Economic Growth and Labour Productivity In Europe: Half a Century of East-West Comparisons

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* Address: Faculty of Economics, University of Groningen, PO Box 800, 9700 AV Groningen, The Netherlands. Tel. 31 50 363 3674. Fax 31 50 363 7337. Email: h.h.van.ark@eco.rug.nl. This paper makes extensively use of earlier studies that I did on Eastern Europe, including Van Ark (1995, 1996) and Horlings and Van Ark (1998). I am grateful for comments on an earlier draft from Eva Ehrlich, Peter Havlik, Simon Kuipers, Angus Maddison, Gábor Révész, and from participants in the conference on "The Enlargement of the European Union" (Centre for European and Russian Studies, University of California, Los Angeles, 25-27 February 1999) and a seminar at the CEPII (Paris, 24 June 1999).

Abstract

This paper discusses the comparative productivity performance of Eastern and Western Europe since 1950. Firstly, it looks at the productivity estimates since the beginning of transition in 1989. Despite a decline in output, the turmoil of the late 1980s affected labour participation more strongly, so that labour productivity growth has been less affected than per capita income growth. Presently, there are signs of a renewed slowdown in productivity growth in Central and Eastern European countries (CEEC's), even though there is much diversity between the countries.

Secondly an historical approach is adopted by taking into account the growth performance of CEEC's for the period 1950-1989. The estimates suggest a long-term trend towards productivity slowdown in Eastern Europe beyond the slowdown in Western Europe since 1973. Indeed the growth path in the CEEC's before transition can be characterised as "extensive growth". Growth was based on rapid accumulation of resources without successful application of new technologies, which led to declining efficiency in the use of resources. It is argued that the present difficulties in closing the productivity and income gap between East and West are still partly due to the legacy of the past. Policies to improve work organisation, change production strategies, and strengthen quality of training are typically effective in the long run and will not materialise in immediate sustained gains in productivity.

Thirdly the paper takes a look at the convergence and divergence trends in productivity since 1950. It outlines a continuous process of productivity divergence between Eastern and Western Europe, despite convergence within each of the two regions. It is argued that the brief episode of convergence since 1992 is primarily the result of the recovery of shock effects of the transition. A long term process of productivity convergence depends on the success by which the past process of extensive growth can be transformed into intensive growth, i.e., growth based on efficient resource use and successful adaptation of new technologies. This requires institution building to strengthen the effectiveness of product, labour and capital markets in the long run.

1. Introduction

The rapid changes in the political, economic and social constellation in Central and Eastern Europe a decade ago, have had a large impact on economic performance relative to Western Europe and the rest of the industrialised world. Following the turmoil of the late 1980s, real GDP levels in the region fell by 20% on average between 1989 and 1992. Since 1993/1994 most Central and East European countries (CEEC's) have seen a recovery of growth. However, there has been substantial diversity across countries. Some countries (Czech Republic, Hungary, Slovakia and Slovenia) are now more or less back to the 1989 output level, and Poland has even surpassed it. Other countries (including the Baltic States, Bulgaria and Romania) also show recovery, but at a much slower pace. In contrast, most economies of the Commonwealth of Independent States (CIS) and those of the war-struck Balkan nations continue to shrink year after year. Some CEEC's (Czech Republic and Slovenia) are now at per capita income levels between 60 and 70 per cent of the EU-average, but others (Bulgaria and Romania) are only at 20 to 30 per cent of the EU per capita income level.

This paper brings out three major points:

1) To assess the comparative growth performance of CEEC's, other indicators besides output and per capita income are needed. In particular measures of growth rates and levels of productivity measures help in evaluating the efficiency with which resources are used.
2) Evaluation of the productivity performance of Eastern Europe requires a long-term perspective. This should include an assessment of the legacy of the past concerning the process of capital formation and resource allocation. It requires a reconciliation of measures obtained from "statistical" studies on the one hand and "matched plant" studies or other microeconomic evidence on the other.
3) To achieve long run productivity convergence between Eastern and West Europe a long term commitment to efficient resource use and successful adaptation of new technologies, based on institution building that strengthens the effectiveness of product, labour and capital markets, is needed.

The paper begins by outlining trends in output, employment and labour productivity in Eastern Europe relative to the European Union, the Russian Federation and the USA over the past decade. With the use of labour market indicators, Section 2 also reconciles per capita income and labour productivity levels for three East European countries, i.e. the Czech Republic, Hungary and Poland, relative to the European Union for 1996. Section 2 also briefly deals with the question how productivity in the eastern provinces of Germany (formerly East Germany), which became fully integrated in the European Union immediately after the collapse of communism, has developed relative to the most advanced East European countries.

Section 3 adopts a historical perspective by reviewing the evidence on real output and productivity growth in Eastern Europe relative to the European Union over the past half century. It briefly discusses the major problems involved in comparing growth rates between

centrally planned economies (CPE's) and western economies. There is still a great deal of uncertainty about the growth performance of the East European economies during this period. However, a pattern of long-term productivity slowdown beyond that of the slowdown in the European Union has clearly emerged. This slowdown is ascribed to the "extensive growth" path in Eastern Europe, based on excessive use of inputs and increasingly slow output growth.

Section 4 focuses on the productivity performance of the industrial sector, which is of crucial importance in the process of technology creation and productivity growth. New estimates are provided from a series of benchmark comparisons of manufacturing productivity carried out within the framework of the ICOP project at the University of Groningen. A confrontation is made of these "statistical results" with those derived from "matched plant" studies carried out for the Czech Republic, East Germany and Hungary by Hitchens and associates (1993, 1996). This sheds further light on the causes of the long-term productivity slowdown and the major bottlenecks to move onto an "intensive growth" path, i.e. growth that is primarily productivity-led.

Section 5 discusses the convergence issue in more detail. It establishes a pattern of productivity divergence between Eastern Europe and the EU since the 1950s, which has continued until the early 1990s.

Finally, Section 6 discusses the challenges ahead for East European countries to improve productivity performance. The main point is that the legacy of the past has not been wiped out overnight and that policies should have a long run focus aimed at generating a sustained improvement in economic performance.

2. The Shock Effects on Per Capita Income and Productivity Growth during Transition

Per Capita Income versus Productivity Trends

The collapse of the communist regimes, and with it the termination of central economic planning, had an immediate and very negative effect on the economic performance of the countries involved. Graphs 1a and 1b compare trends in GDP per capita and labour productivity. The graphs show that the collapse in per capita income between 1989 and 1992 in Central and Eastern Europe the Commonwealth of Independent States (CIS) has been bigger than that of labour productivity.[1] Graph 1c shows why. Between 1989 and 1992 employment/population ratios in Eastern Europe and the CIS declined dramatically.[2] Since 1992 the recovery in per capita income has been somewhat slower than for labour

[1] Unless otherwise mentioned "Central and Eastern Europe" in this paper includes Bulgaria, Czech Republic, Hungary, Poland, Romania, Slovakia and Slovenia.

[2] All labour input estimates in this paper are based on numbers of persons employed. Reliable and internationally consistent estimates of working hours of employed persons are scarce, even for advanced western economies (see, for example, OECD, 1998). The lack of working hours for East European countries and CIS probably implies an overstatement of the collapse in labour productivity, because during the period 1989-1992 many firms engaged in short-time working of employees who were kept on the payroll.

productivity as average employment/population ratios continued to decline. Labour productivity in Eastern Europe grew at almost 6 per cent per year on average between 1992 and 1996 compared to 4.9 per cent growth in per capita income. For Eastern Europe, employment/population rates are now at similarly low levels as in the European Union, i.e. at about 40 per cent. In the CIS countries, employment/population rates are still relatively high, but lower than in the United States where it is about 50 per cent.

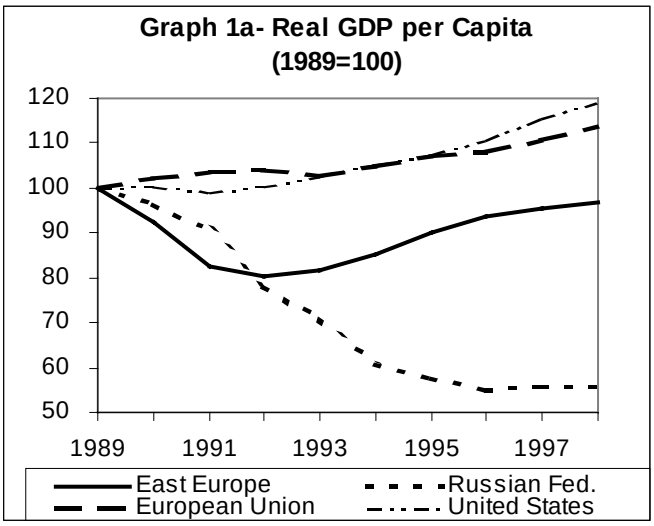
The greater decline and slower recovery of per capita income relative to productivity can be explained by the rapid shake-out of unproductive activities. This caused a rapid rise in unemployment, but helped productivity to recover.[3] Hence the burden of transition was primarily placed on living standards. It should be noted, however, that both Graphs 1a and 1b signal a slowdown in per capita income and productivity growth since 1996, which may be a cause of concern for the near future.[4]

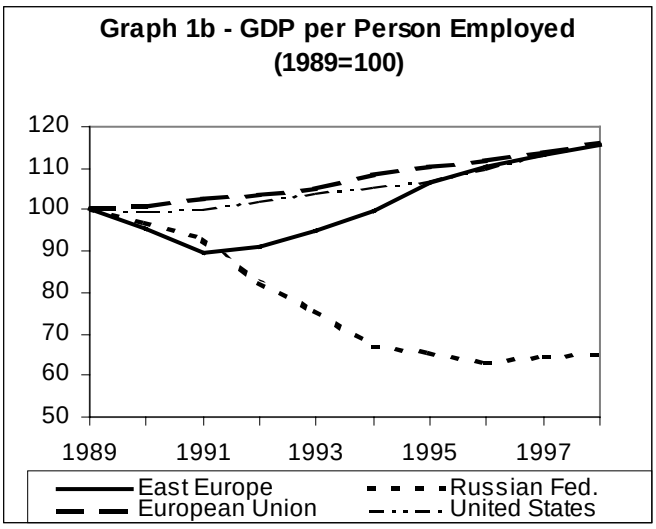
A more disaggregated view on each of the seven East European countries in our sample reconfirms the diversity mentioned in the introduction. Even though the direction of the trends was more or less the same in all countries, the phasing of the shake-out process described above was different (Graphs 2a to 2g). For example, Poland, Hungary and Slovenia experienced a rapid decline in labour intensity and relatively rapid recovery of labour productivity. In contrast productivity in the Czech Republic employment/population ratios hardly declined, but at the same time productivity did not increase much since 1992. This atypical development of the Czech economy may be due to the fact that the large privatization programme speeded up structural reallocations (as is confirmed by measures reported by Blanchard (1997)) but did not necessarily lead to the much-needed restructuring of firms within sectors and industries (Havlik, 1999).

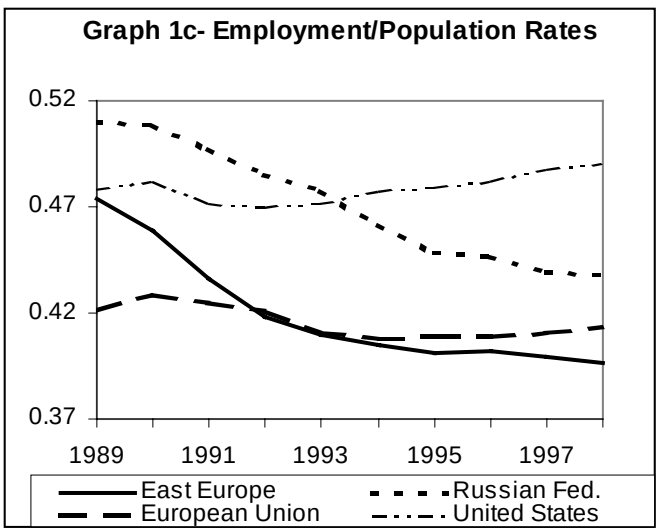
Slovakia experienced a larger drop in the employment/population ratio than the Czech Republic, but compared to Bulgaria and Romania, Slovak productivity recovered beyond the 1989 level. Romania is a clear case of limited restructuring during the first part of the transition period. Whereas the share of employment in the population remained virtually constant, productivity and per capita income collapsed by more than 30 per cent. Even though Romania experienced some recovery between 1992 and 1996, the past two years have led to a further deterioation of the situation.

[3] Blanchard (1997) observes similar U-shaped responses of output and productivity in CEEC's since the beginning of transition

[4] Part of the collapse in per capita income in Eastern Europe may be overstated because of a rise in non-market production and non-registered economic activity. In this respect the labour productivity figures may be more exact even though they do not cover all economic activity: both the numerator (GDP) and the denominator (employment) of the equation relate to registered economic activities only.

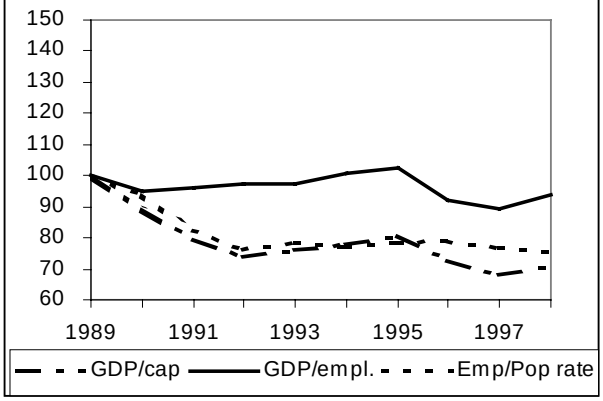




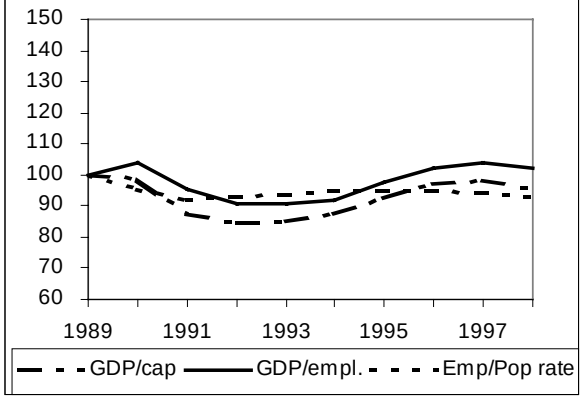


Sources: GGDC Total Economy Data Base (see Appendix I)

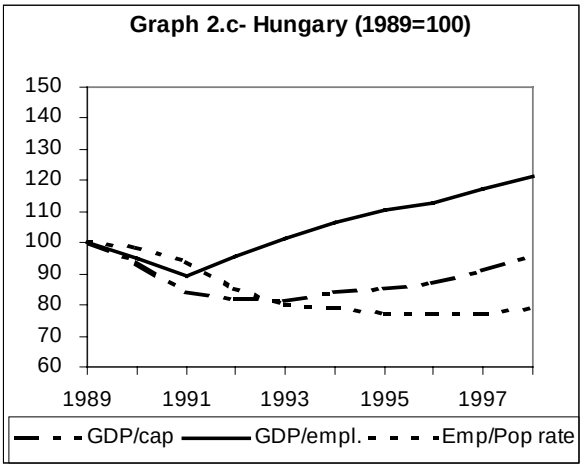
Graph 2.a- Bulgaria (1989=100)



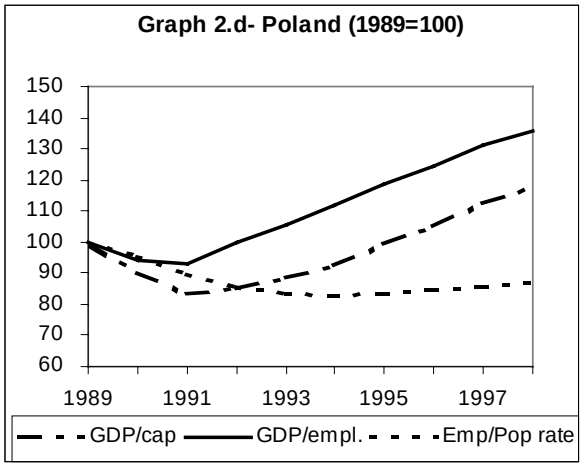
Graph 2.b- Czech Republic (1989=100)



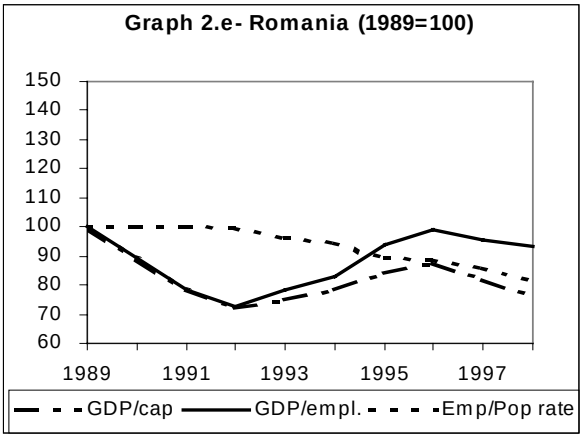
Graph 2.c- Hungary (1989=100)



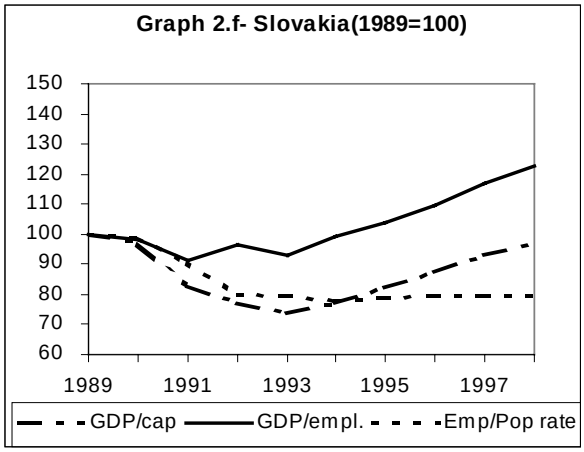
Graph 2.d- Poland (1989=100)



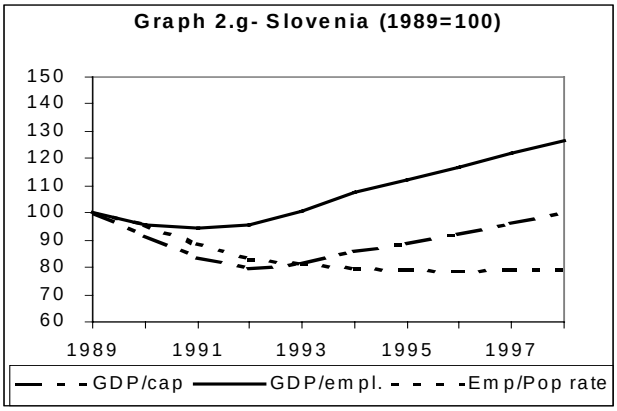
Graph 2.e- Romania (1989=100)



Graph 2.f- Slovakia(1989=100)



Graph 2.g- Slovenia (1989=100)



Comparative Levels of Labour Productivity

Apart from looking at growth rates, estimates of relative levels of economic performance provide additional information on the potential of East-European countries for catch-up with the world's economic leaders. Estimates of levels are troubled by the fact that, apart from reliable figures on GDP and employment, purchasing power parities (PPPs) are required to correct for relative price differences across countries. PPP estimates for East European countries involved serious complications in the past, but even today there are reasonably good and comparable estimates of PPPs for only a limited number of countries. Poland, Hungary and the Czech Republic are now full OECD members, and therefore participate in the regular updating of PPPs within the multilateral ICP programme of Eurostat and OECD. Nevertheless most East European countries also participated in the European Comparisons Programme which developed PPPs on a bilateral basis relative to Austria for 1996 (Havlik, 1999).

Table 1 shows the average level of labour productivity in Eastern Europe and the Russian Federation relative to the European Union. Between 1989 and 1992, East European labour productivity relative to the EU fell by more than 4%-points. Since then the average relative level has recovered and almost reached the 1989 level in 1997. The last two columns of Table 1 show the hypothetical catch-up period ahead. If Eastern Europe is able to generate a growth advantage over the EU growth rate of 2 or 3 per cent per year it would still take about 30 up to 50 years to catch up with the latter's average per capita income level.

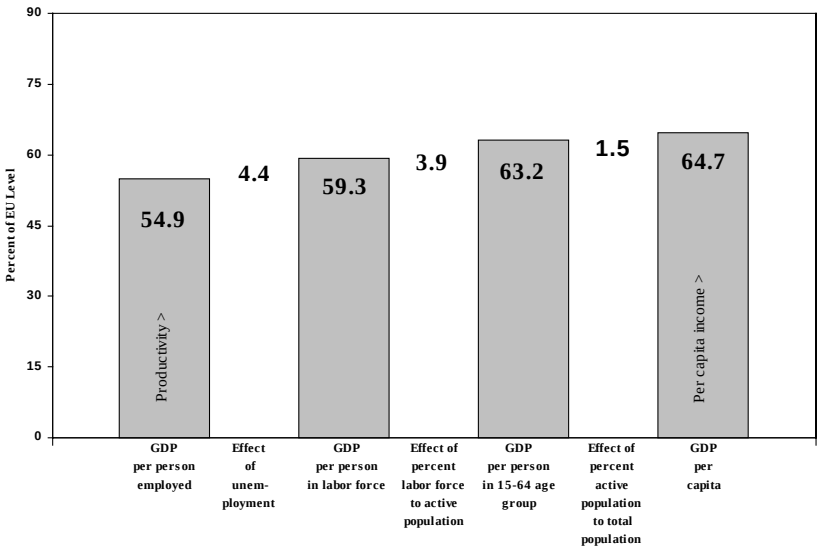
Table 1 also shows that the collapse in the Russian Federation was much more serious than in Eastern Europe, and that the productivity gap relative to the European Union has continued to increase over the past few years. Even if the economy of the Russian Federation would get onto a recovery track creating a 3% growth advantage over the European Union, it would still take almost 50 years to reach the average EU productivity level. In the remainder of this paper we will concentrate on the countries that are potential entrants to the EU.

Table 1
GDP per Person Employed (levels relative to EU) and number of years required to reach full convergence on the basis of given 2% or 3% growth surplus

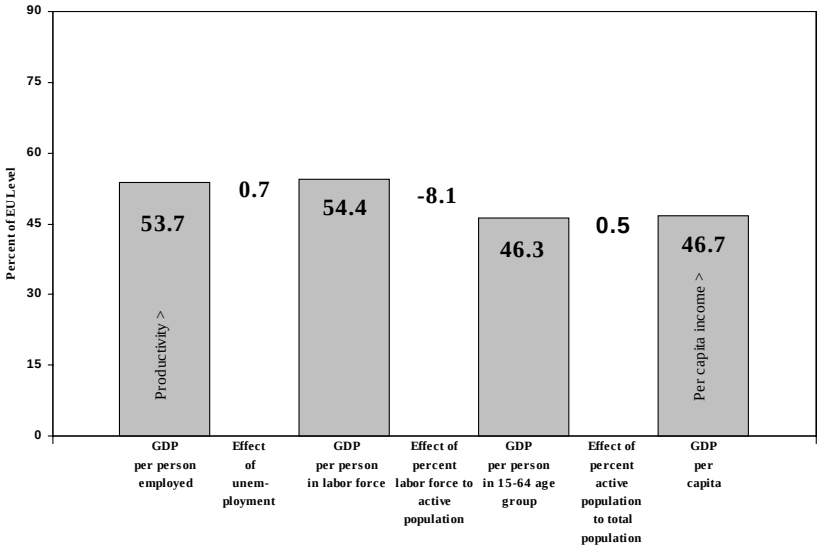
	GDP per Person Employed European Union = 100 (c)			Number of Years for Convergence to EU level	
	1989	1992	1998	2%-growth surplus in lab. prod'ty	3%-growth surplus in lab. prod'ty
Eastern Europe (a)	40.0	35.0	39.9	46	30
Russian Federation	52.5	41.2	29.4	60	40
European Union (b)	100.0	100.0	100.0	---	---
United States	122.1	119.7	120.8	---	---

(a) Includes Bulgaria, Czech Republic, Hungary, Poland, Romania, Slovakia and Slovenia.
(b) Excludes Luxembourg
(c) Estimates are PPP-based
Source: GGDC Total Economy Data Base (see Appendix I)

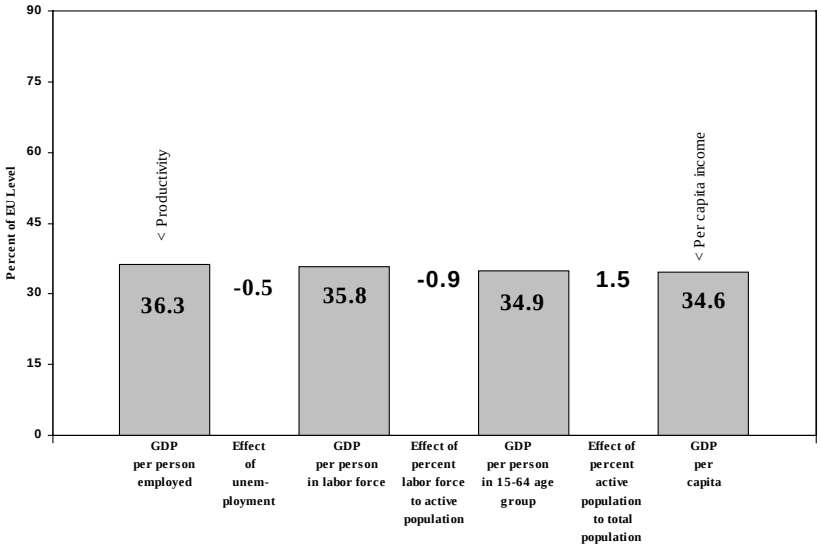
Graph 3a - Czech Republic, 1996, EU=100



Graph 3b - Hungary, 1996, EU=100



Graph 3c - Poland, 1996, EU=100



Graphs 3a to 3c show a reconciliation of comparative levels of labour productivity (represented by the bar most to the left) and per capita income (represented by the bar most to the right) for the Czech Republic, Poland and Hungary relative to the EU average. The numbers in between the bars in each diagram represent the percentage contribution to the difference between the relative productivity and the relative per capita income level. These differences are due to unemployment, labour force participation and demographic structure.

Graph 3a shows that low unemployment and high labour force participation in the Czech Republic relative to the European Union provides the Czechs with a relatively high per capita income level compared to their relative labour productivity level vis-à-vis the EU. In contrast, Hungary's substantially lower labour force participation relative to the EU average, makes it show up better in terms of productivity than in terms of per capita income (Graph 3b). Hence the much better labour market performance of the Czech Republic is reflected in a 18%-percentage lead of the Czech Republic over Hungary in terms of per capita income. However, given recent observations that up till recently the Czech economy has undergone less restructuring than the Hungarian economy, it is not certain whether the Czech per capita income advantage over Hungary can be maintened in the long run. (Havlik, 1999)[5] Productivity and per capita income levels in Poland are substantially lower than in either the Czech Republic or Hungary (Graph 3c).[6]

The Performance of East German Provinces Relative to Eastern Europe

A specific case of interest is the performance of the economy of the East German provinces relative to the most advanced East European countries. In contrast to the other former communist countries, East Germany was fully exposed to the joys and burdens of political and economic integration with the EU, and West Germany in particular, right after the collapse of communism.

Graph 4b shows that during 1989-1991, East Germany experienced lower productivity levels than Hungary and, in particular, the Czech Republic. But since 1991 East German labour productivity has moved ahead of that of the other East European countries. Graph 4c shows the mirror-side of the acceleration of East German productivity, i.e. a rapid decline in employment/population rates to levels well below those of the Czech Republic, and close to those of Hungary and Poland. East German participation rates have historically been high, and to some extent the decline in labour force participation may be ascribed to an adjustment to more common levels. This observation is reinforced by the fact that the fall in employment during 1989-1991 did not lead to a large drop in productivity, and that since 1992 East

[5] Indeed the most recent OECD figures show a smaller per capita income gap between Hungary and the Czech Republic. In 1998 GDP per capita in Hungary (at 1996 PPPs) is estimated 10,129 US$ relative to 12,517 US$ in the Czech Republic, which is a gap of 19 percentage points compared to 28 percentage points in 1996. Hungarian labour productivity was almost 2 percent ahead of the Czech level in 1998.

[6] Because of limited quality of the data this analysis was not carried out for the other East European countries. For estimates of productivity levels of other East European countries relative to the EU, see Appendix I.

Germany's participation rate has slowly improved.[7] Moreover, Graph 4a shows that East Germany experienced the most rapid improvement in GDP per head of the population.

Compared to the other East European countries, East Germany's transition was one of very rapid structural change as out-of-date capital and obsolete technologies were quickly disposed off. The rapid rise in wage and price levels due to the 1:1 conversion of the Ost-Mark to the D-Mark seriously affected competition. These burdens of reunification were to a large extent cushioned by the huge transfers from West- to East Germany of social payments and investment in construction and other capital-intensive projects. Compared to the other East European countries, and the Czech Republic in particular, the East German provinces seem to have benefited from integration in terms of productivity and per capita income gains, following the initial serious losses.

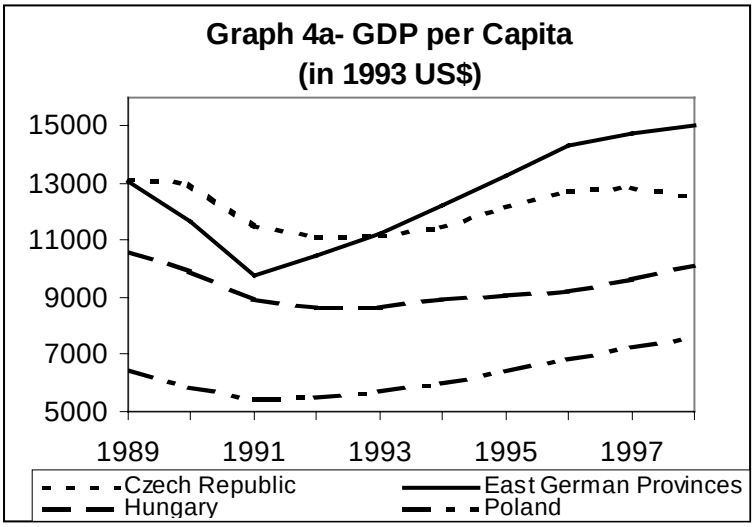
However, in 1997 and 1998 growth in East Germany has leveled off. This is partly related to the overall persistent slowdown of the German economy, but growth of real output in East Germany was also slower than in West Germany for the first time since reunification. The nearing end of the construction boom in East Germany and the slowdown of transfers from West Germany, which served as an impetus to demand, are important factors explaining the slowdown. Hence the long term benefits of rapid integration are not yet confirmed by the East German experience.

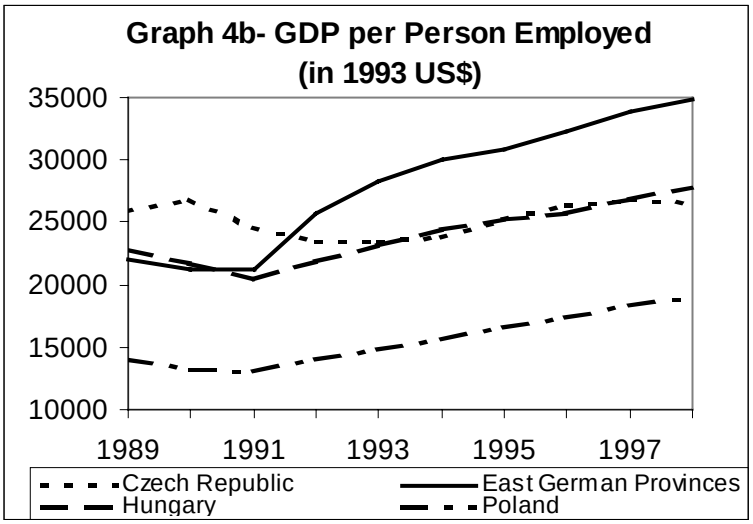
Conclusion

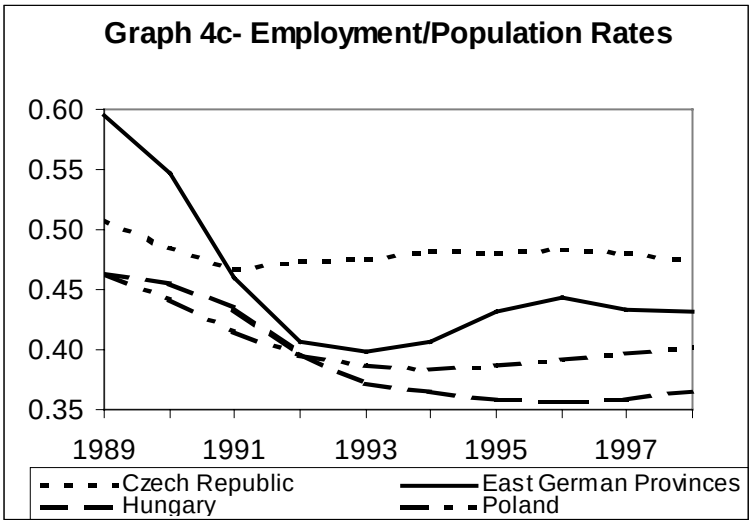
The conclusion from the analysis so far is that during the transition years per capita income was much more strongly hit than labour productivity. In particular during 1989-1992 the slowdown in productivity growth was less than that of per capita income. This is because the shock effects from the transition primarily affected labour input. Under the new economic regime, inefficient firms exited or laid off labour to a large extent. The remaining firms which managed to restructure or newly entering firms benefited from new investment and new market opportunities. The latter effect began to dominate the growth trend since 1992. Hence productivity restored more quickly than per capita income since then.

However, the diversity in the recovery among the East European countries is big. For example, except for Slovenia, the Czech Republic started off with the highest productivity levels in the region at the beginning of the period of transition, but was subsequently overtaken by East Germany and more recently by Hungary. The Czech per capita income level remained more stable as labour force participation rates did not fall much. On the other hand, there are indications that the Czech Republic has been less successful than Poland and Hungary in restructuring economic activity and in absorbing foreign direct investment.

[7] In contrast to the other East European countries, reasonably reliable estimates of working hours exist for East Germany since 1989. These suggest a drop in hours per person between 1989 and 1991, but since then the trend moved back to the 1989 level and remained relatively stable since then. Hence the decline in East German productivity between 1989 and 1991 may be somewhat overstated, but the upward trend since 1991 is not much affected by changes in working hours per person (see Lindlar, 1998)







Sources: GGDC Total Economy Data Base (see Appendix I)

There is also a group of CEEC's, notably Bulgaria and Romania, which are still not even back at their 1989 levels of productivity and face a trend in per capita income which is still negative. But even for the more successful reformers, the long run prospects for sustained productivity growth remain uncertain. Despite an acceleration of productivity growth since 1992 there are signs of somewhat slower growth in the region since 1996. Part of the slowdown may be due to an exhaustion of the "reconstruction effect" as observed by Jánossy (1971) in relation to the rapid growth episode in Europe during the first two decades following the World War II. Most clearly, the recent slowdown of output growth in East Germany suggests no evidence of the advantages of rapid and full integration for the long run.

3. The Long Term Productivity Slowdown

It is important to distinguish between productivity growth in the long run and the short run. In the short term, labour productivity measures can be strongly affected by the business cycle and by shifts in industry structure due to changing competitive pressures. As the previous section showed, such short term effects impacted the slowdown in productivity in Eastern Europe immediately after the collapse of central planning economies and the subsequent recovery thereafter. Indeed, Baumol, Blackman and Wolff (1989) emphasise that policies which focus on accumulation and technological change and therefore support productivity growth, matter less for combating such important but transitory problems as reducing inflation, unemployment and balance of payments deficits.

In the long term, productivity growth contributes to a rise in real wages, high participation rates and increased living standards. This being also the ultimate aim of intensified economic cooperation among European states, a focus on the longer term is needed. Indeed it is unlikely that, despite the past decade's fundamental changes in Eastern Europe's economic and political regimes, the impact on efficiency of the structural and institutional conditions under central planning during the four decades before, were fully wiped out with the revolutions of the late 1980s. This section therefore goes back into history to establish the legacy of output and productivity performance in Eastern Europe during the period 1950-1989.

Comparisons of Productivity Growth Rates Using the Adjusted Factor Cost Method

There are many problems in adequately measuring the growth of real output and productivity in Eastern Europe during the period of central planning. Official growth rates have been highly overstated. A study of the literature suggests that the following factors are the most important:[8]

[8] See, for example, Bergson (1991), Maddison (1995, 1998), Marer (1985, 1991) and Schroeder (1995).

1) The estimates of real output growth in centrally planned economies (CPE's) were directly based on an aggregation of enterprise accounts. According to these accounts, output was priced in both current and "comparable" prices.[9] Managers often inflated their output because they claimed relatively high prices for "new" products. This was motivated by suggesting higher production costs for these new products or by claiming substantial quality improvements which in reality were often minor compared to existing products. Prices of existing products were insufficiently adjusted downwards once cost reductions had occurred or when the quality began to deteriorate. When net material product in current prices was deflated by the official "constant price" deflator, insufficient account was taken of the actual pricing practices of firms.

2) The estimated growth rates of gross output in CPE's were upwardly biased by the rising share of production for intermediate use. The planning system often required intensive cooperation among firms supplying each other with intermediate inputs. Frequently firms were also forced to subcontract to fulfil production targets.

3) The accounts of the former CPE's were based on the Material Product System (MPS), which only reported the output of physical production and material services. In practice the coverage of the MPS gradually expanded over time. For example, in Czechoslovakia the concept of production since the early 1950s developed from the value of "production of goods delivered" to the value of "productive work and services", and finally also to the value of "production produced and consumed" by the enterprise.

4) Finally, at different stages in the process there was deliberate overreporting of output. Managers may have overreported their gross output in order to achieve their planned targets. There may also have been some overreporting at the national level to put the country performance in a favourable light internationally.

The reconstruction of the growth performance of former CPE's could in principle be carried out along two different routes. The first approach aimed at reestimating the current value aggregates or price indexes to eliminate the effects of hidden inflation and make a correction for the effect of the introduction of the so-called "new" products. However, reconstructing the price series appeared a difficult path to pursue for long term studies mainly because of the lack of appropriate price statistics.

The second more widely used approach was based on the "adjusted factor cost" (AFC) method. This method, which originates from the work of Abram Bergson on the reconstruction of Soviet growth performance, was used by the CIA to monitor Soviet economic performance.[10] The AFC-method made use of physical output measures which were weighted at adjusted factor

[9] It is important to distinguish "comparable" prices from "constant" prices, as the former does not necessarily mean that prices refer to one and the same base year. This was in particular so when new products were introduced for which no price was available at the time of the base year.

[10] See, for example, Bergson (1961, 1991) and Joint Economic Committee (1982, 1990).

cost weights. The factor cost weights approximately represented the compensation for labour (i.e. the sum of wages and salaries and social security contributions) and capital (i.e. depreciation allowances and an estimate of the return on capital). This approach had advantages over the "repricing" method, because the basic data, in particular the quantity information, was more readily available than the prices.

The reliability of the AFC estimates has been widely discussed in the literature on Soviet growth. Some scholars argued that the alternative estimates understated real output growth.[11] The main argument was that the adjusted factor cost method relies too heavily on the output in terms of physical quantities, and took insufficiently account of the introduction of new products in particular in the area of machinery and electrical equipment. In contrast, other scholars argued that, despite the substantial downward adjustment relative to the official estimates, the AFC growth rates were still upwardly biased, because of the increased deterioration in product quality, the decline in technology performance and the higher raw material content of products originating from CPE's compared to market economies.[12] In a recent review, Maddison (1998) has argued that "the CIA estimates of Soviet growth performance … are the best documented and most reasonable estimates we have" (p. 322).

For East European countries the AFC method, or a particular variant of it, was applied in a range of studies by a team of researchers headed by Thad Alton.[13] Alton's "Research Project on National Income in East Central Europe" produced about hundred and twenty research reports over a period of about 25 years. It provided separate estimates by industry of origin and by expenditure category. The estimates were carefully documented, in particular in the earliest reports covering the period 1937 to 1967. For this period the factor cost weights were usually benchmarked in the mid-1950's, but subsequently weights were shifted to later benchmark years.

Maddison (1995) and van Ark (1996) have extensively used the estimates from the "Research Project on National Income in East Central Europe" for the reconstruction of the growth of total GDP and manufacturing output in Eastern Europe respectively. Table 2 provides the growth rates of labour productivity for the total economy for the sub-periods 1950-1973 and 1973-1989. These AFC-based growth rates are substantially lower than the official estimates. For example, van Ark (1996) shows that with output derived on the basis of the net material product concept, growth of labour productivity in industry was 1.5 percentage higher in Czechoslovakia and 2 percentage points higher in East Germany for the whole period 1950-1989.[14]

Table 2 shows that in all countries a strong slowdown in productivity growth set in during the period 1973-1989 relative to 1950-1973. To some extent the productivity slowdown was also experienced by the western countries, mainly due to oil crises of the

[11] See, for example, Boretzky (1987).

[12] See, for example, Aslund (1990).

[13] For a discussion of the estimates for Eastern Europe by Alton and associates, see Marer (1985) and Maddison (1995). Van Ark (1996) deals in detail with "Alton estimates" for manufacturing.

[14] See van Ark (1996), Table 7.6.

1970's. Indeed productivity growth in the European Union was 2.2 percentage points slower during the period 1973-1989 than during the period 1950-1973. But for most East European countries the slowdown was bigger than in the West. Only Czechoslovakia and Hungary experienced a more moderate slowdown compared to the EU average.

Table 2
Annual Compound Growth Rates of Real Output per Person Employed for Total Economy according to Adjusted Factor Cost Estimates

		Bulgaria	Czecho-slovakia	East Germany	Hungary	Poland	Romania	European Union (e)
		Total Economy						
(1)	1950-73	5.7	2.9	3.7	3.3	3.4	5.8	4.2
(2)	1973-89	1.3	1.1	0.8	1.2	0.9	1.2	1.9
(3)	1989-98	-0.7	0.3 (a) 2.3 (b)	5.2	2.2	3.5	-0.8	1.7
	growth differential (%-points)							
(4)	(2)-(1)	-4.4	-1.8	-2.9	-2.1	-2.5	-4.6	-2.2
(5)	(3)-(2)	-2.0	-0.8 (c) 1.2 (d)	4.4	1.0	2.6	-2.0	-0.2

(a) Czech Republic
(b) Slovakia
(c) Slowdown of Czech Republic relative to Czechoslovakia
(d) Slowdown of Slovakia relative to Czechoslovakia
(e) Present EU membership, excluding Luxembourg
Source: GGDC Total Economy Data Base. See Appendices I and II.

For the period 1989-1998 the diversity in East European productivity performance, alluded to before, is reflected once more in Table 2. In East Germany, Hungary, Poland and Slovakia productivity growth accelerated compared to the period 1973-1989, but it continued to slow even more compared to the earlier period in the Czech Republic and in particular in Bulgaria and Romania.

Comparisons of Productivity Levels

Backward extrapolation of levels of labour productivity relative to Western economies using the growth indices described above is troublesome for two reasons. Firstly, the real growth estimates use fixed weights for relatively long periods, so that the index increasingly deviates from the "real" growth the further one moves away from the benchmark year.[15] Secondly, there have been substantial statistical breaks in the output series around 1989-1990. In particular the change from MPS to SNA systems of national accounting has led to a different classification of industries and another method of estimating output.[16]

[15] Until recently the use of fixed weights was also practised in the US National Income and Product Accounts (NIPA), but most West European countries have been using shifting for 5- or 10-year periods. Most recently, the US NIPA has begun to use annual weights to construct constant price series.

[16] An alternative approach to comparisons of per capita income is the physical indicator (PIM) method. In short it uses statistical relationships between selected physical indicators and per capita GDP in market economies to obtain measures of income per head for countries which lack reliable national accounts (see, for example,

Table 3
Relative Levels of Output per Person Employed for Total Economy (European Union = 100)

	Bulgaria	Czecho-Slovakia	East Germany	Hungary	Poland	Romania	European Union (a)
1950	25	76	67	68	45	30	100
1960	33	75	75	66	43	36	100
1973	35	57	60	57	38	43	100
1979	37	55	60	56	36	47	100
1989	32	50	50	52	32	37	100
1998	26	52 (b) 51 (c)	69	55	38	30	100

(a) Present EU membership, excluding Luxembourg.
(b) Czech Republic
(c) Slovakia
Source: GGDC Total Economy Data Base. Backward extrapolation from 1996 US$ GDP per person employed. For time series see Appendices I and II.

Table 3 shows the comparative levels of labour productivity relative to the European Union-average for a number of years on the basis of backward extrapolation from the post-transition PPP-adjusted estimates presented in Section 2. The table shows the large productivity gap which has arisen between all East European countries and the EU since 1950. It also shows that Czechoslovakia clearly started off as the most productive country among the six countries in the region. Over time productivity levels converged between Czechoslovakia, East Germany and Hungary. Bulgaria, Poland and Romania clearly remained among the poorer countries in the region. As shown before East German productivity levels rapidly moved ahead of those of the other countries since 1989. These estimates are analysed in some more detail in the framework of the discussion on convergence in Section 5.

Causes of the Slowdown under Central Planning from a Macro Perspective

The causes for the slowdown in productivity growth have been extensively discussed in a wide range of studies using qualitative as well as quantitative evidence.[17] As mentioned above, some of the causes are not specific to the centrally planned economies, as the advanced market economies experienced a growth slowdown since the mid-1970's as well. But clearly in the case of the CPEs there have been additional factors explaining the slowdown, including structural distortions causing large inefficiencies on the supply side, and institutional factors which limited the mobility of resources to more efficient uses.

However, it has appeared difficult to systematically assess the sources of growth and stagnation for East European countries by combining the qualitative and quantitative evidence

Ehrlich, 1991, and UN/ECE, 1993). This approach is less suitable for comparisons of productivity than for comparisons of per capita income. See Marer (1985) for a detailed critique of PPPs and the PIM method.

[17] For extensive reviews, see Aldcroft and Morewood (1995) and Berend (1996). The volumes on East European countries in the Routledge series on "Contemporary Economic History of Europe", including Poland (Landau and Tomaszewski, 1985), Hungary (Berend and Ránki, 1985), Bulgaria (Lampe, 1986) and Czechoslovakia (Teichova, 1988) are also recommended.

in a comprehensive growth accounting framework.[18] This is mainly due to the sensitivity of growth accounting estimates for both the method and the data used. Concerning data, reliable estimates of the capital stock for centrally planned economies are mostly lacking. Another substantial problem is that changes in intensity of labour cannot be properly measured without estimates of man-hours.

Concerning the methodology of the growth accounts, there has been much controversy about the nature of the production function which would best fit the performance of these economies. Some authors have been in favour of using a traditional Cobb-Douglas production function, and ascribed the slowdown in productivity growth primarily to an excessive use of inputs in combination with a decline in the efficiency of factor inputs use (Bergson, 1983, Ofer, 1987). Others have favoured the use of less restrictive production functions, which ascribe the slowdown to the lack of substitution possibilities of capital for labour over time (Easterly and Fischer, 1994).[19] Other scholars again have emphasized the substantive degree of technical inefficiency in centrally planned economies (Gomulka, 1986).

In Van Ark (1996) I have tried to assess the sources of growth stagnation in Czechoslovak and East German manufacturing since 1950 by comparing the "proximate" sources of growth in these two countries with those of two South European countries (Portugal and Spain), and with the average for four EU countries (France, Germany, the Netherlands and the United Kingdom). The major proximate sources explaining the stagnation in Eastern Europe were:

1) The ineffectiveness of the rapid investment in capital goods and technology, which appeared from the paradox between slow TFP growth in combination with rapid technological progress in the East European countries.
2) The slowdown in the accumulation of human capital in both quantitative and qualitative terms since the 1970s.
3) The lack of openness to foreign trade and foreign direct investment outside the CMEA region, and the lock-in into a selfcontained and regulated trading system.

Underlying these three proximate sources of stagnation was a fourth explanation of a more "ultimate" nature, namely the political-institutional system. Essentially the central planning system lacked the instruments to improve the quality of products and services, and it failed to put in motion a process of transforming the structure of output, demand and trade.[20]

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[18] In the case of the former Soviet Union some growth accounting work has been undertaken. See, for example, Ofer (1987). For Eastern Europe, see Bergson (1987), for a regression analysis, including USSR, Hungary, Poland and Yugoslavia, establishing the influence of capital and land intensity as well as a "socialism" dummy on the level of output per worker in 1975.

[19] This controversy directly relates to the recent debate sparked by Young and Krugman on Asian economic growth (Young, 1995; Krugman, 1994). Krugman goes at length into drawing parallels between the failure of the accumulation model of the former Soviet Union and the possibility of a growth slowdown in East Asia.

[20] See van Ark (1996), pp. 296-303. In fact the study by Bergson (1987), referred to above, estimates that the communist planning systems of the East European countries accounted for a decline in efficiency by some 25% to 30%.

4. Diversity in Industrial Performance

So far we have mainly dealt with the output and productivity performance of the total economy. However, both during the period of central planning and since transition, major changes have occurred in the structure of the economy. Under central planning all East European economies underwent rapid industrialisation. Moreover the industrial sector has mostly been characterised by above-average growth rates of labour productivity. For example, on the basis of the "adjusted factor cost" estimates of Alton and others, Van Ark (1996) and Horlings and Van Ark (1998) obtained manufacturing productivity growth rates for Czechoslovakia, East Germany, Hungary and Poland for the period 1950-1989. These growth rates were 0.3 percentage points (Czechoslovakia and Hungary) up to 1.2 percentage points (East Germany) higher than the productivity growth rates for the total economy. The transition since 1989 has hit the industrial sector particularly hard, but as shown above, the productivity slowdown was limited due to the rapid shake-out of inefficient activities once the markets for industrial products opened up.

Benchmark Comparisons of Manufacturing Productivity

To fully assess the reliability of the industrial growth estimates of the former centrally planned economies, it is useful to complement these with estimates of relative levels of output and productivity, which are obtained independently from the growth rates above. Such research work, which involves industry-wise comparisons of physical quantities between countries, weighted at employment or output values, originates from two pioneering studies on comparative productivity in the UK and the USA by Rostas (1948) and Paige and Bombach (1950). Several scholars have replicated this approach for different countries and benchmark years, including several studies by the United Nations Economic Commission for Europe during the mid 1960s for Czechoslovakia and Hungary in comparison with Austria and France (Conference of European Statisticians, 1971, 1972).

Since 1983 a substantial research effort has been underway at the University of Groningen to develop the industry-of-origin approach as part of the International Comparisons of Output and Productivity (ICOP) project.[21] Tables 4 and 5 report the results from six ICOP studies, comparing manufacturing productivity levels in Czechoslovakia (1989), East Germany (1987 and 1992), Hungary (1987) and Poland (1989 and 1993), all relative to West Germany.[22] All six studies are based on information concerning nominal output values and employment obtained from each country's production census or industrial survey. Industries were reclassified to match the West German classification system. Gross output and "value added" (i.e. gross output minus material inputs) were converted to D-Marks with "industry-specific" purchasing

[21] A description of the ICOP project and a complete list of publications, reports and notes can be obtained from the web-site of the Groningen Growth and Development Centre: http://www.eco.rug.nl/ggdc/homeggdc.htm

[22] Except Poland (1993) which was compared to All Germany

power parities which were based on ratios of unit values for matched products between each country and West Germany.[23]

Table 4 shows comparative levels of gross output and value added, and gross output and value added per employee for the benchmark years on which the comparisons are based. The estimates show that the output gap between the East European countries and West Germany was smaller in terms of gross output than in terms of value added, which suggests a greater use of intermediate inputs in the East European countries (see final column of Table 4).[24] There are various explanations for the larger share of material inputs in gross output in centrally planned economies compared to market economies. These range from a greater wastage of intermediate inputs, often related to distorted prices, to low the technology-content and high material input-content for many products from CPE countries (see below).

Table 4
Gross Value of Output, Value Added and Labour Productivity in Manufacturing in East European Countries as a % of West Germany (a), 1987-1993

	Gross Value of Output (1)	Value Added (2)	Gross Value of Output per Employee (3)	Value Added per Employee (4)	*Material Inputs as a % of Gross Output (c)* (5)
Czechoslovakia (1989)	14.7	10.6	44.7	32.3	*65.1*
East Germany (1987)	19.6	12.9	48.6	32.0	*65.8*
East Germany (1992)	5.9	4.8	56.0	46.9	*61.1*
Hungary (1987)	6.3	5.3	33.4	28.6	*59.5*
Poland (1989)	16.5	13.5 (b)	35.2	29.3 (b)	*41.9*
Poland (1993) (a)	9.1	7.9	27.0	23.5	*59.1*
West Germany	100.0	100.0	100.0	100.0	*48.0-52.9*

Note: the conversion to common currency was done at the geometric average of "industry PPPs" (unit value ratios) at own country weights and (West)-German weights.
(a) Poland as a % of All Germany
(b) After adjustment of gross output UVR to a value added UVR by using a UVR for intermediate inputs which was derived by backdating the gross output UVR by six months using the producer price index. This adjustment was necessary because of an inflation rate of over 700% in Poland in 1989
(c) Calculated on the basis of domestic prices
Source: Van Ark, Monnikhof and Timmer (forthcoming). Czechoslovakia/W-Germany from van Ark and Beintema (1993) with revisions (see van Ark, 1996); East Germany/W-Germany (1987) from Beintema and van Ark (1994) with revisions (see van Ark, 1995); East Germany/W-Germany (1992) are unpublished ICOP/LCRA estimates (January 1996); Hungary/W-Germany (1987) from Monnikhof (1996); Poland/W-Germany (1989) from Liberda, Monnikhof and van Ark (1996); Poland/All Germany(1993) are unpublished ICOP/LCRA estimates (January 1996).

[23] The East-European ICOP studies for manufacturing are summarised in Van Ark, Monnikhof and Timmer (forthcoming). For references to individual country studies, which include further details, see sources of Table 3. See Kouwenhoven (1996) for a USSR/USA comparison of manufacturing productivity using the ICOP method.

[24] The Polish case for 1989 was exceptional. Because of the high inflation during that year, prices of intermediate inputs, which were purchased well before output was sold, were lower relative to output prices than usual.

Table 4 shows that gross output per employee in manufacturing varied from 33 per cent of the West German level in Hungary to 49 per cent in East Germany during the late 1980s. The value added per person employed varied from 29 per cent in Hungary and Poland to 32 per cent in Czechoslovakia and East Germany. In contrast to the relative productivity levels for the total economy, the Hungarian productivity levels in manufacturing are lower than in Poland. The two benchmark comparisons for the early 1990s suggest a large improvement in manufacturing productivity in East Germany relative to West Germany, but a worsening of the productivity performance in Poland versus All Germany.

Table 5
Comparative Levels of Value Added per Employee in Manufacturing,
Czechoslovakia, East Germany, Hungary and Poland as a % of West Germany (a), 1987-1993

	Czecho-slovakia 1989 (1)	East Germany 1987 (2)	East Germany 1992 (5)	Hungary 1987 (3)	Poland 1989 (4)	Poland 1993 (a) (6)
Food Products, Beverages and Tobacco	23.7	46.3	44.5	29.3	30.4	29.6
Textile Products, Wearing Apparel, Leather Products and Footwear	31.0	41.1	43.4	32.9	24.2	19.2
Chemicals, Rubber and Plastic Products and Oil Refining	73.9	44.4	33.7	29.6	39.1	27.5
Basic and Fabricated Metal Products	35.7	40.1	63.7	30.0	21.9	19.7
Electrical and Non-electrical Machinery and Transport Equipment	28.0	22.4	48.1	29.8	34.4	25.9
Other Manufacturing (b)	34.2	27.7	47.5	26.3	25.6	17.8
Total Manufacturing	32.3	32.0	46.9	28.6	29.3	23.5

(a) Poland as a % of All Germany
(b) Includes wood products and furniture; paper and paper products and printing; non-metallic minerals and "other manufacturing".
Source: see Table 4.

Table 5 shows the productivity results for six major branches in manufacturing. The estimates suggest a different pattern across East European countries. In Czechoslovakia and East Germany, the machinery and equipment branch experienced relatively low productivity levels compared to West Germany, whereas chemicals scored relatively well. In East Germany, basic metals and metal products showed high productivity levels compared to the other East European countries. In Poland, chemicals and machinery and equipment showed a relatively good productivity performance, whereas basic metals and metal products had by far the lowest productivity level compared to West Germany. Finally, Hungary showed relatively little variation in productivity levels by major branch around the mean for total manufacturing.[25]

[25] Van Ark, Monnikhof and Timmer (1999) show that in particular the machinery and equipment branches in East European countries have a relatively large employment share in manufacturing, which is almost as high as in advanced market economies. Hence, the relatively good manufacturing productivity performance of Poland

Table 6
Comparative Levels of Value Added per Employee in Manufacturing, Czechoslovakia, East Germany, Hungary and Poland as a % of West Germany (a), 1950-1996, on the basis of backward extrapolation and benchmark estimates

	Czechoslovakia		East Germany		Hungary		Poland	
	extra-polated	Benchmark	extra-polated	Benchmark	extra-polated	benchmark	extra-polated	benchmark
1954	41.8		37.9	<u>52.0</u>	32.1	<u>58.7</u>	37.5	<u>46.2</u>
1960	43.9		38.6		27.9		38.0	
1973	31.6		29.7		22.1		32.9	
1979	30.9		29.3		23.7		30.4	
1987	34.2		32.0	**32.0**	28.6	**28.6**	30.2	
1989	32.3	**32.3**	32.7		27.6		29.3	**29.3**
1991			28.1	*59(a)/33(b)*	23.9		21.7	
1992			46.9	**46.9**	25.8		20.9	
1993		*30(a)/18(b)*	64.2		30.8	*44(a)/20(b)*	23.2	**23.5**
1996			85.6		35.5		27.5	

Note: The extrapolated figures are benchmarked on the figures printed in bold: Czechoslovakia was benchmarked on 1989; East Germany: 1954-1989 was benchmarked on 1987, and 1991-1996 was benchmarked on 1992; Hungary was benchmarked on 1987; Poland: 1954-1989 was benchmarked on 1989, 1991-1996 was benchmarked on 1993 (relative to All Germany). The underlined benchmark figures are historical benchmark comparisons for the year indicated. The results in italics are based on matched plant comparisons.

(a) average physical productivity estimates based on matched plant comparisons in engineering, food products, clothing and textiles, furniture and miscellaneous products

(b) average gross output value per employee deflated at actual producer producer prices and allowing for differences in physical productivity

Sources: ICOP Industry Data Base. Contemporary benchmark estimates from Table 4. Historical benchmark estimates from Horlings and Van Ark (1998). Time series for extrapolation from Van Ark (1996) and Horlings and Van Ark (1998) and updated on the basis of ICOP Industry Data Base (see Appendix III). Matched plant comparisons from Hitchens, Wagner and Birnie (1993) and Hitchens, Birnie, Hamar, Wagner and Zemplinerová (1996)

Table 6 shows the results of backward extrapolation of the contemporary benchmark estimates from Table 4 (shown in bold in Table 6). The time series up to 1990 were obtained on the basis of the "adjusted factor cost" estimates from the Alton group. The extrapolated estimates of relative productivity suggest an increase in the manufacturing productivity gap relative to West Germany for all countries. Between 1950 and 1989 the productivity gap increased by almost 10 percentage points in Czechoslovakia, in Poland by 8 percentage points, and in East Germany and Hungary by about 5 percentage points. In a separate study, Horlings and Van Ark (1998) replicated the ICOP method for an earlier benchmark year, namely 1954. These independent benchmark estimates (shown as underlined in Table 6) show significantly higher productivity levels in manufacturing at the beginning of the period. Hence, on the basis of these historical benchmark estimates, the productivity gap might have declined by as much as 20-30 percentage points between 1954 and the late 1980s. Further research on the reliability of historical benchmark estimates relative to backward extrapolations with "adjusted factor series" is needed to assess the dynamics of productivity change in Eastern Europe over the past half century.

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can be traced to its high productivity levels in machinery and equipment, even though that productivity advantage seriously declined between 1989 and 1993.

Reconciling "Statistical Comparisons" and Matched Plant Studies

It is clear from Table 6 that since 1989 manufacturing productivity in Eastern European countries relative to West Germany has improved. In Hungary the gap has closed by 8 percentage points, but productivity is still not much more than one third of the West German productivity level. In Poland manufacturing productivity collapsed between 1989 and 1992 but since then there has been a clear improvement. In the East German provinces the manufacturing productivity gap has narrowed in a spectacular way since 1992. Manufacturing labour productivity in East Germany was 85 per cent of the West German level in 1996. However, it should be emphasised that this productivity gain is related to the very substantial cut in manufacturing employment since 1989. In 1998 the number of manufacturing employees in East Germany was less than one million compared to around three million by the end of the 1980s. The decline in manufacturing employment in the other East European countries was much less.

Further evidence on the causes of the productivity gap which, with the exception of East Germany, only narrow slowly, can be obtained from comparing the "statistical" results with the results from studies which are directly based on observations at factories and plants. Of particular interest are a range of studies by Hitchens and associates on comparisons of a cross section of about 40 manufacturing plants in the Czech Republic, East Germany and Hungary carried out in 1991-1993 (Hitchens, Wagner and Birnie, 1993; and Hitchens, Birnie, Hamar, Wagner and Zemplinerová, 1996). The strength of matched plant studies is that these are based on structured interviews with firms producing similar products in different countries, allowing to cover the whole range of issues related to productivity, including the quantity and quality of the capital stock in place, the performance of human capital and R&D, the effects of organisation of shop-floor practices, production strategies and the role of demand. As emphasized by Hitchens et al., the relatively small sample of firms in the matched plant approach does not allow precise weighting of the relative importance of causal factors, but the observations can be indicative of the predominant factors.

The aggregate results of the studies of Hitchens et al. are included in Table 6 (in italics). For each country two estimates are shown. The first and highest estimate is based on information on physical output (volumes or tonnages) per amount of labour input allocated to the production of the products included. The second estimate is obtained after correcting gross output value for actual price differences between countries. The price differentials between countries for matched products are assumed by the authors to represent quality differences. Even though the authors somewhat imprecisely call the second measure "value added", it is relatively close to the "value added"-productivity measure obtained from the statistical comparisons in Table 4.

Hitchens et al. identify five performance factors which are of fundamental importance in understanding the productivity differentials between East European countries and West Germany:

1) The relatively old age of machinery and, linked to that, the inferiority of embodied technology is an important reason for East European productivity disadvantage. Between 30 and 40 per cent of machinery in East European countries was more than 10 years old (compared to 21 per cent in West Germany), and in between 80 and 90 per cent of the cases the technology performance of the machinery was inferior to that of West Germany
2) An important legacy of the period of central planning were the relatively large batch sizes of mass standardized products. While in many cases causing high physical productivity, these production strategies tended to involve low quality products and therefore affect the second productivity measure in the studies by Hitchens et al..
3) Linked to the previous point are the limited learning effects that can be obtained from mass production strategies characterized by "low technology – high raw material content".
4) Despite relatively high R&D levels and high percentages of skilled people on the shop-floor in Eastern Europe, doubts were expressed about the productivity of R&D and quality levels of the formal qualifications compared to West Germany
5) Lack of sophistication in consumer preferences in "shortage" economies and limited trade opportunities with capitalist market economies prevented producers from upgrading the quality standards of products.

To some extent these factors causing the long-run underperformance of productivity in Eastern Europe represent inefficiencies of an allocative nature. However, these factors are perhaps more indicative of technical inefficiencies (or "X-inefficiencies"), which have become particularly important in central planned economies. In particular the latter type of inefficiencies are not immediately removed with the introduction of a market system.

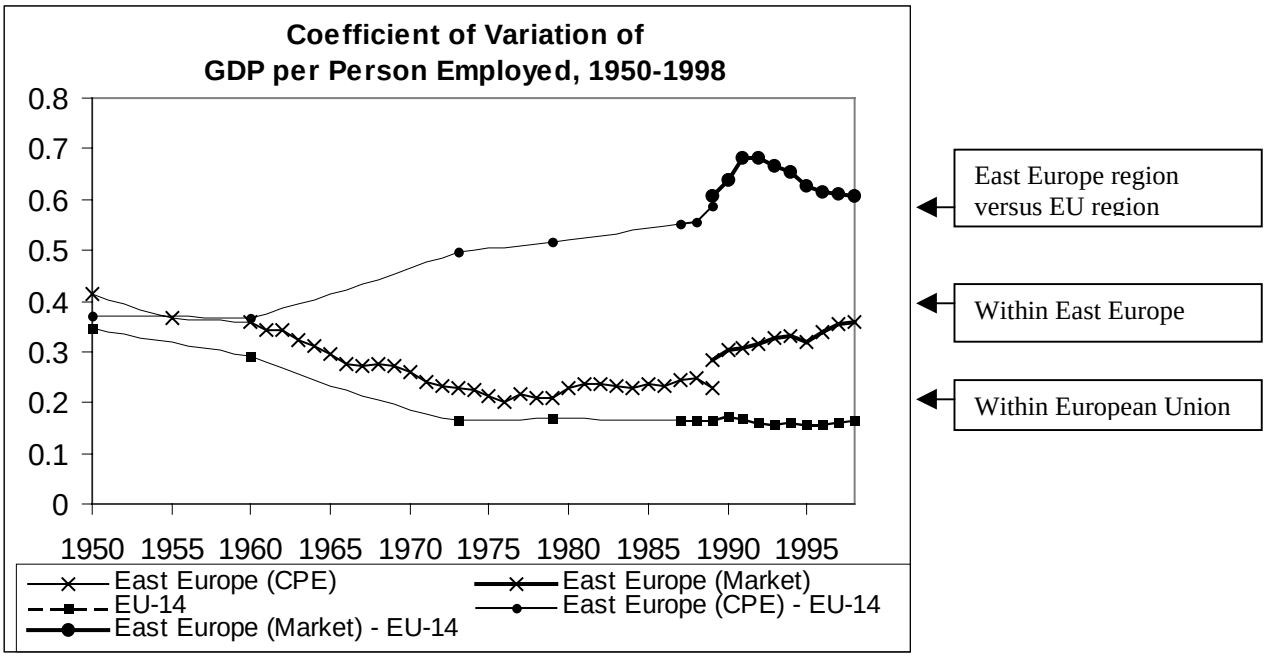
Conclusion

Summarising, this section and the previous one have made clear that the experiences in productivity performance during recent years cannot be understood without looking back at the experiences during the period of communism in Eastern Europe. Though worded differently, the five factors inhibiting long-run productivity growth, described above, are surprisingly similar to those described at the end of Section 3 which were based on the "statistical" comparisons. Both sets of explanations suggest that Eastern Europe inherited a growth paradigm which can be characterized as "extensive growth", based on rapid accumulation of resources without successful application of new technologies in both product and process improvement. This system ground to a halt by the end of the 1980s. Indeed the main challenge for Eastern Europe is to turn this growth path into one of intensive growth, based on efficient resource use and successful adoption of new technologies. These changes are not made in a decade's time, but indicate the direction for productivity policies which can be only successful in the long term (see the concluding Section of this paper).

5. East-West Productivity Divergence and the Recent Trend Towards Convergence

So far, we have seen that the past fifty years can be characterized as having shown increasing disparity in productivity performance in Europe. Whereas both Eastern and Western Europe achieved rapid productivity growth during the period 1950-1973, West European growth rates have mostly been higher than in Eastern Europe. Indeed Graph 5 shows a substantial increase in the coefficient of variation between East and West European productivity levels, in particular between 1960 and 1973. During the same period and within each of the two regions, low productivity countries showed faster productivity growth than high productivity countries. This is reflected in the decline in coefficients of variations for both regions separately. Between 1973 and 1989 both Eastern and Western Europe have experienced a productivity slowdown, and not much further convergence has taken place in any of the two regions. However, on the whole the slowdown was bigger in Eastern Europe than in Western Europe so that divergence between the two regions increased further.

The collapse of communism at the end of the 1980s created very diverse effects among East European countries, which explained the rapid rise in divergence within Eastern Europe. The collapse of productivity during the period 1989-1992 raised divergence between Eastern Europe and the European Union, but since 1992 the recovery of productivity growth has led to a convergence path between the two regions, even though diversity within the East European region remains.



Source: see Tables 2 and 3

A long-term trend towards convergence will primarily depend on the removal of the large technical inefficiencies which have arisen during the period of central planning. This will be a long-run process and depends primarily on the capability to create the right conditions to combine adequate levels of human and physical capital with the adoption of frontier technologies. In growth accounting terms, this means the capacity to create the technical and social congruence that is needed for a process of continuous catch-up (Abramovitz, 1991). Openness to foreign direct investment is often seen as an important vehicle to strengthen the capacity to catch-up. In this respect the recent overtaking of the Czech labour productivity level by Hungary may be a sign of greater effectiveness of FDI.

It is even questionable whether, from a short run perspective, rapid convergence between East and West Europe since 1992 should be seen as a measure of potential success for further economic integration. Both classical and neoclassical trade theories suggest that, with integration and free mobility of resources, productivity is not likely to fully converge. Instead countries will specialise in those industries and products where factor resources can be put to their most productive uses. Nevertheless there is some evidence of increased intra-industry trade between some Eastern European countries (Czech Republic, Hungary and Slovenia) and the European Union rather than specialization (Freudenberg and Lemoine, 1999). However, Freudenberg and Lemoine show that this intra-industry trade in practice represents specialisation in vertically differentiated products. These trends are supported by observations from new trade theories on the impact of economies of scale and locational advantages on production structures.

However, from a long term perspective, productivity growth is the most effective way for CEEC's to raise per capita income and to improve living standards. Moreover, with very large differences in productivity and efficiency use of factors between the regions, transfers of capital and labour may take proportions which are undesirable from a social or political perspective. Policies to attract foreign direct investment can assist in moderating the negative effects of capital and labour mobility.

6. Conclusion

This paper has shown that the short-term changes in per capita income and productivity in Eastern Europe should not be primarily interpreted as trends towards long-term convergence or divergence. These are mainly temporary effects of the shocks of the late 1980s. The rapid fall in per capita income relative to productivity is due to the rapid decline in employment-population rates during the first three years after 1989. The productivity recovery since 1992 is mainly due to the better performance of restructured and new firms since inefficient firms were removed during the years before. There are now signs that these temporary effects have had their largest impact. Recently, productivity growth has shown a tendency to slow.

The long run trend in catch-up and convergence of East European productivity relative to the European Union depends on the success by which the past process of extensive growth, which is based on rapid accumulation of resources without adequate technological change, can be converted into intensive growth. The latter is based on efficient resource use and successful adaptation of new technologies. The accumulated problems, which stem from technical inefficiencies related to out-of-date capital, inadequately trained workers and low R&D productivity are not removed within a decade. Indeed, 1989 should not be seen as a watershed in terms of analysing the driving factors behind productivity growth.

In order to prevent a productivity slowdown, investment and technology policies should focus on the long term. An economic environment needs to be created that is conducive to productivity growth based on technological change and the upgrading of quality of resources and products. As stated by Hitchens et al. (1993, 1996) the major future productivity gains which are expected by managers in East European factories are better machinery, work organisation and training required by foremen and management. In addition, policies which reduce barriers to mobility of resources and maintain effective demand through reducing product market restrictions, supporting foreign trade and inflow of foreign capital are necessary complements to improve the performance of firms.

The diversity in economic performance across East European countries has been big. This is partly due to different effects of macroeconomic and structural policies as well as different success rates of political reforms. For example, the relatively good performance of per capita income compared to productivity in the Czech Republic can be traced to the moderate decline in labour force participation. Since 1989 the Czech Republic has been characterized by fairly large transfers of high skilled labour from manufacturing to services, but the restructuring of firms has been slower than in, for example, Hungary. In Hungary, structural reforms started already in the 1980s, and after 1989 restructuring initially led to a large decline in labour force participation, but recently Hungary's productivity and per capita income growth has been faster than in the Czech Republic.

A final conclusion to be drawn from this paper is that comparisons of productivity between Eastern and Western Europe should be high on the research agenda. The research should be long-term focussed, and aim to develop a variety of different productivity and efficiency measures, including total factor productivity and measures of allocative and technical inefficiency. This paper described the problems with TFP estimation for the period of central planning. But even for the past decade, still very little is known about capital intensity and TFP performance of East European economies. As argued in this paper many of these estimates are not so useful in the immediate aftermath of the turmoil of the late 1980s, when changes in output and factor inputs are very volatile. Moreover, the complete overhaul of the statistical system in most East European countries has required time before estimates became more reliable and internationally consistent. However, in the near future new work on TFP growth and growth accounting in Eastern Europe seems desirable.

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Appendix I – GDP, Population, Employment, GDP per capita and GDP per Person Employed, 1989-1997

The data in appendix I and II are all part of the GGDC Total Economy Data Base of the Groningen Growth and Development Centre. Information on this data base and exact source descriptions will be published on the internet site of the GGDC (http://www.eco.rug.nl/ggdc.html) in due course. In the meantime further information can be obtained from the author.

Appendix Table I.1 – GDP in 1996 million US dollars

	Bulgaria	Czech Republic	East Germany	Hungary	Poland	Romania	Slovakia	Slovenia	East Europe*	Russian Federation	European Union**	United States
1989	61782	135329	213848	112043	245795	175392	52704	28503	811548	1711501	6371819	6345256
1990	55034	133705	187590	104572	221997	156354	51386	26194	749243	1660156	6557347	6398628
1991	48556	118357	154813	92130	206520	136148	43902	23857	669469	1578004	6657733	6334555
1992	44984	114456	164675	89309	211941	124222	41056	22546	648513	1345240	6713540	6512727
1993	44318	115102	175747	88792	219972	129357	39475	23201	660218	1232281	6665830	6670586
1994	45116	118218	189900	91411	231412	134531	41410	24431	686527	1075781	6848825	6920099
1995	46424	125258	196988	92764	247602	144217	44267	25432	725964	1031674	7014185	7118256
1996	41735	131197	202547	94050	262912	149842	47189	26323	753247	995566	7132785	7418700
1997	38814	132660	206215	98139	280992	139503	50256	27533	767897	1003530	7325457	7811189
1998	40172	128758	210628	103104	294175	129319	52467	28607	776603	957368	7531926	8114282

* countries in Table, excluding East Germany; ** present EU membership, excluding Luxembourg

Sources and Methods: 1996 GDP levels in US$: for OECD countries, including Czech Republic, Hungary and Poland, on the basis of GDP in market prices and EKS purchasing power parities obtained from OECD *National Accounts, Volume I, 1960-1996* supplemented with printout on purchasing power parities from OECD internet site (http://www.oecd.org). East Germany on the basis of share of East German "länder" in All Germany GDP at national currencies from Deutsches Institut für Wirtschaftforschung (DIW), *Vierteljährliche Volkswirtschaftliche Gesamtrechnung* (http://statfinder.diw-berlin.de). Bulgaria, Romania, Slovakia, Slovenia and the Russian Federation from P. Havlik *et al.* (1999), "The Transition Countries in 1999", WIIW Research Report no. 257. Movement of GDP in constant prices: 1994-1998 for OECD countries, including Czech Republic, Hungary and Poland, from OECD internet site (http://www.oecd.org) linked to 1996. 1990-1994 extrapolated from 1994 with GDP trend from OECD *National Accounts, op cit.*. 1989-1997 for East Germany from movement of GDP for All Germany minus GDP for West Germany from DIW *op cit*.. Bulgaria, Romania, Slovakia, Slovenia and the Russian Federation for 1990-1994 from Economic Commission for Europe, "Economic Survey of Europe, 1998" and for 1994-1998 from Havlik (1999), *op. cit.* 1989-1990 (except East Germany) from A. Maddison (1995), *Monitoring the World Economy, 1820-1992*, OECD Development Centre.

Appendix Table I.2 – Population (in millions)

	Bulgaria	Czech Republic	East Germany	Hungary	Poland	Romania	Slovakia	Slovenia	East Europe*	Russian Federation	European Union**	United States
1989	8989	10314	16399	10576	37963	23152	5245	1962	98201	147419	346484	248781
1990	8966	10310	16111	10553	38119	23200	5263	1969	98379	148088	348299	249911
1991	8914	10309	15910	10344	38245	22974	5283	1966	98035	148465	349942	252643
1992	8869	10319	15730	10313	38365	22748	5307	1959	97880	148592	351843	255407
1993	8495	10329	15635	10296	38462	22716	5329	1960	97588	148483	353709	258120
1994	8448	10333	15544	10278	38543	22683	5352	1965	97602	148306	355028	260651
1995	8399	10327	14831	10255	38596	22638	5368	1970	97553	148124	356841	263057
1996	8345	10313	14135	10229	38617	22580	5379	1974	97437	147746	358692	265557
1997	8291	10298	14020	10203	38621	22519	5388	1973	97293	147306	359437	268006
1998	8240	10286	14021	10179	38613	22451	5393	1972	97135	146861	359985	270418

* countries in Table, excluding East Germany; ** present EU membership, excluding Luxembourg
Sources and Methods: Midyear population up to 1992 from Maddison (1995). From 1992 updated with population estimates US Dept. of Commerce, International Data Base (http://www.census.gov/ipc). East Germany derived from All Germany minus West Germany.

Appendix Table I.3 – Total Employment (in millions)

	Bulgaria	Czech Republic	East Germany	Hungary	Poland	Romania	Slovakia	Slovenia	East Europe*	Russian Federation	European Union**	United States
1989	4481	5245	9747	4899	17586	10848	2498	939	46496	75168	146000	119029
1990	4205	4995	8820	4808	16840	10865	2478	902	45093	75325	149133	120430
1991	3658	4817	7321	4506	15853	10785	2281	832	42733	73848	148750	119282
1992	3360	4883	6387	4083	15181	10595	2013	777	40893	72071	148135	120058
1993	3307	4911	6219	3827	14894	10234	2012	760	39946	70852	145159	121744
1994	3242	4977	6330	3752	14802	10011	1977	746	39507	68484	144696	124478
1995	3283	4962	6396	3679	14929	9493	2020	745	39111	66441	145729	126242
1996	3286	4976	6267	3648	15099	9379	2036	742	39166	65950	146478	127995
1997	3157	4946	6078	3659	15295	9023	2041	743	38865	64639	147574	130811
1998	3106	4872	6055	3714	15479	8572	2032	745	38520	64300	148878	132773

* countries in Table, excluding East Germany; ** present EU membership, excluding Luxembourg

Sources and Methods: 1989-1996 for OECD countries, including Czech Republic, Hungary (from 1992 onwards) and Poland (from 1992 onwards) from *OECD Labour Force Statistics 1976-1996*. 1996-1998 movement from *OECD Economic Outlook* (June 1999). East Germany from Deutsches Institut für Wirtschaftforschung (DIW), *Vierteljährliche Volkswirtschaftliche Gesamtrechnung* (http://statfinder.diw-berlin.de). 1989-1994 movement for Bulgaria, Hungary (1989-1992), Poland (1989-1992), Romania, Slovakia, Slovenia and the Russian Federation from P. Havlik *et al.*, "Exchange Rates, Competitiveness and Labour Cost in Central and Eastern Europe", WIIW Research Report no. 231, and 1994-1998 from P. Havlik *et al.* (1999), "The Transition Countries in 1999", WIIW Research Report no. 257. Romania 1997-1998 change in employment assumed at -5%.

Appendix Table I.4 – GDP per capita in 1996 US dollars

	Bulgaria	Czech Republic	East Germany	Hungary	Poland	Romania	Slovakia	Slovenia	East Europe*	Russian Federation	European Union**	United States
1989	6873	13120	13040	10594	6475	7576	10049	14525	8264	11610	18390	25505
1990	6138	12969	11644	9909	5824	6739	9764	13302	7616	11211	18827	25604
1991	5447	11481	9731	8907	5400	5926	8310	12135	6829	10629	19025	25073
1992	5072	11092	10469	8660	5524	5461	7737	11506	6626	9053	19081	25499
1993	5217	11143	11241	8624	5719	5695	7407	11836	6765	8299	18846	25843
1994	5341	11441	12217	8894	6004	5931	7737	12432	7034	7254	19291	26549
1995	5527	12130	13282	9045	6415	6371	8246	12907	7442	6965	19656	27060
1996	5001	12722	14330	9194	6808	6636	8772	13338	7731	6738	19886	27936
1997	4681	12882	14708	9619	7276	6195	9328	13954	7893	6813	20380	29146
1998	4875	12517	15022	10129	7619	5760	9729	14509	7995	6519	20923	30006

* countries in Table, excluding East Germany; ** present EU membership, excluding Luxembourg
Sources: see Appendix Tables I.1 and I.2

Appendix Table I.5 – GDP per person employed in 1996 US dollars

	Bulgaria	Czech Republic	East Germany	Hungary	Poland	Romania	Slovakia	Slovenia	East Europe*	Russian Federation	European Union**	United States
1989	13789	25802	21940	22870	13977	16168	21099	30366	17454	22769	43643	53308
1990	13087	26768	21269	21752	13183	14391	20737	29029	16616	22040	43970	53132
1991	13272	24571	21146	20446	13027	12624	19247	28667	15666	21368	44758	53106
1992	13386	23440	25783	21873	13961	11725	20392	29014	15859	18665	45320	54247
1993	13400	23438	28260	23202	14769	12640	19617	30520	16528	17392	45921	54792
1994	13918	23753	30000	24363	15634	13438	20947	32740	17377	15709	47333	55593
1995	14142	25243	30799	25214	16585	15192	21916	34128	18562	15528	48132	56386
1996	12701	26366	32320	25781	17413	15976	23173	35490	19232	15096	48695	57961
1997	12293	26821	33928	26822	18371	15461	24624	37037	19758	15525	49639	59714
1998	12933	26428	34786	27762	19005	15086	25819	38389	20161	14889	50591	61114

* countries in Table, excluding East Germany; ** present EU membership, excluding Luxembourg
Sources: see Appendix Tables I.1 and I.3

Appendix II –GDP per Person Employed, 1950-1989

Appendix Table II.1 – GDP per person employed in 1996 US dollars

	Bulgaria	Czecho-slovakia	East Germany	Hungary	Poland	Romania	Eastern Europe*	European Union **
1950	3179	9539	8316	8488	5624	3760	6197	12288
1951	3822	9556		9096	5802			
1952	3636	9742		9246	5864			
1953	4032	9609		9296	6130			
1954	3945	9898		9537	6400			
1955	4215	10641	10569	10256	6631	5296	7672	
1956	4207	10979		9643	6844			
1957	4639	11479		10469	7119			
1958	5028	12259		11063	7376			
1959	5412	12731		11354	7500			
1960	5907	13619	13538	11907	7809	6529	9498	19129
1961	6274	14261	13627	12642	8332	6961	9940	
1962	6770	14480	14020	13144	8120	7196	10106	
1963	7058	13996	14538	13760	8504	7703	10435	
1964	7592	14446	14916	14384	8778	8180	10853	
1965	8024	14854	15479	14481	9152	8677	11262	
1966	8632	15380	15939	15192	9613	9655	11876	
1967	9069	15711	16388	15855	9842	10083	12264	
1968	9209	16353	17139	15990	10313	10282	12676	
1969	9630	16562	17464	16408	10087	10741	12855	
1970	10148	16803	17860	16291	10484	10968	13150	
1971	10441	17284	18200	16976	11011	12500	13829	
1972	10894	17799	18775	17298	11513	13287	14360	
1973	11283	18293	19282	18150	12101	13694	14879	34138
1974	11596	18853	20055	18574	12560	14445	15431	
1975	12502	19304	20680	18925	12932	15074	15936	
1976	12885	19441	20910	18934	13215	15865	16282	
1977	12770	20142	21445	20072	13288	16246	16652	
1978	13054	20208	21647	20507	13715	16794	17014	
1979	13569	20199	22071	20496	13354	17301	17099	39648
1980	13188	20634	22424	20655	12979	17369	17087	
1981	13444	20395	22687	20909	12377	17207	16926	
1982	13785	20713	22419	21774	12354	17169	17040	
1983	13430	20938	22636	21662	13060	16963	17274	
1984	13875	21236	23136	22316	13505	17563	17760	
1985	13443	21199	23740	21810	13538	17389	17741	
1986	13758	21313	24061	22225	13926	17541	18031	
1987	13744	21285	24398	22724	13780	17102	17997	44620
1988	13711	21619	24598	23254	14183	16921	18229	45950
1989	13789	21715	21940	22870	13977	16168	17673	47096

* countries in Table; ** present EU membership, excluding Luxembourg

Source: GDP from Maddison (1995) but converted from 1990 GK dollars into 1996 EKS dollars as described in Appendix Table I.1. Employment: OECD countries 1970-1989 from *OECD Labour Force Statistics* (various issues); 1950, 1960 and 1973 from Maddison (1991, 1995) linked to 1973 estimates from OECD; East European countries from Table I.3, extrapolated backwards with trends from UN/ECE (1998), P. Marer and associates (1992), *Historically Planned Economies. A Guide to the Data*, World Bank, and Maddison (1995), *op. cit*

Appendix III –Output, Employment and Labour Productivity in Manufacturing, 1950-1997

The data in appendix III are all part of the ICOP Industry Data Base. Information on this data base and exact source descriptions can be obtained from the author.

Appendix Table III.1 – Output per person employed, 1975=100

	Poland			Hungary			Czechoslovakia			East Germany			West Germany		
	Output	Employ-ment	Produc-tivity	Output	Employ-ment	Produc-tivity	Output	Employ-ment	Produc-tivity	Output	Employ-ment	Produc-tivity	Output	Employ-ment	Produc-tivity
1950	13.2	41.4	31.9	25.0	45.7	54.6	28.3	57.1	49.5	23.6	72.9	32.3	19.3	73.2	26.3
1951	15.4	44.9	34.4	28.2	53.2	52.9	29.7	61.4	48.5	28.2	79.0	35.7	22.1	77.6	28.5
1952	16.7	47.7	35.0	32.2	60.7	53.0	30.2	64.0	47.2	30.3	82.8	36.6	25.2	79.4	31.7
1953	19.0	51.1	37.2	33.5	65.5	51.1	30.3	65.4	46.3	34.1	85.3	39.9	28.1	82.3	34.2
1954	20.8	53.4	38.9	34.8	66.9	52.0	31.2	66.9	46.6	38.3	86.2	44.4	31.5	85.7	36.8
1955	23.0	55.8	41.2	37.5	65.5	57.3	35.4	68.3	51.9	41.3	86.2	47.9	36.9	91.9	40.1
1956	24.8	58.1	42.6	34.3	66.9	51.3	38.6	70.0	55.2	43.5	86.4	50.4	39.9	95.8	41.6
1957	27.1	60.3	45.0	38.9	65.5	59.4	42.5	72.8	58.3	44.7	89.5	50.0	42.6	98.7	43.2
1958	29.4	61.0	48.3	42.4	68.3	62.1	47.4	74.6	63.5	48.1	91.4	52.7	45.0	98.8	45.5
1959	31.8	61.7	51.6	45.9	72.4	63.4	51.7	77.0	67.1	54.0	89.3	60.5	49.1	99.5	49.3
1960	35.1	62.1	56.5	50.0	77.1	64.8	56.5	80.7	70.1	58.6	90.5	64.8	55.7	105.8	52.6
1961	37.9	63.7	59.4	54.7	80.5	67.9	60.0	83.8	71.6	60.5	91.0	66.5	59.0	108.9	54.2
1962	40.7	66.3	61.4	58.9	82.3	71.6	62.7	86.2	72.8	63.6	90.6	70.2	61.9	109.4	56.6
1963	43.0	67.9	63.2	61.7	85.0	72.5	61.6	86.6	71.2	66.2	90.0	73.6	63.1	108.6	58.1
1964	46.7	69.2	67.4	66.6	87.3	76.4	63.4	87.0	72.8	68.0	88.2	77.1	68.7	108.7	63.2
1965	50.5	72.7	69.5	70.9	88.8	79.9	67.4	90.2	74.7	70.5	88.4	79.8	74.0	110.6	66.9
1966	53.5	75.3	71.1	77.0	90.1	85.5	69.2	91.6	75.5	72.5	88.7	81.7	75.3	109.4	68.8
1967	57.3	78.4	73.0	80.4	91.6	87.8	72.8	93.0	78.3	74.6	89.3	83.5	73.7	103.5	71.1
1968	61.3	81.2	75.4	83.4	94.1	88.6	76.4	94.4	80.9	78.3	91.6	85.4	81.3	104.3	78.0
1969	65.3	84.2	77.5	84.3	97.5	86.4	78.4	95.9	81.8	81.7	92.1	88.7	90.8	108.6	83.6
1970	69.4	85.6	81.1	87.9	99.8	88.0	82.7	97.3	85.0	84.7	92.1	92.0	95.5	111.2	85.9
1971	73.9	88.7	83.4	89.2	98.2	90.9	84.9	97.8	86.8	86.9	92.1	94.4	96.5	110.5	87.3
1972	79.9	92.4	86.4	90.4	97.7	92.5	88.6	98.3	90.2	88.6	97.8	90.5	99.6	108.4	91.9
1973	86.1	95.5	90.2	94.1	99.2	94.8	92.1	98.9	93.1	91.0	99.0	91.9	106.0	109.1	97.1

1974	92.1	98.1	93.9	96.4	100.4	96.1	95.5	99.4	96.1	95.4	99.4	96.1	105.0	106.5	98.5
1975	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0
1976	101.0	100.5	100.4	103.0	93.1	110.6	104.4	100.3	104.1	104.2	100.9	103.2	107.7	97.7	110.1
1977	102.2	101.7	100.6	108.0	93.0	116.1	108.1	101.0	107.0	106.4	101.5	104.9	109.6	98.1	111.8
1978	103.7	101.2	102.5	111.5	93.1	119.7	111.0	101.4	109.5	109.6	101.9	107.6	111.7	97.9	114.1
1979	101.9	100.3	101.6	113.5	91.6	123.9	113.1	102.0	110.9	113.3	102.4	110.6	117.3	99.1	118.4
1980	100.4	102.1	98.4	112.2	89.1	125.9	115.8	102.3	113.3	116.8	102.4	114.1	115.3	100.0	115.3
1981	87.2	101.3	86.1	113.9	86.9	131.1	118.4	102.5	115.6	120.5	103.0	117.0	113.7	98.2	115.9
1982	82.6	94.6	87.4	115.3	84.8	136.0	120.0	102.6	117.0	120.5	103.5	116.4	109.7	95.3	115.1
1983	88.6	93.3	94.9	116.3	81.5	142.7	122.7	102.7	119.5	121.9	104.1	117.0	110.8	92.1	120.3
1984	91.8	92.8	99.0	120.0	81.0	148.1	124.6	103.0	120.9	126.1	105.0	120.0	113.9	91.7	124.2
1985	93.5	93.4	100.0	120.1	82.1	146.2	127.3	103.3	123.2	128.1	105.7	121.1	117.5	92.8	126.6
1986	94.4	88.9	106.2	122.5	81.6	150.2	128.3	103.6	123.9	128.6	105.3	122.1	119.2	94.3	126.4
1987	92.5	88.3	104.8	123.8	79.9	155.0	128.6	101.2	127.1	131.2	104.8	125.2	115.9	94.4	122.8
1988	93.4	86.7	107.7	121.9	77.7	157.0	130.8	103.1	126.8	134.5	104.8	128.4	119.6	94.2	126.9
1989	89.4	83.5	107.1	115.6	75.2	153.6	129.8	102.5	126.6	139.7	103.6	134.8	123.7	95.5	129.4
1990	67.9	75.9	89.4	105.0	67.3	156.1	126.9	99.4	127.6	94.8	89.4	106.0	130.5	98.2	132.9
1991	59.8	71.7	83.4	85.8	59.9	143.3				51.3	87.7	58.5	135.3	99.6	135.9
1992	62.2	64.2	96.8	77.5	50.6	153.1				53.9	55.8	96.5	131.6	97.9	134.5
1993	66.1	62.9	105.1	80.6	45.0	179.0				61.4	47.5	129.2	121.1	92.0	131.6
1994	74.2	61.5	120.5	88.2	42.6	207.0				72.4	44.9	161.3	123.8	87.4	141.7
1995	81.3	61.9	131.4	92.3	40.8	226.2				79.3	44.3	179.0	123.8	85.5	144.9
1996	88.0	62.1	141.8	95.4	40.9	233.6				84.0	42.9	195.6	123.6	82.8	149.3

Methods and Sources: East European countries up to 1990 (except East Germany: up to 1984): based on Adjusted Factor Cost method derived from various reports of Alton and Associates, *Research Project on National Income in East Central Europe*. For full references for Czechoslovakia and East Germany, see B. van Ark (1996), "Convergence and Divergence in the European Periphery: Productivity in Eastern and Southern Europe in Retrospect", in B. van Ark and N.F.R. Crafts, eds., *Quantitative Aspects of Post-War European Economic Growth*, CEPR/Cambridge University Press, pp. 271-326. For full references for Hungary and Poland, see E. Horlings and B. van Ark (1998), "Benchmark Comparisons of Manufacturing Productivity in Eastern Europe, 1937-1989", in Bart van Ark, Erik Buyst and Jan Luiten van Zanden, eds., *Historical Benchmark Comparisons of Output and Productivity*, Proceedings of 12th International Economic History Congress, Madrid. East Germany 1984-1990 from B. Görzig (1991), "Produktion und Produktionsfaktoren in Ostdeutschland", *Dokumentation*, DIW, Berlin. Hungary and Poland since 1990: time series on industrial output from UN/ECE (1998) and labour input series from *OECD Labour Force Statistics*. West Germany and (since 1990) East Germany: Statistisches Bundesamt, *Volkswirtschaftliche Gesamtrechnungen*, various issues, supplemented with estimates from DIW on East Germany (1989-1991).

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