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An Empirical Analysis of the Output Declines in Three Eastern European Countries

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The declines in economic activity experienced by Bulgaria, the Czech and Slovak Federal Republic, and Romania in the period since market-oriented reforms were initiated are analyzed. After reviewing developments in these three countries, the paper empirically investigates two questions that are central to an interpretation of the output decline. First, to what extent does the output fall reflect "structural change," or a reallocation of resources across sectors, rather than a conventional macroeconomic recession? Second, to what extent have demand-side or supply-side forces been dominant in generating the output decline? [JEL E2, O5, P5]

IN THE TWO-YEAR PERIOD since the Eastern European countries implemented market-oriented economic reform, measured output in the region has declined sharply. Some have argued that the magnitude of the decline (more than 20 percent for the region as a whole) has been

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overstated by official statistics, either because their coverage excludes all or part of the growing private sector (Berg and Sachs (1991)) or simply because, beginning from an initial situation in which prices are controlled, standard index numbers will generally overstate the extent of the output decline once prices are freed (Osband (1992)). Such explanations do not claim, however, that the output decline is entirely an artifact of official statistics.

The purpose of this paper is to offer some tentative explanation for this output decline by focusing on the experience of three countries—Bulgaria, the Czech and Slovak Federal Republic (CSFR), and Romania—since they initiated reform. The focus on this particular set of countries (hereafter referred to as BCR) is motivated by the fact that they were perhaps the most rigidly centralized economies in the region. While other countries, notably Hungary and Poland, experimented with enterprise autonomy, limited price liberalization, and private ownership before the beginning of large-scale reform, the three BCR countries remained wedded to rigid central planning more or less until the end. The three countries differed significantly, however, in their degree of adherence to financial discipline during the years of central planning. At one extreme was the CSFR, with low foreign debt and relatively few shortages. At the other was Bulgaria with high foreign debt and significant shortages. In Romania, the economy was able to generate—with considerable hardship—external surpluses sufficient to eliminate its foreign debt, but significant internal imbalances were nonetheless apparent.

Although our analysis of the output declines focuses on the move toward a market economy—defined with reference to the date on which most prices were liberalized—it should be noted that the initiation of market-oriented reforms was not a necessary condition for economic activity to decline, as the experience of the former U.S.S.R. (which began to liberalize much later) clearly shows. Nor is it the case that the cumulative decline in output was largest for countries that started the transition earlier, as the Bulgarian case clearly illustrates. Put differently, output was already falling in much of the region even before reforms were initiated, and it is not obvious what the "counterfactual" to the reforms would look like: that is, how far output would have fallen had markets *not* been liberalized. To a large extent, the fact that output started to collapse before the reforms was a result of the situation of "neither plan nor market" that emerged after the political changes, a situation in which state enterprises were not tightly controlled but did yet not face appropriate incentives.

The average percentage decline in output in the BCR country group in the two-year period ending in 1991 was a relatively large 23 percent,

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when compared with an average decline in the entire region of about 19 percent.[1] In addition, the BCR group contains the Eastern European country that experienced the largest cumulative drop in output over this period (Bulgaria) and also a country that did relatively well (Czechoslovakia). The cross-country variation in the extent of the output decline should prove instructive in the empirical work that follows.

In Bulgaria and Czechoslovakia, the "big bang" of price liberalization occurred in the first couple of months of 1991, while in Romania, which followed a more phased approach, the first major step toward reform was taken in November 1990. The timing, therefore, makes the reform in the trading arrangements of the Council for Mutual Economic Assistance (CMEA) implemented in 1991, with the subsequent collapse in trade among the CMEA-member countries and the terms of trade deterioration experienced by the BCR countries, strong candidates for factors that could account for the decline in activity. This would appear especially true for Bulgaria given the extent of its prior dependence on CMEA-area trade. To some extent, however, the CMEA shock simply reflected a collapse of activities that were no longer competitive once the system of central planning was abandoned and enterprises began to face world market prices for their inputs and outputs. Enterprises operating in such sectors were bound to experience losses in market share to competing firms from third countries. Viewed in this way, the CMEA reform, in conjunction with price and trade liberalization, helped set in motion a series of changes in the BCR countries that, over time, would be responsible for a radical transformation in the productive structure of these economies. This process of resource reallocation could easily generate an initial decline in aggregate output, especially if an expansion of activities that would be profitable under the new relative price structure were delayed by the presence of significant adjustment costs and uncertainty.

Apart from these longer-term "structural" factors, more conventional macroeconomic forces are also likely to have contributed to the output decline. Price liberalization, in conjunction with the policy stance necessary to harness inflation, led to declines in real wages, money, and credit, which likely depressed domestic absorption and output. On the supply side, reductions in subsidies to energy use could also have been important. In addition, binding credit ceilings imposed on state enterprises may have reduced available working capital to such an extent that firms were

[1] Eastern Europe is defined to include Poland and Hungary as well as the BCR countries.

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unable to pay for their inputs, thereby leading them to contract supply and enter into arrears vis-à-vis their suppliers.[2]

These arguments suggest that the output decline needs to be interpreted with reference to at least two questions. First, to what extent can "structural change" (or a reallocation of resources across sectors), rather than a macroeconomic recession, account for the output decline? Second, to what extent have demand-side rather than supply-side forces been dominant in generating the output decline? This paper empirically investigates these two questions.

With respect to the first question, one would expect that, in response to a new relative price structure, resources would move toward sectors producing goods and services the relative prices of which (and profitability of which) had risen and away from other sectors, in line with comparative advantage. If the type of economic distortions in these countries was similar before reform (say, because energy prices facing domestic producers were "too low"), and if technologies were also similar, resource reallocation would follow a similar pattern in each economy. Thus, evidence of structural change might imply that sector-specific factors were relatively more important than economywide (aggregate) factors in accounting for the evolution of output. We discuss this issue below with reference to an econometric procedure that separates the effects of aggregate versus industry-specific shocks on output changes. Our findings suggest that the bulk of the variance of output in these countries is accounted for by aggregate (or national) factors, with industry-specific components playing only an insignificant role. Therefore, the data do not support the view that much structural change has taken place in the BCR countries since the initiation of reforms.

Corroborating evidence for this view is obtained by using principal components analysis to investigate the proportion of the variance of price and output movements that can be accounted for by a small number of common macroeconomic factors.[3] These results are compared with those obtained for a benchmark country, taken here to be the United States. Our results suggest that the first few principal components account for similar proportions of the variances of the price and output series in the BCR countries and in the benchmark country, again consistent with the view that relatively little of the output decline is attributable to structural change. This conclusion is also supported by regressions of output changes on "comparative advantage"—proxied here by measures of "domestic resource cost" (DRC)[4]—which do not suggest that resources

[2] See Calvo and Coricelli (1992) and Berg and Blanchard (1992).

[3] For a discussion of principal components analysis, see Dhrymes (1978).

[4] See Hughes and Hare (1991) for the calculations in the cases of Bulgaria and Czechoslovakia.

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have been moving toward sectors with relatively low DRCs, as a simple version of comparative advantage theory would predict.

The second issue to be investigated in this paper is the relative importance of supply and demand factors. The simplest way of determining which of these factors has been predominant in the evolution of output is to examine the correlations between price and output changes in particular markets. If shocks to the supply (demand) function predominate, this should be reflected in a preponderance of negative (positive) correlations between price and output changes. The evidence presented below suggests that supply disturbances predominate in the cases of both Bulgaria and Czechoslovakia; in the Romanian case, the relative importance of supply and demand shocks seems to vary over time.

The paper also attacks the "supply shock versus demand shock" problem by estimating a simple "supply-demand" model of output determination.[5] Such a model allows us to decompose the source of output fluctuations between supply and demand factors. It also allows us to shed some light on the relative importance of various macroeconomic factors (energy price increases, credit contraction, wage increases) in accounting for the output decline.

In this paper, we first briefly review the economic background to the reforms in the three countries, the main components of the reforms themselves, and the salient features of developments in the real sectors of the economies of Bulgaria, Czechoslovakia, and Romania. A second section discusses the structural change hypothesis and presents evidence on the relative importance of national and industry-specific factors in accounting for the output decline. The third section describes the methodology and presents results on the relative importance of demand and supply factors in the output decline.

I. Developments in Bulgaria, Czechoslovakia, and Romania[6]

This section briefly reviews the main components of the reforms themselves and the salient developments in the real economies of Bulgaria, Czechoslovakia, and Romania.

[5] For all three countries in the sample, the output decline was concentrated in the industrial sector, and we use disaggregated data from this sector to estimate the model. The necessary data were available for Czechoslovakia and Romania on a monthly basis, while the data available for Bulgaria permitted only a more qualitative assessment.

[6] For a more detailed account of these developments, see Borensztein, Demekas, and Ostry (1992). On stabilization and reform in Eastern Europe more generally, see Bruno (1992).

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Bulgaria

After the toppling of the communist regime, Bulgaria adopted a far-reaching economic reform program aimed at introducing market mechanisms, eliminating excess demand, and limiting the external deficit. The day of the "big bang"—taken as the start of the reform period in this paper—was February 1, 1991, when prices covering more than 70 percent of retail turnover were liberalized and when administered prices were increased fourfold, with the elimination of most subsidies. As a result, prices more than doubled in February alone, and the inflation rate exceeded 330 percent in 1991. At the same time, interest rates were raised (the central bank's basic rate rose from 4.5 percent per annum in January 1991 to 70 percent by year's end); real wages in the state sector fell by about 40 percent relative to 1990; foreign trade was liberalized; and the introduction of a floating exchange rate resulted in an immediate depreciation of the currency by more than 400 percent.

Following the big bang, economic activity all but collapsed in Bulgaria: real GDP is estimated to have declined by about 23 percent in 1991 and by 8–10 percent in 1992. Although official data, which do not capture many activities of the newly emerging private sector, probably overestimate this decline, the collapse was nonetheless larger than in any other Eastern European country. The large decline in 1991 was concentrated in the first half, during which output is estimated to have fallen by more than one quarter, and in industry, where gross output fell by about 28 percent in 1991 (15 percent in February alone) and an additional 15–16 percent in 1992.

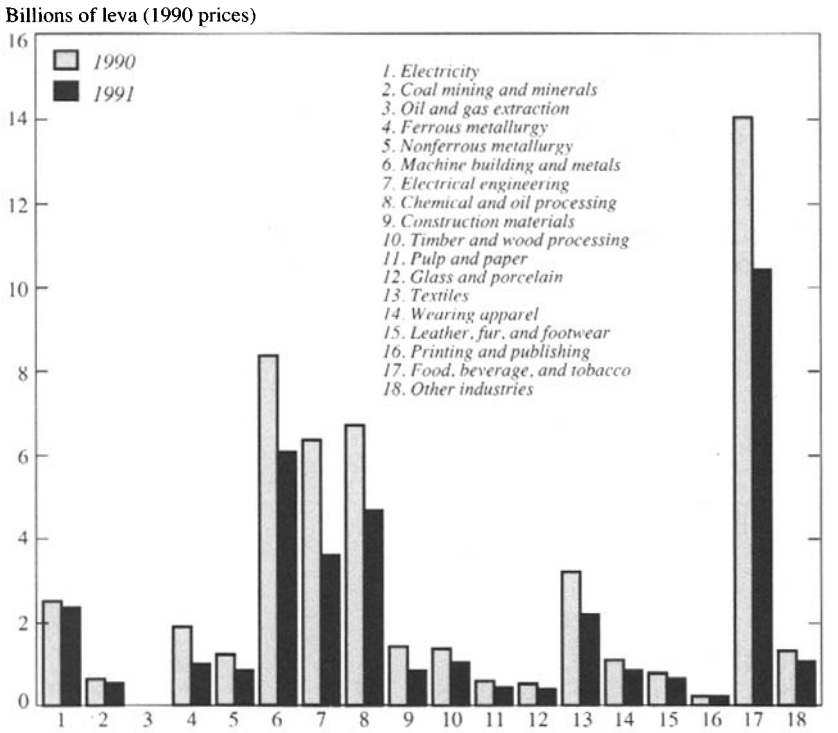
The degree of the decline in industry in 1991 (the focal period of the empirical work that follows) differed significantly across sectors, ranging from 40–45 percent in ferrous metallurgy, construction materials, and electrical engineering, to 5 percent or less in coal and printing and publishing (Figure 1).

Three main factors account for the output decline following Bulgaria's big bang. First, the total volume of Bulgarian exports to the ex-CMEA area is estimated to have shrunk by about 66 percent in 1991, and by a further 15–25 percent in 1992.[7] This collapse in CMEA trade had a massive impact, owing to the large prior dependence on trade with this region (exports to the U.S.S.R. alone had been accounting for about half of total exports in recent years), especially in sectors like machinery, electrical appliances and electronics, and, to a lesser extent, textiles and

[7] Reported diversion of trade with the ex-U.S.S.R. through western countries during 1992 makes this a very approximate estimate.

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Figure 1. *Bulgaria: Industrial Output by Sector, 1990–91*



Source: Bulgarian Central Statistical Office.

food. Indeed, these sectors registered the largest output losses, together with sectors characterized by upward linkages, notably metallurgy. In addition, diversion of these products to convertible-currency markets was hindered either by their poor quality or, in the case of textiles and food, by trade barriers.

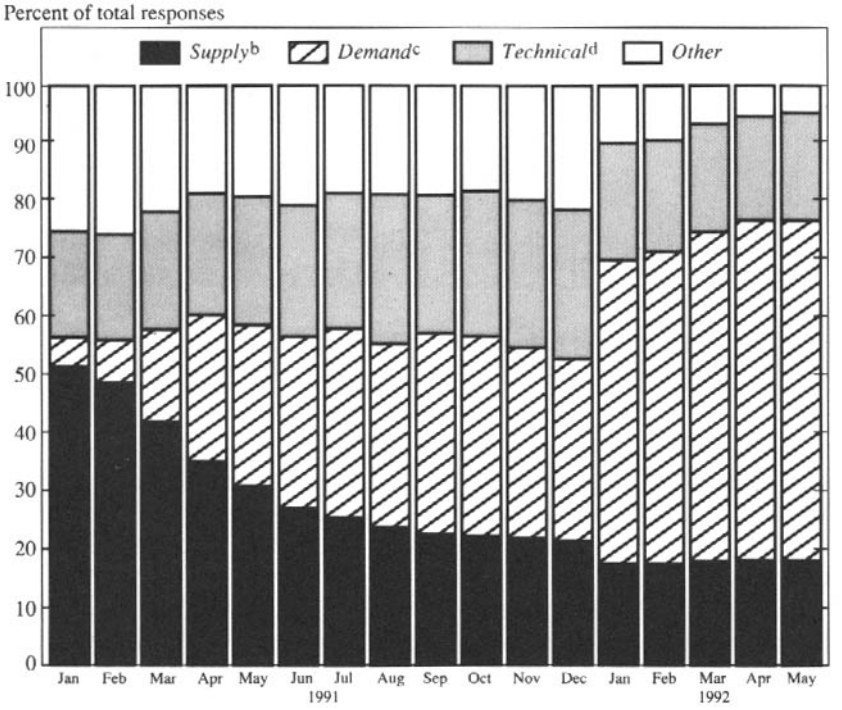
Second, supply factors also affected output, notably the shortage of raw materials, energy, and semifinished goods previously imported from the U.S.S.R. and the disruption in the domestic nuclear industry. Partial data on the consumption of oil and oil products show a decline of 38 percent in 1990 compared with 1989, and an estimated decline of 30 percent in the first half of 1991 compared with the same period of the previous year. This impinged most directly on the heavier industrial subsectors (chemicals and metallurgy), the decline of which aggravated the shortages of inputs in the rest of the economy.

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The third contributor to the output decline was the compression of domestic demand resulting from the negative income effects of the trade and supply factors above; tight financial policies probably also contributed to the collapse in output. Demand compression appears to have influenced mostly consumer goods sectors, particularly food processing (where output was down 25 percent in 1991), and services and retailing among the nonindustrial sectors.

Surveys of industrial enterprise managers conducted in 1991 suggest that the perceived relative importance of demand and supply factors in the output decline changed during the year. As Figure 2 shows, in early

Figure 2. *Bulgaria: Reasons Given by Industrial Enterprise Managers for the Decline in Industrial Output, 1991–92*[a]



Source: Bulgarian Central Statistical Office.

[a] The methodology of compiling data changed in January 1992; data before and after that date are not directly comparable.

[b] Supply factors reflecting shortages of raw materials and other inputs.

[c] Demand factors reflecting an inability to sell output.

[d] Production interruptions owing to refitting, work stoppages, and so forth.

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1991, about half the surveyed managers viewed supply factors (such as input shortages and supply disruptions) as most responsible for the decline, while only about one in ten managers cited demand factors (lack of orders and loss of markets). By midyear, however, demand factors had become the most important element for about half the enterprises.

Following the big bang, the state enterprise sector in Bulgaria shed excess labor faster than in perhaps any other reforming country. As a result, unemployment rose from less than 2 percent in January 1991 to more than 12 percent of the labor force in September 1992. Average employment in state industry, in particular, declined by about 26 percent in 1991 compared with 1990, and by an estimated 15 percent in the first nine months of 1992. This decline was unequally distributed across sectors: employment fell about 30 percent in machinery, construction materials, and electrical appliances and electronics and by about 20 percent in metallurgy, chemicals, glass, and food, drinks, and tobacco. However, employment also declined substantially in a few sectors that did relatively better in terms of output (20 percent in printing and publishing and 40 percent in other industry). As a result, the pattern of productivity changes differed across sectors. Although average output per worker in industry appears to have declined by very little between 1990 and 1991, some sectors registered large productivity losses (oil extraction, ferrous and nonferrous metallurgy, electrical appliances and electronics, and chemicals), while others registered gains (food, clothing, leather, printing and publishing, and other industry). The evidence suggests that light industrial sectors shed labor much faster than heavy industry, even if the decline in demand for light industrial output was smaller.

The Czech and Slovak Federal Republic[8]

The comprehensive reform program implemented on January 1, 1991, included a major liberalization of domestic prices and external trade and a rapid privatization program following an initial preparatory phase. A fairly tight set of financial policies, supported by the double anchors of wage controls and a fixed exchange rate—after substantial depreciation—was designed to prevent the expected price jump from igniting an inflationary spiral. This big bang approach was viewed as the only alternative to a slide into a "no-man's-land" economy in which the central

[8]This section draws heavily on Aghevli, Borensztein, and van der Willigen (1992). Other useful references include Begg (1991), Dyba and Svejnar (1991), *European Economy* (1991), and Prust and IMF Staff Team (1990).

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planning system could no longer be made to function but in which the transformation of the economy into a full-fledged market system was thwarted by the prevalence of price controls and other restrictions.

Although price increases after the big bang were promptly contained, the initial price jump of about 45 percent was much higher than envisaged, implying that the program's monetary targets became more restrictive than anticipated. In addition, cautious behavior on the part of banks slowed credit to enterprises beyond what was targeted, particularly in the first quarter of 1991. The situation was compounded by a fiscal position that proved much tighter than expected. An unanticipated surge in profit tax revenues—a result of extraordinary accounting profits related to the revaluation of inventories in the state enterprise sector—was mainly responsible for a fiscal surplus of nearly 10 percent of (quarterly) GDP in the first quarter of the year. These developments did not help to soften the output costs of the transition. As elsewhere in the reforming economies of Eastern Europe, GDP fell sharply in the first year of the reform-cum-stabilization program in Czechoslovakia, by about 17 percent in 1991.

Development of national income accounts is an ongoing process in Czechoslovakia, and information is therefore incomplete and perhaps not entirely reliable. Taken at face value, the figures suggest that personal consumption bore the brunt of the adjustment in 1991, declining by 33 percent relative to 1990. Fixed investment, by contrast, fell more or less in line with GDP, and government consumption fell by about 4 percent. Contrary to widespread belief, foreign trade appears to have had a positive impact on output (when measured on a national accounts basis), with exports falling by 4 percent and imports plunging over 31 percent, both in real terms.

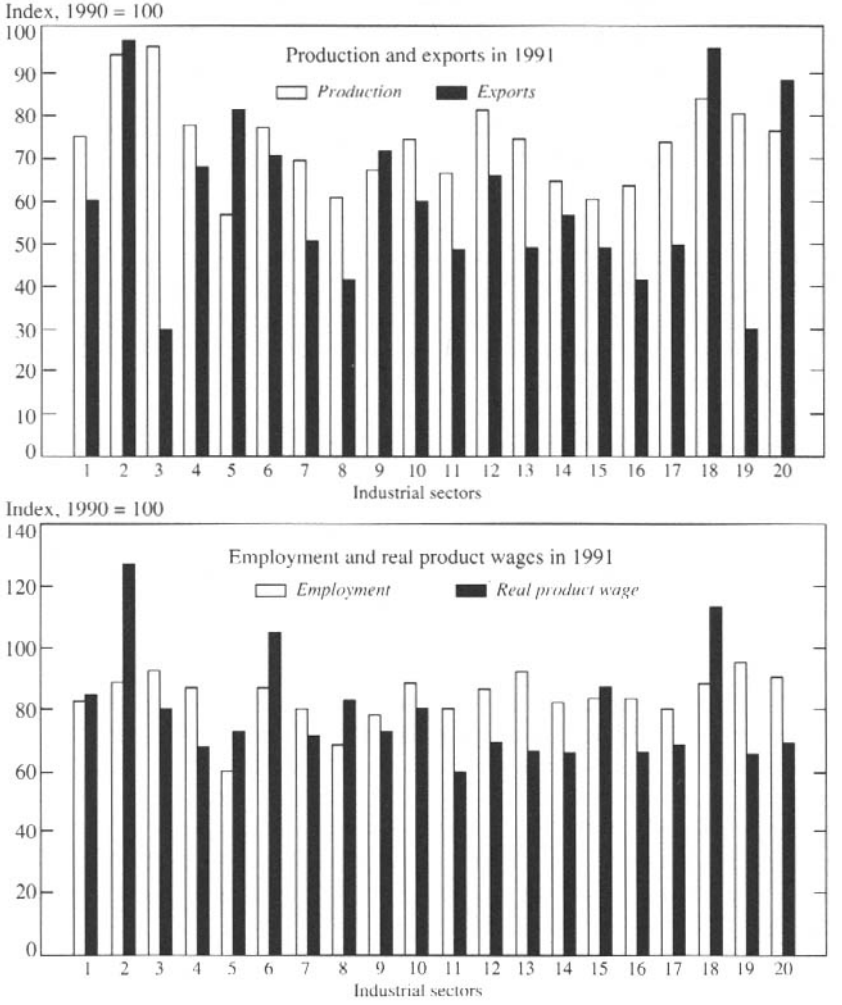
Regarding the composition of output, available information suggests a larger decline in industry (20 percent) and construction (32 percent) than in agriculture (9 percent). Although data on the services sector remain fragmentary, anecdotal evidence points to a boom in activity in private services. This was reflected in the geographical distribution of unemployment: in Prague in October 1991, for example, the unemployment rate stood at less than 1.5 percent (lower than in 1990), compared with rates above 10 percent in the more industrial regions of Slovakia.[9]

Developments within the industrial sector can provide clues to the major determinants of the output decline in Czechoslovakia. With the exception of the fuel and energy sectors, all branches of industry experienced a very pronounced fall in production in 1991 (see Figure 3), with no obvious rationale for the sectoral pattern in the output decline. Al-

[9]The national unemployment rate was about 6 percent.

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Figure 3. *Czechoslovakia: Indicators of Industrial Activity, 1991*



Legend:

1. *Total*
2. *Coal and gas*
3. *Electricity*
4. *Ferrous metallurgy*
5. *Nonferrous metallurgy*
6. *Chemicals and rubber*
7. *Machinery*
8. *Electrotechnical*
9. *Construction materials*
10. *Wood manufactures*
11. *Fabricated metal products*
12. *Paper and cellulose*
13. *Glass, pottery, and chinaware*
14. *Textiles*
15. *Clothing*
16. *Leather products*
17. *Printing*
18. *Food and beverages*
19. *Frozen foods and tobacco*
20. *Other industrial production*

Source: Federal Statistical Office of Czechoslovakia.

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though several of the worst-performing sectors are heavily oriented toward foreign markets and are among those sectors that experienced the largest drops in exports (namely, clothing, leather products, and electronics), the textile sector did not suffer a decline in exports and exports of nonferrous metallurgy increased considerably (although from a relatively low base). Some of the best-performing sectors are oriented toward domestic consumer markets—such as food and beverages and tobacco—but the opposite is true for ferrous metallurgy and chemicals.

Employment in the industrial sector fell continuously from April 1991 and by December industrial employment had fallen by some 17 percent from its pre-program level. The correlation between changes in employment and output is not perfect (Figure 3). Some of the sectors that experienced the sharpest declines in output did cut back drastically on employment—for example, in nonferrous metallurgy (where employment declined by 40 percent) and electronics (30 percent)—but others that experienced similarly large drops in output reduced employment by no more than the average across industry as a whole (for example, textiles, clothing, and leather products). This difference may reflect varying perceptions about the permanence of the decline in output, the extent of pre-existing distortions in the level of employment, and different degrees of adaptation to new market conditions.

Average nominal wage increases were considerably more uniform across sectors, to a large extent because of the ceilings on wage increases imposed by the incomes policy adopted by the authorities. Real product wage increases (depicted in Figure 3) appear to have been fairly closely related to the output performance of each sector. Exceptions to this pattern are nonferrous metallurgy and textiles, where wage increases approximated the industrial average despite the very large declines in output experienced by these sectors. Because these two sectors also shed labor the fastest, changes in the *wage bill* would appear to be related to changes in output in these sectors.

Romania[10]

The government that took over in the last days of 1989 after the collapse of Nicolae Ceausescu's regime began implementing a reform program similar to that of other countries in the region. In February 1991, private economic activity and foreign investment were liberalized, and the state monopoly in trade abolished. Prices were liberalized in three rounds of reform starting in November 1990. In January 1991, a stabilization pack-

[10] For further details on the Romanian economic reform program, see Demekas and Khan (1991).

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age was introduced and tight fiscal and monetary policies were implemented (although a huge expansion of credit and money took place in December 1991 as part of a scheme to clear interenterprise arrears). A dual exchange rate regime was introduced in February 1991 and unified in November 1991. As a result, the exchange rate of the leu vis-à-vis the U.S. dollar jumped from lei 30 at the end of 1990, to lei 189 at end-1991, and to lei 430 at end-September 1992. Although in Romania—unlike in Bulgaria and Czechoslovakia—many critical reforms were introduced gradually, for purposes of the empirical work here the "beginning" of reform will be taken to be November 1, 1990, the date of the first major price liberalization.

Despite initial hopes, the stagnation and decline of the Ceausescu years were followed by further reductions in output during 1990–92. Real GDP fell by 7.4 percent in 1990, while a rise in real consumption of about 10 percent, financed by large wage increases, contributed to a substantial trade deficit and inflationary pressures. The stabilization program of 1991 accelerated the decline: real GDP fell by 14 percent in 1991 and an estimated 10 percent in 1992. As elsewhere, the decline was concentrated in industry: 18.2 percent in 1990, 22 percent in 1991, and an estimated 20 percent in the first half of 1992.

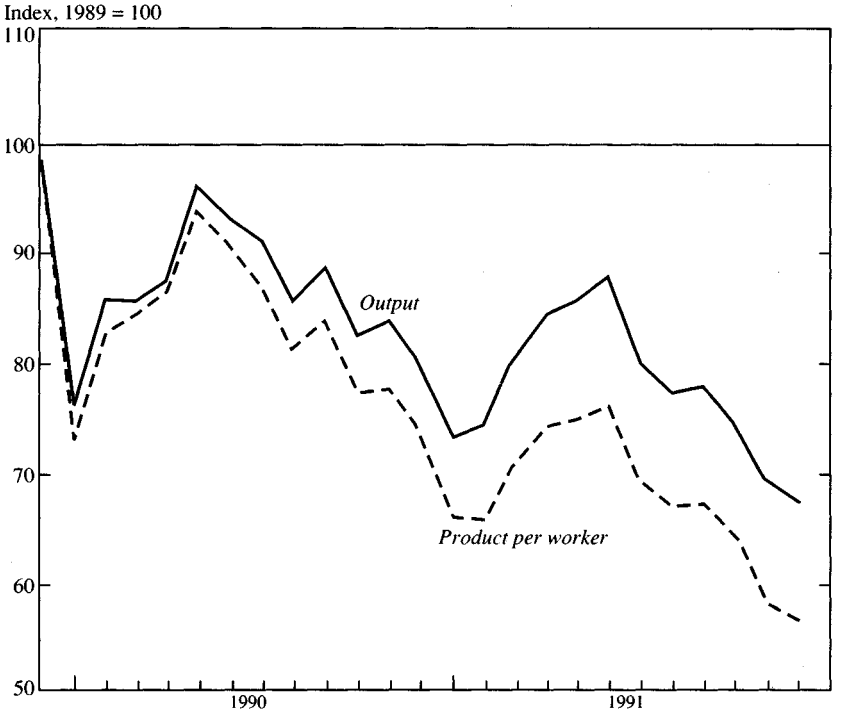
Unlike in Bulgaria and Czechoslovakia, the decline in industrial output in Romania was spread more evenly over time. A large decline in early 1990 caused by the civil disturbances following the toppling of Ceausescu was partially reversed by midyear, so that by June 1990, industrial output was about 90 percent of its average 1989 level. Then began an accelerated, if somewhat erratic, period of decline. This decline continued throughout 1991, and by December industrial output stood at about 70 percent of its average level in 1989 (Figure 4).

Supply factors were perhaps dominant in the decline of industrial output, at least in 1991. The decline in domestic production of energy and the collapse of energy imports (mostly in 1991),[11] as well as the reversal of the previous policy of diverting energy from households to industry in early 1990, significantly affected energy-intensive industry. Other supply factors were the disruptions associated with the violent change of regime in December 1989, which continued in various forms (worker absenteeism and work stoppages) during most of 1990; the effects of an aging and increasingly inefficient capital stock; and a reduction in working hours introduced in early 1990. On the demand side, markets for some industrial products disappeared as a result of the collapse of the CMEA.

[11] Although Romania imported little of its oil from the CMEA area during the 1980s, it was dependent on the U.S.S.R. for almost all of its natural gas and most of its electricity imports. Total primary-energy imports, in tons of oil equivalent, fell by 15 percent in 1990 and more than 41 percent in 1991.

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Figure 4. *Romania: Industrial Output and Productivity, 1990–91*
(In percent of annual average for 1989)



Source: Romanian National Commission on Statistics.

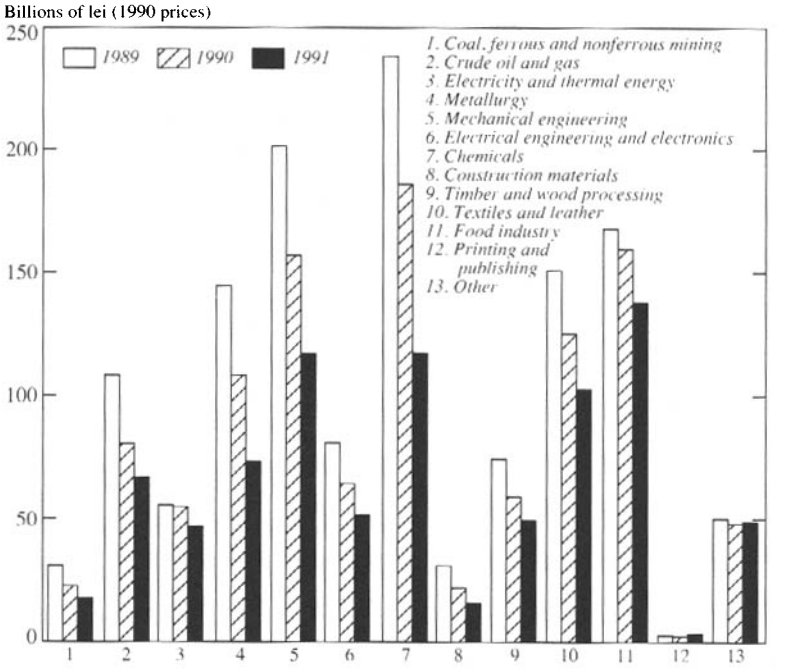
These effects were concentrated in some sectors such as railway equipment, which had been exclusively geared toward exports to the U.S.S.R. Finally, the emergence of large interenterprise payments arrears in late 1991 probably also contributed to a slowdown in production.

The rates of output decline were not uniform across sectors (Figure 5). The biggest losses in the two-year period were registered in chemicals, crude oil and gas, metallurgy, and mechanical engineering. By contrast, output of other sectors—for example, food and the printing and publishing sectors—declined by a relatively small amount, or even increased.

As regards employment, unlike in Bulgaria, Romanian industrial enterprises were relatively slow to shed excess labor. Industrial employment actually increased slightly to almost 3.8 million in the first quarter of 1990, and then declined to 3.5 million by the end of 1990 and to 3.2 million at end-1991—a cumulative decline of 13 percent, compared with a cumulative decline in output of more than 23 percent over the January

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Figure 5. *Romania: Gross Industrial Output by Sector, 1989–91*



Source: Romanian National Commission on Statistics.

1990–December 1991 period. Total unemployment started increasing only after mid-1991, reaching 5.6 percent of the labor force in June 1992.

The employment losses were not equally distributed across sectors and do not appear, at first glance, to have been closely correlated with the decline in output. Sectors such as mining (ferrous and nonferrous), electrical appliances and electronics, and chemicals and petrochemicals lost only a total 10–12 percent of their employment during the two years, while employment in mechanical engineering (including transport equipment) and building materials declined by about 20 percent.[12] On the other hand, employment actually increased in some sectors, such as electricity and thermal power, crude oil and gas, and food. In all these sectors, however, the gains in employment materialized in the first quarter of 1990, and the number of workers remained steady or gradually declined thereafter.

[12] Data on employment are available on a less disaggregated basis than those on output.

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II. Is There Evidence of Structural Change?

Successful economic reform in the previously centrally planned economies will require a massive reallocation of productive resources within the industrial sector, as well as between industry and the rest of the economy. This process has already begun, as price and trade liberalization, together with a "hardening" of budget constraints, is leading to a reorientation of economic activity toward more profitable sectors. The boom in the services sector in most of the economies is commonly mentioned as an example of resource reallocation under way.

Structural change is likely to generate a drop in output in the short run, however, because of asymmetric responses. Enterprises that become uncompetitive may be forced to curtail production because of financial constraints or because demand is simply absent, while enterprises that find profitable opportunities to expand production may be slow to respond because, in addition to normal lags, they may be reluctant to undertake large investments just before privatization. Macroeconomic developments may also generate a fall in output, as the combination of large adjustments in exchange rates and administered prices and stabilization policies designed to reduce inflation restrains economic activity in the short run.[13] Distinguishing between these two sources of output decline—macroeconomic versus industry-specific—is important because if the observed fall in output does not now reflect structural change to a significant extent, it may be concluded that this shock is still to come.

Although looking at the evolution of different productive sectors may give some indication of how generalized output developments have been, this method is not sufficient to answer the question posed in this section. In any economy, some productive sectors are more sensitive to business cycles than others; in fact, some activities behave countercyclically. This type of divergence among sectors is normal in any business cycle and does not signal any particular tendency toward a reallocation of productive resources. In order to deal with this problem, a statistical procedure is implemented below, using data on a set of (roughly) two-digit industrial branches, that should allow us to distinguish more precisely the extent to which structural change is taking place, as opposed to the intersectoral differences that arise in the course of any normal business cycle.[14]

[13] The "CMEA shock" contains both structural and macroeconomic elements. On the structural side, one factor behind the collapse in trade has been increased competition from world markets. On the macroeconomic side, foreign exchange constraints and tightness of policies may have reduced the demand for exports among the CMEA-member countries.

[14] Although an important part of the reallocation of resources is likely to involve an expansion in nonindustrial activities (for example, financial and other services), structural change is also likely to involve a substantial reallocation of resources *within* the industrial sector itself.

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Factors Common Across Industrial Sectors

If the output decline were mainly the result of *macroeconomic* forces, a relatively large fraction of the variance in production and employment across sectors would be accounted for by a small number of common factors, or principal components. The technique of principal components finds (mutually orthogonal) linear combinations of a group of time series that can explain the highest proportion of the variability (sum of the variances) of those time series. The first principal component accounts for the highest fraction of the variability of the series, the second for the second highest, and so forth (see, for example, Dhrymes (1978)). Naturally, there are as many principal components as there are variables in the set, but the relevant indicator for our purposes is how much variability can be explained by the first one or two principal components.

Results from applying this procedure to the data at hand only mildly support the structural change hypothesis. Specifically, we applied principal components to the monthly logarithmic rates of change of output and employment for the BCR countries since the initiation of reforms and, as a control procedure, on data from the United States with roughly the same level of disaggregation and sample length. The results, displayed in Table 1, indicate that the fraction of the variance explained by the first one or two factors is only moderately smaller for the BCR countries than for the United States. The only exception appears to be the results on

Table 1. *Fraction of Variability Explained by Principal Components*

Principal component	Bulgaria	CSFR	Romania	USA
Industrial output				
1	0.53	0.55	0.29	0.60
2	0.72	0.68	0.45	0.77
3	0.88	0.79	0.58	0.85
4	1.00	0.87	0.69	0.89
5	1.00	0.92	0.77	0.92
Industrial employment				
1	0.49	0.32	0.32	0.38
2	0.79	0.49	0.54	0.54
3	0.98	0.65	0.68	0.65
4	0.99	0.77	0.79	0.74
5	1.00	0.85	0.88	0.81

Note: The sample period for Bulgaria begins in February 1991; that for the CSFR begins in January 1991; Romania, October 1990; United States, July 1990. All sample periods end December 1991. The numbers of industrial sectors are Bulgaria: 16; CSFR: 19; Romania: 24 for output and 11 for employment; and the United States: 16.

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output in Romania, where less co-movement among the sectors seems present.

National and Industry Factors

Because the reform programs in this region share common features, including the removal of distortions (for example, the subsidization of energy use) that were common across countries, the resulting changes in the structure of industrial production might also be expected to be similar across countries. This hypothesis is strengthened to the extent that, in a global context, the countries of eastern and central Europe share a similar pattern of comparative advantage. In this case, as relative-price distortions come down, the resulting shifts in intersectoral resources would tend to be similar across countries.

The strategy in this part of the paper involves decomposing the change in output for each industrial sector in each country among factors common to all industries in that country and among factors common to all countries for a specific industry. The factors common to all industries in each country are associated with macroeconomic developments in that country and are therefore not related to structural change. By contrast, factors common to a given industry in all countries are indicative of resource reallocation in production, or structural change. Following Stockman (1988), our strategy is to pool data on rates of change of output across industries and countries in a variable y_t and to estimate the following regression:[15]

$$y(t) = m(i) + n(c,t) + u(i,c,t), \tag{1}$$

where $m(i)$ represents (the inner product of coefficients and) dummy variables that single out industries indexed by i (referred to in Table 2 as industry factors), $n(c,t)$ represents (the inner product of coefficients and) dummy variables that single out countries indexed by c and by time t (referred to in Table 2 as national factors), and u is the regression residual. Because the dummy variables are linearly dependent, a normalization is necessary, and thus one industry was excluded from the set $m(i)$.

[15] Although Stockman (1988) estimates essentially the same regression for a set of industrial countries, he is testing for a different effect, namely evidence of a "real business cycle" in the form of significant industry-specific shocks. There is a small literature on the decomposition of output changes into industry-specific, regional, and national components. Stockman's methodology was applied here mainly because it imposes fewer structural assumptions on the data than some of the other papers in this literature.

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Table 2. *Influence of National and Structural Factors*

	F-statistic	*P*-value[a]	Percent of explained sum of squares[b]
Regression 1: $y(t) = m(i) + n(c,t) + u(i,c,t)$			
$R^2 = 0.34$, DF = 680			
National factors	6.51	0.00	97
Industry factors	0.16	0.99	1
Regression 2: $y(t) = m(i,t) + n(c,t) + f(i,c) + u(i,c,t)$			
$R^2 = 0.35$, DF = 638			
National factors	3.64	0.00	88
Industry factors	0.17	0.99	9
Nation-specific industry factors	0.77	0.84	2
Regression 3: $y(t) = m(i,t) + n(c,t) + f(i,c) + u(i,c,t)$			
$R^2 = 0.53$, DF = 364			
National factors	3.56	0.00	42
Industry (time-varying) factors	0.58	0.99	38
Nation-specific industry factors	0.81	0.83	10

[a] Marginal significance level.
[b] Percent of explained sum of squares attributable to orthogonal part of corresponding regressors.

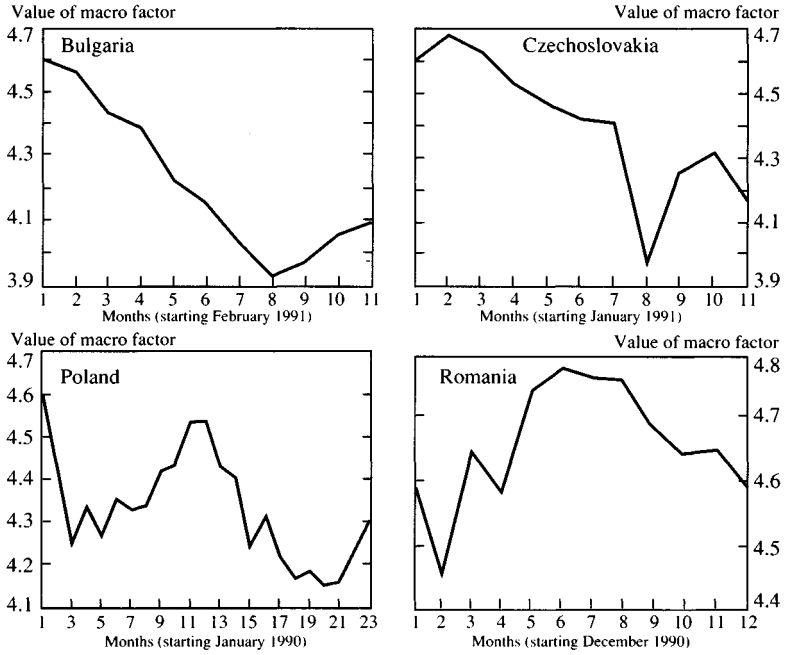
This means that the resulting coefficients represent values *relative* to the excluded industry coefficient. The energy industry was chosen to be the "numeraire" sector in all countries, because it showed the least variability over the sample.

Estimation of equation (1) gives overwhelming support to the view that macroeconomic factors, rather than structural factors, have accounted for most of the variability of output in the region since the reforms were initiated.[16] As shown in Table 2, nearly all of the variance of output

[16] The estimation of equation (1) was carried out by pooling data from 14 industrial sectors for the BCR countries and Poland (data from the other previously centrally planned economies were not available) on samples that begin on the dates of each country's big bang.

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Figure 6. *Macroeconomic Influence on Industrial Output*



changes explained by the regressors is accounted for by the dummy variables that represent national, or economywide, factors. More formally, an F-test cannot reject the null hypothesis that the entire set of industry-specific dummies has no effect on the rate of change of output in these countries.

It is possible to recover the path followed by the "national factors" driving industrial output in each country, as estimated by equation (1).[17] The (cumulative) effect of the factors is plotted in Figure 6 for each country in the sample. It is interesting that the pattern roughly matches the general thrust of policies in the countries.

To allow for the possibility of country-specific structural change (in addition to the structural change common across countries), a modified version of equation (1) was also estimated:

$$y(t) = m(i) + n(c,t) + f(i,c) + u(i,c,t), \qquad (2)$$

[17] Again, this factor is defined relative to the shock to the energy industry in the four countries, which it is hoped is neutral.

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where the additional set of dummies $f(i,c)$ identifies shocks that are specific to industry i in country c. A further normalization was now required, involving the exclusion of the country-effect dummies ($n(c,t)$) in the last period. As displayed in Table 2, the estimation of equation (2) produces essentially the same results as equation (1), namely that the country-specific macroeconomic effects are the most important in accounting for output developments. An F-test finds that the joint effect of the industry effects, $m(i)$, and the country-specific industry effects, $f(i,c)$, is not statistically different from zero.

An even more general form of this equation,

$$y(t) = m(i,t) + n(c,t) + f(i,c) + u(i,c,t), \tag{3}$$

was also estimated. Equation (3) allows for international industry shocks that are time-specific. Thus, it geometrically increases the number of dummy variables representing industry shocks common across countries. Although this has the predictable effect of increasing the fraction of the variance explained by the industry factors, it only marginally improves the statistical significance of the industry factors. The F-statistic still cannot reject the null hypothesis that the whole set of coefficients on industry dummies is equal to zero. The evidence in favor of the view that macroeconomic shocks have been much more important than sector-specific shocks in accounting for the output decline thus appears to be quite robust.

Comparative Advantage and Sectoral Shifts

An important element in the process of structural change in production is the opening of the economy to international competition. This may, in fact, be the single most powerful influence on the process of resource reallocation, both because international competition provides a particularly strong mechanism for ensuring market discipline—given the generally monopolistic character of domestic markets—and because the productive structure of previously centrally planned economies is so far removed from what would have likely emerged from comparative advantage alone.

This line of reasoning leads immediately to the question of whether the anatomy of the output decline has closely followed the pattern of comparative advantage within industry. For this purpose, we make use of recent work by Hughes and Hare (1991, 1992) who calculate measures of domestic resource cost for different industrial sectors in Bulgaria and Czechoslovakia. We investigate the extent to which their measures can predict the performance of each sector.

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Table 3. *Comparative Advantage and Output Changes*

Regression result	Bulgaria	Czechoslovakia
Coefficient on domestic resource cost	−0.188	0.013
Standard error	(6.237)	(0.084)
R^2	0.001	0.003
Durbin-Watson statistic	1.17	2.43
F-statistic (zero slopes)	0.001	0.020

Domestic resource costs are defined as the ratio of value added at domestic prices to value added at international prices (that is, valuing products and inputs using estimated domestic-currency equivalents to the world price). Thus, the DRCs measure the level of protection enjoyed by each industry and the degree of adjustment in domestic costs and prices that is necessary to face international competition. It should be noted that, as Hughes and Hare acknowledge, the estimates of DRC are necessarily tentative because a number of judgmental assumptions are necessary to value products at world prices, including several arising from the existence of nontraded goods, quality differences, and peculiar exchange rate arrangements in the CMEA area. At a more fundamental level, DRCs are based on the assumption of a fixed-coefficient technology and do not consider the possibility of different elasticities of substitution across sectors.[18] Notwithstanding these caveats, the DRC estimates are the only available measures of comparative advantage and for this reason cannot be overlooked.

To determine the extent to which output changes are correlated with this measure of comparative advantage, we regress the cumulative change in output since the beginning of the reform program on a transformed[19] measure of DRC. The results, reported in Table 3, do not provide clear evidence that resources have moved in the direction dictated by the estimates of comparative advantage in either Bulgaria or Czechoslovakia, since the level of the DRC is not statistically significant in the regression of output changes.

[18] For example, if industries that utilize underpriced inputs intensively are doing so because they have a high elasticity of substitution, the DRC criterion would nevertheless reveal these industries to be among the most uncompetitive, even though in fact they would be hurt relatively less by raising the price of the relevant inputs.

[19] The transformation is necessary because DRCs are not a monotonic measure. The transformation is such that the higher the measure, the more competitive is the sector.

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III. Supply Versus Demand Factors in the Output Decline

This section presents evidence on the question of whether supply or demand shocks have predominated in the evolution of output in the BCR countries since the initiation of reforms. As suggested previously, there are reasons to believe that the tight financial policies pursued to reduce inflation and maintain a satisfactory external position, as well as the drop in export demand associated with the CMEA shock, adversely affected demand in these countries, while increases in energy prices—resulting both from increases in international prices and from reductions in domestic subsidies—and financial constraints on enterprises likely had an adverse impact on aggregate supply.[20]

Price-Output Correlations

In any market, changes in the equilibrium configuration of price and output reflect shifts in both the demand and the supply functions. However, if demand shifts have been relatively more important, the correlation between price and output changes will tend to be positive; if supply shifts predominate, the correlation will be negative. If data on relative price changes and relative output changes in a cross-section of markets are collected, and if sectors that experience relatively more inflation are also those sectors that experience a relatively large decline in output, then the correlation between price and output changes would be negative, indicating that supply shifts have been relatively more important in these markets over the period in question. Conversely, if those sectors that experience large price changes are also those that experience a relatively small decline in output (or an increase in output), then demand shifts have been relatively more important, and the correlation between price and output changes would be positive.

Table 4 gives results on price-output correlations for Bulgaria, Czechoslovakia, and Romania.[21] The table suggests, in the cases of Bulgaria and the CSFR, that supply shocks have played a more important role than demand shocks in accounting for the output decline since the

[20] The increase in energy and other input prices would have a large impact on output if enterprises were liquidity constrained or if they faced limited substitution possibilities because of adjustment costs, for example.

[21] Disaggregated price and output data from the industrial sectors in the three countries were collected for this purpose. The number of sectors varied slightly across countries: 16 for Bulgaria; 19 for the CSFR; and 13 for Romania. Data were available for the whole of 1991 for the CSFR and Romania, but only through the third quarter of 1991 in the case of Bulgaria.

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Table 4. *Correlations Between Quarterly Price and Output Changes*

Quarter	Mean change[a]		Correlation
	Output	Prices	
Bulgaria			
1991:1	−0.345	1.770	−0.593
1991:2	−0.144	0.591	−0.489
1991:3	0.084	0.001	−0.835
CSFR			
1991:1	−0.191	0.400	−0.259
1991:2	−0.160	0.092	−0.332
1991:3	−0.167	−0.003	−0.051
1991:4	0.088	0.007	−0.023
Romania			
1991:1	−0.122	0.856	−0.250
1991:2	0.106	0.197	0.184
1991:3	−0.105	0.194	0.354
1991:4	−0.129	0.050	−0.024

[a] Logarithmic rate of change relative to previous quarter.

initiation of reforms.[22] The Romanian results are not as clear-cut. For the period as a whole, there is a relatively low negative correlation, but this reflects a negative correlation in the first quarter of 1991 followed by positive correlations in the second and third quarters and a correlation close to zero in the last quarter of the year.

A Simple Model of Supply and Demand

This section presents results from the estimation of a simple supply-demand model of industrial output determination in Czechoslovakia and Romania.[23] The main purpose of undertaking the estimation is to shed light on the relative importance of supply and demand shocks in accounting for the output decline. The analysis in the previous section was deficient in this regard, since the approach there could only reveal which type of shock *predominated* in a particular period. In principle, the results that follow permit us to account for the output declines in terms of shocks to the exogenous variables affecting the demand function and to those affecting the supply function. In addition, they should also enable us to consider the relative importance of various macroeconomic disturbances, such as increases in energy prices and restrictions on credit to enterprises.

[22] Which specific supply and demand shocks have played a role is investigated in the next section.

[23] The necessary data were unavailable in the Bulgarian case.

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In fairly standard fashion, the estimated model has the following characteristics. Demand is a function of a relative price variable (the relative price of sector *i*'s output divided by the overall industrial price index) and a scale variable that proxies for aggregate spending. Supply in a given sector is a function of relative prices, the price of the energy input, the level of employment, and a real credit variable.[24] If employment is monotonically related to the real (product) wage as is conventionally assumed, then supply is simply a function of the product price and the prices of the relevant inputs (labor and energy).[25] The real stock of bank credits to enterprises is incorporated to allow for possible liquidity constraints faced by firms over this period (see Calvo and Coricelli (1992)).[26]

Because of the relatively short sample length, it was not possible to estimate the model individually for each sector. Instead, the estimation was performed on a pooled data set, that is, forcing the coefficients to be equal across all sectors. An instrumental variables procedure was used to account for the endogeneity of the sectoral price indices and to permit the identification of both the demand and supply functions. Estimations with and without industry-specific constants, or "fixed effects," were performed; for both countries, the fixed effects were significant on the demand side but produced very imprecise estimates on the supply side.[27] For this reason, only the supply estimates without fixed effects are reported below.

The results for Romania are reported in Table 5. On the demand side, both instrument sets produce coefficients that have the expected signs and are statistically significant. On the supply side, all coefficients have the expected signs and, with the exception of the credit variable, are statistically significant. Jointly, the coefficients are highly significant, as reflected by the *F*-statistics and the R^2s. The empirical results suggest that both demand- and supply-side factors have exerted an influence on the evolution of output. In particular, the elasticity estimates suggest that

[24] All input prices, as well as the stock of credit, are deflated by the aggregate industrial price index.

[25] Lack of disaggregated real wage data prevented us from incorporating real wages directly into the supply function. Also, lagged (rather than contemporaneous) employment was used in the specification, in order to avoid problems of simultaneity bias and also to allow for the fact that production takes time.

[26] Although this specification only crudely reflects the Calvo-Coricelli hypothesis, it could represent a model in which the real stock of credit simply represents another input (like labor and capital) into the firm's production function.

[27] The apparent reason was multicollinearity arising from the correlation between the fixed-effect coefficients and the employment variable.

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Table 5. *Romania: Demand and Supply Estimation Results*

Variable and summary statistic	Instrument set 1	Instrument set 2
Demand		
Relative price	−2.08	−0.60
	(3.85)	(2.29)
Aggregate spending	0.29	0.71
	(2.10)	(8.65)
R^2	0.95	0.99
Durbin-Watson statistic	1.58	1.67
F-test (zero slopes)	177.80	933.47
Supply		
Relative price	0.51	0.38
	(2.20)	(1.71)
Real price of energy	−0.70	−0.69
	(3.12)	(3.05)
Lagged employment ($t - 1$)	0.91	0.91
	(19.73)	(19.71)
Credit to enterprises	0.22	0.22
	(0.80)	(0.78)
R^2	0.79	0.79
Durbin-Watson statistic	2.11	2.19
F-test (zero slopes)	106.89	105.41

Note: Instrument set 1 uses broad money in real terms to proxy for aggregate spending. Instrument set 2 uses aggregate industrial production to proxy for aggregate spending. From the point of view of an individual sector, this variable is effectively exogenous.

Absolute values of *t*-statistics are in parentheses.

changes in the real price of energy exert a strong effect on the supply function.

Similarly, for Czechoslovakia (Table 6), the model seems to fit reasonably well on the demand side but less well on the supply side. Although the coefficients in the supply function have the expected signs, their statistical significance is low. Moreover, the real credit variable had the wrong sign and was not statistically significant, and so was dropped from the final estimations. This result may simply have been caused by the crude formulation of the credit hypothesis, but a similar specification for Poland did identify a significant credit variable.[28] This finding suggests

[28] See Borensztein and Ostry (1992). A difference with the current estimation, however, was that the longer sample period in the Polish case permitted the estimation of a supply function on a sector-by-sector basis.

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Table 6. *Czechoslovakia: Demand and Supply Estimation Results*

Variable and summary statistic	Estimate
Demand	
Relative price	−2.56
	(1.84)
Aggregate spending	1.46
	(13.33)
R^2	0.96
Durbin-Watson statistic	1.99
F-test (zero slopes)	292.50
Supply	
Relative price	0.82
	(0.24)
Real price of energy	−0.41
	(1.37)
Lagged employment ($t - 1$)	1.03
	(3.75)
R^2	0.69
Durbin-Watson statistic	1.68
F-test (zero slopes)	151.30

Note: Panel estimation with fixed effects for 17 industrial sectors on monthly data, December 1990–November 1991.
Absolute values of *t*-statistics are in parentheses.

that credit conditions may have been less stringent in Czechoslovakia than in Poland, perhaps because enterprises in the former country had relatively stronger financial positions at the outset of the program.

The regression results were used to allocate the change in output over the estimation period to demand- and supply-related effects, although the large standard errors associated with some of the estimates imply that such results should be regarded as indicative only. In Table 7, a "shift" refers to the horizontal shift in the function arising from changes in the explanatory variables of that equation over the sample period. A "change" refers to the equilibrium change in output resulting from the shift in the function—that is, the move along the other function. Therefore, the amount by which a supply-side *change* falls short of the supply *shift* is a direct function of the price elasticity of demand. The sum of the demand- and supply-side changes gives the change in output predicted by the regression coefficients, which differs from the actual changes by the combined effect of the error terms, given in the last column of the table.

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Table 7. *Decomposition of Output Decline*
(In percent)

	Total change	Supply shift	Supply-side change	Demand shift	Demand-side change	Error terms
Czechoslovakia 1991	−0.390	−0.358	−0.307	−0.514	−0.116	−0.003
Romania 1991	−0.181	−0.264	−0.171	−0.132	−0.053	0.043

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The results indicate significant shifts in both the supply and demand functions for both countries. In Czechoslovakia, the computed demand shift is larger than the supply shift, whereas in Romania the supply shift is larger. However, because of the inelasticity of the estimated supply curve, the largest contribution to the output decline in Czechoslovakia is also due to supply-side factors. This result is consistent with the price-output correlations reported above.

IV. Conclusion

This paper has sought to examine some important issues surrounding the declines in output experienced by Bulgaria, Czechoslovakia, and Romania since the initiation of market-oriented reforms. After reviewing developments in these countries over the past two years, as well as the main features of the reform programs that were adopted, our empirical work focused on two main questions. First, to what extent is the decline in industrial output in each country a general phenomenon? Or, put differently, is there much evidence that a significant reallocation of resources took place within the industrial sectors of these economies since the initiation of reforms? Second, to what extent can the decline in output be attributed to shocks that primarily affected demand versus those that affected supply?

On the issue of supply versus demand shocks, we first looked at disaggregated price and output data for a cross-section of industrial sectors to determine the signs and magnitudes of correlations between price and output changes. Our findings were that for Bulgaria and Czechoslovakia the correlations were negative throughout 1991, indicating a predominance of supply shocks over demand shocks during this period. In the case of Romania, the results were less conclusive, since the correlation between price and output changes varied over time.

Although price-output correlations can provide useful summary information on which shocks (that is, whether to the demand curve or the supply curve) have been quantitatively most important, a more structural approach is necessary in order to investigate the extent to which specific shocks—such as increases in energy prices or credit policies vis-à-vis state enterprises—have played a role. For this purpose, the paper went on to estimate a simple supply-demand model of industrial output determination. The analysis yielded coefficient estimates for the partial effects of various macroeconomic variables affecting supply and demand, which were, for the most part, consistent with their theoretical counterparts and statistically significant. The results suggested that energy price increases,

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in particular, exerted a quantitatively important effect on the supply of industrial goods over the period.

As far as the issue of structural change was concerned, a variety of statistical tests were performed to determine the extent to which resources have been reallocated within the industrial sector, as one would have expected once firms began to respond to the new structure of relative prices. Our results suggest that aggregate, or national, factors are capable of explaining nearly all the variation in output in the BCR countries during the period since the initiation of reforms, with sector-specific factors playing a very minor role. The data confirmed this conclusion in other ways—using principal components analysis—revealing that the first few principal components of the time series of industrial output and employment accounted for a similar proportion of the variance in these countries' series as in the benchmark country. Finally, the data did not reveal any strong tendency for resources to be moving toward those sectors with relatively low domestic resource costs, as a simple version of comparative advantage theory might predict. Thus, it is not possible to discern much evidence of structural change within the industrial sectors of these three economies, perhaps because not enough time has elapsed since the initiation of reforms.

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