Why did socialist economies fail?

The role of factor inputs reconsidered

Tamás Vonyó[1] Bocconi University

Alexander Klein[2] University of Kent

ABSTRACT

We present new estimates for investment and new growth accounts for three socialist economies between 1950 and 1989. Government statistics reported distorted measures for both the rate and trajectory of productivity growth in Czechoslovakia, Hungary, and Poland. Researchers have since benefited from revised output data but continued to use official statistics on capital input, or estimated capital stock from official investment data. Investment levels and rates of capital accumulation were much lower than officially claimed and over-reporting worsened over time. A setback in factor accumulation, both equipment investment and labour input, contributed significantly to the socialist growth failure of the 1980s.

Keywords: growth accounting, capital accumulation, Socialism, Eastern Europe

JEL classification: N14, N64, O47, P27.

ACKNOWLEDGEMENTS

We acknowledge the support of the Economic History Department at the LSE that provided financial assistance for data collection and the Dondena Centre for Research on Social Dynamics and Public Policy at Bocconi University. We owe a debt of gratitude to Lin Ma and Cecylia Leszczyńska for their help in data collection. We thank Nicholas Crafts, Herman de Jong, Mark Harrison, Leandro Prados, and Nikolaus Wolf for their suggestions and participants of conferences and research seminars in Berlin, Florence, Kyoto, London, Pisa, Prague, and Warsaw for their insightful comments.

[1] Department of Policy Analysis and Public Management, Bocconi University, Via Roentgen 1, 20136 Milan, Italy, Email: tamas.vonyo@unibocconi.it

[2] School of Economics, Keynes College, University of Kent, Canterbury, Kent, CT2 7NP, United Kingdom, Email: A.Klein-474@kent.ac.uk

The relative economic decline of Eastern Europe after 1945 has been linked to institutional failure. The inefficiency of central planning compared to the market economy is well established both theoretically and empirically.[1] Socialism, it has been argued, was relatively successful in mobilizing resources but stifled innovation and entrepreneurship. Planned economies thus achieved 'a satisfactory productivity performance in the era of mass production, but could not adapt to the requirements of flexible production technology', which contributed to their collapse in the 1980s.[2] They maintained high labour participation and invested heavily in physical capital but were inefficient compared to western market economies in their use of production factors and intermediate inputs.[3]

We do not refute that the planned economy was inefficient, but the above characterization of the socialist growth experience requires revision. As the literature review will show, the majority of existing growth accounts demonstrated productivity failure in socialist economies. We consider these results biased by the inconsistent use of data on output and factor inputs. Researchers benefited from revised data on national income that yielded more modest growth rates than what government statistics implied, but they continued to use official data on capital formation. Under central planning, investment statistics are difficult to trust. We show that socialist economies invested considerably less in physical capital than previously claimed. Likewise, employment statistics overstate the growth of labour input as average work hours declined over time. We suggest a greater role for factor inputs and a smaller one for productivity in the relative decline of Eastern Europe. Moving beyond Total Factor Productivity (TFP), we demonstrate an accumulation failure during the last decade of communism. Our findings imply fundamental differences between the growth experience of small socialist countries and what we know from the accounts of the Soviet economy over the same period.

We reconstruct investment series for the aggregate economy in Czechoslovakia, Hungary, and Poland from 1950 to 1989 and derive capital accumulation from these estimates. We adjust employment for changes in average work hours and educational attainment. We then use these new data on factor inputs to establish new growth accounts. Weighted input growth in all three countries began to slow down in the 1960s and in Hungary and Poland turned negative after 1980. Labour-productivity growth remained respectable until the fall of communism, even though structural change had an adverse effect on productivity during the 1980s. Average rates of TFP growth fell considerably after the postwar golden age. However, their continued decline after 1980 was much less dramatic. All three economies ran out of steam not so much because of diminishing rates of productivity growth but mainly because of inadequate factor accumulation.

Technological inefficiencies contributed to this growth retardation, but focusing only on them paints an incomplete picture. External shocks affecting both the supply of imports and public spending on investment projects played a very important role, too. They invoked austerity policies that ignited

[1] For a general summary see Eichengreen, *European economy*, chapters 5 and 10.
[2] Broadberry and Klein, 'When and why', p.37.
[3] Bergson, 'Comparative productivity'; Van Ark, 'Convergence'.

public discontent and undermined the economic legitimacy of communism. Two such shocks hit Eastern Europe simultaneously. Firstly, rising oil prices made socialist industries less competitive because they applied energy-intensive technologies, while fuel imports became more expensive. Secondly, refinancing their external debt, which had expanded throughout the 1970s, was more costly as western creditor nations raised interest rates to combat inflation at home. Socialist governments responded by limiting imports and by reducing international borrowing. Consequently, even where GDP continued to grow, domestic absorption stagnated or declined. Scarce resources were allocated to consumption and social infrastructure to satisfy popular demands. Thus equipment investment became the victim of austerity. Insufficient machinery investment, in turn, thwarted both technological modernization and employment creation. Labour input declined further with shorter official workweeks and popular welfare measures that reduced female labour participation.

Our growth accounts bring the experience of East Central Europe after the postwar golden age closer to what the literature has described for developing regions following their flirtation with import-substituting industrialization. By contrast, it differs from what we know about the Soviet economy, which was hampered by the wasteful allocation of resources that the boom in hydrocarbons mobilised. The crisis of the 1980s in East Central Europe was not idiosyncratic and did not result from the inefficiencies attributed to the socialist system. This does not mean that technological or allocation inefficiencies can be refuted; indeed there is plentiful evidence for their existence. But, they are not the sole reason for the loss of momentum in economic growth after 1980; insufficient factor accumulation was equally important, if not more.

After a brief literature review, we discuss the data and describe our methodology to estimate investment and capital stock in section II. Section III reports our new estimates, compares the imputed investment ratios across countries, and contrasts these with data on Southern European economies. In section IV, we reconstruct the aggregate growth accounts of Czechoslovakia, Hungary and Poland, and discuss the role of structural change. Section V explains the crisis of the 1980s, before section VI concludes. In the supplementary online material, Appendix I describes the sources we used to reconstruct investment. We report investment and capital stock by year in Appendix II and robustness checks in Appendix III.

I

The theory of socialist development reaches back to the Marxian extended reproduction. Feldman formalized this concept and alongside Preobrazhensky stressed the role of the state in accumulating resources for investment.[4] Primary socialist accumulation was used to justify state intervention in late-developing nations, as it 'provided for lacking prerequisites'.[5]

[4] Feldman, 'Theory', p. 312; Preobrazhensky, 'Primary socialist accumulation', pp. 235-40.
[5] Gerschenkron, *Economic backwardness*. Pp. 359-60.

Even though recent scholarship has downplayed the role of economic motives behind the Stalinist industrialisation program[6], Allen reinterpreted Soviet industrialization in the 1930s as 'Feldman and Preobrazhensky in action'. Centralized resource allocation with the simultaneous application of output planning and soft budget constraints favoured heavy industry.[7] Earlier, Nurkse had posited that, capital accumulation in poor countries generated rapid growth through the reallocation of inefficiently employed farm labour into industry. High rates of investment yielded fast growth as long as this labour surplus was not absorbed.[8] Common to these interpretations is that they did not define the role of technology and did not specifically acknowledge the limits of extensive growth. Horvat was among the first to introduce diminishing returns into the theory of socialist development, with the capacity to absorb new capital limited by the supply of labour.[9]

The failure of socialist economies has been blamed on the neglect of technological progress and inefficient investment.[10] These factors were complemented by the high and growing material intensity of production. State enterprises operating with soft budget constraints maximized their investment allocations and intermediate inputs regardless of the expected returns. This evolved into a shortage economy, in which profit maximization was replaced by resource hunger that undermined productivity and innovation.[11] Shortages emerging from poor allocation are believed to have become more disruptive as planned economies modernized. Grey markets emerged to satisfy increasingly complex consumer demands and to reallocate intermediate inputs between firms.[12] Input-output data indicated that, on average, the material intensity of production was higher in socialist countries than in western market economies and that this gap widened after the mid-1970s.[13]

Krugman articulated the dominant view on planned development, suggesting that authoritarian growth was unsustainable in the long run.[14] Early success, he argued, came from 'perspiration' (factor accumulation), followed by an inevitable slowdown because of the lack of 'inspiration' (innovation and creative entrepreneurship). Krugman's characterization of the East Asian growth miracles as the product of neoclassical transition dynamics received support from quantitative research[15], but has since been convincingly refuted. Official statistics overstated capital accumulation; TFP contributed strongly to the catching up of newly industrialized countries between 1960 and 1990.[16]

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[6] See Kontorovich, 'Military origins'.
[7] Allen, 'Capital accummulation', pp. 7-16; Allen, *Farm to factory*, ch. 8-9.
[8] Nurske, *Problems*
[9] Horvat, *Towards a theory*. Marxists economists saw capital accumulation as the main driver of development and focused on the capital-output ratio, as in the Harrod-Domar model, rather than joint factor productivity (see Berend, *Capital intensity*).
[10] See the works of Kalecki in Osiatyński, *Socialism*.
[11] Kornai, 'The Hungarian reforms', pp. 140-5.
[12] Banerjee and Spagat, 'Productivity paralysis'.
[13] Gomulka and Rostowski, 'International comparison', pp. 481-2, 488.
[14] Krugman, 'The myth'
[15] Mankiw, 'Growth of nations'; Young, 'Tyranny of numbers'
[16] Hsieh, 'What explains'

By contrast, extensive growth remained the mainstream interpretation of socialist development. Most research conducted on the USSR and Central Europe reported high productivity growth for the 1950s and, in some cases, the 1960s, followed by rapid deceleration. For the Soviet economy, most studies found negative TFP growth during the late 1970s and 1980s.[17] Brada applied a frontier production function to examine Eastern European manufacturing performance between 1960 and 1985 and confirmed the declining rate of TFP growth, especially after 1980.[18]

This conventional story of productivity failure is, at least in part, the product of statistical illusion. Growth accounts derived entirely from official statistics on both output and factor inputs suggested no such failure; instead constant or increasing rates of TFP growth until the early 1980s.[19] Signs of a productivity meltdown emerged from subsequent research that benefited from revised national income data but that continued to use official statistics on capital accumulation or estimated capital stock from inflated official investment data. New cross-country evidence has only made good on these shortcomings in part. The last version of the *Penn World Tables* (PWT) to include all socialist countries reported investment ratios of almost or above thirty per cent across Eastern Europe throughout the 1970s and 1980s.[20] Recent updates of the PWT suggest dramatically lower investment rates for some of the former socialist countries, thanks to the introduction of post-1990 benchmarks based on market prices, but still report high rates of capital accumulation and zero, or even negative, TFP growth for the 1980s.[21]

We demonstrate that, in addition to productivity, factor inputs played a prominent role in the relative decline of socialist economies. Rather than recording modest growth rates despite very high levels of investment, Central European countries fell behind, in large part, because they invested much smaller proportions of their national income in productive capital than faster growing market economies, especially in Southern Europe. This finding differs fundamentally from what we know about the retardation of the Soviet economy over the same period.

II

Socialist national accounts must be treated with suspicion. Data on physical units of production are considered comparatively trustworthy. Eastern European scholars often used such measures as proxy for economic growth and the standard of living.[22] By contrast, national income statistics were distorted by unrealistic producer prices, incorrect weighting of sectoral output, and inappropriate index-number methods.[23] Independent western research has established alternative estimates based on the System of

[17] Balassa and Bertrand, 'Growth performance'; Bergson, 'Comparative productivity'; Easterly and Fischer, 'Soviet economic decline'; Ofer, 'Soviet economic growth'; Ritschl, 'Exercise'; Sleifer, *Planning ahead*; Van Ark, 'Convergence'
[18] Brada, 'Technological progress', pp. 437-43.
[19] On the East German economy, see Ritschl, 'Exercise', table 16.1, p. 500. On Czechoslovak and Polish industry, see Rusek, 'Industrial growth', and Kemme, 'Productivity' respectively.
[20] Heston et al., *Penn World Tables*
[21] Feenstra et al., 'The next generation'
[22] Bródy, 'Measuring GDP'; Ehrlich, 'Contest'
[23] On the methodology of socialist national accounts, see Horvat, 'Conceptual background' and Kaser, 'Survey'.

National Accounts. They used official data only on physical output to construct time series that they linked to independently established benchmarks, which aggregated output by sector using factor-cost weights.[24] The *Research Project on National Income in East Central Europe* carried out the most substantial work. It reported GNP for several countries including Czechoslovakia, Hungary, and Poland, which have been widely used in empirical research and remain the main source of the Maddison data for the period 1950-1989.[25] The same working papers provide evidence on GNP by sector of origin of product.[26]

We obtain employment data from official publications.[27] In the absence of comprehensive government statistics on labour hours outside industry, we follow a shortcut method to adjust total employment for changes in average work hours. If we assume that the number of extra hours that employees were required to work did not change dramatically over time, then, for the economy as a whole, the official workweek is a good indication of actual work hours. We have exact figures on total hours worked in Hungary after 1980, which confirm the accuracy of our approach.[28] Legislation on the official workweek and its implementation are well documented. In addition, for Czechoslovakia and Poland, we assume that in 1989 at least five per cent of contract hours were lost due to the extensive strikes. To adjust labour input for returns to education, we use the most recent Barro-Lee data on average years of schooling for the adult working-age population.[29]

For investment and capital stock, we generate new data that we consider more reliable than official statistics or scholarly estimates built on them. Socialist investment data suffered from numerous distortions. Under fixed prices and allocations, capital-goods suppliers could increase value added by degrading quality, either by changing product specifications or by shifting to less valuable inputs. Prices for new machines were inflated by unsubstantiated claims of major product innovation. Concealed inflation in the investment statistics was discussed in the Soviet context.[30] But, gross capital formation was also magnified by additional items, such as the training of personnel, R&D, and inventories, which were fabricated in order for the main components of national accounts to match. Government accounts were often internally inconsistent, for instance when the sum of construction and machinery investment did not even approximate the value of gross fixed capital formation in the national accounts. Past investment data were frequently revised, especially for the 1950s and for Poland, in order for the current

[24] On the construction of the benchmarks, see Alton et al., *Statistics*, and Alton et al., *The structure*.
[25] See Maddison, *World economy*, pp. 469-71.
[26] Alton, 'Economic structure'; Alton et al., *Chechoslovakia*; Alton et al., *Economic growth*; Alton et al., *East European GNP*; Czriják, *Hungarian GNP*; Holesovsky, *Czechoslovakia*; Lazarcik, *Czechoslovak*.
[27] Employment statistics are generally considered uncontroversial. See Adam, 'Employment policies'.
[28] See *The Conference Board Total Economy Database* (http://www.conferenceboard.org/data/economydatabase/).
[29] See Barro and Lee, 'New dataset', and data available at http://barrolee.com/.
[30] Nove, 'Note on growth'; Wiles, 'Soviet consumption'; Bergson, 'Soviet real investment'; Kontorovich, 'Inflation'

rate of capital formation to appear higher relative to earlier periods. The sources of these inconsistencies are difficult, often impossible, to identify.

Investment statistics appeared consistent at the time with capital stock levels because government figures overstated capital depreciation, not only gross investment. For Hungary, the statistical yearbooks reported total depreciation by asset type from 1985 onward. These values imply depreciation rates of approximately 10 per cent for equipment, which are much higher than what researchers applied pre-1960 and almost as high as what they assumed for the period 1960-2000 for Spain.[31] Given that socialist economies extended the service lives of both machinery and transport equipment, these depreciation rates are implausible. State enterprises seem to have made excessive use of their allowance to write off depreciated assets, which may have helped them overstate their needs for capital replacement and thus their claim for investment funds.

We determine capital stock with the perpetual-inventory method developed by economists and social accountants to build up stocks of capital from flows of investment.[32]

$$K_1 = \sum_{t=0}^{n} (1 - \delta)\, I_t \qquad [1]$$

Following this approach, the stock of fixed capital in a given year evolves according to the value of new investments made in that year and the depreciation of the existing stock.

$$K_t = (1 - \delta) K_{t-1} + I_t \qquad [2]$$

The capital stock (K) in year *t* is derived from the stock of the year *t-1* by adding investment (I), more precisely gross fixed capital formation, and subtracting capital depreciation. The same method can be applied to estimate past capital stock from more recent levels with retrospective calculation.[33] The exact formula in equation (2) measures the capital stock at the end of year *t*.

$$\delta = R/T \qquad [3]$$

The depreciation rate δ is asset-specific and inversely related to the service life of the asset, with parameter *R* (declining balance) and *T*, the average service life typical for the type of asset. If *R* equals one, then depreciation is arithmetic. This pattern is typical for buildings and structures. Geometric depreciation, when *R* equals two, is more suitable for estimating the stock of machinery and equipment. Empirical studies adopted the 'modified' geometric depreciation pattern proposed by Jorgenson that falls between the arithmetic and geometric patterns.[34] We take the depreciation of structures to be

[31] See Prados de la Escosura and Roses, 'Capital', table 2, p. 146.
[32] Jorgenson, 'Economic theory'; Jorgenson, 'Accounting for capital'; Hulten, 'Measurement'
[33] Feinstein, N*ational income* was among the first to make such calculations.
[34] See Jorgenson, 'Productivity', pp. 42-5. Using data from the *U.S. National Income and Product Accounts*, Hulten and Wykoff, 'Measurement', p. 94, estimated econometrically *R*=1.65 for equipment and *R*=0.91 for structures.

arithmetic and assume R=1.5 for equipment, but we also run robustness checks with alternative depreciation patterns in Appendix III.

Previous accounts of postwar growth have used a range of values for the service life. 50-70 years are typical for dwellings, 30-40 years for other structures.[35] We use T=50 until the late 1960s and T=40 thereafter. Soaring public investment from 1968 in Czechoslovakia and Hungary and from 1971 in Poland shifted resources to transport infrastructure and modern standardized housing using cheap materials that were assumed to have shorter lifespans than traditional buildings. Previous studies have used asset lives of 10-25 years for machinery, with road transport vehicles and communications equipment, and more modern vintages, in general, thought to have faster depreciation. Since command economies were known for capital goods being kept beyond the point where they were fully depreciated by wear-and-tear, we assume long service lives for machinery: T=25 in the early postwar decades T=20 for the 1970s and 1980s. These assumptions imply depreciation rates of 2 per cent for structures and 6 per cent for equipment until 1967 (1970 for Poland) and rates of 2.5 per cent and 7.5 per cent respectively thereafter. The estimated rates of capital accumulation are not very sensitive to alternative values of T used in the literature that are plausible for the period and the countries we study. We report robustness checks in Appendix III.

The perpetual inventory method requires data on the benchmark value of fixed assets and on levels of machinery and construction investment expressed in the prices of the benchmark year. The former cannot be independently established. We must cautiously select the most trustable official sources. For Czechoslovakia and Hungary, we use data from 1990, the first year after transition and the introduction of market prices for many capital goods, which can be directly linked with our new investment series. The reported values are plausible: they imply capital-output ratios close to 3, which is standard globally for this period.[36] Poland experienced hyperinflation in the late 1980s and the early 1990s. The best pre-inflation benchmark is 1971, when the country, following other nations in Central Europe, introduced radical economic reforms that systematically revised official prices. The comprehensive re-evaluation of fixed assets in the socialist sector aimed at producer prices that better reflect factor costs, since enterprises were subsequently required to pay interest on their capital and could to write off depreciation.[37] These are the most reliable statistics for capital stock during the socialist period and the relative prices of the reform year approximate most closely real factor costs.[38]

[35] See Prados de la Escosura and Roses, 'Capital', table 1, p. 145.
[36] Feenstra et al., 'The next generation', online appendix, p. 16.
[37] On the reforms in the three countries, see Staller, 'Czechoslovakia', Balassa, 'The economic reform', Kýn, 'Rise and fall', Portes, 'Economic reforms', Hare and Wanless, 'Polish and Hungarian', and Kornai, 'The Hungarian reforms'.
[38] Official data for Czechoslovakia and Hungary report net capital stock for both machinery and structures in 1990. Polish statistics for 1971 only report gross capital stock. We derive net values using the ratio of net to gross stock in Czechoslovakia and Hungary, but we assume somewhat lower ratios, as the Polish capital stock in 1970 had to be considerably older, after decades of very low investment.

Previous studies have used alternative methods to estimate initial capital stock, especially when official data is not available, or cannot be relied on to construct plausible benchmarks. The production-function approach, originally proposed by Harberger, determines the initial stock by the steady-state relationship between the initial level of investment, the growth of investment, and the rate of depreciation.[39] It has been used in empirical research on developing countries and on long-run growth.[40] However, it has the caveats that European economies were far off their steady state after the war and that it is difficult to establish the steady-state growth rate of investment. The recent PWT updates determine initial stock by assuming plausible capital-output ratios. This approach also becomes problematic in the postwar context, when factor proportions were temporarily dislocated from their norm.

Recent advances in estimating capital input used the concept of capitals services, which has been applied in historical research.[41] This approach provides a more direct measure of capital inputs in production and the imputed ratio of capital input to stock can be used as an indicator of capital quality in the growth accounting formulae. However, it requires data on the rental price of capital. It is, therefore, inappropriate for centrally planned economies, where capital goods were directly allocated, and thus there were no market interest rates. The only solution to circumvent this problem would be to use values estimated for market economies, but this would imply critical assumptions about technology use. In addition, computing capital input would likely not yield rates of capital accumulation radically different from our estimates. Prados de la Escosura and Roses found very similar rates of net capital formation for Spain using a battery of alternative computations, even in the postwar era of high growth.[42]

We follow two strategies to construct new investment series. For the period 1950-1967, the Research Project published independent estimates for investment in both equipment and structures that reflect the volume of investment goods and construction services.[43] They measure construction investment by gross output in construction that, in turn, is approximated by the availability of building materials. Equipment investment is estimated by the production of machinery and other instruments, adjusted for net imports and disregarding year-to-year changes in inventories.

These are upper-bound estimates of actual investment. Until the mid-1960s, reported levels of machinery investment can be deemed accurate, as the share of consumer durables in engineering output remained very small, and items seldom used as capital goods, such as bicycles, motorcycles and

[39] Harberger, 'Perspectives'
[40] Nehru and Dareshwar, 'New database'; Young, 'Tyranny of numbers'; Prados de la Escosura and Roses, 'Sources'; *Idem*, 'Capital'
[41] Jorgenson, 'Capital', p. 10; Jorgenson, 'Productivity', pp. 46-8; Prados de la Escosura and Roses, 'Sources', p. 1068; *Idem*, 'Capital', pp. 146-8.
[42] Prados de la Escosura and Roses, 'Capital', table 5, p. 155.
[43] Bandor et al., *Hungary*; Czirják, *Hungarian investment*; Holesovsky, *Czechoslovakia*; Korbonski et al., *Poland*; Staller, *Czechoslovak index of investment*; Staller, *Czechoslovak index of construction*

communication equipment, were subtracted from machinery output.[44] Military hardware may have carved out more substantial shares from engineering output, but we have no reliable data on the components of defence spending for the 1950s and early 1960s. Scholarly estimates using both detailed budgetary figures and proxy methods for the period after 1965 suggest that these shares never surpassed 5 per cent after adjusting for arms trade, and were likely smaller because military hardware included equipment that could be put to productive use, such as transport vehicles.[45] Approximating construction investment with the volume of available building materials can be considered plausible for the entire period, provided that the value-added share of construction services remained constant. The literature argued that waste in materials, if anything, increased over time, due both to the growing complexity of input requirements and the long duration of building projects.[46] To the extent that these arguments hold, we go against our hypotheses by overstating the growth of investment and thus the rate of capital accumulation.

For the period after 1967, the Research Project did not publish similar estimates, since they would have no longer measured the level and structure of investment accurately. Instead, it reported an index of domestic final use, decomposed into three major items: household consumption, government consumption, and a residual.[47] The residual is largely gross capital formation but also includes sub-components of public spending not included under government consumption, most notably national defence and R&D, and changes in inventories.

For the period after 1965, we use the index of the Research Project on construction to account for investment in structures, but we derive the index of equipment investment by decomposing the residual term of domestic absorption.[48] Specifically, we subtract for each year the index of military spending and of R&D reported elsewhere by the Research Project from the index of residual final use, weighting each sub-component by its share in total GDP in the benchmark years of the index-number series.[49] To determine these weights, we take disaggregate data on research outlays from official sources and total military expenditure as a percentage of GDP from the Stockholm International Peace Research Institute (SIPRI).[50] In light of the controversy about Soviet budgetary figures on national defence, one could question the reliability of this evidence.[51] However, previous research has shown data on military spending in Central Europe to be much more accurate. Estimates constructed using wages and living-costs for personnel expenses and input-output and trade statistics to determine material costs came close

[44] Even in Austria, a more prosperous and consumer-oriented economy relative to socialist countries, very few private households owned modern appliances before the late 1960s. See Seidel, *Österreichs Wirtschaft*, table 1.13, p. 57.
[45] Crane, 'Military spending', pp. 530-8.
[46] Banerjee and Spagat, 'Productivity paralysis'
[47] Alton et al., *Eastern Europe*; Alton et al., *East European GNP*
[48] We assume that aggregation errors were random and that the relative size of inventories did not change over time, since we cannot establish these items independently.
[49] Alton et al., *Economic growth*; Alton et al., *East European GNP*
[50] SIPRI, *Yearbook*, 1980, p. 29; 1991, pp. 174-5.
[51] Epstein, 'Economic costs', p. 127; Davis, 'Defence sector', pp. 155-6; Harrison, 'Secrets', see abstract.

to budgetary figures.[52] The lack of transparency in government accounts was found to be much more serious in the Soviet Union than in the smaller Warsaw Pact countries.[53]

The index for equipment investment is obtained by subtracting the construction index from the index of fixed-capital investment. We assume that gross fixed capital formation evolved as gross capital formation, disregarding changes in inventories that we cannot establish independently. In order to minimize the impact of aggregation errors and of unobserved swings in inventories, we smooth the index-number series for residual final use before we decompose this index. We then link our post-1965 index for equipment investment to the level estimates of the Research Project for the period 1950-1967. The thus obtained investment levels are converted into prices of the benchmark years for capital stock using official price indexes for investments by asset type.[54] We discuss the methods the Research Project used to estimate the different components of domestic final use in Appendix I.

III

In this section, we compare our estimates for equipment and construction investment to official statistics. We then trace the share of gross capital formation in GDP and contrast these rates with the investment ratios of Southern European countries. This exercise demonstrates that slow capital accumulation was instrumental in the falling behind of Central Europe. We report investment and capital stock by year in Appendix II. Figure 1 and figure 2 plot investment in Czechoslovakia and Hungary respectively. We compare these new estimates with official data on total investment, since government statistics on gross fixed capital formation did not always distinguish between asset types.

Figures 1 and 2

Following the rapid recovery after World War II and a temporary setback in the early 1950s, investment continued to grow steadily until about 1970. Thereafter, the two economies walked different paths. The share of equipment in total investment increased in Czechoslovakia until the mid-1970s. In Hungary, machinery investment declined from 1971 and in the 1980s fell back to levels achieved already two decades earlier. Construction investment began to diminish after 1978 but remained higher relative to earlier periods than equipment investment. In Czechoslovakia, construction stabilized after 1978, while machinery investment plummeted in the early 1980s and recovered after 1985. Over the last twenty years of communism, capital accumulation focused more strongly on machinery in Czechoslovakia than in Hungary, even if during the 1980s the share of equipment investment fell considerably in both countries. This is not surprising given the structural differences between the two economies, which we discuss in the following section. The value-added share of the most mechanised

[52] These estimates are similar to the data published in Alton et al., *East European defence*, which we rely upon.
[53] Clements, 'Costs'; Wiles, 'Soviet defence expenditures'
[54] The series might be affected by hidden inflation. If we were abel to account for it, the real investment in the 1980s would have been even lower than in the earlier decades, strenghtening our arguments even further.

sectors, especially industry, was larger in Czechoslovakia and continued to increase moderately even during the 1970s and 1980s, when it was already declining in Hungary.

In both countries, retrospective official accounts underestimated investment during the 1950s and the early 1960s, but the rates of investment growth do not differ much from our estimates. By contrast, official data massively overstate the growth of investment during the 1970s and, therefore, investment levels in the 1980s. In reality, investment at best stagnated and most likely declined from the mid-1970s onward. The fall of investment after 1980 affected predominantly machinery investment. Even in Czechoslovakia, investment growth in the 1970s and 1980s was much less remarkable than officially claimed and resulted mainly from increasing outlays for building projects.

Poland represents a different case (see figure 3). Investment levels were very low after the war, and the stock of fixed capital declined until 1950, of machinery until 1952. Investment growth resumed thereafter, but remained modest until the mid-1960s, contrary to the official statistics. Slow capital accumulation in this period reflected the unique factor proportions that the Polish economy inherited from the 1940s. Destruction of physical capital was substantial, for sure, but western research found contemporary Polish estimates deliberately exaggerative as they were meant to serve as basis for reparations and foreign economic assistance.[55] Furthermore, most of the damage affected residential and transport infrastructure, not production equipment.[56] In fact, production capacity was enhanced significantly in the primary industries. Between 1938 and 1943, steel production in Upper Silesia had almost tripled.[57] By contrast, Poland suffered colossal wartime casualties and even greater loss of manpower due to the exodus and expulsion of ethnic Germans from the eastern provinces of Prussia after the war. The total population declined by one fifth between 1939 and 1947. It was not before 1963 that Poland recovered from this demographic shock.[58] However, the impact of the war was even larger on the industrial labour force and especially skilled labour. 79 per cent of all victims were urban dwellers, the number of industrial workers declined by more than 20 per cent, among self-employed by more than 40 per cent, and employment in commerce was down 60 per cent. Both the Holocaust and the extensive purge of the Polish economic elites by the German occupiers decimated management personnel in engineering, trade, and finance even more.[59] Thus, the Polish economy was short of labour during the 1950s and, therefore, could grow into existing production capacities. After 1970, investment growth became explosive, both in construction and equipment, but only temporarily, and investment levels plummeted in the early 1980s more than they did in the other two countries.

Figure 3

[55] Alton, *Polish postwar economy*, p. 31.
[56] Von Delhaes, *Quellen*, pp. 23-4.
[57] Landau and Tomaszewski, *Wirtschaftsgeschichte*, pp. 225-6.
[58] Maddison, *The world economy*, pp. 474-5.
[59] Von Delhaes, *Quellen*, p. 17.

Throughout the 1960s and until the mid-1970s, investment in machinery was catching up with levels of construction investment. From 1978, investments declined but fell much more dramatically for equipment. The final collapse of investment activity after 1985 was entirely the product of sluggish machinery investment. Official figures report considerably faster investment growth already after 1960, but the overstatement of growth rates in the 1970s was spectacular. It was suggested that investment doubled between 1972 and 1975. This and the apparent recovery after 1985 are serious distortions produced by official statistics, the source of which is difficult to identify.

Two core results stand out for all three economies. Firstly, investment levels during the 1980s were much lower than what official data had suggested and what researchers using these data believed. Secondly, capital formation slowed down in the last decade of communism mainly because of the sharp decline in machinery investment. Still, investment levels alone do not tell much about growth dynamics. Rates of capital accumulation and of economic growth depend more on relative levels of investment, the ratio of gross capital formation to GDP. The PWT are the most commonly used source for investment ratios in cross-country investigations. Vonyó published a new set of investment rates across Eastern Europe between 1950 and 1989, which reflect continuously increasing ratios until the 1970s and sharply falling rates in the 1980s, except for the Soviet Union. Socialist economies invested considerably smaller proportions of their national income than faster growing nations in Western Europe, except in the 1970s.[60] However, these investment ratios are upper-bound benchmark estimates that may reflect biased relative prices for investment goods and that included, in some cases, minor residual items of domestic final use other than investment.

Figure 4

We take a different approach. We derive benchmark investment rates from the last version of the PWT that reported data on all the former socialist countries in Eastern Europe. PWT 5.6 reported investment rates both as real GDP components and in current international prices. For the benchmark year 1985, both shares were taken directly from official national accounts. We correct these benchmark rates for the proportional difference between our investment levels and official figures, assuming that this ratio for gross fixed capital formation also holds for gross capital formation. The investment ratios for all other years are then interpolated using our constant-price investment series and Maddison data on GDP.[61] We again assume that gross capital formation evolved over time as gross fixed capital formation. Figure 4 reports striking results. Relative levels of investment in Central Europe were rather modest, and fell dramatically during the 1980s. In both Czechoslovakia and Hungary, investment ratios surged during the collectivization drives of the early and late 1950s. In the late 1960s and the early

[60] Vonyó, 'War and socialism', pp. 259-60.
[61] The time series for GDP from the Research Project used by Maddison applied factor cost weights for 1985 or 1987. See Alton et al., 'Economic growth', p. 20.

1970s, Hungary and Poland borrowed heavily from international creditors and used money from abroad to scale up investment. Other times, Polish investment rates were well below 20 per cent, and were very modest by the standards of the postwar era.

Figure 5

Figure 5 compares investment ratios for the three Central European countries weighted by their real GDP with the weighted average rates calculated from the most recent PWT data for Greece, Italy, Portugal, and Spain. PWT 9.0 reports investment shares in current international PPPs using multiple benchmarks for GDP spending components. For OECD countries, these include 1975, 1980, 1985 and 1995 onward. Price indices are interpolated for all years between these benchmarks and extrapolated from 1975 for all previous years.[62] Italy being the most advanced economy of the region and the only country with a democratic political system since the start of the period, we chart two alternative sets of investment ratios- with and without Italy respectively. Except for the 1970s, Central Europe lagged behind the market economies of Southern Europe not just in rates of economic growth but also in rates of investment. The bar charts measured on the secondary vertical axis show that the largest growth differentials in real GDP per capita averaged over five-year periods between 1950 and 1990 typically correspond with the most substantial gaps in the investment ratios. This finding concurs with recent research in that the falling behind of socialist economies can, to a large extent, be explained within a standard conditional convergence framework.[63] We reveal this to be true even for the 1980s, when the growth failure of Central Europe versus strong growth in Southern Europe coincided with a striking divergence in investment activity between the two regions.

IV

Table 1 reports average growth rates of national income and factor inputs according to alternative sources and specifications. Previous research benefited from downward-revised estimates for the growth of national income. Official sources reported rapid growth until the late 1970s, followed by a sudden and sharp slowdown. In fact, socialist economies ran out of steam more gradually from the late 1960s onward. They were falling behind successful modernizers in both Southern Europe and East Asia throughout the postwar period, not only after 1980. The extent to which government statistics overstated economic growth was drastically reduced during the 1980s. We observe the opposite pattern in the capital-stock data. Our estimates show that official accounts overstated the rate of capital accumulation only in the second half of the period, and the margin of error increased over time. This finding already suggests that previous research on the relative decline of socialist economies may have been seriously mislead by faulty statistics.

[62] See Feenstra et al., 'Next generation', Appendix B.
[63] Vonyó, 'War and socialism', pp. 261-6.

Table 1

Polish official data were inaccurate even in comparison with the accounts of other socialist governments. The rate of capital accumulation was overstated even more than economic growth. Price distortions are the most likely culprit in the margin of error for the 1980s, when inflation spiralled out of control. Polish statistics on capital stock do not allow us to construct growth rates for the 1950s, meaning that our new estimates not only improve on the existing evidence but also extend it. The common feature in our figures for all three countries is that capital accumulation accelerated until the early 1970s, but the economic slowdown after 1980 coincided with sharply reduced rates of net capital formation.

This is not the end of the story! Employment figures alone do not measure the growth of labour input accurately. In the 1970s and 1980s, which saw most of the reductions in weekly work hours, the total number of hours grew much slower than employment. In Czechoslovakia, the official workweek was already shortened in the late 1950s and again a decade later. In addition, by the end of the 1980s, extensive strikes reduced actual labour input considerably in both Czechoslovakia and Poland. We made a conservative assumption that this effect cost only 5 per cent of contract hours in both countries in 1989. The adjusted growth rates show only modest labour expansion in Czechoslovakia between 1950 and 1970 and practically zero after 1980. In both Hungary and Poland, labour input declined sharply during the 1980s. This contraction did not only result from falling average work hours; total employment fell, too.

We apply the standard growth accounting framework developed by Solow, which applies a Cobb-Douglas production function with constant returns to scale and constant elasticity of substitution (CES) equal to one between capital and labour.[64]

$$Y_t = A_t(K_t)^{\alpha}(L_t)^{1-\alpha} \qquad [4]$$

Value added *Y* in period *t* is the function of the capital stock (K), labour input (L), and Total Factor Productivity (A). The coefficients α and $1\text{-}\alpha$ denote the elasticity of output with respect to capital and labour. Output growth can arise from the expansion of factor inputs or from TFP growth.

$$\Delta lnY = \alpha \Delta lnK + (1-\alpha)\Delta lnL + \Delta lnA \qquad [5]$$

Equation (5) can be rewritten to express TFP growth as the proportion of labour-productivity growth unexplained by capital deepening, the increase of the capital-labour ratio. This formula is more appropriate to assessing the nature of growth under central planning.

$$\Delta lnA = \Delta ln(Y/L) - \alpha[\Delta ln(K/L)] \qquad [6]$$

[64] Solow, 'Technical change', p. 312.

Growth accounts commonly use the value of 1/3 for α, which is a reasonable approximation of the share of capital in national income in advance market economies. However, it has been argued that a higher capital share is more realistic for command economies.[65] Following this literature, we assume constant α of 0.4. In theory, if production factors are paid their marginal products, factor elasticities can be computed from data on factors. Since these factor shares are difficult to determine for centrally planned economies, we report robustness checks using both upper-bound and lower-bound plausible values of α in Appendix III.

The growth accounting framework was developed for market, not centrally planned, economies. Nevertheless, we consider it a useful analytical tool even for the latter, where central planner rather than the market determined prices and factor costs. Weitzman proposed that socialist economies were better represented by a production function with CES below one.[66] Easterly and Fischer argued the same for the Soviet Union, and Rusek for Czechoslovakia.[67] But, we agree with Allen's rebuttal, supported by Crafts, that the technological possibilities available to planned and market economies did not differ profoundly enough to validate the assumption of radically different underlying production functions.[68] To the extent that Weitzman was correct, our approach would underestimate TFP growth, especially in the 1980s. Since unit CES does not fully capture diminishing returns to capital, it may overstate the contribution of higher capital-labour ratios to labour-productivity growth. Our estimates for TFP growth are, therefore, lower bound.

We adjust labour input for returns to education, even though true returns are difficult to determine for centrally planned economies. Denison developed the first extended Solow model with education as a labour-augmenting factor, but we use the specification proposed by Hall and Jones.[69]

$$Y_t = A_t(K_t)^{\alpha}(H_t)^{1-\alpha} \qquad [7]$$

Human capital-augmented labour (H) is defined as the product of labour input and the efficiency of labour with *E* years of schooling relative to the efficiency with no schooling. The derivative $\phi'(E)$ is the actual return to education and is estimated with Mincerian wage regressions.

$$H_t = e^{\phi(E_t)}L_t \qquad [8]$$

Hall and Jones take the rate of return to be piecewise linear, 13.4 per cent for each of the first four years of education, 10.1 per cent for each of the next four years, and 6.8 per cent per year after the eighth year of schooling.[70] Previous research using the wage grid of socialist economies computed

[65] Easterly and Fischer, 'Soviet economic decline'. Higher capital shares were also used for developing countries, as in Benhabib and Spiegel, 'Role of human capital'.
[66] Weitzman, 'Soviet postwar economic growth'
[67] Easterly and Fischer, 'Soviet economic decline'; Rusek, 'Industrial growth'
[68] Allen, *Farm to factory*, pp. 192-4; Crafts, 'Solow', p. 208.
[69] Dennison, *Sources*; Hall and Jones, 'Why do some countries', pp. 87-8.
[70] Hall and Jones, 'Why Do Some Countries', p. 89. The underlying estimates come from Psacharopoulos, 'Return to Investment'.

substantially lower returns to education, but we consider these estimates biased by the strong wage compression that socialist governments enforced.[71] These low rates reflect not so much the poor efficiency derived from education, but the modest monetary rewards offered for these efficiency gains. To the extent that the true returns to education were smaller than the global average rates, our refined estimates of TFP growth can also be considered lower bound. Letting *h* denote human capital per worker (H/L), TFP growth is computed as the residual of labour-productivity growth after subtracting the contributions of capital deepening and education.

$$\Delta lnA = \Delta ln(Y/L) - \alpha[\Delta ln(K/L)] - (1-\alpha)\Delta lnh \quad [9]$$

Our revised growth accounts in Table 2 paint a different picture from past research that underestimated labour-productivity growth from the 1960s, and overestimated the increase in the capital-labour ratio. The growth of labour productivity and TFP slowed down throughout the postwar era, but we obtain higher rates of TFP growth than what the previously available data implied. The upward revision of productivity growth is most notable after 1970, especially for the 1980s. Hungary and Poland both recorded respectable rates of labour productivity growth until the end of communism, and while TFP growth slowed down after the golden age, it did not decline further between the 1970s and the 1980s. Czechoslovakia posted comparatively modest rates of productivity growth from the 1960s, but TFP growth remained positive and it slowed down gradually. These results do not refute previous findings that socialist countries performed poorly relative to western market economies, but they have important implications for our understanding of their growth failure during the 1980s and of the economic forces behind the fall of communism.

Table 2

Poland represents a unique case. In contradiction with the standard view of socialist development, Polish growth in the early postwar period was driven entirely by labour expansion, not capital accumulation. The capital-labour ratio was markedly reduced during the 1950s, and then it stagnated until the late 1960s. This is *prima facie* evidence for increasing capacity utilization and for the existence of a vast capital surplus in the early days of communism. The most pressing challenge for Polish governments was not how to rebuild destroyed capital, but how to make use of existing capacities given the evident shortage of skilled labour, already recognised as the main bottleneck of reconstruction by the famous postwar economist Oskar Lange.[72] Consequently, there was little need for additional investment, which explains why the capital stock grew so slowly before 1970. With less investment in new equipment, labour-productivity grew was modestly than in other socialist countries. By contrast, soaring investment in the early 1970s and the sharp contraction of labour input during the 1980s made labour-productivity

[71] See Münich et al., 'Returns', and Jolliffe and Campos, 'Market liberalisation'.
[72] Lange, *Probleme*

growth more and more investment driven. Still, TFP growth remained positive, and slowed down gradually from the 1960s, not abruptly after 1980.

Surplus capacities also have a role in explaining high TFP growth in Czechoslovakia during the 1950s. Due to the expulsion of ethnic Germans from the Sudetenland, the population decline after 1945 combined with robust capital accumulation during the war left Czech industry with surplus capital. Subsequent investment was used to adopt more capital-intensive production technology (which had its beginnings in the interwar years) and to substitute capital for scarce labour in agriculture, which lost a quarter of its workforce in the late 1950s. [73] The reallocation of farm workers into industry, in turn, reduced surplus capacity in manufacturing. The failure of the Polish economy to replicate this process was most likely the consequence of an initially weaker industrial base, especially in capacities to produce steel-based capital goods, and the failed attempts at collectivizing the farming sector. Input-output bottlenecks in the machinery sector arising from border effects and the differential impact of wartime destruction across industries, due to their different spatial concentration, may also be partly to blame.

Our main quantitative findings hold, at large, when we adjust for returns to schooling. Improvements in education and vocational training are among the least doubted achievements of socialism. Even when at the expense of teaching quality, educational standards increased, especially in primary schooling and technical education. However, since the growth of educational attainment was rather smooth over the socialist period, accounting for labour quality does not alter the trajectory of productivity growth – except for Poland in the 1960s and Hungary between the 1970s and the 1980s. As Poland recovered from the demographic shock it had suffered in the 1940s, the best educated young cohorts born after 1945 and newly entering the labour force made up a large share of the working age population in the late 1960s. Labour qualifications improved little in Hungary after 1980, when the youngest working-age cohorts carried less weight in average attainment levels than the oldest workers, whose schooling had been disrupted during the war and the first postwar years.[74]

Figure 6

Figure 6 summarizes our main findings. As in many other regions of postwar Europe, the gradual slowdown of economic growth reflected declining rates of productivity growth.[75] However, the socialist growth failure after 1980 was mainly input driven. This conclusion becomes even stronger, when we recognize that structural change thwarted aggregate productivity growth in the 1980s. Given the emphasis that the literature placed on labour reallocation between agriculture and industry, our revision of the socialist growth record cannot be complete without some discussion of structural development.

[73] Teichova, *The Czechoslovak economy*, pp. 88-102.
[74] See the Barro-Lee data for details: http://barrolee.com/.
[75] For comparisons, see, Crafts and Toniolo, 'Postwar growth', p. 10; *Idem*, 'Aggregate growth', p. 306; Maddison, 'Macroeconomic accounts', p. 44, 59.

Data limitations prevent us from being able to estimate structural components of labour-productivity growth or of TFP growth. We do not have reliable evidence on capital input at the sector or industry level. In addition, the industry classification used in the official employment statistics is not consistent across the three countries and differs from the industry coverage of our sources for sectoral GDP data, especially in services. Finally, we do not have any way of estimating hours worked outside of mining and manufacturing. Therefore, any disaggregate measure of labour productivity or TFP that we could construct would not only be inaccurate and hard to compare across countries; they would be methodologically inconsistent with our productivity estimates for the economy as a whole. Nonetheless, we can trace structural shifts in the growth of national income.

Table 3

Table 3 reports the share of six major sectors of the economy in GDP in constant prices. The share of industry ceased to increase by the late 1970s, but deindustrialization after the oil shocks was not as dramatic as in western market economies. Structural modernization lost momentum after the 1960s. In Hungary, the relative decline of agriculture came to a halt already in the 1970s, and after 1980 the share of the farming sector in total value added increased in all three countries. The view that central planning was not flexible enough to support a successful transition from an industrial to a more service-based economy needs qualification. Modern services, including trade, transport, and communications, made a great leap forward during the 1970s but contracted more than any other sector after 1980, most drastically in Poland. By contrast, the relative decline of non-material services, including the government, was reversed after 1980. As the following section will explain, this reversal of structural change in socialist economies was a response to exogenous shocks. Despite the industrialisation drive of the 1950s and 1960s and the expansion of services since the 1970s, the overall pattern emerging from Table 3 is remarkably little structural change over the forty-year period. This is largely the reflection of the fact that previous research accounted for sectoral shares in the labour force, not in GDP. The relative size of farm employment fell sharply until the 1970s, but to a large extent this was offset by much faster factor substitution within agriculture than in industry.

V

If the growth failure that eventually undermined communism in Central Europe was input driven, then what caused the sharp fall in investment and the diminishing rate of capital accumulation? Answers need not be invented. We can draw from the literature on developing regions and from contemporary observers in the three countries we study. Parallels with Latin America are particularly striking, where the ‘lost decade’ of growth has been linked to poor investment in physical and human capital, which in

turn was explained by the debt overhang and the payments crises of the 1980s.[76] These factors were overlooked in studies that sought to interpret the failure of planned economies as the consequence of technological and allocation inefficiencies above all else.[77]

Two exogenous shocks negatively affected Eastern Europe at the turn of the 1970s and the 1980s. Firstly, the oil shocks were more detrimental than elsewhere. Until 1975, COMECON countries imported crude oil, natural gas, and petroleum products from the Soviet Union at prices fixed typically well below the world market price. This practice prompted scholars to argue that the USSR subsidized the economic development of its satellites.[78] After the first oil shock had radically improved the Soviet terms of trade with western markets and Soviet industry was in grave need to import western machinery, the fixed-price regime was abandoned and COMECON prices were determined as five-year moving averages of the world market price. The ensuing increase of import bills in Central and Southeast Europe was initially smoother and somewhat delayed, but lasted longer than elsewhere, until the mid-1980s.[79]

Rising fuel prices made socialist industries less competitive because they applied fuel-intensive technologies. This was not the outcome of technical backwardness but of rational choice. Due to the vast fossil-fuel deposits of the COMECON, energy prices were both nominally and relatively lower than in the West until the late 1970s. It thus paid to employ fuel-inefficient technologies. This argument is supported by existing research on input use in manufacturing. Data derived from the material balances of socialist economies and input-output matrices constructed for OECD countries indicate that input-output ratios differed as much or more within these two groups of economies as between them, especially in manufacturing.[80] It was because of their consistently higher energy intensity that the input-output ratios of socialist economies on average appeared higher and that these ratios increased over time relative to market economies.[81] After the oil shocks, this implied for socialist countries outside the Soviet Union loss of competitiveness, worsening terms of trade, and the need for massive investments to replace the existing stock of fuel-inefficient equipment.

Secondly, public debt in Eastern Europe soared during the 1970s, thanks to cheap international credit and urged by popular demands for improved social infrastructure. After 1980, refinancing their external debt became more costly for socialist countries as western creditors raised interest rates in an attempt to combat inflation at home. In the context of the Cold War, autarky was the logical, albeit self-destructive, policy response. Both the Soviet politburo and the COMECON council called upon socialist countries to limit their imports and to drastically cut back on international borrowing.[82] This had damaging consequences for economic growth and productivity. In aggregate terms, even though GDP

[76] See Ocampo, 'Latin America-s growth', pp. 77-8; Astorga, 'Century', p. 239; Astorga et al., 'Productivity growth', pp. 215-6, 220.
[77] Snell, 'Economic efficiency'; Brada and Montias, 'Industrial policy'
[78] Marrese and Vanous, *Soviet subsidization*
[79] Beckmann and Fidrmuc, 'Oil price', p. 36.
[80] See Gomulka and Rostowski, 'International comparison', table 1, p. 481.
[81] Drábek, 'Natural resource'; Gomulka and Rostowski, 'International comparison', pp. 488-91.
[82] See Berend, *Central and Eastern Europe*, from p. 195.

continued to increase, domestic absorption effectively stagnated. As governments struggled to satisfy demands to expand public services, increase the availability of consumer goods, and improve housing, investment in machinery became the prime victim of austerity.[83] Our estimates have shown that the shrinking share of national income available for investment was shifted from equipment towards construction. Paradoxically, as communist regimes were nearing their collapse, they disbursed record sums for building projects. Social housing programs are partly to blame, but equally hurting was the construction of nuclear power plants in Czechoslovakia and Hungary, precisely with the aim of reducing the dependence of both countries on imported hydrocarbons.

These external shocks and the policy response they invoked limited both the expansion and modernization of production capacities. The need to improve their balance of trade forced socialist countries to promote exports at all cost. To achieve this, they diverted investment to low-productivity sectors with relatively strong export potential in hard-currency markets, especially food products. Deflationary policies (most notably in Czechoslovakia) seeking to dampen the impact of rising energy prices and to improve trade balances also hampered investment and productivity.[84] The need to curtail imports from hard-currency areas may have also contributed to slower productivity growth by making it harder to implement advanced western technologies.[85]

Low levels of equipment investment and hard-currency constraints on the import of western technology implied slow growth in productive capacity and sluggish technological progress as well as employment creation. Therefore, austerity affected both input growth and productivity negatively. Previous research on the importance of machinery investment for productivity supports this argument.[86] It also corresponds with recent evidence pointing to the conditionality of technological gains on sufficiently high capital-labour ratios, and thus investment.[87] Labour input declined further because of the shortening of the official workweek and popular welfare measures, including very generous maternity benefits and a low retirement age for women that diminished female labour participation after it had increased robustly for decades.[88]

Although the 1980s demonstrated these common features in most socialist countries, the severity of the crisis varied because the strength of the external shocks was not uniform either. In Poland, GDP per capita fell between 1980 and 1989. After reckless borrowing in the 1970s, the Polish government was the first to declare insolvency in the wake of the second oil shock, before the avalanche of Latin American defaults began. Extreme austerity and the return to violent political repression under General Jaruzelski spurred popular dissent. The Solidarity strikes reduced manufacturing output, which further

[83] Alton et al., *Eastern Europe*; Bálek, 'Czechoslovak economy'
[84] Brada, 'Technological progress', p. 439.
[85] Whitesell, 'Influence', p. 241.
[86] De Long, 'Productivity growth'; De Long and Summers, 'Equipment investment'
[87] Kumar and Russel, 'Technological change'; Allen, 'Technology and the Great Divergence'
[88] See Adam, 'Employment policies'.

curbed resources for investment.[89] Czechoslovakia, by contrast, recorded the highest growth rates in Eastern Europe after the Soviet Union.[90] Because of limited borrowing in the 1970s, Czechoslovakia did not need to tighten the belts as much as other countries and, therefore, could maintain higher levels of investment. Machinery investment declined less drastically than in Hungary and Poland. Hungary represents a special case within the Soviet bloc. It managed to ease the pressure of austerity by maintaining access to western credit after it joined the IMF and the World Bank in 1982.

VI

Why did socialist economies fail? The falling behind of Eastern Europe in income per capita and productivity during the Cold War has been blamed on the intrinsic inefficiencies of central planning. This view is widely accepted in both the theoretical and the empirical literature. In most of the existing growth accounts for Eastern Europe, the inefficiencies of socialism were manifested in the productivity failure that brought economic growth to a standstill by the 1980s and undermined the viability of communism. Planned economies, it has been argued, failed because they were bound to. By construction, they were incapable of a successful transition from an extensive growth model to one driven by innovation and rising productivity.

While we accept that socialism was relatively inefficient, we argue that the socialist growth experience requires revision. Official statistics not only overstated the growth of national income but also the rate of capital accumulation. Planned economic development was not as capital intensive as previous research has suggested. Productivity growth never came to a standstill and certainly did not turn into reverse. The growth retardation of the 1980s in East Central Europe did not result from the failure to sustain productivity growth but mainly from the failure to sustain factor accumulation. As in many other late-developing regions, this was the outcome of powerful exogenous shocks. Unlike in the Soviet Union, the oil shocks and the debt crises that emerged in their aftermath invoked austerity, and investment in new machinery became the victim thereof. This caused growing technological backwardness, structural sclerosis, and even employment contraction. By reducing investment in new equipment, austerity also contributed to the lack of innovation after the era of mass production, and thus the widening technological gap with advanced market economies that the literature has emphasised. The policy response to the crisis undermined the legitimacy of the socialist system and brought it to collapse, or at least accelerated its downfall.

[89] For a discussion, see Berend, *Central and Eastern Europe*, ch. 7.
[90] A leading exporter of hydrocarbons, the USSR maintained high investment levels after 1980 and, consequently, achieved the highest growth rates in Easter Europe in both GDP and GDP per capita (see Maddison, *The World Economy*, pp. 477-9).

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Appendix I: Data sources used in the reconstruction of gross fixed investment

We used a combination of index-number series for construction and equipment investment to estimate levels of investment in fixed capital. Construction investment comes from the occasional papers of the Research Project on National Income in East Central Europe (hereafter Research Project).[91] The same sources report estimates for equipment investment up to 1965.[92] For the period 1965-1990, we derive indexes of equipment investment by decomposing data on the domestic final use of gross product.[93] Here, we explain in detail how each subcomponent had been estimated in the sources that we used.

Construction investment is defined as the gross output of the construction industry, which for the economy as a whole is assumed to equal the total value of investments in new buildings and repairs on existing structures. Construction output, in turn, evolves according to the availability of construction materials. The sources make two critical assumptions, namely that both the value-added ratio and the share of material waste in the building trades remained constant over time. The weights of construction investment in GDP in the benchmarks are established as the sum of industry value-added and of material purchases from other sectors using official prices.

Equipment investment up to 1965 is calculated by constructing an index of machinery available for domestic investment purposes. The Research Project built this index from disaggregated data on industrial production that it had complied and later published in other papers. Items believed to be used as consumer durables, such as bicycles, motorcycles, and all communications equipment, were excluded from the product sample. The index of machinery output was constructed from five aggregate production indexes for machine tools, agricultural machinery, prime movers and other equipment, transport vehicles, and electrical instruments incl. power generating equipment. To arrive at domestic availability, output was adjusted for net imports from official foreign-trade statistics. Values in foreign-exchange currencies were converted into domestic producer prices using a basket of goods that were included in the production indexes and were listed in both domestic and international prices in official sources. Adjustments were made for net foreign investment, whenever possible, but the ratio of these transfers to total investments was found to be small. Official data indicated inventories to be highly volatile, and thus changes in inventories were assumed to be random.

Fixed-capital investment up to 1965 was computed by the Research Project from the index of construction and equipment investment, weighted by using current prices for machinery items from official sources. From 1965, we derived investment from total domestic absorption. The Research Project reported indexes of three final-use components: personal household consumption; government services; and a residual composed of gross investment, R&D expenditure, and defence spending. We constructed a provisional index of gross investment by subtracting from residual final use the indexes on defence and R&D spending. We assume inventories to be random and, therefore, that gross fixed investment evolved according to gross investment. We finally subtract from this provisional index the construction index to arrive at investment in machinery.

> *Indexes of final-use subcomponents*: The index of personal consumption was constructed by aggregating indexes for several categories of consumer goods and services using official data from representative consumer surveys. Indexes of public consumption, disaggregated into

[91] Alton et al., *Economic*; Alton et al., *East European GNP*; Czirják, *Hungarian GNP*; Holesovsky, *Czechoslovakia*; Korbonski et al., *Poland*; Staller, *Czechoslovak index of construction*.
[92] Czirják, *Hungarian GNP*; Holesovsky, *Czechoslovakia*; Korbonski et al., *Poland*; Staller, *Czechoslovak index of investment*.
[93] Alton et al. *Economic growth*; Alton et al., *East European GNP*

administration and justice, health care, education, and social services, were the same as indexes for government services in the computation of GNP by sector of origin of product. These indexes, in turn, were derived from employment data, weighted using both wage returns and the value of materials and services purchased from other sectors of the economy.

Index of R&D expenditure: The occasional papers on GNP by sector of origin also report indexes for science and research, using the same approach as for other government services. We establish the weight of total R&D spending in GDP from official data in the benchmark years that the Research Project used in the construction of indexes on final use.

Index of military spending: The Research Project collected data on defence expenditures in East Central Europe.[94] Based on this work, they established an index of military services in the occasional papers on GNP by sector of origin. As opposed to other government services, this index was based both on personnel and purchases of goods and services. Spending levels are similar to what we could derive from Crane up to 1984.[95] We adhered to the Research Project data for three reasons: (i) consistency with the sources on other indexes, (ii) the lack of an appropriate prices index to deflate the constant-price estimates of Crane, and (iii) that these data suggest the largest drop (in Poland the slowest rise) in military spending over time, which makes us, if anything, overestimate investment growth and within that the share of equipment investment. We take the weight of defence expenditure in GDP from cross-country data published by the Stockholm International Peace Research Institute (SIPRI).[96]

[94] Alton et al., 'East European defense expenditures'
[95] Crane, 'Military spending', pp. 530-2.
[96] SIPRI, *Yearbook*, 1980, p. 29; 1991, pp. 174-5.

Appendix II: New estimates for investment and capital stock

Table II.1. Gross fixed investment and gross capital stock in Czechoslovakia (billion 1990 crowns)

	Investment		Capital Stock			
	Equipment	Structures	Equipment	Structures	Total	Index
1948	9.5	26.5	168.8	575.6	744.5	96.0
1949	8.6	26.0	167.3	590.1	757.4	97.6
1950	10.8	29.3	168.1	607.6	775.7	100.0
1951	11.8	30.3	169.8	625.7	795.5	102.6
1952	10.2	33.9	169.8	647.1	816.9	105.3
1953	9.9	35.2	169.5	669.4	838.8	108.1
1954	10.1	36.5	169.4	692.4	861.8	111.1
1955	11.9	41.3	171.1	719.9	891.0	114.9
1956	13.6	45.7	174.4	751.2	925.6	119.3
1957	16.0	49.3	179.9	785.5	965.4	124.5
1958	18.4	53.4	187.5	823.2	1,010.7	130.3
1959	19.9	58.9	196.2	865.7	1,061.9	136.9
1960	22.6	61.1	207.0	909.4	1,116.4	143.9
1961	23.3	60.9	217.9	952.2	1,170.1	150.9
1962	23.4	60.7	228.2	993.8	1,222.0	157.5
1963	23.1	54.8	237.6	1,028.8	1,266.3	163.3
1964	22.0	58.2	245.4	1,066.3	1,311.7	169.1
1965	25.3	60.7	255.9	1,105.7	1,361.6	175.5
1966	25.4	64.0	265.9	1,147.6	1,413.6	182.2
1967	28.3	67.2	278.3	1,191.9	1,470.2	189.5
1968	31.1	68.3	292.7	1,236.4	1,529.1	197.1
1969	36.0	66.6	306.7	1,272.1	1,578.8	203.5
1970	38.1	71.4	321.8	1,311.6	1,633.4	210.6
1971	38.6	76.3	336.3	1,355.1	1,691.4	218.1
1972	38.6	78.6	349.6	1,399.8	1,749.4	225.5
1973	42.6	80.1	366.0	1,444.9	1,810.9	233.5
1974	42.2	83.4	380.7	1,492.1	1,872.9	241.5
1975	47.5	86.5	399.7	1,541.3	1,941.0	250.2
1976	51.2	89.0	421.0	1,591.8	2,012.8	259.5
1977	51.6	90.3	441.0	1,642.3	2,083.3	268.6
1978	47.2	92.0	455.1	1,693.3	2,148.4	277.0
1979	45.8	92.5	466.8	1,743.5	2,210.3	284.9
1980	40.7	93.4	472.5	1,793.3	2,265.8	292.1
1981	38.1	93.3	475.2	1,841.8	2,316.9	298.7
1982	32.6	90.6	472.2	1,886.4	2,358.5	304.1
1983	30.4	90.2	467.2	1,929.4	2,396.6	309.0
1984	27.4	89.9	459.5	1,971.1	2,430.6	313.4
1985	32.6	89.5	457.7	2,011.3	2,469.0	318.3
1986	38.6	90.4	462.0	2,051.4	2,513.4	324.0
1987	44.9	91.7	472.2	2,091.8	2,564.0	330.6
1988	46.6	93.1	483.4	2,132.6	2,616.0	337.3
1989	50.1	92.6	497.3	2,171.9	2,669.2	344.1
1990	47.0	88.0	507.0	2,205.6	2,712.6	349.7

Sources and methods: See the text and footnotes in the article in section III.

Table II.2. Gross fixed investment and gross capital stock in Hungary (billion 1990 forints)

	Investment		Capital Stock			
	Equipment	Structures	Equipment	Structures	Total	Index
1949	14.7	30.3	93.4	1,125.7	1,219.1	97.5
1950	19.1	40.0	106.9	1,143.2	1,250.1	100.0
1951	24.9	44.3	125.3	1,164.6	1,290.0	103.2
1952	33.0	48.9	150.8	1,190.2	1,341.1	107.3
1953	31.3	52.3	173.1	1,218.7	1,391.9	111.3
1954	27.9	45.5	190.6	1,239.9	1,430.5	114.4
1955	26.7	50.7	205.9	1,265.8	1,471.7	117.7
1956	26.0	47.6	219.6	1,288.1	1,507.7	120.6
1957	24.4	56.0	230.8	1,318.4	1,549.2	123.9
1958	24.3	59.8	241.3	1,351.8	1,593.0	127.4
1959	32.9	68.5	259.7	1,393.2	1,652.9	132.2
1960	35.3	75.3	279.4	1,440.6	1,720.0	137.6
1961	34.8	77.7	297.5	1,489.5	1,786.9	142.9
1962	41.4	80.5	321.1	1,540.2	1,861.2	148.9
1963	42.5	81.4	344.3	1,590.8	1,935.1	154.8
1964	43.6	87.9	367.3	1,646.9	2,014.2	161.1
1965	44.9	92.0	390.1	1,705.9	2,096.0	167.7
1966	45.4	92.4	412.1	1,764.2	2,176.4	174.1
1967	51.1	99.0	438.5	1,828.0	2,266.5	181.3
1968	60.5	115.2	472.7	1,906.6	2,379.3	190.3
1969	63.8	116.3	501.0	1,975.2	2,476.3	198.1
1970	61.6	126.1	525.0	2,051.9	2,576.9	206.1
1971	63.3	135.2	548.9	2,135.8	2,684.7	214.8
1972	61.7	135.4	569.5	2,217.8	2,787.3	223.0
1973	60.1	139.1	586.8	2,301.4	2,888.2	231.0
1974	55.5	146.1	598.3	2,390.0	2,988.3	239.0
1975	60.3	149.0	613.7	2,479.3	3,092.9	247.4
1976	58.6	151.3	626.2	2,568.5	3,194.8	255.6
1977	63.8	156.2	643.1	2,660.5	3,303.6	264.3
1978	61.0	163.3	655.8	2,757.3	3,413.2	273.0
1979	59.6	160.2	666.3	2,848.6	3,514.9	281.2
1980	51.3	152.6	667.6	2,930.0	3,597.6	287.8
1981	49.9	148.1	667.4	3,004.9	3,672.3	293.8
1982	45.7	144.1	663.0	3,073.9	3,736.9	298.9
1983	42.3	144.0	655.6	3,141.0	3,796.6	303.7
1984	37.0	138.9	643.5	3,201.4	3,844.8	307.6
1985	42.9	125.0	638.1	3,246.4	3,884.5	310.7
1986	40.4	127.0	630.7	3,292.2	3,922.9	313.8
1987	41.5	131.9	624.9	3,341.8	3,966.6	317.3
1988	44.7	123.7	622.7	3,381.9	4,004.7	320.4
1989	43.3	125.0	619.4	3,422.4	4,041.8	323.3
1990	42.7	112.5	615.6	3,449.4	4,064.9	325.2

Sources and methods: See the text and footnotes in the article in section III.

Table II.3. Gross fixed investment and gross capital stock in Poland (billion 1971 złotys)

	Investment		Capital Stock			
	Equipment	Structures	Equipment	Structures	Total	Index
1946	2.1	10.5	128.5	1,263.2	1,391.7	102.5
1947	4.1	14.2	124.9	1,252.1	1,377.1	101.4
1948	6.1	15.9	123.6	1,242.9	1,366.5	100.6
1949	8.3	18.2	124.5	1,236.3	1,360.8	100.2
1950	10.9	18.5	127.9	1,230.1	1,357.9	100.0
1951	12.2	20.9	132.4	1,226.4	1,358.8	100.1
1952	13.2	22.4	137.7	1,224.3	1,361.9	100.3
1953	14.8	26.3	144.1	1,226.1	1,370.3	100.9
1954	15.5	30.9	151.0	1,232.5	1,383.5	101.9
1955	16.4	31.2	158.4	1,239.0	1,397.4	102.9
1956	15.9	33.3	164.8	1,247.5	1,412.3	104.0
1957	15.9	34.4	170.8	1,256.9	1,427.7	105.1
1958	16.5	36.0	177.0	1,267.8	1,444.9	106.4
1959	18.8	39.4	185.3	1,281.9	1,467.1	108.0
1960	21.2	40.6	195.3	1,296.8	1,492.1	109.9
1961	23.4	41.6	207.0	1,312.5	1,519.5	111.9
1962	27.2	42.8	221.8	1,329.0	1,550.8	114.2
1963	29.0	42.9	237.5	1,345.3	1,582.8	116.6
1964	29.0	45.5	252.2	1,363.9	1,616.1	119.0
1965	33.2	48.4	270.3	1,385.0	1,655.3	121.9
1966	36.0	51.1	290.1	1,408.4	1,698.6	125.1
1967	39.5	55.5	312.2	1,435.7	1,747.9	128.7
1968	38.8	60.2	332.2	1,467.2	1,799.5	132.5
1969	40.1	64.9	352.4	1,502.8	1,855.2	136.6
1970	45.9	70.0	377.1	1,542.8	1,919.9	141.4
1971	52.6	75.7	407.1	1,587.6	1,994.7	146.9
1972	71.9	82.3	448.5	1,630.2	2,078.6	153.1
1973	83.5	99.0	498.3	1,688.4	2,186.8	161.0
1974	91.2	112.3	552.1	1,758.5	2,310.6	170.2
1975	97.4	119.5	608.1	1,834.0	2,442.1	179.8
1976	96.3	126.2	658.8	1,914.4	2,573.2	189.5
1977	96.3	125.7	705.7	1,992.2	2,697.9	198.7
1978	92.7	125.1	745.4	2,067.6	2,813.0	207.2
1979	83.8	119.3	773.3	2,135.1	2,908.4	214.2
1980	72.1	113.4	787.4	2,195.2	2,982.6	219.6
1981	70.0	95.6	798.3	2,235.9	3,034.2	223.4
1982	61.9	85.3	800.3	2,265.3	3,065.6	225.8
1983	62.1	90.7	802.4	2,299.4	3,101.8	228.4
1984	62.4	92.0	804.7	2,333.9	3,138.6	231.1
1985	68.8	89.6	813.1	2,365.2	3,178.3	234.1
1986	64.8	91.5	816.9	2,397.6	3,214.5	236.7
1987	60.7	93.1	816.4	2,430.8	3,247.1	239.1
1988	50.2	93.6	805.3	2,463.6	3,268.9	240.7
1989	42.5	89.9	787.4	2,491.9	3,279.3	241.5
1990	35.2	79.0	763.5	2,508.5	3,272.1	241.0

Sources and methods: See the text and footnotes in the article in section III.

Appendix III: Robustness checks

Table III.1 reports robustness checks for our estimation of capital stock. We explain the baseline assumptions in the article in section III. The annual average rates of net capital formation are those reported in Table 1 in section IV. We run two robustness checks. First, we assume different depreciation patterns for both equipment and structures. Hulten and Wykoff estimated the values of the parameter *R* to average 1.65 for equipment and 0.91 for buildings.[97] These values have been used in empirical studies and recently in the historical growth accounts of Spain by Prados de la Escosura and Roses.[98] In the article, we assume slower depreciation because shortage economies are characterised with capital hoarding, meaning that firms keep some of their new equipment in storage, where they are not worn out as fast as they would in production. The net to gross capital stock ratio in the benchmark year is adjusted accordingly. Since these values deviate proportionally the same from our assumptions for both type of assets but in opposite directions, the combined effect on the rates of capital accumulation is minimal and depends on the share of each asset type in the total capital stock. Second, we assume that the typical service life for structures remained constant over time despite the inter-temporal changes in the composition of the stock of buildings. Assuming constant service life of 50 years results in slower depreciation and thus faster growth in structures in the second half of the period under investigation, but the rates of net capital formation do not differ substantially from our baseline estimates.

Table III.1. Annual rates (log %) of capital accumulation using alternative depreciation rates

	1950s	1960s	1970s	1980s
		Czechoslovakia		
Baseline	3.6	3.8	3.3	1.8
Alternative patterns	3.2	3.5	3.1	1.8
Longer service life	3.6	3.9	3.5	2.0
		Hungary		
Baseline	3.2	4.0	3.4	1.3
Alternative patterns	3.1	4.2	3.6	1.5
Longer service life	3.2	4.1	3.6	1.6
		Poland		
Baseline	0.9	2.5	4.4	1.1
Alternative patterns	0.9	2.5	4.4	1.1
Longer service life	0.9	2.5	4.7	1.3

Baseline: T = 20-25 years for equipment, 40-50 years for buildings; R = 1.5 for equipment, 1 for buildings
Alternative patterns: R = 1.65 for equipment, 0.91 for buildings; T as in Baseline
Longer service life: 50 for buildings constant over time; all else as in Baseline

Table III.2 reports robustness checks for our estimates of TFP growth from Table 2 in section IV. Two sets of alternative rates of productivity growth are derived from lower-bound and upper-bound assumptions for the share of capital in national income, or the elasticity of output with respect to capital. In the article, we proposed an elasticity of $\alpha = 0.4$, following Easterly and Fischer, but in centrally planned economies factor shares are arbitrary.[99] We cannot accurately estimate factor shares from factor incomes, since factor prices do not necessarily reflect true factor costs. In other words, factors do not necessarily earn their marginal products. Therefore, it is appropriate to provide estimates for TFP growth using a wider range of plausible values for the share of capital.

[97] Hulten and Wykoff, 'Measurement', p. 94.
[98] Prados de la Escosura and Rosés, 'Capital accumulation', p. 145.
[99] Easterly and Fischer, 'The Soviet economic decline', p. 353.

Table III.2. Annual rates of TFP growth using alternative factor shares (log %)

	1950s	1960s	1970s	1980s
		Czechoslovakia		
$\alpha = 0.3$	3.2	1.6	1.2	0.6
$\alpha = 0.5$	2.5	0.9	0.7	0.3
		Hungary		
$\alpha = 0.3$	2.6	2.8	1.5	1.6
$\alpha = 0.5$	2.3	2.1	0.8	1.0
		Poland		
$\alpha = 0.3$	2.9	1.9	1.6	1.4
$\alpha = 0.5$	3.1	1.8	0.9	0.9

Note: α is the elasticity of output with respect to capital, or the share of capital in national income.

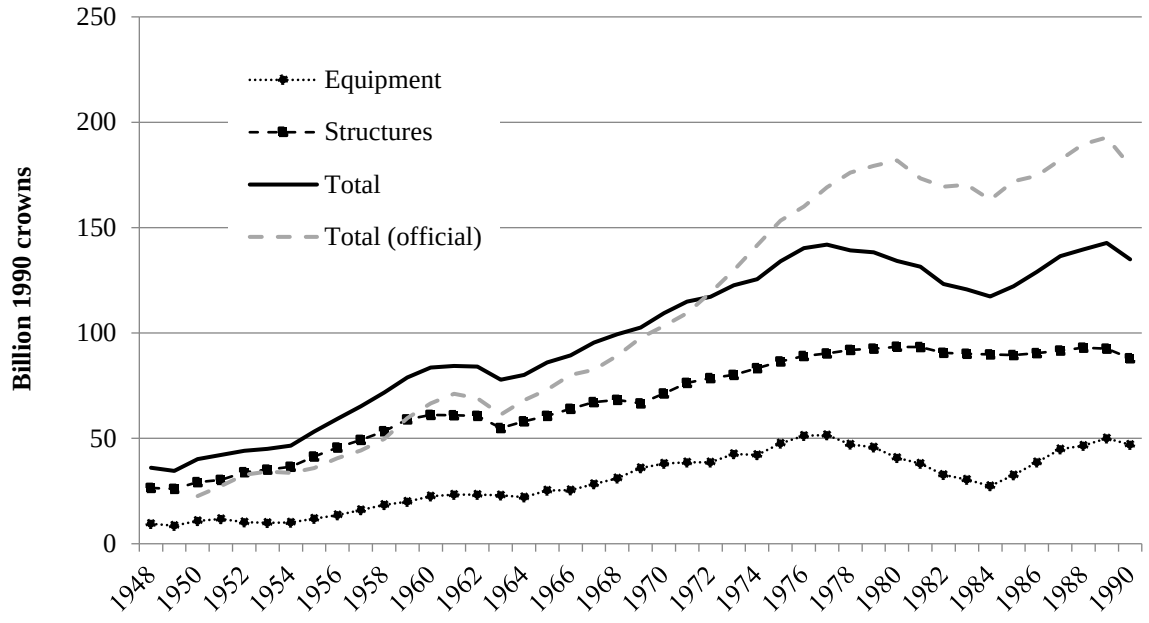

Figure 1. *Alternative estimates for investment in Czechoslovakia, 1948-1990*

Sources: Revised estimates are from Table II.1 in the online appendix. Official data, incl. investment prices, from *Historická statistická ročenka ČSSR 1985*, Tables 8-1 and 8-2, p. 169, *Statistická ročenka Československé socialistické republiky 1986*, Table 8-1, p. 205, and *Statistická ročenka České a Slovenské federatívni republiky 1990*, Table 8-1, p. 220.

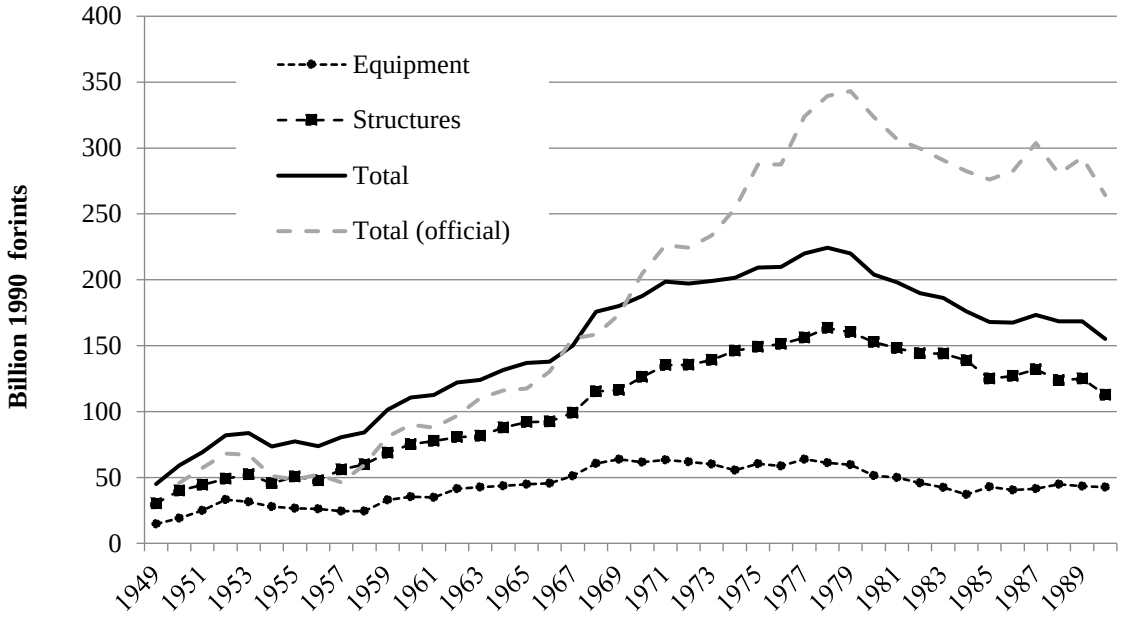

Figure 2. *Alternative estimates for investment in Hungary, 1949-1990*

Sources: Revised estimates are from Table II.2 in the online appendix. Official data, incl. investment prices, from KSH, *Beruházási adattár 1950-1977*, p. 32; KSH, *Beruházási évkönyv 1989*, pp. 13-14; KSH, *Beruházási évkönyv 1990*, p. 3.

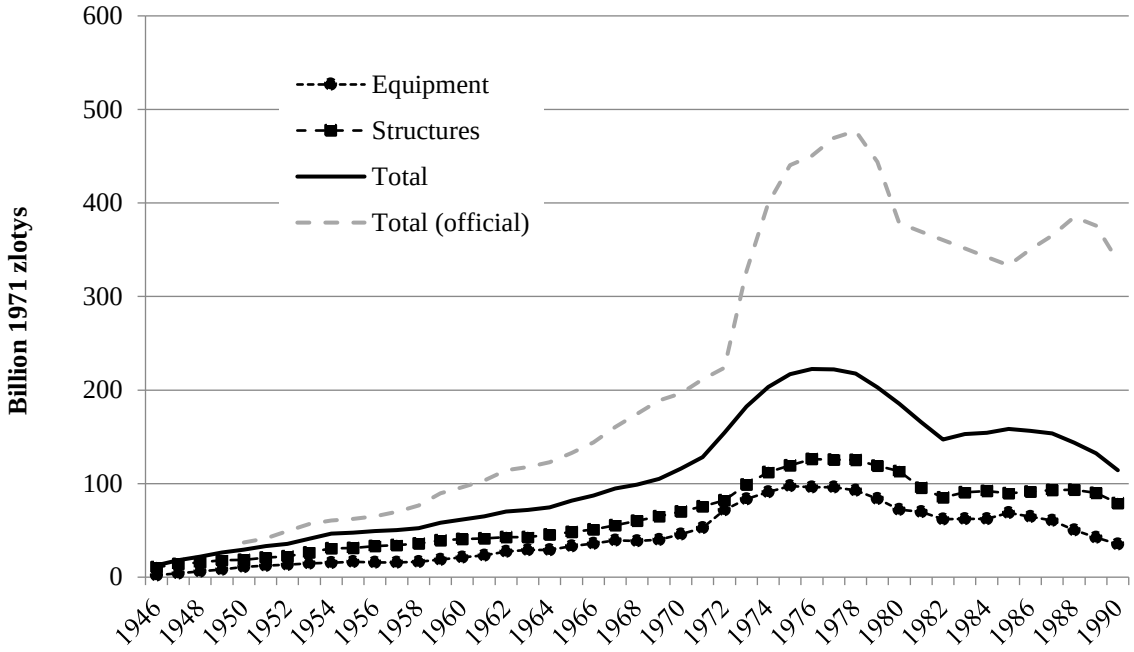

Figure 3. *Alternative estimates for investment in Poland, 1946-1990*

Sources: Revised estimates from Table II.3 in the online appendix. The official index is calculated from *Rocznik Statystyczny 1995*, Table I, p. 68, and converted into 1971 prices with additional data from *Rocznik Statystyczny 1968*, Table I, p. 98.

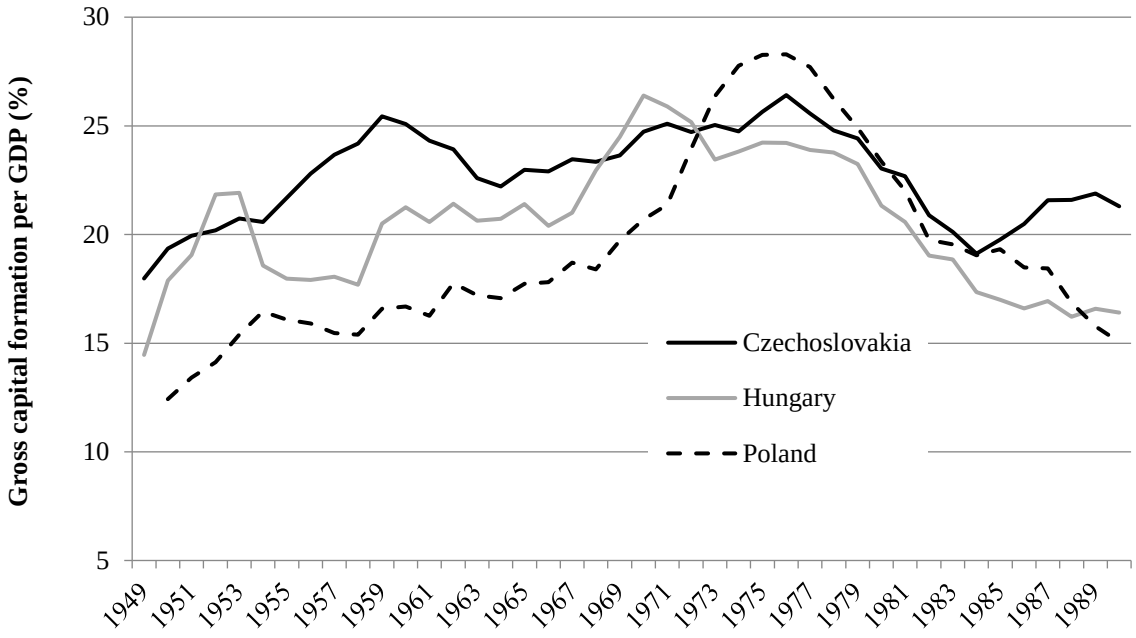

Figure 4. *Investment ratios in Central Europe, 1949-1990*

Sources: Investment levels are taken form Appendix II (online), GDP data from Maddison, *The world economy*, p. 478. The benchmark rates of investment per GDP are calculated from PWT 5.6 and adjusted for the difference between our estimates and official data on gross fixed investment (http://www.rug.nl/research/ggdc/data/pwt/pwt-5.6).

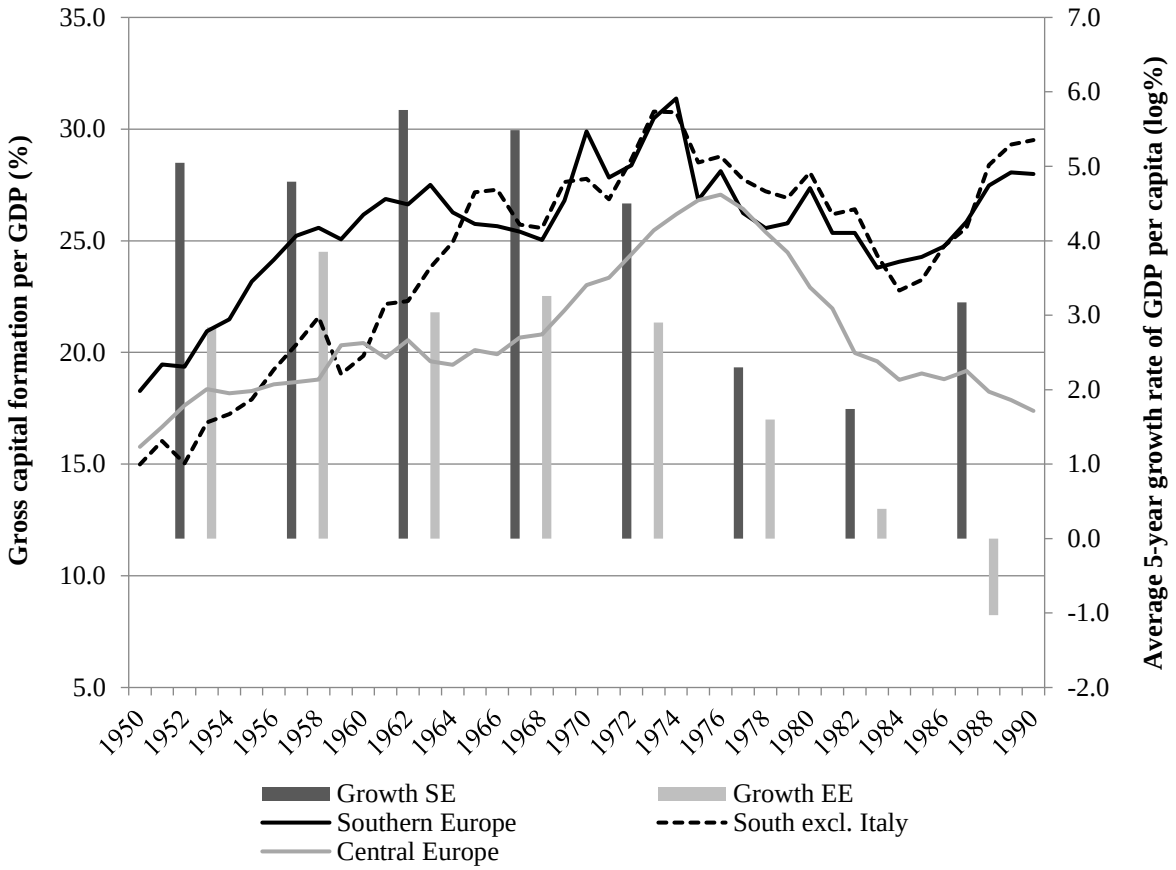

Figure 5. *Investment ratios and economic growth on the European periphery*

Sources: Investment ratios are from Figure 4 for Central Europe and from PWT 9.0 (http://www.ggdc.net/pwt), for Southern Europe, weighted with GDP data from PWT 9.0 (output-side real GDP at current PPPs). Growth rates of GDP per capita established form Maddison, *The world economy*, pp. 434-5, 477.

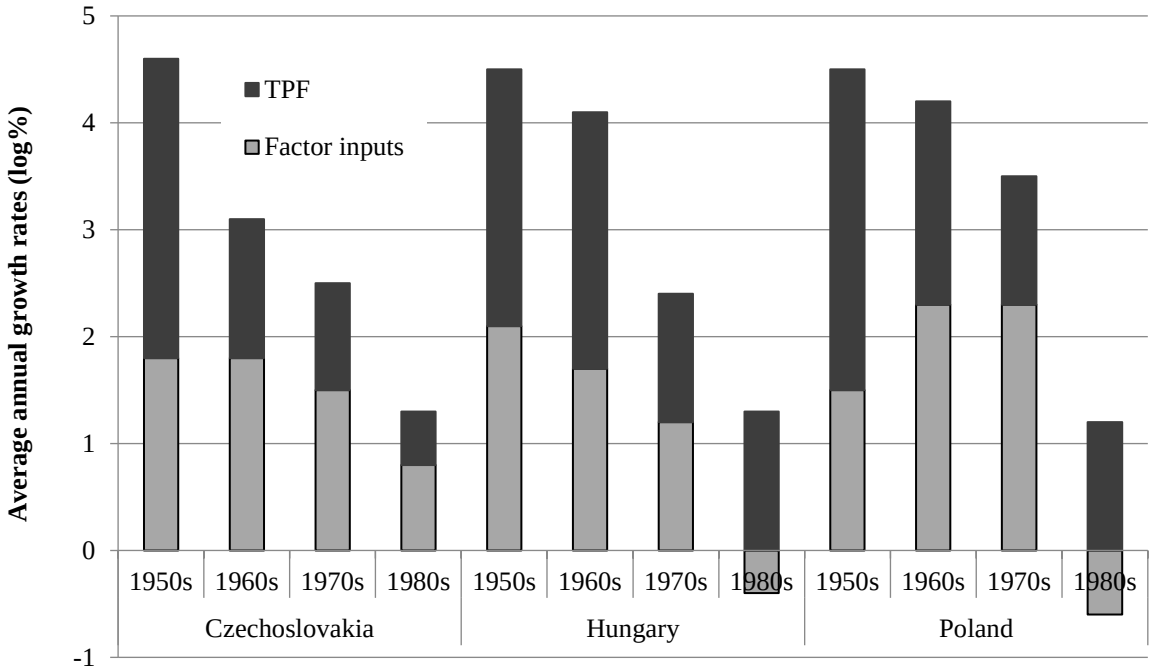

Figure 6. *The proximate sources of growth in Central Europe, 1950-1989*

Sources and methods: Rates of factor accumulation and GDP growth from Table 1. *ΔlnTFP = ΔlnGDP – ΔlnTFI* (total weighted factor input). Factor shares are 0.4 for capital and 0.6 for labour (see TFP I in Table 3).

Table 1 *Annual average growth rates of national income and factor inputs (log %)*

	1950s	1960s	1970s	1980s
		Czechoslovakia		
Net Material Product	7.3	5.5	4.5	1.9
Gross Domestic Product	4.6	3.1	2.5	1.3
Fixed capital (official)	3.4	3.8	4.2	4.3
Fixed capital (revised)	3.6	3.8	3.3	1.8
Total employment	0.9	1.2	0.7	0.7
Total hours worked	0.5	0.5	0.4	0.2
		Hungary		
Net Material Product	5.7	5.3	4.4	1.1
Gross Domestic Product	4.5	4.1	2.4	0.9
Fixed capital (official)	3.5	4.2	5.5	3.9
Fixed capital (revised)	3.2	4.0	3.4	1.3
Total employment	1.4	0.5	0.2	-0.5
Total hours worked	1.4	0.1	-0.2	-1.6
		Poland		
Net Material Product	7.3	7.3	5.3	1.0
Gross Domestic Product	4.5	4.2	3.5	0.6
Fixed capital (official)		4.1	6.1	6.4
Fixed capital (revised)	0.9	2.5	4.4	1.1
Total employment	1.9	2.1	1.3	-0.3
Total hours worked	1.9	2.1	0.9	-1.6

Sources: GDP is from Maddison, *The world economy*, p. 477; NMP, capital stock (official), and employment from statistical yearbooks; capital stock (revised) from Appendix II (online). Total hours worked is employment adjusted for changes in official weekly work hours.

Table 2 *Growth accounts using revised data on factor inputs (log %)*

	1950s	1960s	1970s	1980s
		Czechoslovakia		
GDP per worker hour	4.1	2.6	2.1	1.1
Capital intensity	3.2	3.3	2.8	1.7
Capital deepening	1.3	1.3	1.1	0.6
TFP I	2.8	1.3	1.0	0.5
Education	0.3	0.3	0.3	0.3
TFP II	2.5	1.0	0.7	0.2
		Hungary		
GDP per worker hour	3.1	4.0	2.6	2.5
Capital intensity	1.8	3.9	3.6	2.9
Capital deepening	0.7	1.6	1.4	1.2
TFP I	2.4	2.4	1.2	1.3
Education	0.2	0.4	0.5	0.0
TFP II	2.2	2.0	0.7	1.3
		Poland		
GDP per worker hour	2.6	2.1	2.6	2.3
Capital intensity	-1.0	0.4	3.5	2.7
Capital deepening	-0.4	0.2	1.4	1.1
TFP I	3.0	1.9	1.2	1.2
Education	0.4	0.8	0.4	0.4
TFP II	2.6	1.1	0.8	0.8

Notes: TFP (I) and TFP (II) are the residuals of growth accounts not accounting and accounting for educational attainment respectively. 'Education' refers to human-capital deepening and is the weighted contribution of average improvement in educational attainment to aggregate labour-productivity growth.
Sources: Table 1; average educational attainment from http://barrolee.com/.

Table 3 *GDP by sector of origin of product (% share)*

	1950	1960	1970	1980	1989
			Czechoslovakia		
Agriculture	32.4	23.6	17.7	16.3	17.0
Industry	25.5	32.2	37.5	39.8	40.0
Construction	6.6	9.4	8.7	8.6	7.6
Transport and communications	4.0	7.2	7.7	8.2	8.3
Trade	5.5	6.3	7.9	8.5	8.7
Non-material services	25.0	21.3	20.5	18.4	18.4
			Hungary		
Agriculture	36.6	30.0	23.2	23.4	24.3
Industry	22.5	28.1	33.4	32.7	32.4
Construction	4.5	5.8	7.5	7.0	5.3
Transport and communications	5.1	7.8	8.3	9.0	8.2
Trade	3.4	4.3	6.1	7.0	7.0
Non-material services	27.8	23.9	21.7	20.9	22.8
			Poland		
Agriculture	49.5	42.4	32.3	24.1	28.9
Industry	15.5	23.1	30.7	33.7	29.1
Construction	2.5	4.5	5.5	6.6	5.0
Transport and communications	3.2	4.3	5.7	9.2	8.3
Trade	3.7	4.3	5.2	6.5	6.5
Non-material services	24.5	21.3	20.6	19.9	22.3

Notes: Agriculture includes farming, fishing, and forestry. Industry includes mining, manufacturing, and electrical power. Trade includes both wholesale and retail. Non-material services include finance, housing, water and gas utilities, government services, catering, and personal services. All shares reflect 1976-7 prices (see Alton et al., *The structure*).

Sources: Own calculations from Alton, 'Economic structure', Alton et al, *Economic growth*, Alton et al., *East European GNP*, Czirják, *Hungarian GNP*, Holesovsky, *Czechoslovakia*, and Lazarcik, *Czechoslovak.* Benchmark weights for 1976/7 were constructed in Alton et al., *The structure*.