from previous works and data availability, we choose two categories of variables: macroeconomic variables and structural reform variables. The first category includes CPI inflation (*INF*), fiscal balance as percentage of GDP (*FBAL*), size of the government as measured by the percentage share of government consumption expenditures in GDP (*GOV*), nominal exchange rate (*X*), employment growth (*EMP*), real money growth (*MONEY*), real domestic credit growth (*DOMCREDIT*), real lending rate (*LRATE*), and gross foreign exchange reserves as a percentage share of GDP (*RES*).

These variables either reflect the effects of macroeconomic stabilisation policies or represent macroeconomic factors that potentially affect growth. For example, like Berg *et al*. (1999), we use inflation as a stabilisation proxy. Fiscal balance is expected to affect growth through crowding out and government consumption expenditures through a short-run aggregate demand stimulus. The nominal exchange rate captures the effect of exchange rate targeting in stabilisation policies. However, because these countries adopted different exchange rate regimes and they made changes, some drastic, over the time it is difficult to speculate on the effects of the exchange rate on growth.[12] Employment growth is expected to affect growth through augmentation of the labour stock. Real money growth, domestic credit growth, and the lending rate are assumed to capture real effects of monetary policy and of developments in the financial sector. Gross foreign exchange reserves are expected to contribute to growth by alleviating the foreign exchange constraint for trade and investment.

The category of structural variables includes the share of private sector in GDP (*PVT*), tariff revenue as a percentage of total imports (*TARIFF*), budgetary subsidies and current transfers as a percentage share of GDP (*SUB*), percentage share of industry in total employment (*INDEMP*), and infrastructure reform index (*INFRA*). The first variable is an indicator of the speed and extent of structural reform and is expected to have a positive effect on growth through increased efficiency. *TARIFF* measures the extent of trade

[12] For a discussion on exchange rate regime, stabilisation, and growth in transition economies, see Fischer *et al*. (1996a).

liberalisation. Budgetary subsidies to enterprises and households are expected to have a positive effect on growth by encouraging investment, thus galvanising aggregate demand. The share of industry in total employment reflects the relative size of the labour force engaged in electricity, power, manufacturing, mining, and water, and a larger share in those crucial sectors is assumed to contribute positively to growth through structural change of the economy. The infrastructure reform index is expected to capture the effects of improvements in transportation, communication, and power generation on growth.[13] Country-specific fixed effects will capture some of the important differences in institutions across the transition economies.[14]

We estimate a pooled time-series cross-section regression of the following form:

$$g_{it} = \mu_i + \beta' X_{it} + \gamma' Z_{it} + \varepsilon_{it}$$

where g_{it} is the annual growth rate of per capita real GDP for country i in year t; μ_i is the country-specific fixed effect; X_{it} is the vector of variables of interest: *GDI, FDI,* and *TRADE*; and Z_{it} is the vector of control variables; $i = 1, 2, \ldots N$ indexes country and $t = 1, 2, \ldots T$ indexes time.

Among various issues and concerns about this empirical methodology, the following have been formally addressed. First, nonstationarity of time-series data is often a cause for concern for meaningful analysis of the data because it may lead to a spurious relationship. The conventional univariate unit root tests suffer from lack of power when the length of the sample period is short. The panel unit root tests, which are relatively new techniques, supposedly alleviate the problem of lack of power by combining data in time and cross-section dimensions. We, therefore, conduct panel unit root tests on the variables of interest as well as on all potential control variables. We use two most commonly used test procedures suggested by Levin *et al.* (2002) and Im *et al.* (2003), respectively. The first test assumes a common unit root process for all cross-sectional units whereas the second assumes different unit root processes for individual cross-sectional units. Both methods have their advantages and disadvantages (see Baltagi (2002) for a discussion).

Second, given the differences in growth experiences among transition economies, one would expect tremendous variation of variables in the model. Moreover, geographic contiguity, and similarity and links between erstwhile

[13] Intuitively some of the variables are expected to affect one another and, therefore, to be correlated. Our general-to-specific approach of model selection should eliminate the possible collinearity among the variables.

[14] Grogan and Moers (2001) present a cross-section analysis of 25 transition economies to show that institutions are important for growth and FDI.

political systems make it likely that there are some common factors that affect these countries. We, therefore, formally test for groupwise heteroscedasticity and cross-sectional correlation. Following Greene (1997), we conduct simple Lagrange multiplier (LM) Tests. For serial autocorrelation, however, we rely on pooled Durbin–Watson (DW) test statistics. These tests also help us determine the appropriate estimation method.

Third, although country fixed effects take care of time invariant country-specific factors, the model may still suffer from an omitted variable problem if some important time-variant control variables are not included. Moreover, some of these variables may be correlated with each other. Thus, while exclusion of relevant variables may lead to the omitted variables problem, inclusion of them may give rise to the problem of collinearity. To address these problems, we first estimate a general model including all control variables listed above. The obvious drawback of including many variables is that, given lack of degrees of freedom, the coefficients are imprecisely estimated. If some variables have negligible effects, excluding them would lead to more precise estimates. Moreover, multicollinearity may show up in terms of statistically insignificant individual coefficient with high R^2. Remedies of this problem include exclusion of variables that are collinear with others. We therefore adopt a less stringent application of Hendry (1995)'s general-to-specific approach. We then apply a sequence of *F*-tests to reduce the model to more parsimonious specifications admissible under our data set. We start with excluding a single variable under each category of control variables, and then we test for exclusion of an entire category of variables. This general-to-specific approach would help us find the most parsimonious specification of our model.[15]

EMPIRICAL RESULTS

Table 2 presents the results of the panel unit root tests conducted on growth of per capita real GDP and all other variables that are potential determinants of growth. Specifying the test equation under both Levin-Lin-Chu and Im-Pesaran-Shin test procedures is a formidable task. Because there are no clear-cut guidelines, we conduct these tests under two specifications: with only individual effects in the test equation, and with both individual effects and linear time trends. As we can see from the table, for *GDI*, *FDI*, *X*, *DOMCREDIT*,

[15] Note that we do not apply the general-to-specific approach to our variables of interest. Therefore, even in the most parsimonious specification, a multicollinearity problem may arise if two or more of these variables are collinear.

Table 2: Panel unit test results

Variables	Levin-Lin-Chu Test		Im-Pesaran-Shin Test	
	Only individual effects in test equation	Individual effects and linear trends in test equation	Only individual effects in test equation	Individual effects and linear trends in test equation
	1	2	3	4
Growth of per capita real GDP(*GROWTH*)	−11.52***	−4.91***	−8.29***	−3.58***
GDI-to-GDP ratio (*GDI*)	0.31	−2.60***	−1.70**	−3.45***
FDI-to-GDP ratio (*FDI*)	−2.24**	−2.90***	−0.88	−1.58*
(Exports+Imports)-to-GDP ratio (*TRADE*)	−1.84**	−14.03***	−2.54***	−10.30***
Inflation (*INF*)	−77.01***	−154.97***	−57.71***	−105.69***
Fiscal balance (*FBAL*)	−4.20***	−7.88***	−3.62***	−4.18***
Size of the government (*GOV*)	−4.42***	−2.73***	−3.73***	−5.05***
Nominal exchange rate (*X*)	−22.96***	8.19	−25.98***	−0.69
Employment growth (*EMP*)	−4.95***	−5.00***	−2.82***	−3.39***
Real money growth (*MONEY*)	−66.01***	−0.90	−22.75***	−9.85***
Real domestic credit growth (*DOMCREDIT*)	3.89	−51.88***	−6.16***	−17.26***
Real lending rate (*LRATE*)	−216.00***	−231.52***	−130.19***	−95.22***
Gross reserves-to-GDP ratio(*RES*)	−2.00**	−2.66***	0.68	−1.81**
Tariff revenue-to- imports ratio (*TARIFF*)	−5.72***	−8.33***	−3.90***	−4.26***
Share of industry in total employment (*INDEMP*)	−4.12***	−5.68***	−1.96**	−2.44***
Share of private sector in GDP (*PVT*)	−13.84***	−3.01***	−10.30***	2.59
Budgetary subsidies- to- GDP ratio (*SUB*)	0.21	1.10	0.48	0.47
Infrastructure reform index (*INFRA*)	−7.20***	−1.43*	−1.14	0.30

Note: For each test, the lag lengths are chosen on the basis of Schwarz Information Criterion (SIC).
*** Significant at 1% level; **significant at 5% level; *significant at 10% level.

Table 3: *LM* tests for groupwise heteroscedasticity and cross-sectional correlation

Null hypothesis	Estimated test statistic	Degrees of freedom	5% critical value
	1	2	3
There is no cross-sectional heteroscedasticity	167.04	12	21.03
There is no cross-sectional correlation	94.39	78	99.62

Note: The first test result is based on the variance–covariance matrix of the estimated residuals obtained from the pooled LS estimation. The second test result is based on the correlation matrix of the estimated residuals obtained from a feasible GLS estimation that uses estimated cross-section variances as weights for various observations.

RES, and *INFRA*, the results are mixed. While we can reject the null of unit root under some specifications we cannot do so under others. Because in at least two out of four specifications we do not find them to be unit root processes, we assume that these variables are stationary. Only for *SUB* do the results unequivocally indicate that it is a unit root process. Therefore, we use the first difference, which is the stationary form, of *SUB* in our estimation of the regression equation.

We then estimate a fixed effects panel regression equation for *GROWTH* with the three variables of interest, *GDI*, *FDI,* and *TRADE*, and all other controls as discussed above. The estimation results are used to conduct tests for groupwise heteroscedasticity, and then for cross-section correlation. The test results are reported in Table 3. Although the test strongly rejects the null hypothesis of no heteroscedasticity across countries, there is little evidence of cross-section correlation. Based on these results, we decide to use a feasible generalised least square (FGLS) method with cross-section weights that mitigate the problems arising from cross-section heterogeneity. It corrects for cross-sectional heterogeneity by using estimated cross-section residual variances as weights to transform the variables.

The test results for the general-to-specific approach of model selection are presented in Table 4. Based on these results we decide to include *INF*, *FBAL*, *GOV, MONEY, LRATE, RES, TARIFF*, and *INFRA* as control variables in our panel regression model. In Table 4, we also report the test result that indicates that including the country-specific fixed effects is appropriate.

In Table 5, we present the regression results.[16] Column 1 includes coefficient estimates along with standard errors and other relevant statistics

[16] From the data description in the Appendix, it is clear that we have missing data for some variables used in this study. That is, we have to use an unbalanced sample. In the case of missing values for the variables, we use the largest sample possible in each cross-section. An observation

Table 4: *F*-test results for exclusion of control variables and fixed effects

Category of variables	Variable	*F*-statistics	Degrees of freedom	*P*-value
	1	2	3	4
Macroeconomic variables	Inflation (*INF*)	4.15**	(1,118)	0.04
	Fiscal balance (*FBAL*)	7.18**	(1,118)	0.01
	Size of the government (*GOV*)	16.45***	(1,118)	0.00
	Exchange rate (*X*)	0.31	(1,118)	0.58
	Employment growth (*EMP*)	1.40	(1,118)	0.24
	Real money growth (*MONEY*)	2.76*	(1,118)	0.09
	Real domestic credit growth (*DOMCREDIT*)	2.32	(1,118)	0.13
	Real lending rate (*LRATE*)	63.66***	(1,118)	0.00
	Gross reserves-to-GDP ratio (*RES*)	7.06**	(1,118)	0.01
	All macro variables	14.20***	(9,118)	0.00
Structural variables	Tariff revenue-to-imports ratio (*TARIFF*)	10.40***	(1,118)	0.00
	Share of industry in total employment (*INDEMP*)	0.04	(1,118)	0.84
	Share of private sector in GDP (*PVT*)	0.14	(1,118)	0.71
	Budgetary subsidies- to- GDP ratio (*SUB*)	1.55	(1,118)	0.21
	Infrastructure reform index (*INFRA*)	14.59***	(1,118)	0.00
	All structural variables	4.26***	(5,118)	0.00
Fixed effects		5.96***	(12,118)	0.00

***Significant at 1% level; **significant at 5% level; *significant at 10% level.

estimates from the FGLS method, which we will call the one-stage/single-stage method in order to distinguish it from its alternative. Note that the standard errors are estimated using White's heteroskedasticity consistent variance–covariance estimates that are robust to general heteroskedasticity. Column 2 presents estimates obtained from the two-stage estimation process. Intuitively, *GDI*, *FDI*, and *TRADE* may affect each other.[17] Therefore, we estimate an equation for each of these three variables, using another two as regressors in the first stage, obtain the residual and use it as a regressor in our growth equation in the second stage. For example, we regress *GDI* on *FDI* and *TRADE*, *FDI* on *GDI* and *TRADE*, and *TRADE* on *GDI* and *FDI* and extract the residuals, which are then included as explanatory variables in the growth

will be excluded from the estimation of our regression model if any of the explanatory or dependent variables for that cross-section are unavailable in that period.

[17] There is some evidence of mutual relationship among *GDI*, *FDI*, and *TRADE*. For example, Campos and Kinoshita (2003) find that trade has a positive effect on FDI in transition economies. Kutan and Vuksic (2007) further investigate the effects of FDI on the export performance of 12 CEE countries and find that while FDI has increased exports by increasing supply capacity through augmentation of the physical capital stock in all countries in their sample, it has helped exports through FDI-specific effects such as technology transfer, higher productivity, and information about export markets, only among the new members of the European Union.

Table 5: Trade, FDI, and per capita real GDP growth: fixed effects panel estimates for 13 CEEB transition economies

Independent variables	Feasible generalized least square estimates			
	One-stage	Two-stage	One-stage	Two-stage
	1	2	3	4
1-year lagged per capita real GDP growth rate			0.259*** (0.043)	0.259*** (0.043)
Gross domestic investment-to –GDP ratio (*GDI*)	0.111*** (0.027)	0.141*** (0.038)	−0.002 (0.053)	0.044 (0.051)
FDI-to-GDP ratio (*FDI*)	0.007 (0.094)	0.008 (0.116)	−0.124 (0.098)	−0.108 (0.113)
(Exports+Imports)-to-GDP ratio (*TRADE*)	0.060** (0.025)	0.069** (0.026)	0.033* (0.018)	0.032 (0.022)
Inflation (*INF*)	−0.017 (0.012)	−0.017 (0.012)	−0.016 (0.010)	−0.016 (0.010)
Fiscal balance (*FBAL*)	0.315*** (0.087)	0.315*** (0.087)	0.222** (0.100)	0.222** (0.100)
Size of the government (*GOV*)	−0.281** (0.121)	−0.281** (0.121)	−0.089 (0.134)	−0.089 (0.134)
Real money growth (*MONEY*)	0.042** (0.016)	0.042** (0.016)	0.038** (0.018)	0.038** (0.018)
Real lending rate (*LRATE*)	−0.032*** (0.008)	−0.032*** (0.008)	−0.033*** (0.007)	−0.033*** (0.007)
Gross reserves-to-GDP ratio (*RES*)	0.062 (0.053)	0.062 (0.053)	0.058 (0.045)	0.058 (0.045)
Tariff revenue-to-imports ratio (*TARIFF*)	0.262** (0.115)	0.262** (0.115)	0.119 (0.125)	0.119 (0.125)
Infrastructure reform index (*INFRA*)	−0.480 (1.067)	−0.480 (1.067)	−0.467 (0.954)	−0.467 (0.954)
R^2	0.645	0.645	0.672	0.672
Adjusted R^2	0.588	0.588	0.616	0.616
D–W statistics	1.263	1.263	1.807	1.807
No of observations	166	166	165	165

Note: The numbers in parentheses are the White robust cross-section standard errors**.** For the results reported in columns 2 and 4, we estimate

$$GDI = C - \underset{(0.088)}{0.699}\times FDI + \underset{(0.011)}{0.063}\times TRADE;\ FDI = C + \underset{(0.018)}{0.037}\times TRADE - \underset{(0.074)}{0.285}\times GDI \text{ and } TRADE = C + \underset{(0.204)}{0.471}\times GDI + \underset{(0.307)}{1.441}\times FDI$$

in the first stage. The estimated standard errors are in parentheses. The estimated fixed effects are not shown above and included in equation as *C*. We obtain the residuals from these equations and use them as regressors in the growth equation in the second stage.
Sample period: 1991–2005. Dependent variable: Growth rate of per capita real GDP.
***Significant at 1% level; **significant at 5% level; *significant at 10% level.

equation. Thus, *GDI* now represents the residual variation in domestic investment after controlling for the effects of *FDI* and *TRADE*. Similarly, *FDI* and *TRADE* reflect residual variations in FDI and trade, respectively, after controlling for the effects of the remaining two variables of interest.

The results indicate that among the variables of interest, trade has a significant positive effect on per capita real GDP growth, and this result is robust under alternative estimation methods. The single-stage FGLS estimate indicates that a 1% point increase in *TRADE* increases per capita real GDP growth rate by about 0.06% point, whereas two-stage estimate indicates a slightly larger effect, 0.068. Domestic investment also has significant positive effect on the per capita growth rate. A 1% point increase in *GDI* leads to about a 0.11% point increase in per capita GDP growth rate in single-stage estimate, whereas the effect is larger, 0.141, when the two-stage estimation method is used. Although the effect of FDI on per capita growth is positive, it is statistically not significant. It may be noted that *GDI* and *FDI* have a significant negative relationship, as revealed by the first-stage estimates, which may be suggestive of crowding out as a result of *FDI* in transition economies. *GDI* and *TRADE*, and *TRADE* and *FDI* are found to have significant positive relationships indicating complementary roles between them.

Among the control variables, significant positive effects of fiscal balance and real money growth and significant negative effects of size of the government and real lending rate are robust across specifications. The significant effect of fiscal balance accords well with the previous study by Berg *et al*. (1999), and highlights the importance of macroeconomic stabilisation for growth of the transition economies of the CEEB region. Contrary to our expectation of a positive effect of *GOV* through its effect on aggregate demand, the size of the government has significant negative effect on growth. This may reflect inefficiency associated with large government. Although inflation appears to have a negative effect, it is not statistically significant. The significant positive effect of real money growth may have highlighted the aggregate demand stimulus of money supply growth. Furthermore, that real lending rate has significant negative effect suggests that tighter credit market conditions adversely affect growth. The significant positive impact of tariff is, however, counterintuitive. One might suspect that there is collinearity between *TRADE* and *TARIFF*, but exclusion of *TRADE* does not render the coefficient negative nor makes it statistically insignificant. The result may just reflect better enforcement of tariff laws.

We report the pooled DW test statistics for all three methods and they indicate that the null of no serial correlation is rejected at a 5% significance level. We therefore estimate a dynamic version of the equation including the

LDV. As LDV is correlated with country-specific fixed factors, it renders estimates of the coefficients biased and inconsistent. Note that only if $T \to \infty$, the least squares estimates will be consistent for the dynamic error panel model. Some researchers, for example Islam (1995), favour least squares estimates for moderate size T if N is relatively large, arguing that the bias may not be large in those cases.[18] The trade coefficient is statistically significant at a 10% level when single-stage FGLS is used. The two-stage estimate is, although positive, not statistically significant. Both *GDI* and *FDI* have negative signs under single-stage FGLS, and neither is statistically significant. Under two-stage estimation, the coefficient estimate of GDI becomes positive but remains statistically insignificant. Even long-run effects of these variables, calculated by multiplying the estimated coefficients by $1/(1-\hat{\rho})$ where $\hat{\rho}$ is the estimated coefficient of the LDV, are smaller than those in the static model. Note that the earlier results about the effects of the control variables are robust to this dynamic specification of the model except that *GOV* and *TARIFF* are no longer significant. The DW statistics in the LDV models suggest that the issue of autocorrelation is resolved.

Sensitivity analysis

We conduct three different sensitivity exercises. First, because the relative importance of initial conditions and reform measures is one of the central topics in the growth literature on the transition economies, we will examine whether our results with regard to the effects of trade, FDI, and GDI on growth hold when we explicitly introduce initial conditions and reform measures in our regression models. We experiment with three different sets of initial conditions.

We first use the logarithm of per capita real GDP in 1990 for the CEEB countries as the initial conditions. Some studies (de Melo *et al.*, 1996; Fischer *et al.*, 1996a, b) use this variable as the only initial condition. The neoclassical growth model predicts that countries with higher initial per capita income will experience slower growth compared to countries with lower initial per capita income. However, as de Melo *et al.* (1997) argue, in addition to initial per capita income, there may be a host of initial conditions representing initial level of development, resources and growth, initial economic distortions, and institutional characteristics that are important for growth in the transition

[18] See Baltagi (2002 pp. 129–30) for a discussion. Many alternatives for getting around the problems associated with dynamic specification of fixed effects model have been suggested. Notable works include Anderson and Hsiao (1981), Arellano (1989), and Arellano and Bond (1991).

economies. Following their suggestions, we consider 11 initial conditions: per capita real GDP in 1990 (*Y1990*); the average annual growth rate between 1985 and 1989 (*PRGR*); urbanisation in 1990 (*URBAN*); a dummy variable for richness in terms of natural resources (*RICH*); a categorical variable for whether the country was an independent state, part of a federal state, or a newly created country (*STATE*); black market exchange rate premium (*BLCMKT*); extent of overindustrialisation in 1990 (*INDIST*); a dummy variable for whether the country is neighbouring a thriving market economy (*LOCAT*); repressed inflation (*REPR*); trade dependence (*TDEP*); and the time under central planning (*MARME*).[19] For details on these conditions, see de Melo *et al*. (1997). Finally, we also consider a set of eight initial conditions as suggested by Polanec (2004). In addition to the last six initial conditions of de Melo *et al*. (1997), this set also includes price liberalisation index (*PLI*) and trade liberalisation index (*TLI*) in 1990 published by EBRD.

As for reform measures, following Polanec (2004) we use the year-to-year change in an unweighted average of EBRD transition indicators (*DREFORM*). There are eight indicators that cover large- and small-scale privatisation, enterprise restructuring, price liberalisation, trade and forex system, competition policy, banking reform and interest rate liberalisation, securities markets and nonbank financial institutions, and overall infrastructure reform. The values of these indicators range from 1 to 4 and are based on subjective judgments of country economists at the EBRD. Furthermore, as Polanec (2004) points out, by using these indicators we are assuming that the effects of reforms on growth are the same at various stages of reform, which may be highly unlikely.

As discussed by de Melo *et al*. (1997) and Polanec (2004), these initial conditions may be highly correlated and, therefore, inclusion of all these time-invariant conditions may introduce the problem of multicollinearity. In order to reduce the dimensionality of the set of initial conditions and to find an appropriate common interpretation, we resort to the method of principal components. For the set of 11 initial conditions, the first two components account for about 60% of variability in initial conditions. The most important cluster has high positive factor loadings for *TDEP*, *BLCMKT*, *MARME*, *URBAN*, and *REPR*, and has high negative factor loading for *STATE*. Except for *URBAN*, this cluster looks very similar to *PRIN1* in de Melo *et al*. (1997), which they interpret as a measure of macroeconomic distortions. The second most important cluster has high positive factor loading for *REPR*, *RICH*, *INDIST*, *BLCMKT*, and high negative factor loading for *LOCAT* and *Y1990*. In this case,

[19] Except for initial per capita real GDP, for other initial condition variables we use the same acronyms as de Melo *et al*. (1997).

the similarity with *PRIN2* in de Melo *et al*. (1997) ends in high positive factor loadings for *INDIST*. Given that we consider only a subset of the countries in their sample, this is not surprising. We include these two clusters (*IC_cluster1* and *IC_cluster2*) in one of the specifications of the panel regression model with initial conditions.

For the next set of eight initial conditions that we consider, the first principal component explains about 45% of variability. The most important cluster of these conditions, has high positive factor loadings for *BLCMKT*, *TDEP*, *MARME*, and *REPR*, and has negative factor loadings for both *PLI* and *TLI*. Although the factor loadings are smaller in value than those obtained by Polanec (2004), they are qualitatively very similar. We include this cluster (*IC_cluster*) along with the initial per capita real GDP in an alternative specification of our panel regression model. Note that a table (Table A1) presenting the factor loadings for all the principal components discussed above is included in the Appendix.

The results from two-stage estimation of these alternative specifications with initial conditions and reform measures are presented in Table 6. Columns 1–3 present the results when only the initial conditions are included in panel regression model. As we can see, significant negative effect of per capita real GDP in 1990 is a robust result. *IC_cluster1* and *IC_cluster2* do not have any significant impact on growth. When the cluster of eight initial conditions is included along with 1990 per capita real GDP, however, it appears to have significant positive effect on growth.[20] The fact that there are some similarities between *IC_cluster1* and *IC_cluster* in terms of factor loadings seems to suggest that this positive significant effect may have been driven by price and trade liberalisation in 1990. In all cases, *GDI* has a significant positive effect on growth. The estimated coefficient of *FDI* is not statistically significant under any of the specifications. *TRADE* has a statistically significant positive effect on growth under all specifications.

[20] An experiment with the sample period 1991–1995 reveals that *IC_cluster1* has significant negative, *IC_cluster2* has significant positive, and *IC_cluster* has significant negative effects on growth. Although the result for *IC_cluster1* accords well with de Melo *et al*. (1997), the result for *IC_cluster2* does not seem to conform to these results. This may be due to some important interactions the *IC-cluster2* may have with the control variables included in our regression model. The result for the *IC_cluster*, on the other hand, accords well with the result of Polanec (2004) for the period 1990–1994. The estimated coefficient of *Y1990* is negative and statistically significant under all specifications and estimation methods. We do not report the results to save space. Interested readers can obtain the results of this experiment, and also the one-stage estimation results for specifications in Table 6 from the author.

Table 6: Trade, FDI, and per capita real GDP growth: fixed effects panel estimates for 13 CEEB transition economies

Independent variables	1	2	3	4	5	6	7
1990 Per capita real GDP (*Y1990*)	−1.087*** (0.339)		−0.699* (0.385)		−1.052*** (0.346)		−0.737* (0.394)
Cluster of 8 initial conditions (*IC_cluster*)			0.248*** (0.069)				0.245*** (0.064)
Cluster of 11 initial conditions 1 (*IC_cluster1*)		0.379 (0.291)				0.492* (0.252)	
Cluster of 11 initial conditions 2 (*IC_cluster2*)		−0.055 (0.363)				−0.255 (0.306)	
Gross domestic investment-to-GDP ratio (*GDI*)	0.115*** (0.039)	0.195*** (0.047)	0.179*** (0.044)	0.088** (0.037)	0.057 (0.045)	0.116** (0.048)	0.109** (0.043)
FDI-to-GDP ratio (*FDI*)	−0.020 (0.118)	0.007 (0.140)	−0.015 (0.130)	−0.015 (0.095)	−0.045 (0.100)	−0.024(0.116)	−0.057 (0.107)
(Exports+Imports)-to-GDP ratio (*TRADE*)	0.038* (0.021)	0.073*** (0.025)	0.062*** (0.022)	0.053*** (0.017)	0.024 (0.016)	0.057*** (0.021)	0.044** (0.018)
Inflation (*INF*)	−0.024 (0.015)	−0.026* (0.014)	−0.024* (0.014)	−0.004 (0.013)	−0.017 (0.014)	−0.013 (0.015)	−0.015 (0.014)
Fiscal balance (*FBAL*)	0.120** (0.081)	0.081 (0.070)	0.132* (0.071)	0.342*** (0.079)	0.215*** (0.068)	0.114* (0.060)	0.151** (0.061)
Size of the government (*GOV*)	−0.254*** (0.062)	−0.112 (0.073)	−0.109 (0.070)	−0.204** (0.103)	−0.227*** (0.059)	−0.112 (0.070)	−0.099 (0.066)
Real money growth (*MONEY*)	0.044*** (0.016)	0.042** (0.016)	0.046*** (0.015)	0.055*** (0.019)	0.054*** (0.017)	0.060*** (0.019)	0.061*** (0.017)
Real lending rate (*LRATE*)	−0.040*** (0.009)	−0.041*** (0.009)	−0.042*** (0.009)	−0.032*** (0.007)	−0.042*** (0.008)	−0.043*** (0.008)	−0.045*** (0.010)
Gross reserves-to-GDP ratio (*RES*)	0.009 (0.021)	0.018 (0.032)	0.035 (0.026)	0.048* (0.028)	0.004 (0.017)	0.014 (0.020)	0.034* (0.018)
Tariff revenue-to-imports ratio (*TARIFF*)	0.012 (0.077)	0.175** (0.071)	0.122** (0.058)	0.283*** (0.098)	0.013 (0.067)	0.175*** (0.055)	0.114** (0.050)
Infrastructure reform index (*INFRA*)	−0.192 (0.318)	−0.136 (0.309)	−0.179 (0.310)				
Change in average transition indicators (*DREFORM*)				−5.604*** (1.809)	−4.516* (2.509)	−5.392** (2.181)	−5.042** (2.046)
R^2	0.501	0.537	0.551	0.669	0.522	0.603	0.602
Adjusted R^2	0.461	0.497	0.512	0.616	0.484	0.569	0.568
D–W statistics	1.007	1.102	1.120	1.461	1.091	1.210	1.231
No of observations	166	166	166	166	166	166	166

Note: The numbers in parentheses are the White robust cross-section standard errors. *IC_cluster* is calculated using the factor loadings of the first principal component of eight initial conditions suggested by Polanec (2004). *IC_cluster1* and *IC_cluster2* are calculated using the factor loadings of the first two principal components of 11 initial conditions suggested by de Melo *et al*. (1997).

Sensitivity analysis results with initial conditions and reform measures. Dependent variable: Growth rate of per capita real GDP. (Two-stage feasible generalized least square estimates).

***Significant at 1% level; **significant at 5% level; *significant at 10% level.

Columns 4–7 of Table 6 present the results for specifications that include reform measures in addition to initial conditions. As the infrastructure reform index is part of the overall reform indicator, we now exclude this variable. Except that *IC_cluster1* is now significant at the 10% level, the effects of initial conditions remain qualitatively unaltered. As before, both *GDI* and *TRADE* have positive effects on growth. The estimated coefficients are, however, not statistically significant when *Y1990* is included as the only initial condition. *FDI* does not seem to matter for growth. The reforms variable has a significant negative effect. Although it seems to suggest that an increase in the change in reform measures, that is, an acceleration in reform, hurts growth, a plausible interpretation of this result is difficult to obtain without further scrutiny. Thus, positive, and often significant, effects of trade and domestic investment, and insignificant effects of FDI on growth are robust to the inclusion of initial conditions.

Second, we exclude those years when most transition economies in the CEEB region experienced negative growth. By 1995 the transition recession largely ended in the region except in Macedonia. Therefore, we re-estimate the model for the period 1995–2005. The results are presented in columns 2–3 of Table 7. As we can see, the effect of *GDI* is similar in magnitude as before, though it is now significant at the 5% level. *TRADE* is significant at a 1% level and the magnitude of its effect is larger. Under the two-stage estimation, these effects are even larger in magnitude and stronger in statistical significance. The most interesting result is that although the *FDI* coefficient is positive and not statistically significant under the single-stage FGLS method, it is not only positive but also highly significant under the two-stage estimation method. The effects of fiscal balance, size of the government, real money growth, and real lending rate are still significant and have the same signs as before. However, foreign exchange reserves now have a significant positive effect but the effect of tariff is no longer statistically significant. Infrastructure, on the other hand, has a statistically significant negative effect, which is puzzling. It may be correlated with one of the variables of interest. Only an estimation of the model without *TRADE* makes the estimated coefficient of *INFRA* positive, though statistically insignificant. Thus, trade and infrastructure index may be correlated.

Third, since *N* is small in our case, we estimate the dynamic version of the model using the generalised method of moments as suggested by Arellano and Bond (1991). This method exploits the orthogonality conditions that exist between lagged values of the dependent variable and the disturbances to introduce the lagged values as instruments. We estimate the model in differences, with lags of the dependent variable from lag 2 and above, and all

Table 7: Trade, FDI, and per capita GDP growth: fixed effects panel estimates for 13 CEEB transition economies

Independent variables	Feasible generalised least square estimates 1995–2005		Panel generalised method of moments 1991–2005	
	One-stage	Two-stage	One-stage	Two-stage
	1	2	3	4
1-year lagged per capita real GDP growth rate			0.262* (0.138)	0.262* (0.138)
Gross domestic investment-to –GDP ratio (*GDI*)	0.111** (0.043)	0.205*** (0.068)	−0.158 (0.134)	−0.112 (0.127)
FDI-to-GDP ratio (*FDI*)	0.006 (0.068)	0.506*** (0.150)	−0.231 (0.159)	−0.082 (0.156)
(Exports+Imports)-to-GDP ratio (*TRADE*)	0.076*** (0.012)	0.112*** (0.019)	0.059* (0.033)	0.049 (0.038)
Inflation (*INF*)	−0.008 (0.008)	−0.008 (0.008)	−0.022 (0.016)	−0.022 (0.016)
Fiscal balance (*FBAL*)	0.346*** (0.061)	0.346*** (0.061)	0.188* (0.105)	0.188* (0.105)
Size of the government (*GOV*)	−0.325*** (0.101)	−0.325*** (0.101)	−0.230 (0.280)	−0.230 (0.280)
Real money growth (*MONEY*)	0.046*** (0.014)	0.046*** (0.014)	0.041 (0.027)	0.041 (0.027)
Real lending rate (*LRATE*)	−0.029*** (0.003)	−0.029*** (0.003)	−0.039*** (0.008)	−0.039*** (0.008)
Gross reserves-to-GDP ratio (*RES*)	0.101*** (0.036)	0.101*** (0.036)	−0.007 (0.097)	−0.007 (0.097)
Tariff revenue-to-imports ratio (*TARIFF*)	0.163 (0.113)	0.163 (0.113)	0.197 (0.248)	0.197 (0.248)
Infrastructure reform index (*INFRA*)	−2.501*** (0.625)	−2.501*** (0.625)	−0.210 (1.463)	−0.210 (1.463)
R^2	0.794	0.794		
Adjusted R^2	0.753	0.753		
D–W statistics	1.938	1.938		
No of observations	140	140	152	152

Note: The numbers in parentheses are the White robust cross-section standard errors.
Sensitivity analysis results. Dependent variable: Growth rate of per capita real GDP.
***Significant at 1% level; **significant at 5% level; *significant at 10% level.

explanatory variables as instruments.[21] The results are reported in columns 3–4 of Table 7. The trade coefficient is statistically significant at a 10% level of significance under the single-stage method, and the magnitude of the estimated coefficient is comparable to the one under single-stage FGLS. Estimated coefficients for both *GDI* and *FDI* are negative but not statistically significant. The estimated coefficients of the control variables have the same signs as the FGLS estimates except for *RES*, which now becomes negative but statistically not significant. Also, only for fiscal balance and real lending rate are the coefficients statistically significant. The AR(1) coefficient is positive and statistically significant at the 10% level.[22]

To summarise, our results indicate that the significant positive effect of trade on growth is a robust empirical result for transition economies of the CEEB region. Domestic investment, too, appears to be an important determinant of growth. FDI does not have any significant effect on growth when we consider the entire sample period. However, when we control for the effects of domestic investment and trade on FDI, it appears to have significant positive effects on growth after 1995. Among other findings, macroeconomic stabilisation through fiscal and monetary policies as reflected in fiscal balance, size of the government, and real money growth play a significant role. That real lending rate turns out to be an important determinant of growth underlines the importance of the development of the financial sector in transition economies.

These results have important policy implications for the transition economies of the CEEB region. They are even more significant as most of these countries have recently joined the European Union. With free mobility of factors of production and liberal trade policies these countries are expected to achieve high growth.

[21] Under the assumption that the regressors are strictly exogenous. See Baltagi (2002, pp. 139).

[22] We do conduct some additional experiments, the results of which are not reported. For example, although we choose our model based on formal tests for exclusion of control variables, some of the included variables may intuitively affect each other or may affect one of our variables of interest. For example, real money growth may have an effect on real lending rate through its effects in the money market. Similarly, tariff that reflects trade liberalisation policy may have an impact on the trade variable. Gross reserves may also affect trade by alleviating the foreign exchange constraint. Size of the government may have a negative impact on fiscal balance. Finally, infrastructure may have a positive impact on FDI and trade. Therefore, in a series of experiments, we exclude one control variable at a time from the benchmark equation and re-estimate the model. The main conclusions are that *GDI* and *TRADE* are significant determinants of growth. Under none of these alternative specifications, the estimated coefficient for *FDI* turns out to be significant when full sample is used. Because the main results do not change, we do not report the results, and thereby save space.

CONCLUDING REMARKS

This paper examines the effects of trade and FDI on growth using data for 13 transition economies in the CEEB region. An extension of traditional growth theory that includes trade and FDI as additional determinants of growth provides the motivation for this study, which tries to understand growth and its sustainability in the transition economies. The transition countries of the CEEB region have witnessed a substantial increase in trade and FDI during the first decade of their transition from plan to market. Applying fixed effects panel estimation methods to a data set for 1991–2005, this paper finds that a significant positive effect of trade on growth is a robust result for these transition economies. Domestic investment appears to be an important determinant of growth. In general, FDI does not have any significant impact on growth in transition economies. However, when we control for the effects of domestic investment and trade on FDI, it appears to be a significant determinant of growth for the period after 1995. Among other findings, macroeconomic stabilisation through fiscal and monetary policies as reflected in fiscal balance, size of the government, and real money growth play a significant role. That real lending rate turns out to be an important determinant of growth underlines the importance of the development of the financial sector in transition economies.

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APPENDIX: DESCRIPTION OF THE VARIABLES AND DATA

GROWTH: Growth rate of per capita real GDP. Calculated as 100 times first log differences of per capita real GDP (1990 USD), available from *UN Statistical Database*. Available for the entire period 1991–2005 for all countries.

GDI: Real gross domestic investment as a percentage of real GDP. Data on real gross fixed capital formation are obtained from the *UN Statistical Database* and real net FDI inflows are subtracted and the percentage shares in GDP are calculated. Data are available for all years: 1991–2005 for all countries.

FDI: Real foreign direct investment as a percentage of real GDP. Data on net FDI inflows at current USD are obtained from the UNCTAD. They are converted into constant dollars by applying an implicit deflator for gross fixed investment. Percentage shares in real GDP are then calculated. Data are

available since 1992 for Albania, Croatia, Estonia, Latvia, Lithuania, Macedonia, and Slovenia. For Czech Republic and Slovak Republic, data are available only since 1993.

INF: CPI inflation. Percentage change in annual average consumer price index (CPI). Available from the EBRD's *Transition Reports*. For Estonia, Latvia, Lithuania, and Macedonia, data are available only from 1992.

FBAL: Fiscal balance. Government budget balance as a percentage of GDP. Available from the EBRD's *Transition Reports*. For Estonia and Latvia, data are available only from 1994; for Lithuania from 1993; and for Macedonia, Romania, and Slovak Republic from 1992.

GOV: Size of the government. Real government consumption expenditures as a percentage share in real GDP (1990 USD). Calculated from the data obtained from the *UN Statistical Database*. Data are available for all years: 1991–2005 for all countries.

X: Nominal exchange rate. Natural log of nominal exchange rate as reported by the EBRD's *Transition Reports*. Data are available for all years: 1991–2005 for all countries.

EMP: Employment growth. Percentage growth of employment as reported in the EBRD's *Transition Reports*. Data are available for Estonia, Latvia, Lithuania, and Macedonia since 1992.

MONEY: Real money growth. Percentage changes in broad measures of money (M2) are available from the EBRD's *Transition reports*. The real money growth rate is calculated by subtracting CPI inflation. Data are available for Bulgaria, Lithuania, and Slovenia from 1992; for Albania, Czech republic, and Slovak republic from 1993; for Croatia, Estonia, and Latvia from 1994; and for Macedonia from 1996.

DOMCREDIT: Real domestic credit growth. Percentage changes in outstanding bank credits available from the EBRD's *Transition Reports*. Data are available for Bulgaria and Slovenia from 1992; for Croatia, Czech republic, Latvia, Macedonia, and Slovak Republic from 1994; for Estonia from 1995; and for Lithuania from 1996.

LRATE: Real lending rate. Data on nominal lending rates (per annum) are available from the EBRD's *Transition Reports*. We subtract CPI inflation to obtain real lending rates. Data are available for Croatia, Czech republic, Lithuania, Macedonia, and Slovenia from 1992; for Latvia, Romania, and Slovak Republic from 1993; and for Estonia from 1994.

RES: Gross foreign exchange reserves as a percentage share of GDP. Gross foreign exchange reserves excluding gold as a percentage of GDP are available from the EBRD's *Transition Reports*. Data are available for Croatia and Lithuania from 1992; for Estonia, Latvia, Romania, and Slovak Republic from 1993; and for Macedonia from 1995.

PVT: Share of private sector in GDP. Private sector value-added as a percentage of GDP, available from the EBRD's *Transition Reports*. Available for all countries for the entire period: 1991–2005.

TARIFF: Tariff revenue as a percentage of total imports. All revenues from international trade as a percentage of value of imports of merchandise goods. Reported in the EBRD's *Transition Reports*. Data are available for Albania, Poland, and Slovak republic from 1992; and for Czech Republic, Estonia, Latvia, and Lithuania from 1993.

SUB: Budgetary subsidies and current transfers as a percentage share of GDP. Budgetary transfers to enterprises and households, excluding social transfers. Reported in EBRD's *Transition Reports*. Data are available for Albania and Slovak republic from 1992; for the Czech Republic and Lithuania from 1993; for Estonia and Latvia from 1994; for Croatia from 1996; and for Macedonia from 1997.

INDEMP: Percentage share of industry in total employment. Share of employment in electricity, power, manufacturing, mining and water in total employment in the economy. Reported in the EBRD's *Transition Reports*. Data are available for Latvia, Lithuania, and Macedonia from 1992; for Slovenia from 1993; and for Albania from 1994.

INFRA: Infrastructure reform index. EBRD index of infrastructure reform that covers electric power, railways, roads, telecommunications, and water, and waste water reforms. Reported in the EBRD's *Transition Reports*. Available for the entire period 1991–2005 for all countries.

Table A1: Factor loadings of the first two principal components of 11 initial conditions and of the first principal component of eight initial conditions

Initial condition variables	Principal component 1 (11 initial conditions)	Principal component 2 (11 initial conditions)	Principal component 1 (8 initial conditions)
	1	2	3
Y1990	0.234	−0.237	—
STATE	−0.359	0.182	—
PRGR	0.240	0.011	—
RICH	−0.193	0.438	—
TDEP	0.438	0.111	0.465
BLCMKT	0.402	0.303	0.511
INDIST	−0.056	0.384	0.036
URBAN	0.318	0.032	—
LOCAT	0.162	−0.523	0.045
MARME	0.383	−0.010	0.437

Table A1: (***continued***)

Initial condition variables	Principal component 1 (11 initial conditions)	Principal component 2 (11 initial conditions)	Principal component 1 (8 initial conditions)
	1	2	3
REPR	0.301	0.439	0.407
PLI			−0.218
TLI			−0.339

Note: The eigenvalues corresponding to the first two principal components of 11 initial conditions are 4.574 and 1.941, respectively, and these two components together explain 59.23% of variability. The eigenvalue corresponding to the first principal component of eight initial conditions is 3.562 and this component explains 44.52% of the variability.