The Diffusion Of Innovations In Central And Eastern Europe:

A Study Of The Determinants And Impact Of Foreign Direct Investment.

by

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Abstract

The diffusion of innovations plays an important role in determining patterns of growth. Foreign direct investment (FDI) is widely thought to be an important channel for the introduction of new ideas, technologies and standards to the transition economies in Central and Eastern Europe. This paper contains a panel data analysis of the factors affecting aggregate inflows of FDI in the ten accession economies plus Croatia over the five year period from 1992 to 1996. Our results indicate that the method of privatisation, the extent of trade linkages with the advanced economies and proximity to the EU have significant effects on the level of investment. We also detect a role for risk and relative labour costs in the host economies, suggesting a degree of competition to attract inward investment. We augment these results with a separate panel data analysis of the factors affecting technical progress in eight Eastern European economies over the same period. This suggests that spillovers from the stock of inward investment and international trade both have a positive impact on productivity in the transition economies, with the beneficial effects of FDI being higher in the more market-orientated economies.

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I. Introduction

It is widely recognised that technology transfer via foreign direct investment (FDI) is likely to have an important role to play in the transformation of the formerly centrally planned economies of Central and Eastern Europe. FDI may provide a vital source of investment for modernising the industrial structure of these countries and act as a channel for the introduction of new ideas and working practices. However the analysis of FDI to transitional countries is constrained by a lack of firm theoretical foundations. In conventional models multinational enterprises are viewed as arising from a combination of industrial organisation motives that result in a number of activities being placed under common ownership and control, and comparative advantage reasons that cause these activities to be placed in separate countries (Krugman, 1995). Whilst there is no reason to expect that the motivating factors that ultimately determine the level of investment in Central Europe will differ from those that determine investment in other developing economies, much less is known about the relative strength of these factors in the determination of investments during the early stages of transition.

As yet there is little econometric evidence about the factors determining the pattern of inward investment across the transition economies as a whole. The majority of evidence comes from surveys and typically suggests that market-seeking has been the prime motive for FDI in Eastern Europe, with factor cost advantages playing a smaller role. Whilst such qualitative evidence is informative it cannot provide a full explanation of recent patterns of cross-border investment in the transition economies. The timing and pattern of investments differs significantly across countries. Some such as Hungary, the Czech Republic and Estonia have had high inflows (relative to GDP) for a number of years. Others such as Poland, Croatia and Latvia have only recently experienced a significant growth in inward investment. Moreover the survey evidence is only for firms who have actually planned or undertaken investment projects in particular transition economies. Given the extent to which new trade agreements such as the Central Europe Free Trade Area (CEFTA) and the Baltic Free Trade Agreement (BFTA) provide scope for market access throughout many economies in the region from a single production location, it remains possible that some companies chose between alternative locations within Eastern Europe. It is also the case that surveys provide information about a particular point in time. Putting all the separate surveys that have been conducted over time together is difficult because of differences in their design.

One objective of this paper is to obtain quantitative evidence of the importance of factors such as the means of privatisation, risk and relative costs in the pattern of inward

investment. To do this we focus on aggregate FDI in eleven economies over the period from 1992 to 1996. The countries included are the ten with EU accession agreements, plus Croatia. Although the panel is constrained in one sense by the absence of a sectoral dimension, it remains a rich source of information because of the considerable cross-sectional differences between the countries included in it. Economic developments in many Central European economies have been quite different from those in many of the Balkan states for example. The only other detailed econometric studies of which we are aware are for investment in the Visigrád economies (Lansbury, Pain and Smidkova, 1996a,b). Inclusion of other more geographically distant economies allows us to separate out the effects (if any) arising from proximity and contiguity to the European Union. We can also investigate whether the relative costs of different locations within Eastern Europe affect investment decisions.

Our second objective is to explore whether there is any evidence that the growth of inward investment and the increasing international openness of Eastern Europe has made a significant contribution to productivity performance in the region, and thus to longer-term growth prospects, through the transfer of technologies. To this we undertake a separate panel data analysis of aggregate labour demand in 8 transition economies (our FDI sample less the Baltic States) allowing for endogenous technical progress (Barrell and Pain, 1997). The results do support the idea that inward investment raises technical progress, although the direct effects of a given (proportionate) change in the stock of inward investment are found to be lower than those obtained for leading economies such as Germany and the UK. Similar differences are found in separate cross-sectional analyses of the impact of foreign firms on the performance of domestic manufacturing firms in the UK, US and the Czech Republic. These suggest that there are significant within-industry effects on the productivity of domestic firms from the presence of foreign firms in the two Western economies, but not in the Czech Republic, implying that foreign firms have had only a limited impact on the performance of domestic firms to date.

We also examine whether the impact of international linkages is affected by particular host country institutions. We find that the impact of inward direct investment appears greater in the more liberalised economies, suggesting that factors such as product market competition, transparent legal systems and effective corporate governance may all help the assimilation and diffusion of foreign technologies. However there appears to be little impact from cross-country differences in educational attainment.

The paper is organised as follows. In Section II we examine the pattern of FDI in the transitional economies. The following section considers some important factors that may

determine flows of FDI in Eastern Europe. Section IV contains the empirical analysis of the determinants of FDI. The question of whether the existing levels of inward investment have improved economic performance via technology transfer is investigated in Section V. The final section concludes with some policy implications.

II. The Pattern of FDI in Central Europe

The growth in FDI in the transitional economies since restructuring began has remained low compared to that in other developing economies, particularly in South and East Asia and Latin America. Table 1 summarises the main trends over 1991 to 1996. FDI in the transition economies (including the CIS economies) now amounts to around 10 per cent of the total level of inward investment in developing economies and about 4 per cent of total global inward investment. The proportion of foreign investments going to the transition economies has risen steadily since the early part of the decade, reflecting the increased share of all investments taken by developing economies as well as the higher value of new investments in Eastern Europe. Inflows peaked in 1995, coinciding with the peak of the privatisation programmes in Hungary and the Czech Republic.[1]

Table 1. The Distribution of FDI Inflows in Developing Economies (%)

	1991	**1992**	**1993**	**1994**	**1995**	**1996**	***1991-96***
Africa	6.2	5.8	4.6	5.7	4.2	3.5	*4.7*
Latin America	34.5	29.7	22.6	27.9	22.7	27.0	*26.5*
West Asia	5.1	4.3	5.1	1.8	0.7	2.6	*2.8*
East Asia & Pacific	48.3	51.4	59.3	57.7	58.6	57.1	*56.5*
Eastern Europe	5.9	8.8	8.4	6.9	13.8	9.8	*9.5*
Memorandum item							
Developing Countries / World Total	28.0	31.4	36.6	40.5	35.4	41.0	*36.5*

Source: calculations from UNCTAD (1997, Table B3). Eastern Europe includes the CIS economies and the former Yugoslavia. Latin America includes Mexico.

[1] National telecommunications companies were privatised in both countries in 1995, along with other public utilities and a large oil refinery in the Czech Republic. Privatisations in Hungary resulted in inward investments worth around $600 million in 1996, compared to around $3 billion in 1995 (UNCTAD, 1997).

The FDI data we use in this paper are drawn from national balance of payments statistics, as reported to the IMF. This is, in principle, a somewhat broader measure than the data reported in EBRD (1997), since it includes reinvested earnings for those countries where such data are available. This difference is especially marked for Poland.[2]

It can be seen from Tables 2 and 3 that the pattern of FDI varies considerably amongst the transition countries. The vast majority of investments (in dollar terms) have gone to the Czech Republic, Hungary and Poland, three of the largest transition economies and the earliest to begin liberalisation. At face value this might imply that considerations of market size have indeed dominated investment decisions. However as Table 3 illustrates, a number of smaller economies have done relatively well in attracting inward investment, particularly Estonia and Latvia. Equally, countries such as Romania with a relatively large population have failed to attract much investment. The level of inward investment in Poland does not stand out so much once allowance is made for market size, although the performance of Hungary continues to appear impressive, particularly by the standards of inward investments received by many EU economies. Cumulated inflows of FDI in Hungary between 1989 and 1996 were equivalent to around 30 per cent of GDP in 1996, close to the levels of inward investment found in countries such as the UK, the Netherlands and Belgium, and above the level of inward investment in Spain.

In part the underlying bilateral pattern of investment appears to reflect geography. Central Europe's proximity to western markets and the availability of a relatively high skill, but low cost, labour force have led to inward investment by many smaller and medium-sized companies, especially from neighbouring countries such as Germany, Austria and Italy (Bod, 1997). Proximity also appears to matter in the Baltic States, where inward investment has been led by firms from the Nordic economies. However large strategic investments have also been made throughout the region by major multinational firms from more distant economies such as the US, the Netherlands, Switzerland and Korea, reflecting both the once-off opportunities offered by privatisation as well as the desire to fill gaps in global production and marketing arrangements.

[2] One exception is Slovenia, with reinvested earnings included in the balance of payments stock data available from 1993, but not in the capital flow data reported to the IMF.

Table 2. Inflows Of Foreign Direct Investment ($ million)

	Bulgaria	Croatia	Czech Republic	Estonia	Hungary	Latvia	Lithuania	Poland	Romania	Slovenia	Slovak Republic
1992	42	16	1004	82	1479	29	10	678	77	111	100
1993	40	74	654	162	2350	45	30	1715	94	113	199
1994	105	98	878	214	1144	214	31	1875	341	128	203
1995	90	81	2568	202	4519	180	73	3659	419	176	183
1996	82	349	1435	150	1982	328	152	4498	263	185	281
Memorandum: cumulated inflows 1989-96											
	419	628	7318	822	13377	800	298	12934	1191	786	1085

Table 3. Inflows Of Foreign Direct Investment (per cent of GDP)

	Bulgaria	Croatia	Czech Republic	Estonia	Hungary	Latvia	Lithuania	Poland	Romania	Slovenia	Slovak Republic
1992	0.49	0.16	3.59	7.61	3.95	1.93	0.53	0.80	0.39	0.88	0.85
1993	0.37	0.64	1.82	9.64	6.06	2.25	1.21	1.99	0.36	0.89	1.65
1994	1.08	0.69	2.39	9.66	2.76	5.87	0.73	2.03	1.08	0.89	1.48
1995	0.69	0.45	5.44	5.71	10.19	4.05	1.23	3.10	1.18	0.94	1.06
1996	0.94	1.83	2.75	3.44	4.48	6.53	1.95	3.37	0.53	1.00	1.48
Memorandum: cumulated inflows 1989-96 as a per cent of GDP in 1996											
	4.8	3.3	14.0	18.9	30.3	15.9	3.8	9.7	3.4	4.2	5.7

Sources: see Data Appendix.

III. The Determinants of FDI

In general it might be expected that the level of inward investment in developing economies would be positively related to factors such as political stability, transparent and well-established legal and tax systems with protection of property rights, and access to large regional markets (Jun and Singh, 1996). Such factors should be equally important for FDI in the transition economies. Survey evidence suggests that national and regional market access is the prime factor that has influenced potential investors (Lankes and Venables, 1996). Whilst this accords with what might be intuitively expected, it is difficult to undertake any econometric tests of this hypothesis, since there is little consistent data on expectations of market growth. All that we observe, particularly in the early part of the decade, is rising investment at a time of declining output. However other factors are open to test. In this section we briefly review the potential role of four important factors - the role of privatisation, the external orientation of the host economies, labour costs and risk.

III.1 Privatisation

One of the key determinants of the level of direct investments in the early years of transition has undoubtedly been the privatisation process. This acts as a signal of the commitment to private ownership, as well as permitting governments to have some control over the direction and timing of capital movements by determining the extent of available investment opportunities. The one-off opportunities offered by the transfer of state monopolies into the private sector, particularly of public utilities, give a strong incentive for strategic investments.

The earliest countries to embark upon significant privatisation programmes were those in Central Europe. In the early stages of transition many inward investments were in joint-ventures, many of whom were able to negotiate favourable trading conditions. The privatisation programs in these economies were thus an important factor in stimulating inward FDI, even during a period of recession. One means of capturing the speed of privatisation is through the private sector share of GDP. Lansbury *et al*. (1996a,b) find that inward FDI was higher in those Visigrád economies with a higher private sector share. Table 4 reports official estimates of the private sector share in our 11 economies. The Baltic States and the Visigrád economies appear to be converging on a level of 70 per cent or more, close to the shares observed in most economies in Western Europe.

Table 4. Private Sector Share of GDP (per cent)

	Bulgaria	Croatia	Czech Republic	Estonia	Hungary	Latvia	Lithuania	Poland	Romania	Slovenia	Slovak Republic
1991	17	25	17	36	37	21	16	45	24	16	20
1992	25	35	28	45	49	42	37	48	26	20	32
1993	36	41	45	51	58	52	57	54	32	20	39
1994	39	45	56	58	65	55	62	56	35	30	58
1995	45	45	64	64	70	60	65	60	45	45	60
1996	46	50	75	70	73	60	68	65	50	45	71

Table 5. Methods Of Privatisation

	Sale To Outside Owners	**Voucher Privatisation**	**Management/Employee Buy-Out**
Bulgaria	Primary	Secondary	
Croatia			Primary
Czech Republic	Secondary	Primary	
Estonia	Primary		
Hungary	Primary		
Latvia	Secondary	Primary	
Lithuania		Primary	Secondary
Poland		Secondary	Primary
Romania	Secondary		Primary
Slovenia	Secondary		Primary
Slovak Republic		Secondary	Primary

Source: *EBRD Transition Report* (1997, Table 5.7).

Ranking	**Primary Method**	**Secondary Method**
4	Sale to Outside Owners	-
3	Sale to Outside Owners	Voucher or Buy-Out
2	Voucher or Buy-Out	Sale to Outside Owners
1	Voucher or Buy-Out	Buy-Out or Voucher
1	Voucher or Buy-Out	-

In contrast the private sector share in the Balkan economies remains much lower at 50 per cent or less.[3] The privatisation process has been notably slower in the Balkan states, partly reflecting a lack of clear political will, as well as the substantial autonomy enjoyed by some enterprises notionally owned by the state in the former Yugoslavia. In Slovenia the privatisation of socially-owned enterprises was almost complete by 1997, but privatisation of state-owned enterprises had yet to begin.

The figures may be subject to some bias given the likely size of the informal sector (EBRD, 1997). It is also the case that the expansion in the private sector share could reflect a rapid creation of new businesses as well as the privatisation of public assets. Furthermore the chosen method of privatisation may matter as much as the speed and scale of any sales (Gray, 1996; Hunya, 1997).

A number of countries, notably Hungary and Estonia, have pursued a policy of sales to strategic owners, with few restrictions on the involvement of foreign companies. Other countries have largely adopted voucher-based mass privatisation schemes, at least in the initial wave of privatisations, with companies being sold to domestic residents. Such schemes offer fewer direct opportunities for foreign investment. Notable examples include the schemes used in the Czech and Slovak Republics, Latvia and Lithuania. A third method of privatisation, largely used in the Balkan countries, has consisted of management-employee buy-outs. Again this approach offers few opportunities for the direct purchase of assets by foreign firms in the initial stages of privatisation. Table 5 reports the European Bank for Reconstruction and Development (EBRD) classification of countries by their primary and secondary methods of privatisation.

Some countries such as Poland are difficult to classify. Privatisation during our sample period largely proceeded by means of sales, but under the 1990 Privatisation Law enterprise participation was voluntary, requiring the consent of managers and employees. This implicit veto may have acted to make it more difficult for foreign investors to obtain a controlling interest in former state-controlled companies. More recently the rapid development of the Warsaw stock exchange and the important role of privately managed investment funds has also encouraged foreign entry by means of portfolio investments rather than direct investment.

[3] There is some uncertainty about these estimates given the size of the informal economy in many countries (EBRD, 1997). Nonetheless the comparative picture is consistent with other survey evidence on the degree of competition in these economies. For instance Konings (1997) cites survey evidence that suggests about 70 per cent of firms in Hungary and Slovenia face many rivals, while in Romania the figure is only 43 per cent.

To test whether the method of privatisation has indeed affected the scale of inward investment we construct an ordinal variable (ranging from 1-4) for the different types of privatisation method. The implied ranking of the different approaches is shown at the bottom of Table 5. Countries which have solely relied on direct sales are given a ranking of 4. Countries which have primarily used direct sales, but also adopted secondary voucher schemes are given a ranking of 3. A ranking of 2 is given to those countries who have primarily used voucher schemes or buy-outs, but also had a small amount of cash sales. Countries solely using vouchers or buy-outs are given a ranking of 1.

One important point to note is that the classification in Table 5 reflects an 'average' since the privatisation process began. A number of countries, notably Poland, the Czech Republic and Lithuania, have changed their methods of privatisation over time, gradually placing greater emphasis on cash sales (EBRD, 1997). We have thus allowed for some changes in the rankings at the end of our sample period, with these three countries having a higher ranking than shown by 1996.

III.2 Trade Linkages and Borders

A number of studies have suggested that investment and growth in developing economies is positively associated with indicators of 'openness' and export promotion (Balasubramanyam *et al*., 1996; Edwards, 1998). Such findings may suggest that investors prefer countries with relatively liberal trade regimes, possibly within regions with wider supra-national free trade arrangements. Some initial investment may also be in marketing affiliates, designed to support exports by the parent firm.[4] Product cycle models of international investment would also tend to support a close association between trade and investment patterns.

Of our sample, all but Croatia had reached association agreements with the EU by 1995, establishing timetables for free trade and eventual negotiations about membership. Eight of the countries had also accepted international trade obligations required for GATT/WTO membership by the end of 1996.[5] Estonia stands out as having an exceptionally open economy amongst the sample, with imports plus exports of goods and services amounting to 160 per cent of GDP per annum during 1994-96. In part this reflects the tariff-free policy pursued by the government, maximising the advantages of the developed transport and port network for trade with the Nordic countries and Russia.

[4] 17 per cent of the respondents to the survey of Lankes and Venables (1996) indicated that the primary role of their projects was to act as a sales and marketing base to promote exports into Eastern Europe.

[5] The exceptions were Croatia, Latvia and Lithuania.

There is some empirical evidence that contiguity and proximity are important factors in observed trade and investment decisions (Brainard, 1997). Knowledge of the local market and existing business linkages may especially help small and medium-sized enterprises in the neighbouring industrialised economies to take advantage of the opportunities presented by a rapidly evolving market structure (Bod, 1997). To investigate whether the level of investment by individual countries in Central Europe is influenced by trade linkages, we use a measure defined as the share of merchandise trade (imports plus exports) in each of the host economies accounted for by trade with the European Union member states.[6]

Full details of the data used are given in Appendix C. Slovenia, Poland, Hungary, Croatia and Estonia have consistently had a higher proportion of trade with the EU economies than the other countries in the sample (60 per cent plus). Both the Czech Republic and Romania show a marked geographical change in their trade patterns over the sample period, with the proportion of trade with EU economies rising sharply. In contrast, trade with the EU members continues to account for less than two-fifths of the recorded trade of Bulgaria, Lithuania and the Slovak Republic.

There is also increasing evidence that foreign investment decisions are influenced by supra-national trade arrangements (Barrell and Pain, 1998), particularly if regional integration is accompanied by economic liberalisation and macroeconomic stabilisation in member countries (Blomström and Kokko, 1997; Pain, 1997). Within Eastern Europe, numbers of separate trade agreements have superceded the arrangements in place under the old, pre-transition Council for Mutual Economic Assistance (CMEA).

To test whether trade policies and borders matter, we include a separate dummy variable for the CEFTA countries (Poland, Hungary, Slovenia and the Czech and Slovak Republics) all of whom have contiguous borders with the EU.[7] Investors in any one of these countries are relatively well-placed to gain access to markets in the other CEFTA member states or the core EU market. To this extent we might expect to see these economies attracting a higher level of inward investment, all other things being equal.[8]

III.3 Labour costs

[6] This is not meant to imply that trade with say, Italy, has an effect on inward investment and trade with say, Switzerland does not. In practice the share of trade with all industrialised countries is closely correlated with the share of trade with the EU economies.

[7] Romania became a member of CEFTA in July 1997, after the end of our sample period.

[8] Strictly a dummy for contiguous borders with the EU should also include Bulgaria.

The cost of labour in the host country is potentially a major factor in the location decision, particularly for firms seeking to produce labour intensive products for export. Wages in the transitional economies are amongst the lowest in Europe. Of course wage levels reveal only part of the story; firms may be more concerned about differences in unit costs, taking account of the productivity of labour as well as wage levels and social security burdens. The issue of whether labour costs affect the decision to invest in the transition economies is an important one and the subject of some debate.

Until recently the majority of survey evidence suggested that labour costs had not been an especially important element of investment decisions, even though it might be expected that FDI in the smaller transition economies would be outward-looking. However this does not mean that the costs of different locations within Eastern Europe have not been compared in the investment decision. The econometric evidence reported by Lansbury *et al*. (1996a,b) indicates that relative labour costs within the Visigrád economies have influenced the distribution of foreign investment within those economies. Lankes and Venables (1996, Table 5) also report that close to three-quarters of export supply projects in their survey (and thus one-quarter of all projects covered) are either relocations of existing facilities or alternatives to undertaking the project elsewhere.

In comparing locations within Eastern Europe, productivity differentials may matter less than wage costs, particularly for those foreign investors who plan to bring new Western technologies with them, rather than simply attempt to improve the efficiency of usage of existing capital. Lankes and Venables (1997) report that the salaries of skilled workers in export investment projects in their survey are some 16 per cent of the Western level, while productivity is some 72 per cent of that in the West. However their survey also reveals that unskilled labour costs and the presence of skilled labour have a significant effect on the likelihood that investors will choose particular locations (Lankes and Venables, 1996, Table 15). This suggests that the possibility that productivity differentials can affect the location of investments within Eastern Europe should not be ruled out.

To investigate this issue we include two separate labour cost measures in the empirical analysis. The first measures dollar wages in the host economy relative to a weighted average of wages in the other potential 10 hosts in our panel. The second measures labour productivity (per head in constant 1995 US dollars) in the host economy relative to a weighted average of the other 10. The wage data is drawn from the 1997 *Yearbook of Labour Statistics*. Labour productivity was calculated using whole economy employment and output at constant 1995 prices converted using the 1995 PPP values reported in OECD (1997). Full details are given in the Data Appendix.

In including measures of labour costs in common currencies it is important to allow for the effects of absolute differentials. The real bilateral exchange rates of most of the transition economies with the EU countries have risen significantly over the past few years, partly as a result of Balassa-Samuelson type effects from non-tradable prices. The appreciation of the real exchange rate has been particularly marked for those states such as Estonia and Lithuania that have maintained a nominal dollar exchange rate peg for a number of years, even though domestic inflation has been high. In contrast other relatively high inflation economies such as Bulgaria and Romania have seen the effects of rapid domestic price inflation offset by significant depreciations in their nominal exchange rates. Yet the Baltic States still remain attractive investment locations, as dollar wages remain lower than in most other Eastern European economies.

Our constructed data for relative wages and productivity in 1994 and 1996 are summarised in Table 6. There is a statistically significant association between the country rankings for wages and productivity, with the Spearman rank correlation coefficients for 1994 and 1996 being 0.714 and 0.80 respectively. Slovenia, Croatia and the Czech Republic are the three economies with the highest relative wage levels and highest labour productivity. However the wage differential between Slovenia and the other economies is somewhat greater than the productivity differential. The Baltic States all have similar labour costs, as do Hungary and the Slovak Republic. Bulgaria and Romania are estimated to have the lowest wage levels.

One potential criticism of the use of wage data for labour costs is that it fails to take into account the additional costs imposed by social security burdens on employers. However it is not possible to obtain cross-country time series data on labour compensation for all the transition economies because of the relative lack of detailed national accounts statistics. In some cases such as Croatia there is no data at all, whilst in others data is available only intermittently. A cross-sectional comparison of compensation and wage costs in Appendix A suggests that the latter provide a reasonable guide to cross-country differences in the former.

Table 6. Labour Costs

A: Relative Whole Economy Wages ($)

	Bulgaria	Croatia	Czech Republic	Estonia	Hungary	Latvia	Lithuania	Poland	Romania	Slovenia	Slovak Republic
1994	0.41	0.99	1.08	0.59	1.52	0.49	0.36	1.05	0.48	3.56	0.87
1996	0.23	1.25	1.24	0.83	1.03	0.54	0.51	1.13	0.48	3.45	0.90

B: Relative Manufacturing Wages ($)

	Bulgaria	Croatia	Czech Republic	Estonia	Hungary	Latvia	Lithuania	Poland	Romania	Slovenia	Slovak Republic
1994	0.46	0.94	1.11	0.67	1.55	0.51	0.40	1.05	0.47	3.14	0.91
1996	0.29	1.20	1.22	0.89	1.07	0.59	0.60	1.16	0.50	2.87	0.92

C: Relative Whole Economy Productivity Per Employee ($PPP, 1995 prices)

	Bulgaria	Croatia	Czech Republic	Estonia	Hungary	Latvia	Lithuania	Poland	Romania	Slovenia	Slovak Republic
1994	0.80	2.03	1.32	0.58	1.04	0.45	0.58	0.84	0.80	1.86	1.16
1996	0.66	1.77	1.33	0.61	1.03	0.44	0.57	0.89	0.85	1.88	1.17

Sources: see Data Appendix.

III.4 Risk and Macroeconomic Stability

The location of investments in developing countries is likely to be influenced by risk perceptions. The prospects for political and macroeconomic stability together with the transparency of the legal regulations governing factors such as foreign ownership of land and profit repatriation all matter to potential investors. As a group the transition economies have seen improved international credit ratings over time (UNECE, 1997), helped by greater macroeconomic stabilisation and, in the case of the Czech Republic, Hungary and Poland, by membership of the OECD. However it is notable that countries such as Bulgaria, Romania and Lithuania have consistently received poor ratings by international credit agencies.

It is difficult to know how to capture risk perceptions, particularly since allowance needs to be made for factors that evolve over time. At the macroeconomic level there are several widely used indicators that can be employed - growth, inflation and measures of external stability such as the debt/GDP ratio or the level of reserve cover (in terms of months of imports). At the microeconomic level a useful source of information about the evolution of domestic institutions and regulations is provided by the Transition Indicators published by the EBRD. Countries are assigned a ranking of between 1 to 4 in nine separate categories according to how far they have progressed towards the standards of the industrialised economies. The categories cover the legal framework, corporate governance, trade and competition policies as well as the privatisation process. The cross-sectional survey evidence in Lankes and Venables (1996, 1997) indicates that country risk perceptions are closely correlated with these EBRD rankings of national transition levels.

With a large number of potential variables that may capture risk effects in any empirical analysis over time, one possible solution is to use principal components analysis. A similar approach is adopted in Wheeler and Mody (1992) and Lansbury *et al*., (1996a,b). This is a potentially useful statistical technique for combining the information in a number of collinear variables by making use of the covariance between the variables to reduce the dimensions of the data under consideration. The principal components are linear combinations of data that are orthogonal to one another.[9]

[9] The variances of the principal components are the eigenvalues of the variance-covariance matrix of the data and the coefficients of the linear combinations of the data are the elements of the corresponding eigenvector. Since all the eigenvectors are orthogonal to one another, only one at most can have a structural interpretation. If all the principal components are included in the regression then the resulting model is equivalent to that obtained by least squares.

We used four series, GDP growth, consumer price inflation, the average country score on the EBRD Transition Indicators (calculated from successive issues of the EBRD Annual Report) and the reserve cover ratio. The first three series are ones monitored by the IMF in their regular country reports. The coefficients on the eigenvector we obtained (the first principal component) are:

Inflation	Growth	Reserve Cover	EBRD Transition Ranking
0.74358	-0.81222	-0.75818	-0.62332

This component was found to account for about 60 per cent of the sum of the individual variances. The reported coefficients imply that a rise in inflation has an opposite effect from faster growth, higher reserve cover and further economic liberalisation. If this measure captures risk effects, we would expect it to have a negative coefficient in the empirical analysis.

IV. Empirical Analysis of FDI

The basic model with which we begin our empirical work can be expressed as:

$$(FDI_{jt}/GDP_{jt}) = \alpha + \beta_1 PRIV_{jt} + \beta_2 METHOD_j + \beta_3 TRADE_{jt} + \beta_4 RELW_{jt} + \beta_5 RELPROD_{jt} + \beta_6 RISK_{jt} + \beta_7 PROX_j + \beta_8 BALTICS + \varepsilon_{jt} \quad [1]$$

where FDI_{jt} denotes domestic currency inflows of FDI in country *j* at time *t*, GDP_{jt} is the whole economy output of the host country at current prices, $PRIV_j$ is the private sector share of GDP in the host economy and $METHOD_j$ is the indicator for the method of privatisation from Table 5. $TRADE_j$ denotes trade with EU economies as proportion of total merchandise trade, $RELW_j$ and $RELPROD_j$ are the wage and labour productivity of the host economy relative to weighted average of the other 10 possible host economies in Eastern Europe, as shown in Table 6, and $RISK_j$ is the indicator of risk derived using principal components analysis. $PROX_j$ is a dummy variable for proximity to the EU, equal to unity for the CEFTA countries who all have contiguous borders with an EU member, and $BALTICS_j$ is a dummy variable equal to unity for Baltic States. All other influences will be contained in the disturbance term ε_{jt}. The model does not have unrestricted country-specific fixed effects, because of the two regional dummies. However the restrictions required to move from a model with unrestricted (i.e. 11) fixed effects to a model with the two regional dummies plus a single intercept can be tested.

The dependent variable is defined as the flow of FDI into each host economy relative to market size in that economy. Conceptually this is equivalent to deflating the nominal FDI flow by the GDP deflator and scaling by the volume of output. Whilst this provides a convenient way of capturing market size effects, it does have implications for the form of many of the variables included in the model. In particular, indicators such as trade with the EU and private sector output which can trend upwards without bounds have to be entered in relative rather than absolute form. With data for investment in 11 host economies over 1992-96 we have a total panel size of 55 observations

Results

Table 7 summarises the main empirical results. The first column (7.1) reports the parameter estimates obtained for the basic model excluding the risk measure. Past trade linkages, indicators of privatisation and relative labour costs are all found to have a significant impact on the level of inward investment, in line with the findings of Lansbury *et al*. (1996a,b). The method of privatisation appears particularly important, with the positive coefficient implying that countries with a programme of direct privatisation through cash sales have attracted relatively higher inward investment than those countries using voucher privatisation. The results imply that on average inflows of FDI relative to GDP are 1.79 percentage points higher in countries who have pursued privatisation through cash sales than in those who have pursued privatisation through voucher schemes with additional, but limited cash sales.

Of the two relative labour cost measures only the relative wage variable appears significant. Productivity differentials across the potential host economies do not appear significant, although they are correctly signed. However it is not possible to reject the imposition of equal and opposite coefficients on wages and productivity, giving a unit labour cost measure [Chisq(1)=3.54]. The significance of labour costs implies that considerations of comparative factor costs across countries influence some investment decisions.

The regional dummies are also of interest, with significant positive coefficients on each. One point to note is that the Baltic States dummy only includes Estonia and Latvia, implying that these two countries have received significantly higher investment than Lithuania after taking into account the other factors in our model. This could reflect their stronger linkages with Finland and Sweden as well as the element of political risk arising from the poor relations between Lithuania and Russia.

Table 7. FDI Econometric Results, All 11 Economies, 1992-1996.

Dependent Variable: FDI/GDP

	(7.1)	(7.2)	(7.3)	(7.4)
Private Sector Share	0.0273 (2.0)	0.0106 (0.6)		
Privatisation Method	0.8978 (3.7)	0.8521 (3.5)	0.8362 (3.6)	0.8011 (3.6)
EU Trade Share	0.0421 (3.3)	0.0400 (3.0)	0.0414 (3.0)	0.0448 (3.3)
Relative Wages	-0.9683 (4.5)	-1.0216 (4.6)	-1.0733 (5.0)	-0.9637 (5.2)
Relative Productivity	0.4135 (1.2)	0.4038 (1.2)	0.3694 (1.1)	
Risk		-0.4071 (1.4)	-0.5525 (2.4)	-0.5344 (2.4)
EU Proximity Dummy	1.9821 (5.0)	1.6348 (3.4)	1.5626 (3.4)	1.5398 (3.3)
Baltic States Dummy	3.5276 (5.0)	3.6234 (5.1)	3.6854 (5.5)	3.5570 (5.4)
$\bar{R}^2$	0.670	0.670	0.676	0.680
SE	1.448	1.448	1.436	1.426
LM(1)	Chisq(1)=0.23	Chisq(1)=0.12	Chisq(1)=0.06	Chisq(1)=0.04
Time Dummies	Chisq(4)=2.60	Chisq(4)=3.55	Chisq(4)=1.80	Chisq(4)=1.75

Note: All regressions also include a constant. (t-statistics are reported in parentheses in the Table.) Baltic States dummy equals unity for Estonia and Latvia and zero for Lithuania.

In principle it is possible to test whether the proximity dummy is picking up an effect from contiguous borders or from the membership of CEFTA. This is because one of the countries with contiguous borders, Slovenia, has only been a member of CEFTA since 1996. On balance the evidence favours the proximity hypothesis. If (7.1) is re-estimated with an additional dummy equal to one for those years in which each country is a member of CEFTA, the proximity dummy continues to have a significant positive coefficient, whilst the CEFTA dummy has an insignificant negative one. If (7.1) is re-estimated with the CEFTA dummy used in place of the proximity dummy, then the CEFTA dummy does attract a significant positive coefficient, but the standard error of the equation is greater than before.

All the reported parameters in (7.1) have the signs that might be expected, and the model appears to have reasonable explanatory power. A number of specification tests are reported at the foot of each column. The LM(1) test statistic is an asymptotically valid test for the presence of first-order serial correlation (see Barrell and Pain, 1998). The test statistic is insignificant, suggesting the absence of serial correlation in the within-country

errors. A test is also reported for the significance of annual time dummies. These are found to be jointly insignificant. It is also noteworthy that the eight implicit restrictions placed on a model with unrestricted country fixed effects to obtain (7.1) are jointly accepted by the data [F(8,39)=0.96].

In the second column we introduce the risk measure. This attracts a negative coefficient, consistent with our priors, although it is not particularly well determined. The inclusion of this variable causes the size and significance of the coefficient on the private sector share to decline markedly, suggesting that the latter may have also been picking up some risk effects. This would imply that risk is negatively correlated with the private sector share. In column 3 we drop the insignificant private sector share variable and the risk variable becomes significant. There is little change in the coefficients on most of the remaining variables from (7.1), with the exception of the proximity dummy whose coefficient has fallen and become less well determined. This suggests that some of the negative effects of risk on potential investments in countries such as Romania and Bulgaria were previously being attributed to their distance from the core EU markets. In the final column (7.4) we drop the insignificant productivity variable. This makes little difference to the coefficients on the remaining variables. The specification tests continue to be passed and the implicit restrictions on the country-specific fixed effects are accepted by the data [F(8,40)=1.68].

The implied elasticities from models such as (7.3) will vary over time and for host economies. For example a rise of 1 per cent in relative wages in country *j* will lower the annual ratio of inward investment flows to GDP in that country by (-1.07*$RELW_j$ /100) percentage points. The negative effect of higher wages is smallest in those economies where wages are relatively low in the first place. A one percentage point rise in the share of trade with the EU will raise the annual FDI inflow to GDP ratio by 0.041 percentage points. The proximity dummy implies that the investment share in the CEFTA economies is over 1½ percentage points higher than might otherwise be expected.

The results can be used to explain the different patterns of investment across the transition economies. Consider for instance Bulgaria and Slovenia. The former benefits from the more direct privatisation method adopted and low wage costs. However this is offset by a high level of risk, exacerbated by the near-economic collapse in 1996, and a lower level of trade with the EU. In contrast the relatively high wage costs in Slovenia and ‘closed’ method of privatisation are offset by the benefits of proximity, higher labour productivity, macroeconomic stability and a greater degree of integration with the EU economies.

Table 8. Additional Econometric Results, All 11 Economies, 1992-1996.

Dependent Variable: FDI/GDP

	(8.1)	(8.2)	(8.3)	(8.4)
Privatisation Method	0.8182 (3.4)	0.8116 (3.4)	0.8238 (3.5)	0.8278 (3.3)
EU Trade Share	0.0403 (2.8)	0.0401 (2.8)	0.0413 (2.9)	0.0409 (2.9)
Relative Wages	-1.0438 (4.5)	-1.0309 (4.7)	-1.0596 (4.7)	-1.0601 (4.4)
Relative Productivity	0.3628 (1.0)	0.3536 (1.0)	0.3645 (1.1)	0.3667 (1.0)
Risk	-0.6784 (2.2)	-0.7359 (2.5)	-0.6243 (2.2)	-0.6089 (1.9)
EU Proximity Dummy	1.3810 (2.5)	1.2968 (2.6)	1.4588 (2.7)	1.4813 (2.3)
Baltic States Dummy	3.6660 (5.5)	3.6529 (5.5)	3.6752 (5.5)	3.6772 (5.5)
Relative CEEC/EU Costs(1)	-0.6785 (0.6)	-1.1470 (0.9)		
Growth			-0.0812 (0.5)	-0.0132 (0.2)
$\bar{R}^2$	0.670	0.671	0.670	0.669
SE	1.449	1.445	1.449	1.451
LM(1)	Chi (1)=0.07	Chi (1)=0.07	Chi (1)=0.06	Chi (1)=0.06
Time Dummies	Chi (4)=1.43	Chi (4)=1.47	Chi (4)=1.50	Chi (4)=5.68

Notes: (1) relative unit labour costs in (8.1), relative monthly wages in (8.2).

In Table 8 we attempt to assess the robustness of (7.3) by adding a number of alternative variables. The first column reports the results from adding a measure of weighted unit labour costs in all 11 economies relative to a (GDP) weighted average of unit costs in four EU economies, Greece, Spain, Portugal and the UK. This variable is included to test whether comparative costs in Eastern Europe and Western Europe have affected aggregate investment decisions. The four EU economies are those which tend to attract relatively labour intensive foreign investments (Barrell and Pain, 1997).[10] Although the variable is correctly signed with a negative effect from relative costs in Eastern Europe it is not significant. There is a small reduction in the size of the parameter on the proximity dummy suggesting that the these economies may be more affected by costs relative to the EU than the other panel members. In the second column we use relative wages in the EU and Eastern Europe rather than unit labour costs. This makes little difference to the reported results, with a correctly signed but insignificant coefficient again being obtained.

[10] The reported results do not appear particularly sensitive to the choice of countries in the EU.

In (8.3) and (8.4) we test the additional hypotheses that investments across Eastern Europe are affected by volume growth in supra-national markets, either in the EU or in Eastern Europe itself. Both variables are insignificant with a small negative coefficient, suggesting that market size effects are adequately captured by conditioning on the level of host country GDP. Overall the results in Table 8 give little reason to depart from (7.3) (or (7.4)) as our preferred model.

Whilst we appear to have obtained a parsimonious, economically-coherent specification, there remains some possibility that the reported coefficients may be subject to bias given that the panel regression pools investment across a number of different countries in different stages of transition. Pesaran and Smith (1995) illustrate that heterogeneity in dynamic panels can give rise to bias if 'slope homogeneity' is imposed. If sufficient observations are available, consistent estimates of the long-run parameters can be obtained using a mean-group estimator, an average of the parameters obtained from separate regressions for each panel member.[11] This cannot be calculated in our case given the small time dimension of the panel.

We thus follow the procedure employed by Barrell *et al*. (1996) and test for common parameters using three country blocs - the five CEFTA economies, the Baltic States and the three remaining Balkan states. We re-estimate (7.3) allowing for separate slope parameters in each of the three distinct country groups. In effect this decouples the individual regions, although this is unavoidable if we are to test for common slope parameters. With three regions and five explanatory variables, a model with 15 slope parameters was initially estimated.

In Table 9 we report the results of imposing the restrictions required to give common slope coefficients between the particular regional groups. The restrictions required to return to a single set of slope parameters common to all three regions are just accepted at conventional significance levels.[12] The subsequent pairwise comparisons suggest that the primary reason for this finding arises from differences between the Baltic States and the other panel members. We cannot reject the restrictions required to give common slope parameters in the eight non-Baltic panel members, but can reject the imposition of common coefficients in the CEFTA economies and the Baltic States.

[11] Such an estimator is consistent under both the null of parameter homogeneity as well as the alternative of heterogeneity, whereas the fixed-effects estimator is consistent only under the null.

[12] If we use (7.4) the restrictions for common slope parameters are rejected [Chisq(8)=18.93].

Table 9. Testing For Differential Regional Effects

Regions With Common Parameters	Test Of Restrictions
CEFTA Non-CEFTA, non-Baltic Baltic States	Chisq(10)=16.25
CEFTA Baltic States	Chisq(5)=13.66*
CEFTA Non-CEFTA, non-Baltic	Chisq(5)=3.38
Non-CEFTA, non-Baltic Baltic States	Chisq(5)=10.53

Table 10. Econometric Results With Separate Regional Parameters, 1992-1996.

Dependent Variable: FDI/GDP

	Non-Baltic States		Baltic States
	(10.1)	(10.2)	(10.3)
Privatisation Method	0.9553 (3.4)	0.9714 (3.6)	0.1981 (0.3)
EU Trade Share	0.0333 (2.7)	0.0295 (2.5)	0.1340 (2.8)
Relative Wages	-1.0585 (4.4)	-1.0398 (4.2)	-15.0264 (5.1)
Relative Productivity	0.8997 (2.4)	1.0398 (4.2)	5.9875 (2.0)
Risk	-0.7402 (2.4)	-0.7872 (2.9)	-2.7370 (5.7)
EU Proximity Dummy	1.6885 (3.7)	1.6193 (3.8)	
Baltic States Dummy			4.3752 (4.0)
$\bar{R}^2$	0.631	0.640	0.776
SE	1.188	1.173	1.494
No. of obs.	40	40	15

The resulting coefficients for the Baltic and non-Baltic states are reported in columns (10.1) and (10.3) of Table 10 respectively. The coefficients for the non-Baltic states are close to those previously obtained in (7.3), with the exception of the impact of the relative productivity variable. Two of the main differences with the Baltic states arise over trade

and relative labour costs, with both measures having a much greater impact on the pattern of investment in the Baltics. The greater sensitivity of investment in the Baltic States to labour costs may reflect the relatively small size of the domestic market in these economies and the consequent extent to which inward investments are more likely to be aimed at external markets. It is also noticeable that the coefficient on the indicator variable for the method of privatisation is not significant for the Baltic States, suggesting that the 'open' method of privatisation adopted by Estonia is not in fact the main explanation for the high level of inward investment there. The dummy variable for Estonia and Latvia remains significant in the Baltic States panel, suggesting that there are still some important differences between these two countries and Lithuania which are otherwise unaccounted for.

In contrast to the combined panel regression the relative productivity variable is now much better determined. This is consistent with the survey evidence from Lankes and Venables (1996) that the availability of skilled labour does affect the choice of location. It appears that the separate effects from relative productivity were previously being picked up in the combined panel regression by the trade share for the non-Baltic states and by the privatisation indicator for the Baltic States.[13]

The restriction of equal and opposite coefficients on the relative wage and relative productivity variables is accepted for the non-Baltic states [Chisq(1)=0.40], but rejected for the Baltic states [Chisq(1)=5.47]. Imposing the unit labour cost restriction for the non-Baltic states gives equation (10.2). This restriction marginally lowers the size of the coefficient on the trade variable, but otherwise has relatively little impact.

Overall the results indicate that it is possible to find a parsimonious specification which accounts for around two-thirds of the cross-country variation in inflows of inward investment. In the short-term the model offers two direct means by which governments can seek to raise inward investment - the choice of method for further privatisations and the pursuit of macroeconomic stability. Measures to help the performance of national labour markets may also have some effect. Over time the importance of the privatisation method may weaken, particularly if national capital markets develop and allow foreign investors to acquire firms owned by domestic investors. The continuing need to attract and retain foreign investment aimed at serving Western European markets is thus likely to reinforce the desire of many transition economies for ever closer linkages with the EU.

[13] The non-Baltic states with a relatively high level of labour productivity also tend to have a relatively high share of trade with the EU economies.

V. Foreign Direct Investment and Endogenous Technical Progress

In this section we investigate whether there is any evidence that the growing level of inward investment in Eastern Europe has had a significant effect on growth prospects. In one sense this question is easy to answer, as it is clear that labour productivity in foreign controlled firms throughout the transition economies is higher than that of domestic firms, as can be seen from Table 11. One notable difference is that firms with foreign capital account for a much higher proportion of total employment and sales in Hungary than in the other transition economies.

Table 11. Inward Investment in the Transition Economies

Country		Foreign Firms Output Share (%)	Foreign Firms Employment Share (%)	Foreign/Domestic Labour Productivity
Czech Republic(1)	1995	11.2	8.5	1.36
Hungary(2)	1994	38.6	22.6	2.15
Poland(3)	1993	10.8	5.6	2.04
Slovak Republic(4)	1994	7.7	3.8	2.11
Slovenia(5)	1994	7.6	5.3	1.47
Notes: (1) value added, firms with more than 25 employees; (2) output; (3) income from sales and financial operations; (4) value added, firms with more than 25 employees; (5) value added, non-financial corporate sector Sources: Zemplinerova (1997, Table 7); Hunya (1997, Table 7); Rojec (1997, Table 3).				

Comparative figures for inward investment in the manufacturing sectors of several European economies are shown in Table 12. Even in Hungary the level of foreign involvement is lower than in some smaller economies in Western Europe, notably Ireland (and also Belgium) where two-thirds or more of manufacturing output is produced by foreign-owned firms. In the larger European economies such as France, Germany and the UK, foreign-owned firms account for around a quarter of total manufacturing production. Ultimately it might be expected that the importance of inward investment in the transitional economies would at least be similar to that in the UK and Germany, even if it does not reach the level in Ireland. This implies that many more foreign investments will arrive in future years.

Table 12. Relative Productivity of Foreign Firms, Manufacturing Sectors

Country		Foreign Firms Output Share (%)	Foreign Firms Employment Share (%)	Foreign/Domestic Labour Productivity
France[(1)]	1994	30.8	26.3	1.25
United Kingdom[(2)]	1994	25.2	18.6	1.47
Ireland[(3)]	1993	68.4	44.7	2.68
Germany[(4)]	1994	25.3	16.1	1.76
Czech Republic[(5)]	1995	16.1	9.6	1.81
Hungary[(6)]	1993	40.2	30.6	1.52
Slovenia[(7)]	1994	10.7	7.8	1.42

Notes: (1) value added; (2) gross value added at factor cost; (3) net output; (4) sales; (5) value added, firms with more than 100 employees; (6) sales; (7) value added.

Sources: SESSI *L'implantation étrangère dans l'industrie 1994*; *Business Monitor PA1002*, 1997; Ruane and Görg (1997); Belitz and Beise (1998); Zemplinerova (1997, Table 4); Hunya (1997); Rojec (1997).

Snapshots based on detailed company sector data provide a picture of the comparative advantages of foreign firms at particular points in time. A key question left unanswered is whether the build up of foreign investment over time consistently raises the level of labour productivity across the various host economies in our sample. If foreign firms help to close both idea and object gaps (Romer, 1993), then technical progress is endogenous, providing an explanation and a motive for the efforts made to attract new inward investment. Even if such investments occur by means of takeovers rather than through new investment in greenfield sites the resulting injection of new management techniques and working practices can still raise technical progress.

One common way of investigating the impact of absorbed technology on growth is to look at the determinants of total factor productivity (TFP), using an assumed Cobb-Douglas production function:

$$Q = A L^{\alpha} K^{\beta} \quad \text{with} \quad \alpha + \beta = 1 \qquad [2]$$

where L, K and A represent labour, capital and an indicator of technology respectively. Equation [2] can be rearranged to 'back-out' an estimate of TFP growth:

$$\Delta \ln(A) = \Delta \ln(Y) - \alpha \Delta \ln(L) - (1-\alpha) \Delta \ln(K) \qquad [3a]$$

with α given by the share of labour in national income.

The constructed measure of TFP, which will reflect factors such as learning-by-doing and organisational change as well as technological advances, is then regressed on a number of factors which are thought to determine it. Coe and Helpman (1995) provide one recent example of this approach, with TFP related both to domestic R&D and foreign R&D embodied in trade.

There are a number of difficulties with this method. Two are generic and two are specific to the transition economies. One general problem is that the Cobb-Douglas function imposes an elasticity of substitution of unity. If this is invalid, then the constructed measures of TFP will be biased. For instance with a CES production function it can be shown that (Nelson, 1966):

$$\Delta \ln(A) = \Delta \ln(Y) - \alpha \Delta \ln(L) - \beta \Delta \ln(K) - \tfrac{1}{2} \alpha (1-\alpha)[(\sigma - 1)/\sigma][\Delta \ln(K) - \Delta \ln(L)]^2 \qquad [3b]$$

Rodrik (1997) provides a good illustration of the biases that can arise from the inappropriate use of Cobb-Douglas functions by comparing estimates of the sources of economic growth in East Asia. An additional problem with the growth accounting approach is that the TFP calculation makes the assumption that firms are always on their production frontier. In practice firms face adjustment costs, such as hiring and firing impediments and delays in ordering investment goods. In the short-term demand fluctuations can be met by varying utilisation rates, implying that factors such as productivity per head may well vary for reasons that have nothing to do with technological or organisational advances.

The two particular problems with the accounting-based approach for the transitional economies are first, the unavailability of data on the capital stock in some transition economies and the quality of it in others, and second, the assumption of constant factor shares implied by the use of the Cobb-Douglas function. The assumption that the shares of labour and capital in income remain fixed during the transition from a centrally-planned to a market economy appears unduly strong.

An alternative approach is to allow for endogenous technical progress within estimated dynamic factor demand equations consistent with a particular underlying production structure. In this paper we adopt the methodology used by Barrell and Pain (1997) and examine the impact of international linkages on technical change using an estimated labour demand model consistent with an underlying CES production function of the form:

$$Q = \gamma [s(Ke^{\kappa t})^{-\rho} + (1-s)(Le^{\lambda t})^{-\rho}]^{-\nu/\rho} \qquad [4]$$

Here v denotes returns to scale, γ and s are production function scale parameters, and the elasticity of substitution (σ) is given by $1/(1+\rho)$. If $\sigma=1$ ($\rho=0$), then production is Cobb-Douglas. Technical progress can be either labour or capital-augmenting. (If $\kappa = \lambda$, then technical progress is neutral.)

Estimates of σ, λ and κ can be obtained using the factor demand equations implied by the marginal productivity conditions that the marginal product of each input should equal its (mark-up adjusted) real price.[14] Thus:

$$\beta(W/P) = \delta Q/\delta L = v(\gamma)^{-\rho/v}(1-s)Q^{(1+\rho/v)}(Le^{\lambda t})^{-(1+\rho)}e^{\lambda t} \quad [5a]$$

$$\beta(C/P) = \delta Q/\delta K = v(\gamma)^{-\rho/v}(s)Q^{(1+\rho/v)}(Ke^{\kappa t})^{-(1+\rho)}e^{\kappa t} \quad [5b]$$

where W, P and C respectively denote labour costs per head, the price of value added (at factor cost) and the nominal user cost of capital and β denotes the mark-up.

With constant r.t.s. (v=1) we can obtain a log-linear equation for employment as the form:

$$\begin{aligned} \ln(L/Q) &= \sigma\ln(\beta(1-s)) - ((1-\sigma))\ln(\gamma) +- (1-\sigma)\lambda t - \sigma\ln(W/P) \\ &= \text{constant} - (1-\sigma)\lambda t - \sigma\ln(W/P) \end{aligned} \quad [6]$$

The coefficient on the real producer wage provides a direct point estimate of the elasticity of substitution, allowing the technical progress parameter(s) to be identified. Ideally it would be efficient to estimate [6] jointly with the equivalent capital demand equation, with appropriate cross-equation restrictions being imposed (Pain, 1996). However it is difficult to pursue this course with many of the transition economies, since there is little time series data on either the size of the capital stock or the user cost of capital.[15] One consequence of this is that whilst we refer to any observed degree of technical progress in [6] as labour-augmenting, we cannot rule out the possibility that it is in fact neutral.

Many studies of labour demand typically capture technical progress (λt) either by a deterministic time trend (Barrell et al, 1996) or a stochastic one (Harvey et al., 1986). The former implies that technical progress is exogenous, rising at a constant rate over time. The latter provides a means of capturing any underlying change in the rate of technical progress, but does not provide an explanation of why it has occurred. However our main

[14] This assumption may be a strong one given the continuing high level of state involvement in some transition economies. However we do find a significant relationship between employment and real wages, suggesting that relative prices have at least begun to affect real economic decisions.

[15] This poses equal difficulties for the alternative, widely-used, empirical approach of investigating the determinants of an estimated measure of total factor productivity.

interest lies in explicitly testing whether technology transfers and other international spillovers affect the pace of technical change and hence economic growth. Endogenous technical change is typically investigated either by introducing specific variables in the production function or by endogenising technical progress (Keller, 1989).

Much of the literature on endogenous growth focuses on the impact of innovation and knowledge accumulation (Grossman and Helpman, 1991). International trade and investment can either bring access to foreign technologies and new working practices or make available new products and process that embody foreign knowledge, helping to close 'idea gaps' (Romer, 1993). In the case of developing countries, investment and imports from abroad can also help to fill what Romer terms 'object gaps', raising the stock of physical capital equipment.

The approach we adopt in this paper is to allow technical progress to be dependent on the aggregate stock of foreign-owned assets within the domestic economy in real terms (Barrell and Pain, 1997), plus import penetration and an exogenous element. Imports are included to allow for additional spillovers from international trade (Coe and Helpman, 1995; Coe *et al.*, 1997), with the prior expectation that more open economies are more likely to be able to assimilate foreign technologies through trade.[16] We also make the implicit assumption made by Coe *et al*. (1997) in their analysis of developing economies that any effects on technical progress from international factors are independent from those arising as a result of research undertaken by domestic companies.

Thus we assume that labour-augmenting technical progress can be expressed as:

$$\lambda t = \lambda_{TIME}\,TIME + \lambda_{M}\ln(IMPORTS)_{t} + \lambda_{FDI}\ln(FDI/P)_{t-1} \qquad [7]$$

Substituting [7] into [6] gives a long-run labour demand for country *j* of the form:

$$\ln(L_j/Q_j) = \alpha_j - \sigma_j \ln(W_j/P_j) - \beta_{1j}\,TIME - \beta_{2j}\ln(FDI_j/P_j)_{t-1} - \beta_{3j}\ln(IMPORTS_j) + \varepsilon_j \qquad [8]$$

where: $\beta_{1j} = (1-\sigma_j)\lambda_{TIMEj}$ $\beta_{2j} = (1-\sigma_j)\lambda_{FDIj}$ and $\beta_{3j} = (1-\sigma_j)\lambda_{Mj}$

If sufficient observations are available then dynamics could be added to allow for adjustment costs arising from factors such as labour hoarding. Here we include the current

[16] In practice ex-post measures such as import penetration or the level of foreign investment may provide a misleading guide to 'openness' in the sense of the ex-ante stance of trade policy and the extent to which domestic institutions distort trade and investment patterns (Edwards, 1998). There may also be a size bias in such measures, with smaller economies appearing more open than larger ones.

change in output to capture the impact of the economic cycle. If the level of labour productivity (Q/L) is pro-cyclical, then this output term would be expected to have a negative coefficient.[17] Failure to allow for any cyclical effects would imply the strong assumption that companies always use the minimum inputs necessary to produce a given level of output.

One important issue concerns the measurement of imports. Two alternate measures are tried here, the ratio of imports to GDP at current prices and a constructed measure for the volume of imports. The former is more widely used in cross-country growth studies, but the latter should be more appropriate for an equation such as [6] where the level of technical progress is allowed to rise over time. In practice the increasing external orientation of the transition economies in recent years, and the associated rise in import penetration, means that both may capture similar effects. An additional consequence of the use of trade measures is that, as with the study of the determinants of FDI, it limits the span of the panel analysis because of the difficulties of obtaining consistently measured data prior to 1992.

The stock of inward direct investment at constant prices was obtained by cumulating inward investments made from 1989 onwards, as reported in Table 2, and deflating the resulting series by the GDP deflator of the host country. In some cases this procedure neglects a significant stock of investments made in the pre-transition period, although these might now be expected to now be less productive than more recent investments from the industrialised economies. For example, the official estimates for Slovenia indicate that the aggregate stock of inward FDI at the end of 1996 was $1.9 billion, compared to cumulated inflows since 1989 of $0.8 billion. However around one-fifth of the aggregate stock reflects investments owned by Croatian residents as a result of ties left over from the former Yugoslavia (Rojec, 1997), notably in nuclear power.

We estimate the labour demand function for 8 transition economies- the CEFTA members plus Croatia, Bulgaria and Romania over the period 1992-96, using whole economy data for employment, output and wages. Our panel thus has 40 observations. We allow for country-specific fixed effects, but impose common slope parameters. The Baltic States are excluded, because of the finding of significant differences between them and the other

[17] Alternatively it might be possible to capture dynamic effects by including a lagged dependent variable. However this would induce a small sample bias into panel estimates produced using OLS (Nickell, 1981), necessitating the use of an instrumental variable estimator. However the quality of the available data on employment in 1989 and 1990 prevent the use of higher order lags as instruments.

economies in the panel for the determinants of FDI. Full details of the basic data are given in the Data Appendix.

Results

The initial empirical results are reported in Table 13. In the first column we report a simple panel regression in which technical progress is assumed to rise at a constant rate, based on a linear deterministic time trend. The point estimate of the elasticity of substitution is -0.139, which is lower than commonly found in aggregate relationships of this kind for most EU economies (Barrell, Morgan and Pain, 1995; Barrell and Pain, 1997). The restriction required to achieve a Cobb-Douglas production structure would clearly be rejected by the data.[18] The implied technical progress parameter (λ_{TIME}) is displayed at the foot of the column, with technical progress estimated to rise by 3.82 per cent per annum.

One additional variable included is an intercept dummy equal to 1 for all countries in 1992 and zero otherwise. The negative coefficient implies that employment was significantly lower than might otherwise have been expected in 1992, reflecting the ongoing initial shake-out of labour following the collapse of output in the early stages of economic restructuring. The significant effect from the output change term implies that the level of labour productivity is on average procyclical.

In the second and third columns we introduce the real stock of inward direct investment and the level of imports at constant prices (M/PM). There is clear evidence that international spillovers have been an important cause of the improvements in the level of labour productivity in the transition economies, especially from foreign investment. The inclusion of direct investment reduces the implied exogenous technical progress parameter by almost a half, although it remains significant. This implies that the direct investment measure is helping to explain cross-country differences in the rate of technical progress as well as an upward drift in the level of technical progress over time. The technical progress parameters imply that a 10 per cent rise in the stock of inward investment will raise technical progress by around 0.5 per cent. It is of some interest to note that this effect is only about one-quarter of the effect obtained for inward investment in the UK and Germany in Barrell and Pain (1997).

Table 13. Labour Demand Econometric Results, 8 Economies, 1992-1996.

Dependent Variable: $\ln(L_j/Q_j)$

[18] This has implications for the measurement of total factor productivity and its determinants in many growth accounting exercises (Rodrik, 1997).

	(13.1)	(13.2)	(13.3)	(13.4)	(13.5)
$\ln(W_j/P_j)_{t-1}$	-0.1389 (4.0)	-0.1658 (5.3)	-0.1626 (5.2)	-0.1719 (6.3)	-0.1800 (6.1)
TIME	-0.0329 (6.9)	-0.0176 (2.1)	-0.0127 (1.2)		-0.0149 (2.1)
$\ln(FDI_j/P_j)_{t-1}$		-0.0394 (2.6)	-0.0344 (2.2)	-0.0468 (3.6)	-0.0320 (2.4)
$\ln(M_j/PM_j)_t$			-0.0625 (1.1)	-0.1108 (2.4)	
$\ln(M_j/P_jQ_j)_t$					-0.1756 (2.3)
$\Delta \ln(Q_{jt})$	-0.7729 (3.8)	-0.6695 (4.0)	-0.7143 (4.2)	-0.7304 (5.3)	-0.8662 (5.6)
D92	-0.0466 (2.7)	-0.0555 (3.1)	-0.0564 (3.2)	-0.0561 (3.1)	-0.0539 (3.6)
SE	0.0298	0.0279	0.0280	0.0283	0.0258
LM(1)	Chi (1)=2.25	Chi (1)=0.56	Chi (1)=1.71	Chi (1)=2.06	Chi (1)=0.92
λ_{TIME}	0.0382 (7.7)	0.0211 (2.2)	0.0152 (1.3)		0.0182 (2.2)
λ_{FDI}		0.0472 (2.5)	0.0411 (2.2)	0.0566 (3.4)	0.0391 (2.4)
λ_{MVOL}			0.0747 (1.1)	0.1338 (2.5)	
λ_{MRAT}					0.2142 (2.3)

Notes: All regressions include country fixed effects and a dummy for an outlier in Bulgaria in 1992. T-statistics reported in parentheses.

One interpretation of the smaller impact of inward investment found here is that the main impact of foreign firms on the transition economies has arisen from the rapid growth in the number of such firms rather than from significant spillovers into the technologies and working practices of indigenous firms. Such a finding would be consistent with those of Hunya (1997), who argues that in Hungary and the Czech Republic the manufacturing industries under foreign control have restructured much more rapidly than those owned by domestic residents, and Djankov and Hoekman (1998), whose empirical results suggest that the presence of foreign partners has not had a significant impact on the performance of firms in the Czech Republic. The evidence from other important host economies such as Ireland is that spillovers and linkages with domestic firms only develop slowly over time as foreign affiliates mature.

In contrast to the FDI measure, the import volume variable appears to be collinear with the time trend, as neither is individually significant in (13.3) although the two are jointly significant. Dropping the time trend gives (13.4), where the import volume measure is now significant. A 1 per cent rise in the volume of imports is estimated to raise the level of technical progress by 0.13 per cent. In the final column of Table 13 we re-estimate (13.3) with the import volume term replaced by the ratio of imports to GDP at current prices

(M/P*Q). This results in a significant fall in the size of the equation error, and the parameters on all three determinants of technical progress are now significant, implying that the import ratio may in fact pick up different effects from the import volume variable. As with the previous specifications, the serial correlation test indicates that there is no significant evidence of systematic autocorrelation in the within-country errors. The endogenisation of technical progress has also acted to improve the significance of the real product wage and raise the estimated elasticity of substitution a little to 0.18.

The model in (13.4) was extended to examine two further hypotheses implied by much of the existing literature on the cross-country determinants of growth. Many studies tend to focus upon machinery and equipment imports rather than total imports, on the grounds that this provides a more accurate proxy for inflows of technologically advanced products. A related approach employed by Coe *et al.* (1997) is to use imports from industrialised countries rather than total imports, since the former are more likely to embody advanced technologies. In order to test these approaches the import ratio term in (13.4) was split into two components and tests undertaken for equality of coefficients. In neither case was there any evidence of significant differences between the commodity composition of imports or the geographical origin.[19]

In part this may reflect the quality of the data on the commodity composition of trade in a number of transition economies (UNECE, 1997). However whilst machinery and equipment imports form the largest single component of merchandise imports in most of our sample countries, imports of raw materials and intermediate goods (SITC 2, 5 and 6) have also grown rapidly in recent years, reflecting the increasing manufacture of products for Western markets.[20] The lack of any significant differences between imports from industrial and developing countries may in part reflect the extent to which changing national boundaries and production relocation have affected cross-border trade within the region.

The Slovak Republic provides an interesting example. The share of imports from industrialised countries is estimated to have been 43 per cent in 1996, the lowest amongst

[19] We used the log approximation that $\alpha \ln(X+Y) \approx \alpha_1 \ln(X) + \alpha_2 \ln(1 + Y/X)$ and tested for $\alpha_1 = \alpha_2$. The respective test statistics for the commodity composition and geographical origin splits were [Chisq(1)=0.005] and [Chisq(1)=1.185].

[20] Machinery and equipment imports (SITC7) accounted for 37.1 per cent of merchandise imports into the five CEFTA economies in the first half of 1997, whilst imports of industrial raw materials and intermediate products (SITC 2, 5 and 6) accounted for 35.2 per cent (UNECE, 1997, Table 2.1.7). Imports of intermediate goods exceeded imports of machinery and equipment in Bulgaria and Romania in the same period.

the eight panel members. This is due to a high level of cross-border trade with the Czech Republic, primarily as a result of long-standing economic ties from the former Czechoslovakia. However imports from foreign firms located in the Czech Republic have also increased rapidly. The survey evidence in Pomery (1997, Table 12) indicates that Slovakia is the second most important export market for foreign firms in the Czech Republic (with Poland the fourth most important). This implies that products embodying Western ideas and quality standards can arrive from other transition economies as well as directly from the industrialised economies.

The Role of Domestic Institutions

It is possible that scope for spillovers from international trade and investment is dependent upon the effectiveness of domestic institutions and social capabilities (Romer, 1993; Blomström *et al*., 1994). The level of skills and educational attainment of the labour force may for instance affect the scope for adaptation and imitation of new technologies. Equally investments in infrastructure, the quality of the legal and regulatory framework and the competition and trade policy regimes may all affect the type of activities and linkages established by foreign investors. Protection of both property rights and proprietary knowledge affects expectations of the likely stability of the environment within which firms can operate and may influence the choice between simply serving small local markets and developing large export-orientated operations with linkages to domestic suppliers. Blomström *et al*. (1994) also suggest that competitive markets in host economies facilitate the transfer of technologies by multinational firms, possibly by providing a need to use more advanced technologies to protect their market share.

To investigate these issues we follow Romer (1993) and Coe *et al*. (1997) and allow for interactions between indicators of host country capabilities and the factors which drive technical progress in the equations in Table 13. Two separate measures are tried. The first is the average years of schooling for the population aged 25-64 at the start of the present decade. We have a cross-sectional measure only and so this variable cannot be entered separately in the panel model because of collinearity with the country fixed-effects. The highest years of schooling are estimated to be in the Czech Republic and Romania and the lowest in Slovenia and Croatia. Further details are provided in Appendix B. This picture appears quite different from that implied by the wage rate data in Table 6 under the assumption that higher wages reflect higher levels of human capital.

The second measure used is the country average score on the nine Transition Indicators for which the EBRD produce rankings. Lankes and Venables (1996) find that the EBRD

country transition indicator has a significant impact on the probability of a project's success in the transition economies, as well as the type of projects undertaken. We use the average country score from successive EBRD Annual Reports, with the implied index in the Annual Report in year *t* taken as an indicator of the institutional environment prevailing in year *t-1*.[21]

The results are reported in Table 14. The first two columns show the outcome from re-estimating (13.4) and (13.5) respectively, with the time trend, the FDI stock and the import variables all multiplied by the educational attainment measure. There is little difference from the earlier equations, either in the standard error or in the underlying parameters. The implicit gains to improved educational attainment vary positively with the level of inward investment and with import penetration. However whilst the results are consistent with the view that differences in education are important, the fact that inclusion of education makes little difference to the results obtained suggests that we equally cannot reject the alternative hypothesis that higher educational attainment has no effect on the marginal gains from extra investment.

Our results are consistent with the evidence that whilst the Eastern European countries have a relatively high education level compared to other developing countries, the education system has tended to emphasis knowledge accumulation rather than problem-solving (EBRD, 1997). Thus educational attainment in terms of years of education may be an imperfect indicator of the extent to which the workforce can utilise and exploit more advanced technologies.[22]

[21] The average country score for 1992 is assumed to be the same as for 1993. The results do not appear particularly sensitive to this assumption.

[22] The educational attainment of host countries can be entered separately in the model of the determinants of inward investment, since this does not have unrestricted country fixed effects. There is some evidence that differences in attainment matter as the variable has a positive coefficient of 1.02 when added to equation (7.3), although is not significant (standard error = 0.65).

Table 14. Institutions and Labour Demand, 8 Economies, 1992-1996.

Dependent Variable: $\ln(L_j/Q_j)$

Educational Attainment			EBRD Transition Indicators			
	(14.1)	(14.2)		(14.3)	(14.4)	(14.5)
$\ln(W_j/P_j)_{t-1}$	-0.1645 (6.1)	-0.1737 (5.9)	$\ln(W_j/P_j)_{t-1}$	-0.1499 (6.1)	-0.1460 (5.8)	-0.1486 (6.3)
ED*TIME		-0.0014 (1.9)	TI*TIME		-0.0020 (0.9)	
$ED*\ln(FDI_j/P_j)_{t-1}$	-0.0049 (3.7)	-0.0035 (2.6)	$TI*\ln(FDI_j/P_j)_{t-1}$	-0.0147 (4.9)	-0.0118 (3.3)	-0.0118 (4.8)
$ED*\ln(M_j/PM_j)_t$	-0.0103 (2.3)		$TI*\ln(M_j/PM_j)_t$	-0.0019 (0.2)		
$ED*\ln(M_j/P_jQ_j)$		-0.0180 (2.5)	$TI*\ln(M_j/P_jQ_j)$		-0.0035 (0.3)	
			$\ln(M_j/PM_j)_t$			-0.0795 (1.8)
$\Delta \ln(Q_j)$	-0.7184 (5.1)	-0.8637 (5.6)	$\Delta \ln(Q_j)$	-0.8452 (6.1)	-0.8434 (5.1)	-0.8519 (6.0)
D92	-0.0554 (3.0)	-0.0532 (3.6)	D92	-0.0595 (4.0)	-0.0586 (3.8)	-0.0610 (4.1)
SE	0.0286	0.0259	SE	0.0268	0.0270	0.0257
LM(1)	Chisq(1)=2.31	Chisq(1)=1.13	LM(1)	Chisq(1)=0.09	Chisq(1)=0.42	Chisq(1)=1.29
$\lambda_{TIME}^{\dagger}$		0.0164 (2.0)	$\lambda_{TIME}^{\ddagger}$		0.0079 (0.9)	
$\lambda_{FDI}^{\dagger}$	0.0583 (3.6)	0.0416 (2.6)	$\lambda_{FDI}^{\ddagger}$	0.0572 (4.6)	0.0459 (3.2)	0.0459 (4.7)
$\lambda_{MVOL}^{\dagger}$	0.1221 (2.3)		$\lambda_{MVOL}^{\ddagger}$	0.0076 (0.2)		0.0934 (1.8)
$\lambda_{MRAT}^{\dagger}$		0.2165 (2.4)	$\lambda_{MRAT}^{\ddagger}$		0.0136 (0.3)	

Notes: All regressions include country fixed effects and a dummy for an outlier in Bulgaria in 1992. T-statistics reported in parentheses.

†Technical progress parameters evaluated using the mean educational attainment (9.93 years)

‡ Technical progress parameters evaluated using the mean Transition Indicator score for 1996 (3.305).

Equivalent regressions using the EBRD transition indicators are reported in the final three columns in Table 14. Use of this measure has a more marked impact on the results, with foreign investment appearing to have larger effects in the more market-orientated economies. This is consistent with the notion that moves to stimulate product market competition and effective corporate governance may help to facilitate spillovers from inward investment.[23] In contrast the time trend and the import measures are not significant when interacted with the transition index, suggesting that these terms are primarily picking up developments in the less advanced economies. This is reflected in the final column (14.5) where the interaction term in import volumes is replaced by the original series which is close to significance at conventional levels. This equation has the lowest standard error of all the specifications reported in Tables 13 and 14. The inclusion of the transition indicators also results in a small drop in the estimated elasticity of substitution. The implied elasticity on inward investment varies significantly across countries, from a maximum of 0.065 per cent in Hungary in 1996 to 0.046 per cent in Bulgaria.

Again it is important to investigate whether heterogeneity is present within the panel. Using (14.5) we allowed for separate slope coefficients in two separate country blocs - the three OECD member states, Poland, the Czech Republic and Hungary, and the five non-OECD members.[24] The imposition of common coefficients across the two blocs was accepted by the data [Chisq(4)=7.75], suggesting that (14.5) can be regarded as a statistically adequate representation of the data. One difference of interest was that the size of the elasticity of substitution was noticeably larger in the three OECD member states at 0.25, compared to 0.15 for the overall panel in (14.5), suggesting a greater degree of flexibility in production.

Cross-Sectional Comparisons

It was argued above that the relatively small size of the implied elasticity on inward direct investment might suggest that the term was largely picking up the increasing presence of foreign firms within national economies, rather than significant spillovers from foreign firms to domestic firms. To explore this issue further we utilise some cross-sectional evidence from manufacturing industries in the UK, the United States and the Czech Republic using a regression of the form:

$$\ln(DQ_j / L_j) = \mu + \gamma (FQ_j / [DQ_j + FQ_j]) \qquad [9]$$

[23] It would obviously be of interest to explore these findings further by investigating the usefulness of individual components of the overall transition index.

[24] The 3 OECD member states have the highest scores in the EBRD Transition Index.

where DQ_j denotes the value added by domestic firms in industry *j*, FQ_j denotes the value added by foreign firms and L the number of employees of domestic firms. This relationship provides a means of summarising one aspect of the within-industry impact of foreign firms on the performance of domestic firms. The particular functional form employed implies that a rise of one percentage point in the share of industry output produced by foreign firms will raise the level of labour productivity of domestic firms by γ per cent. An instrumental variables estimator is required since it is possible that foreign investors will seek to enter those domestic industries with the highest level of labour productivity. We use the foreign sector share in the previous year as an instrument.[25]

Table 15. Within-Industry Spillovers From Foreign Firms In Manufacturing

	United Kingdom	United States	Czech Republic
μ	3.289 (30.5)	3.707 (28.2)	6.328 (53.6)
γ	0.0082 (2.2)	0.0384 (4.3)	0.0020 (0.4)
Year	1994	1990	1994
No. of industries	19	17	19
R^2	0.151	0.399	0.002

Notes: T-statistics reported in parentheses. All data for two-digit manufacturing industries. UK data for net output per employee and foreign output share calculated from Tables 1, 2, 9(a and b) *Business Monitor PA1002, Summary Volume 1994*. Tobacco, tanning, coke and petroleum products and recycling industries (SIC92 D16, D19, D23 and D37) excluded. US data for productivity and foreign shares calculated from *Survey of Current Business (vol.74/1, Tables 2 and 14, pgs. 37 and 53)* and *(vol.72/10, Table 1 pg.60)*. Tobacco, furniture and petroleum product industries (SIC 21, 25 and 29) excluded. Czech Republic data from Zemplinerova (1997, Tables 1 and 6). Oil refining and recycling industries excluded.

The results are summarised in Table 15. There is some evidence for positive spillovers from the presence of foreign firms in both the UK and the US, particularly in the latter. However in the Czech Republic we fail to detect any significant effects, even though the coefficient on the foreign share is correctly signed. This is consistent with the results obtained by Djankov and Hoekman (1998). Whilst it would be misleading to read too much into simple relationships of this kind, the results for the UK and the Czech Republic are consistent with the idea that the significant effect from foreign direct investment found in Tables 13 and 14 above comes largely from the higher labour productivity of foreign firms rather than from any additional spillovers into indigenous firms. It would be of

[25] The exception is the US where we use the foreign share in 1987.

interest to extend the above analysis to allow for other factors such as capital intensity as well as for the possibilities of spillovers across as well as within industries.

VI. Conclusions

Considerable attention has been paid to the level of inward direct investment in the transition economies of Eastern Europe, based on the widespread assumption that such investments are essential for economic modernisation and reconstruction. Our empirical evidence supports such assumptions by revealing cross-country evidence that the level of technical progress, and hence labour productivity, is significantly related to the stock of inward investment. However in contrast with the findings for other EU economies the beneficial effects from inward investment at present largely appear to have come from the rapid growth in the level of such investments rather than from significant spillovers into the behaviour of indigenous companies. This makes it especially important to understand the factors attracting inward investment for policy purposes, but also raises the questions as to whether linkages between foreign and domestic firms will develop further in the future and whether there are policy options available to encourage such linkages.

Our empirical results on the determinants of inward investment support and extend the findings from existing surveys of investment in Eastern Europe and earlier econometric studies of the factors driving inward investment in the Visigrád economies (Lansbury *et al*., 1996a,b). It is clear that the chosen method of privatisation plays an important role in explaining the differences in the level of inward investment across countries after accounting for market size. Countries such as Hungary have attracted greater inward investment from the use of direct sales to cash investors rather than voucher schemes and management buyouts. This has clear implications for the potential pattern of future investments in both the CIS economies as well as many of the Balkan states where mass privatisation of state-owned businesses has only just begun in earnest. Moving from a system of privatising solely by means of vouchers or buy-outs with no cash sales to a system such as that of Hungary with cash sales is estimated to raise the ratio of inflows of FDI to GDP by close to 2½ percentage points. Ultimately of course this gap may diminish once foreign investors can make investments through well-established domestic equity markets. Government can also improve the prospects for inward investment by ensuring a greater degree of macroeconomic stability.

Geography and contiguous borders also appear to matter, with the CEFTA economies with common borders with the core EU countries doing relatively better than the non-CEFTA

Balkan states in attracting inward investment, even after allowing for risk and differences in privatisation policies. Trade with the major investing economies also matters although, with the notable exception of the Baltic States, the derived effects appear somewhat smaller than found in studies of bilateral investment patterns. Estonia and Latvia have attracted a higher level of investment than might have been expected, possibly because of their boundaries with Russia.

The empirical results also confirm that the pattern of investment is not simply a matter of market size. The choice of location is also affected by relative factors such as production costs in different locations within Eastern Europe and perceptions of country risk. These findings are consistent with those from many other studies of investment in developing economies and suggest that the foreign investment that has taken place in the transition economies does not simply comprise projects to serve the local market of the host economy. Export-orientated investments have also come to be important, with such investments serving both the EU market and other markets within Eastern Europe.

Empirical evidence from other economies is that spillovers from foreign firms often arise through learning by doing and the knowledge taken by workers who move from foreign firms back into domestic ones. Inevitably such factors take time to emerge. The evidence from our model is that governments can seek to maximise the beneficial effects from inward investments by taking further action to liberalise product markets and move regulatory standards towards those in the advanced industrialised economies. Measures to remove any domestic capital market imperfections might also help indigenous companies to fund the investments required to utilise new ideas and techniques brought in by foreign companies.

Appendix A. Alternative Measures of Labour Costs

The empirical work on the determinants of FDI in this paper uses information on average wage levels to capture cross-country differences in labour costs. Conceptually a broader measure of costs such as total compensation per head would be preferable. This includes non-wage benefits and employers' social security contributions as well as basic wages. However there is only limited time series information available from many countries national accounts on total labour compensation. In some cases, such as Croatia, Poland and the Slovak Republic there are no published estimates at all (OECD, 1997). Annual data on wages is more easily obtained. In this appendix we compare the relative cross-country levels of wages in 1994 with what information there is on compensation in order to assess whether use of wages might bias our results.

Data for whole economy compensation can be obtained from national accounts sources for Bulgaria, Estonia, Hungary, Latvia and Slovenia in 1994. Estimates for 1994 can be made for the Czech Republic and Romania using published data for 1995 and 1993 respectively,[26] and information on the growth rates of wages and total employment.[27] Compensation per worker in a common currency was obtained by taking the ratio of total compensation to whole economy employment and multiplying by the average dollar exchange rate in 1994.

The resulting series, normalised so that the Czech Republic = 100 (dollar cost per head of $3625), is shown in Table A1, alongside the corresponding series for wages. It is clear that there is a close relationship between the cross-country differences within the two series, particularly for the countries with relatively high labour costs per head. The only difference of any note is that labour costs in Romania appear somewhat lower using the compensation measure than from the wage data. This suggests that relatively little bias should arise from the use of the wage data in the econometric work.

Table A1. Compensation and Wages per Employee in 1994 ($ index, Czech Republic=100)

	Compensation	Wages
Bulgaria	36	39
Croatia		93
Czech Republic	100	100
Estonia	55	56
Hungary	137	135
Latvia	38	46
Lithuania	30	34
Poland		97
Romania	29	49
Slovenia	307	307
Slovak Republic		82

[26] The Czech Republic estimate is from OECD Historical Statistics, 1960-95 Table A and the Romanian estimate from OECD (1997).

[27] Compensation in year *t* is approximately equal to compensation in year *t-1* multiplied by (1+gW)*(1+gQ), where gW and gQ denote the growth rate of wages and employment respectively.

Appendix B. Estimates of Educational Attainment

Data on the years of education of the adult population can be obtained from census and survey estimates in the UNESCO Statistical Handbook. For each country in our sample there is some data on four basic categories of educational attainment: no schooling, primary only, some secondary and higher education. The nature of the data means that different years are sometimes used as the reference point. Barro and Lee (1993) summarise indicators of educational attainment across regions between 1960 and 1985. Their estimates suggest that the then centrally planned economies had the highest educational attainment, reflecting a long history of compulsory primary education.

The data we use are summarised in Table B1. In principle it might be possible to use further data on enrolment ratios to further split the primary and secondary categories into those completing and those dropping out, but this is beyond the scope of the present paper. We use data for the adult population aged 25-64 (with the exception of the Czech and Slovak Republics where the data refers to those aged 25-60) and exclude non-respondents.

Table B1. Educational Attainment of Adult Population

Country	Year	Population 25-64 (mn.)	Highest Education Level (per cent)			
			No Schooling	Primary	Secondary	Higher
Bulgaria	1992	4.425	2.8	37.7	42.2	17.3
Croatia	1991	2.413	6.4	40.9	45.5	7.2
Czech Republic	1991	4.694	0.2	22.3	67.3	10.2
Estonia	1989	0.822	1.1	32.7	50.6	15.6
Hungary	1990	5.425	0.9	50.6	37.0	11.5
Latvia	1988	1.411	0.2	32.3	52.3	15.2
Lithuania	1989	1.891	3.3	16.3	65.7	14.7
Poland	1988	19.300	0.5	36.7	53.9	8.9
Romania	1992	11.102	3.0	19.3	70.0	7.7
Slovenia	1991	1.044	0.4	40.5	47.3	11.8
Slovak Republic	1991	2.342	0.4	26.4	61.6	11.6

Source: UNESCO Statistical Database available at: http://unescostat.unesco.org

One widely used cross-country measure of educational attainment is average years of schooling. To construct such a measure two steps are necessary. First, an estimate has to be made of the actual number of years of education for those in each category of attainment. Second, adjustments need to be made for differences in the meaning of primary and secondary education across countries, even though the completion of secondary education will involve around 12 years of schooling in each country. For example in four countries, Bulgaria, Estonia, Croatia, Hungary and Poland, pupils completing the primary stage will have had approximately eight years of education.[28] In the other countries they will only have had four years of education. This provides one explanation why fewer pupils appear to enter secondary education in the former countries.

On average 41.5 per cent of the population have only primary education in the countries with eight years of primary schooling, and 44.7 per cent have completed at least some secondary education. In contrast some 60.7 per cent of the population have had some secondary education in the countries with

[28] Six years in Estonia.

a shorter period of primary education, with only 26.2 per cent having finished at the primary level. It is clear that there is little difference in the proportion of the population with some education below the higher level. To indicate the potential bias that can arise from different national classifications, assume that all pupils complete their final stage of education. The average years of schooling of those pupils whose highest attainment is either primary or secondary in the countries with eight years of primary education is 10.07 years [(41.5*8 + 44.7*12)/(41.5+44.7)], compared to 9.59 years in the countries with four years of primary and eight years of secondary education. There might in fact be no differences at all in the average years of education of these two populations.

To correct for this potential bias we adjust the raw data for Bulgaria, Croatia, Estonia, Hungary and Poland by taking the total population in the primary and secondary categories and assuming that some [26.2/(26.2+60.7)] per cent are in fact primary and the rest secondary. This gives comparable attainments across countries. The resulting estimates for years of education were then constructed assuming 4 years for primary, 12 years for secondary and a further 3 for higher education,[29] with all adults assumed to have completed their final level of education.

The final adjusted estimates are shown in Table B2. The countries with the highest average years of education are Lithuania, Romania and the Czech Republic. Croatia and Slovenia have the lowest attainment. It is possible that the assumption that the highest level of education has been completed could impart some upward bias to the overall years of schooling. However the average figure of 9.98 years appears consistent with the estimates for ten centrally planned economies in Barro and Lee (1993, Table 6) of 8.78 years in 1980 and 9.17 years in 1985, particularly since the Barro and Lee estimates include the adult population aged over 64 as well. The educational attainment of this segment of the population is generally lower than the average for the population aged 25-64.

Table B2. Average Years of Schooling Per Adult

Bulgaria	9.89
Croatia	9.37
Czech Republic	10.50
Estonia	9.75
Hungary	10.12
Latvia	9.85
Lithuania	10.74
Poland	10.02
Romania	10.33
Slovenia	9.07
Slovak Republic	10.19

[29] The exceptions are Bulgaria where we assume 11½ years for secondary education in the final numbers, reflecting changes in the educational system over time, and Estonia which has 11 years of secondary education.

Appendix C. Trade Data By Geographical Origin

The data for the share of total trade conducted with the EU was constructed using the IMF *Direction of Trade Statistics Yearbook 1990-96*. The IMF calculate total world exports and imports by summing the recorded trade with each country, as reported by either the host or home country. If an observation is missing, for example if there is no record of the trade conducted between Bulgaria and Turkey, any trade between these two countries will be excluded from the world total. The omission of trade with certain countries over part of the sample period may result in inconsistent estimates of the share of trade with EU, where trade is normally recorded. We have attempted to correct for any obvious missing values where possible. These usually occur in the immediate aftermath of the start of transition. We have also constructed data for those countries that did not exist as independent political entities over the full sample period: the Czech and Slovak Republics, the Baltic states, and Slovenia and Croatia. The raw and adjusted data, where relevant, are reported in Table C1. No adjustments were required for Hungary, Poland or Romania, or to observations after 1993.

Table C1. EU Trade Shares

	Bulgaria		Croatia		Czech Republic		Estonia	
	Raw data	Adjusted	Raw data	Adjusted	Raw data	Adjusted	Raw data	Adjusted
1991	0.504	0.430				0.396		
1992	0.402			0.587		0.495	0.858	0.606
1993	0.436		0.554		0.532		0.547	
1994	0.481		0.645		0.539		0.565	
1995	0.385		0.638		0.555		0.610	
1996	0.394		0.563		0.583		0.592	

	Hungary		Latvia		Lithuania		Poland	
	Raw data	Adjusted	Raw data	Adjusted	Raw data	Adjusted	Raw data	Adjusted
1991	0.564						0.614	
1992	0.593		0.360		0.859	0.459	0.608	
1993	0.560		0.297		0.582	0.469	0.667	
1994	0.627		0.401		0.312		0.670	
1995	0.621		0.474		0.368		0.670	
1996	0.611		0.471		0.387		0.649	

	Romania		Slovak Republic		Slovenia	
	Raw data	Adjusted	Raw data	Adjusted	Raw data	Adjusted
1991	0.339			0.213		
1992	0.389			0.267		0.667
1993	0.436		0.287		0.645	0.631
1994	0.482		0.342		0.676	
1995	0.526		0.361		0.681	
1996	0.539		0.388		0.662	

An adjustment was made to Bulgarian world imports in 1991 due to the absence of any data on imports from the former USSR. This is a considerable distortion of the data, as imports from Russia amounted to more that 20 per cent of Bulgarian imports in 1992-93. We have estimated imports from Russia in 1991 by assuming that imports from countries over than Russia accounted for a constant proportion of total imports in 1991 and 1992.

Estimates were made for Croatia and Slovenia for 1992, based on the trade data for the then Socialist Federal Republic of Yugoslavia. Given the raw data for Yugoslavia, we assumed that the trade share of each republic remained constant from 1992-93. Total trade for Yugoslavia in 1993 was constructed by summing the total trade of the five former republics, and this was used to estimate the trade shares. Total world Yugoslav exports and imports were adjusted in 1992, as the raw data excluded trade with the former USSR. Exports were estimated as USSR imports from Yugoslavia and imports were estimated as USSR exports to Yugoslavia. The trade data for Slovenia in 1993 were adjusted to include trade with Macedonia. Exports were estimated by Macedonian imports from Slovenia and imports were estimated as Macedonian exports to Slovenia. The figures for Yugoslavia in 1992 exclude inter-republican trade, which potentially causes a degree of bias in the data.

Detailed trade statistics exist for the Czech and Slovak Republics from 1993. Prior to then data exist for the former Czechoslovakia. These two sets of data are not consistent since the latter excludes cross-border trade between the two republics. In order to construct comparable figures for Czechoslovakia in 1991-92, we assumed that the (internal) trade between the two republics was the same proportion of their combined GDP in US$ in those years as in 1993. Trade between each of the two republics and the EU in 1991 and 1992 was estimated by assuming that their shares of total trade between the EU and the former Czechoslovakia were the same as their shares in total trade between the EU and the two republics in 1993. A similar method was used to derive estimates of their total trade with the rest of the world.

A similar set of problems exist in the trade statistics for the Baltic States prior to 1993. The IMF report what appears to be a reasonably complete set of data for Latvia in 1992, but coverage for Estonia and Lithuania is sparse and clearly omits a considerable amount of trade within developing Europe. For Estonia we derived data for trade with developing Europe in 1992 by assuming that trade with these economies grew in line with trade with industrialised countries between 1992-93. For Lithuania the incomplete published data for trade with developing Europe in 1992 and 1993 were overwritten, with new estimates derived by backwards interpolation from 1994 in line with the movements in Estonian and Latvian trade with developing Europe. As is clear from Table C1 these changes make a considerable difference to the reported share of trade with the EU.

Data Appendix

Foreign Direct Investment – flow data for 1990-96 from IMF International Financial Statistics if available. Data for Bulgaria for 1990-96, Croatia in 1992, the Czech and Slovak Republics in 1990-92 and Slovenia in 1990-91 from *UN Economic Bulletin For Europe*, Vol.49, Table B16. Data for Lithuania in 1992 from *UN Economic Survey of Europe 1995-96*, Table 3.6.12. Estimates of inflows as a proportion of GDP were calculated as the ratio of inflows to national GDP, multiplied by 100. All figures in US dollars using annual average US$ exchange rates to convert domestic currency data.

The FDI stock data were derived by cumulating inflows in national currencies from 1988 onwards. Estimates of the level of inflows in 1988 and 1989 were derived by subtracting the flow data for 1990-96 from the estimates of the cumulative inflows in 1994 in the *UN Economic Survey of Europe 1996-97*, Table 3.6.16. Estimates at constant 1995 prices were obtained by dividing the nominal stock series by the national GDP deflator.

GDP – GDP at constant 1995 prices derived by interpolation using the value of nominal GDP in 1995 and growth rates of output at constant prices in EBRD (1997). For Lithuania and the Czech Republic updated estimates for nominal GDP taken from IMF(1998).

GDP deflator – derived using the ratio of GDP at current prices to GDP at constant prices (1995=100).

Regional Output – estimates for the aggregate level of GDP at 1995 prices in the 11 Eastern Europe economies were constructed using the national GDP estimates at constant prices converted into US$ using the PPP estimates in OECD (1997). PPP estimates are available for all currencies apart from the Croatian kuna. The PPP rate for the Kuna was assumed to be 0.52 times the market rate in 1995, in line with the average differential for the currencies of the other 10 countries. Country weights for the relative wage and productivity variables were obtained as the share of national GDP in the estimate of Eastern Europe GDP in 1995. The weights are: Bulgaria (0.0633), Croatia (0.0541), Czech Republic (0.1570), Estonia (0.0093), Hungary (0.1045), Latvia (0.0127), Lithuania (0.0232), Poland (0.3293), Romania (0.1526), Slovenia (0.0329), Slovak Republic (0.0611).

Wages – data for manufacturing and whole economy wages per month from ILO Yearbook of Labour Statistics for all countries 1990-96, converted into US$ using annual average bilateral exchange rates. No data for the Baltic States prior to 1992. For Croatia and the Slovak Republic estimates for 1996 derived using the growth rate of nominal earnings in industry in EBRD (1997). For Romania estimates in 1996 derived using growth rate of nominal earnings in industry in *UN Economic Bulletin for Europe*, Vol.49, Table B9. Relative wages constructed as national wages relative to a GDP weighted average of wages in the other 10 host economies.

Employment – numbers employed for 1992-96 were derived from the series for registered unemployment and the unemployment rate in *UN Economic Survey of Europe 1996/7*, Table B6. Data for 1991 from the *UN Economic Bulletin for Europe*, Vol.48, Table B4.

Productivity – GDP at constant 1995 US$ prices (derived using PPPs) divided by total employment. Relative productivity constructed as national productivity relative to a GDP weighted average of productivity in the other 10 host economies.

Import volumes - four series were constructed, total imports of goods and services at current and constant prices, imports of machinery and transport equipment and the share of imports from the industrialised countries (see Appendix C).

Total imports of goods and services at current and constant prices were obtained from OECD (1997) for all countries apart from Bulgaria and Croatia. For those countries with partial constant price data missing observations were obtained by interpolating the published constant price series in line with total imports at current prices deflated by the GDP deflator. For Romania total imports in 1995 came from OECD (1997) and for 1996 were interpolated in line with the estimates in EBRD (1997, pg.232). For Slovenia total imports in 1991 and 1995 were obtained from OECD (1997). Data for 1996 were taken from IMF (1998). Total imports for the Slovak Republic in 1996 were taken from IMF (1998). The data for the Czech Republic in 1995-96 were adjusted for a break in methodology of recording trade statistics. In 1995 this raised the reported value of exports and imports by 27 and 21 per cent respectively (UNECE, Vol. 48, pg.42). For Bulgaria and Croatia we use total current price imports deflated by the national GDP deflator. For 1991-95 the Bulgarian trade data is from OECD (1997), with data for 1996 estimated using EBRD (1997, pg.219). Trade data for Croatia was obtained from EBRD (1997, pg.220), this excludes service imports.

Imports of machinery and transport equipment were obtained from successive issues of the *UN Economic Bulletin for Europe*, using the tables for shares of trade by commodity and data on total merchandise imports.

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