Industrial Growth Rates and Instability: An Historical Analysis of the Former Centrally Planned Economies of Eastern Europe

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Abstract

One of the central tenets of socialism and central planning economics, as practiced by the East European countries, was that this organization of employment, production and activity could achieve higher growth rates than market economies. This paper presents an historical analysis of economic performance of seven countries: Bulgaria, Czechoslovakia, GDR, Hungary, Poland, Romania and Yugoslavia during the crucial period of socialism (1960-80). It studies the relationship between industry output growth rates and output instabilities in approximately twenty-five industries. Using empirically estimated models it was found that the instability (volatility) of industry output increased with growth rates and at an increasing rate. Since instability creates substantial costs, these findings imply that the true value of income and product streams in East European countries, after discounting for instability, was lower than otherwise believed. A decomposition of instability into two sources, systemic structure versus operational implementation is suggested.

Keywords: *Historical analysis, central planning, Eastern Europe, Economic performance, Industrial output and instability*

JEL Classification Codes: *P21, P41, P52*

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1. Introduction

Few problems were more perplexing to the central planners of East European socialist economies (CPEs) than the maintenance of high growth rates with stability (Khanin, 2003; and Whitesell, 1985). A fundamental tenet of socialist development theory was that a system built on the state ownership of nonlabor resources and the coordinated planning of resource allocation could better provide for a society's needs than other approaches to economic organization and management (Brus and Kowalik, 1983; Kaser and Zielinski, 1970; and Wilczynski, 1970). The ideological claims for the superiority of socialism and the command economy model were largely supported by the economic advances that occurred in CPEs after World War II, when industrial production grew at rates substantially higher than those of mature market economies (Alton et al., 1975; Kaser and Zielinski, 1970; Campos et al., 2002; Feiwel, 1977; and Nove, 1982).

These extraordinary growth rates, which were in part accounted for by intensive capital formation and a mobilization of labor surpluses from agriculture, diminished during the late 1950's and early 1960's (Ehrlich, 1991; Gomulka, 1986; Nyiri, 1982; and Pryor, 1985a). In particular, some of the more advanced CPEs, such as Czechoslovakia, GDR, and Hungary began to suffer from the overcentralization of decision making, excessively detailed planning, rigid materials allocation procedures, lack of discretion and initiative at the enterprise level, and distortions in costs and value produced by administratively determined prices. As productivity and growth rates declined, several countries reconsidered their policies and methods for implementing the 'command' model (Portes, 1969). Few substantive changes occurred under reforms, however, except in Hungary (e.g. Bauer , 1990; Ben-Ner and Montias, 1991; Bryson, 1990; Estrin, 1991; and Jackson, 1991). As one author has stated "Since about 1955 most centrally planned systems have been subjected to a sequence of reforms. All in vain. Some minor corrections in the functioning of the systems were sometimes obtained but no fundamental improvement was ever brought about. For some reason the centrally planned economies proved to be neither able to perform nor to reform" Drewnowski (1982, p. 72). Even during the period of marketization, with changes in the centralization versus decentralization of production and resource management decisions beginning in the 1990's, one author likened reforms to a treadmill and concluded, "It seems as if the socialist system rejects measures of reform much as an organism may reject transplanted tissue," (Ickes, 1990, p. 54).

In addition to declining growth rates, more and more evidence emerged suggesting that instabilities existed in investment spending, inventories, construction, and industrial and agricultural production (Bleaney, 1991; and Summers, 1991). J. Goldmann (1964 and 1965), after studying the annual growth rates (1950-64) of industrial production and investment, concluded that several countries in Eastern Europe had experienced regular fluctuations and, furthermore, that there was

some evidence that the oscillations were synchronized. Staller (1964), in an inter-country comparison of instability, concluded that instability indeed did exist in CPEs, and, while the Soviet Union was more stable than the countries of Eastern Europe, market economies were more stable than planned economies. The findings that widespread fluctuations occurred in economic activity in CPEs and the former Soviet Union, many with cyclical characteristics, were later confirmed by (e.g. Bajt, 1974; Soos, 1975-76; Kyn, Schrettl, and Slama, 1979; Boot, 1984; Wiles, 1982; Hutchings, 1969; Pryor, 1985a), and others.

Most of the empirical research on instability in planned economies has been concerned with its identification and measurement in various sectors of the economy, its characterization, and/or comparisons of its relative magnitude with market economies. Numerous other writings have offered explanations for what has been observed, including the origins of instability (Ickes, 1986; and Levine, 1969). Indeed, some authors have concluded that planners themselves were contributors to cycles in output and investment activity (Grosfeld, 1986).

Most analyses of instability in the CPEs have focused on macro aggregates of economic activity including output and have searched for the presence or absence of cyclical movements. That is, "Are there observed movements in these time series that possess systemic, periodic and rhythmic properties (Anderson, 1977)?" If so, researchers have sought to explore linkages and coincidental characteristics between countries and across sectors, and to conjecture about causal factors related to economic organization, institutional structure, culture and/or the incentives and behaviors of agents.

In this paper, we focus on an analysis of physical output at the industry level and specifically conjecture that there was a relationship between output growth rates and instability. That is, "As the tautness of plans increased and enterprises responded, did the deviations of output remain relatively constant or did they increase with increases in growth rates?" If there was a positive relationship between industry output growth rates and production instability, was the rate of change constant? To empirically evaluate these hypotheses, we have studied the production experiences of approximately twenty-five industries in the seven major countries of Eastern Europe: Bulgaria, Czechoslovakia, GDR, Hungary, Poland, Romania and Yugoslavia during the period 1960-80.

2. Plans, Operations, and Fluctuating Growth Rates

While there is substantial evidence of fluctuating, indeed cyclical growth rates, little or no empirical support has been found for a relationship between instability and growth rates (Ickes, 1986). Staller (1964) studied the association between fluctuations and growth rates in total output, agriculture, industry, and construction, and concluded that there were "no consistent patterns." In examining similar measures of aggregate activity in Eastern Europe, to include

investment, Bajt (1974) found the cross country rank correlations between average rates of growth and standard deviations to be negligible, and in some cases negative. Later Pryor (1985b) found a statistically significant relationship between the average annual growth rates and fluctuations of GDP and gross fixed capital investment, but not in those of industrial or agricultural production.

Despite these conclusions, there are three important arguments that motivate our continued interest in a relationship between output growth rates and instability in CPEs. First, from a historical perspective, these countries, for forty years, participated in what was probably the largest, most comprehensive social, political and economic experiment ever undertaken. Despite the remarkable reforms and transformations that have occurred in the post-1989 period, the vastness, magnitude, duration and completeness of the nationalization of all non-human assets, the institutional structures created and the command-control centralized administration of resource utilization and output production is overwhelming. Second, the foundations of socialist growth theory and the practical implications of its implementation suggested that there were strong pressures for over ambitious production plans and inadequate signals (flexible prices and timely information) of stress in product and resource markets with higher growth rates (Lacko, 1980). Inherent in the value system, structures, policies and administrative practices of CPEs is the maximization of activity levels and an allocation of resources between producer and consumer good industries that were unsustainable. Taut planning was the norm and arose for many reasons including asymmetric information at various levels of decision making and the belief that there were hidden, unreported and underutilized resources that would be revealed only by exaggerated expectations (Linz, 1988). However, as Powell (1977, p. 62) noted, "A profound difference between plan construction and plan execution is that the former is unconstrained by reality . . . Actual deliveries never exceed available supplies. Realized outcomes never lie outside the efficiency frontier."

The final motivation for these analyses is that virtually all previous empirical studies have been based on highly aggregated data of macroeconomic activity. Brainard (1974) has argued that policy cycles intended to create higher production levels, greater efficiency or correct for imbalances, for example, are more likely to appear in disaggregated data within agriculture or industrial sectors. The aggregation of industrial sector data tends to smooth instabilities at operating levels and may conceal the impact of growth rates on instability. Bajt (1971, p. 55), for example, noted, "…While the changing relation between two departments necessarily produces oscillations of production of the two departments, it does not necessarily produce fluctuations in the main macroeconomic aggregates." Levine (1969, p. 309), further noted that "…the absence of quarterly data limits our ability to observe short fluctuations. And the possible uneven overreporting of data from below may tend to smooth out fluctuations in growth data."

To rationalize our conjecture that a relationship may have existed between output growth rates and instability at the industry level in CPEs, we first focus on the incentives in CPEs to establish growth rates at over-optimum levels, that is, beyond those that would have existed under balanced growth (Hutchings, 1969; and Soos, 1975-76). The excess of planned output above its equilibrium was accounted for by both accidents and oversights, as well as deliberate, calculated decisions to establish targets that were too taut. Successful planning and enterprise management required an understanding of the interdependencies between industries, the impact of changing technology on the resources employed in production functions, resource availability, and the character of product demand (Hewett, 1980). To the extent that there was ignorance or misunderstanding, one can expect continuous experimentation to determine optimal growth rates. In explaining the continuous errors of planners that overstrain the economy, Kyn, Schrettl, and Slama (1979, p. 120), argue that "…planners do not know what the equilibrium growth path of the economy is." In a study of investment cycles within CPEs, Grosfeld (1986, p. 49) concluded that "adaptive behavior (of planners) plays a destabilizing role in ascending and descending phases of the cycle.. ." Kyn et al. (1979) suggested that an overstrained economy results in part because of planners' preoccupation with growth rates, and essentially an indifference or lack of awareness of the relationship between an output target and the equilibrium.

3. Incentives, Information and Corrections

Beyond information and understanding, planners and enterprise managers were not rewarded for efficiency and/or profitability. Hence, they had inadequate incentives to improve the quality of employment and production decisions (Granick, 1973). The incentive system, in the presence of increasing growth rates, encouraged managers to understate the productive potential of their enterprises, and to accumulate excessive inventories of resource inputs as a buffer against shortages that might jeopardize their ability to fulfill production targets. These activities squandered resources because they were employed with widely varying marginal productivities and/or because they created bottlenecks and shortages before the full capacity levels of production were reached (Oliveira, 1960; Rostowski and Auerbach, 1986; and Bauer, 1978). The excessive build up of inventories and the rapidly declining productivity of resources under higher growth rates prematurely terminated expansions and reduced planned and actual growth rates.

Some part of these necessary corrections arose from inadequacies in management information systems, data accuracy and availability, and because computing technologies were unable to optimize the complex interdependencies and linkages between the resource inputs and product outputs of industry branches. In CPEs there were too few signals of changing product/resource valuation that would have indicated the emergence of shortages or surpluses and a probable departure of

current output from its equilibrium (Brada, 1974). This placed a greater burden on information and decision support systems to identify stresses and imbalances in the system associated with higher growth rates so as to facilitate timely corrections. In market economies rising prices indicate resource scarcities, ration resources in the short run, and encourage corrective actions. Most prices in CPEs were not market determined, nor were they flexible. Hence, early corrections for overambitious plans were less likely, and the need for larger subsequent corrections was greater. These conditions tend to lead to more instability in output than would otherwise have existed. At the core of instability caused by excessive growth rates is the violation of the "law of proportional development," which is fundamental to models of economic growth under socialism. Economic growth involved "balanced expansion" between and within aggregate sectors that was within tolerable and achievable proportions, though the proportions varied between countries for many reasons. Goldmann (1964, 1965, and 1969) argued that it was the appearance of disproportions that necessitated corrections and caused quasi-cyclical fluctuations in growth rates. He asserted that there was a tendency for the raw-material base to lag behind the growth of manufacturing industries whenever rates of growth exceeded certain optimum levels because of the underfulfillment of production and investment plans in the former industries and overfulfillment in the latter (Whitesell, 1985). This in turn led to imbalances in foreign trade and nearly always to fluctuations in investments (Massell, 1970; and Naya, 1973). The various sectors of all economies are interconnected through technology, input-output relationships, shared use of the infrastructure, and competing demands for materials, energy, labor, and capital (Powell, 1977). Hence, the growth rate of any particular industry must be balanced with that of other industries to which it relates. Growth rates in the industries of CPEs that exceeded their equilibria eventually created shortages, bottlenecks, delays, and resulted in only partially fulfilled plans (Boot, 1984). Since prices give no warning of these conditions, they usually occurred as realized experiences, at which point there was a correction. Growth rates were reduced, and instability resulted. As Grosfeld (1986, p. 46) stated, ". . .the expansion stops because it hits a ceiling."

In practice, there were also important political explanations for the correction of excessive growth rates in CPEs. Every economy is ultimately judged by the extent to which it is capable of satisfying the consumption expectations of its population. Indeed, failures of the system to improve the population's standard of living may jeopardize its political stability (Turnock, 1978; and Nove, 1969). Over-optimum growth rates for heavy industry, high labor employment, and improved expectations for consumption, if unmet, will eventually lead to political pressures for changes in the relative growth rates and priorities given to producer and consumer good industries (Bunce, 1980). The back and forth shifts in the relative emphasis of industrialization and consumption, that is, a "growth conflict" (Bajt, 1966), created instability. Consumption possibilities as revealed in the availability, variety, quality and cost of goods eventually formed a constraint to the share of

output that could be devoted to capital and military spending without social and political implications (Bleaney, 1991).

4. Data and Measurements

The data for this study are indices of annual production (output) for three digit ISIC industries and were published by the United Nations in various editions of the Yearbook of Industrial Statistics: Vol. I. Approximately twenty-five different industries are included, such as, food products, textiles, wearing apparel, leather products, wood products, industrial chemicals, petroleum refining, plastic products, non-metal products, iron and steel, and electrical machinery. These industries populate most of the CPEs industrial branches and represent a variety of means and methods, processes, capital-labor combinations and customer types (consumer, industrial, military, foreign exports). See Table 1 for a complete summary of the data set for each country and source citations.

Our statistical analyses involve two stages. First, we estimate the instability (I) and growth rate (G) of each industry, in each country, over its sample period. The number of annual observations varies, as can be seen in Table 1, from industry to industry and country to country. In most cases, the time period for I and G is 1960-80. Second, we then use these estimates as data, and estimate the parameters of linear and nonlinear models for each country, where the I and G of each industry are endogenous and exogenous variables. The number of observations that is, industries contained in each country's sample was: Bulgaria (22), Czechoslovakia (25), GDR (18), Hungary (23), Poland (24), Romania (19), and Yugoslavia (25), respectively.

Numerous alternative measures of "I" have been proposed, each possessing various strengths and weaknesses (e.g. Deans and Bernstein, 1978; Coppock, 1977; Brodsky, 1980; Ickes, 1990; and Paldam, 1983). Most of these measures are computed from some version of the mean squared error of fluctuation around an estimated function of the long run, equilibrium path of activity, or from variations in the actual activity levels as measured by the standard deviation or coefficient of variation (Cuddy and Valle, 1978; and Naya, 1973).

In this study, the author has chosen to use the coefficient of variation because the conditions and experiences of the different industries in each country can not be uniformly represented by a predefined model, or family of models. The relatively small number of annual observations within each industry as well as numerous other specification and estimation problems, preclude the use of time series methods. Indeed, in numerous cases a model can not be found with statistically significant parameters, other than the intercept, in which case its mean squared error is not a valid measure of instability (Yu, 1987). Additionally, comparability between industries is difficult to achieve with the standard deviation of activity levels because of scale or index differences.

Table 1: Industrial Production Data: Sample Periods by Industry and Country

Primary Industry[a.]	Bulgaria	Czecho-slovakia	G D R	Hungary	Poland	Romania	Yugoslavia
			COUNTRY				
Food Products[1]	1967-80	1960-80	1963-76	1960-80	1960-80	1960-80	1960-80
Textiles	1960-80	1960-80	1960-80	1960-80	1960-80	1960-80	1960-80
Wearing Apparel	1960-80	1960-80	1963-80	1960-80	1960-80	1960-80	1960-80
Leather and Products	1960-80	1960-80	1963-80[2]	1960-80	1960-80	1960-80[2]	1960-80
Footwear	1960-80	1960-80	-------[2]	1960-80	1960-80	--------[2]	1960-80
Wood Products	1960-80	1960-80	1963-80[3]	1960-80	1960-80	1960-80[3]	1960-80
Furniture, Fixture	1960-80	1960-80	---------[3]	1960-80	1960-80	---------[3]	1960-80
Paper and Products	1960-80	1960-80	1960-80	1960-80	1960-80	1960-80	1960-80
Printing, Publishing	1960-80	1960-80	n.a.	1960-80	1960-80	1960-80	1960-80
Industrial Chemicals	1960-80	1960-80	1960-80	1960-72	1960-80	1960-80	1960-80
Other Chemical Prod.	1960-80	1960-80	n.a.	1960-80	1960-80	1960-80	1960-80
Petroleum, Refineries	n.a.	1960-80	1960-80[4]	1960-80	1960-80	1960-80	1960-80
Petroleum, Coal Prod.	n.a.	1960-80	---------[4]	n.a.	1960-80	1960-80	1960-80
Rubber Products	1960-80	1960-80	1963-80	1960-80	1960-80	1960-72	1960-80
Pottery, China, etc.	1960-80	1960-80	1960-80[5]	1960-80	1960-80	1960-80[5]	1960-80
Glass and Products	1960-80	1960-80	---------[5]	1960-80	1960-80	---------[5]	1960-80
Non-metal Products	1960-80	1960-80	1960-80	1960-80	1960-80	1960-80	1960-80
Iron and Steel	1960-80	1960-80	1960-80[6]	1960-80	1960-80	1960-80	1960-80
Metal Products	1960-80	1960-80	1960-80	1960-80	1960-80	1960-80	1960-80
Machinery, n.e.c	1960-80	1960-80	1960-80	1960-80	1960-80	1960-80	1960-80
Electrical Machinery	1960-80	1960-80	1960-80	1960-80	1960-80	1960-80	1960-80
Transport Equipment	1960-80	1960-80	1960-72	1960-80	1960-80	n.a.	1960-80
Professional Goods	n.a.	1960-80	1960-72	1960-80	1960-80	n.a.	1960-80
Other Industries	1960-80	1960-80	n.a.	1960-80	1960-80	n.a.	1960-80
Electricity, Gas, Steam	1960-80	1960-80	1960-80	n.a.	1960-76	1960-80	1960-80

Source: Yearbook of Industrial Statistics: VOL. I, Department of International Economic Social Statistics, United Nations, Editions 1969, 1973, 1977, and 1980:
a. "Primary Industry" is based on the ISIC Classification;
1. For some countries, food products includes beverages and/or tobacco
2. Leather and Products and Footwear are aggregated into a single index;
3. Wood Products, and Furniture and Fixtures are aggregated into a single index;
4. Petroleum Refineries, and Petroleum and Coal Products are aggregated into a single index;
5. Pottery, China, etc. and Glass and Products are aggregated into a single index; and;
6. Iron and Steel, and Non-ferrous Metals are aggregated into a single index.

It has also been argued, where growth rates are used as data, that the coefficient of variation provides a perspective for relative change by discounting the standard deviation by a benchmark of growth, that is, the mean (Portes, 1974; and Seton, 1969).

As with measures of instability, numerous approaches have been proposed for the measurement of activity growth rates (e.g. Campos et al., 2002; Klotz, 1973; Levenboch and Reuter, 1976; Adamowitz and Manning, 1985; and Darby, 1984). For reasons noted above, estimates of growth rates from "fitted" models could not be consistently employed across all industries. Therefore, nonparametric methods were employed. Over the sample period of each industry, the following three

growth rates were estimated: the average continuous compounded growth rate, the geometric growth rate, and the arithmetic average growth rate.

The similarity or redundancy of these three measures in the context of industrial production was examined by analyzing the Pearson product-moment correlations between them. The smallest bivariate correlation found between any two growth rate measures in any country was highly significant at .95. Therefore, we have concluded that the three measures yield nearly identical results in this application, and that any one of them is a sufficient measure of growth rates. Hence, G is measured by the average continuous compounded growth rate.

5. Hypotheses and Models

The conjectured relationship between I and G concerns both the existence of such a relationship, as well as the nature of that relationship. A theoretical argument for the conjectured relationship can be found in Banerjee and Spagat (1992), where the output level of an industry is specified as a linear function of the variance of output and parameters based on the actions of branch ministries. Using this model, they state, ". . raising an output target in some range might increase the expected output of a firm, but such an action might also raise the variance of output as the probability of nonfulfillment of the plan rises" (p. 304). In this paper, two hypotheses are tested. The first states that no relationship exists between I and G, with an alternative hypothesis that argues for a positive relationship. That is, as output growth rates increase, plans become tauter and tauter, there is less and less slack in resource availability resulting in shortages and declining marginal productivities, and the supply chain coordinations between interdependent industries becomes more difficult. As has been noted by Banerjee and Spagat (1992), the cost of constraining the variance of output increases with greater and greater growth expectations. Eventually, a downward correction occurs that is larger and more frequent as growth rates are pushed well beyond their "natural rates." If the null hypothesis is rejected and a positive relationship is discovered between I and G, the second level of analysis investigates whether the rate of change in that relationship is constant or increasing.

To test these two hypotheses, we have estimated the parameters of the following two models:

<u>Linear Model</u> $\qquad I_i = \alpha + \beta G_i + \varepsilon_i$ $\qquad$ (1)
and
<u>Exponential Model</u> $\qquad I_i = e^{A + BG_i + \mu_i}$ $\qquad$ (2)

where I_i, G_i refer to the output instability and growth rate of the ith industry; ε_i and μ_i are random disturbance terms (Naya, 1973; and Ickes, 1990). Using the data (I_i, G_i) for each country, the parameters of Equations (1) and (2) were estimated. Hereafter, we will drop the subscripts to Equations (1) and (2). It should be noted

that Equation (2) is intrinsically linear since Z=A+BG+μ, where Z=ln I. Hence, A and B were estimated by ordinary least squares.

The first hypothesis will be tested by examining the sign and statistical significance of parameter estimates $\tilde{\beta}$ and $\hat{B}$. The second hypothesis involves comparing the two models to determine which equation provides the best estimate of the relationship between I and G. Of course, the second hypothesis is irrelevant if $\tilde{\beta}$ and $\hat{B}$ are negative or not significantly different from zero. If the first null hypothesis is rejected, a choice between the two models, that is, a test of the second hypothesis, will be based on Akaike's (1973) information criterion for model selection. To define that criterion for these two models, let their log likelihood functions be log L (Z |A, B) and log H (I |α, β), and their estimators be $\hat{\theta}= (\hat{A},\hat{B},\hat{\sigma}2)$ and $\tilde{\theta}=(\tilde{\alpha},\tilde{\beta}, \tilde{\sigma}2)$, respectively. Then the information criterion is

$$Q= E_{\hat{\theta}}E_{\hat{Z}} (\log L \,(\hat{Z}|\hat{A},\hat{B})) - E_{\tilde{\theta}}E_{\tilde{I}} (\log H \,(\tilde{I}|\tilde{\alpha},\tilde{\beta}) \qquad (3)$$

Equation (3) would be invoked when at least one of the models had a statistically significant F statistic. The decision rule involving Equation (3) would select the exponential model when Q>0, and the linear model when Q<0. If Q=0, we would be unable to distinguish between the two models and, therefore, have no preference for one over the other. Under the information criterion a positive Q implies that a nonlinear relationship exists between I and G, and that incremental increases, of a constant amount, in growth rates results in larger and larger output instability.

6. Empirical Results

As can be seen from Table 2, the slope coefficients ($\tilde{\beta}$ and $\hat{B}$) of both models are positive and highly significant across all countries. Additionally, the fit of each model, as measured by the R2, is exceptionally good. Given these results, we have strong empirical evidence for the conjecture that there was a direct relationship between the growth rates of industrial production and output instability in CPEs. The weakest case for the conjecture seems to have been with the GDR, where growth rates are lower and, hence, the variance is smaller.

Table 2: Parameter Estimates and Statistics

Model	Estimate / Statistic	Bulgaria	Czecho-slovakia	GDR	Hungary	Poland	Romania	Yugoslavia
Linear	$\tilde{\beta}$	439.31*	492.33*	429.54*	490.14*	502.23*	376.23*	494.40*
	(t)[a]	13.26	16.71	4.50	14.86	18.06	6.39	12.00
	R2	0.90	0.92	0.56	0.91	0.94	0.71	0.86
Exponential	$\hat{B}$	8.56*	13.72*	12.45*	16.30*	11.42*	6.27*	10.89*
	(t)[a]	10.19	11.91	4.27	12.54	11.53	5.93	10.19
	R2	0.84	0.86	0.53	0.88	0.86	0.67	0.82
Model Comparison:	Q[b]	84.59	90.63	69.63	77.51	95.46	80.32	91.31

a. t statistic.   b. Q>0 implies that the exponential model is superior to the linear model under the information criterion defined by Equation (3.0) * statistically significant for α = .05.

Rejecting the null hypothesis (β=0, B=0), we have examined the second assertion that $\partial I/\partial G$= constant. Using Akaike's (1973) information criterion for model selection, the computed results for Equation (3) are shown in Table 2; they consistently indicate that the exponential model is superior to the linear model. Thus, in addition to the positive relationship between I and G in CPEs, it appears that instability increases at an increasing rate with the growth rates of industrial production. See Figure 1 and Figure 2.
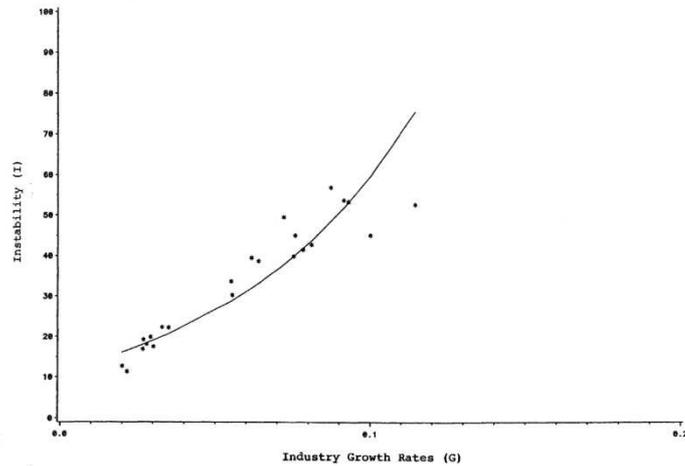
Figure 1: The Empirical Relationship between Industrial Growth Rates and Instability: Hungary
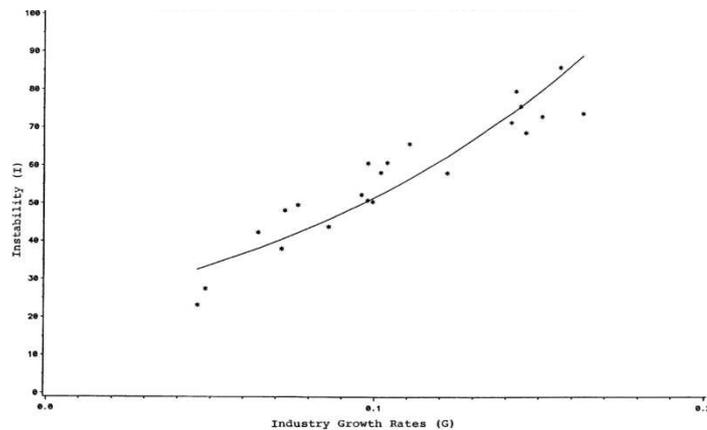
Figure 2: The Empirical Relationship between Industrial Growth Rates and Instability: Bulgaria

## 7. A Decomposition of Production Instability: Conjectures and Explanations

Either the linear or exponential model provides an empirical model that supports a decomposition of production instabilities at the industry level and potential insights into their sources (Dahlstedt, 1979; and Hewett, 1980). In particular, it may be argued that the intercept and the variable term of each equation represent different sources of instability. Since the exponential model was consistently found to best represent the relationship between I and G, subsequent analyses will ignore the linear model.

To decompose instability, first consider the instability that would occur without the stresses of growth. A zero growth environment would be characterized by a comparative abundance of resources, relaxed plans, few binding constraints, and adequate inventories throughout supply chains. A no growth economy would be essentially replicating production plans and objectives over time within stable budgets and institutions. Experience curves would be very mature and investment expenditures would be devoted to replacement of capital consumed. It is conjectured that the intercept may be interpreted as the instability that arises (G=0, i.e. $\hat{I} = e^{\hat{\alpha}}$) from the systemic structure, including the organizational design and institutions of CPEs. It includes the bureaucracy, the extent of resource nationalization, the economic, political and social priorities, the country's infrastructure, technology embedded in capital, and natural resource endowment (e.g. Brus, 1980; Portes, 1971; Mesa-Lago, 1973; Blazyca, 1980; Khanin, 2003; and Grossman, 1983). Bornstein (1985) defines part of structure as the economic mechanism, which includes: the procedures for planning and investment, the allocation of goods through 'material-supply' channels and inter-enterprise contracts, the performance indicators by which the activities of enterprises, associations, and ministries are evaluated, and the incentive structure for managers and workers.

A condition of zero growth involves sufficient slack such that the destabilizing influences of the administrative policies and practices involved in the operational implementation of plans are benign. There is little or no stress on economic agents that implement directives, that is manage activities and operations. In a zero growth environment there are fewer imbalances, less need for corrections and less variation in industry output. See Figure 3.

As Pryor (1985b, p. 66) has noted, "The performance of an economic system is not only a result of its structural elements and environment, but also of the measures taken by certain important policy makers in the system." Decisions are made and actions are taken that produce goods and services, employ resources, establish prices, and generate income. However, the functionality of all systems, as measured by instability, is not constant. Indeed, it may be argued that the increasing rate of instability associated with higher growth rates in CPEs derived

from the inability of institutions to perform with the same effectiveness under conditions of growing scarcity, complexity and time-dependent activities. Higher growth rates removed slack and strained the capacities of institutions to mobilize and direct resources, design production and distribution systems, advance technology, and satisfy employment, income, and consumption expectations of the population. These instabilities derived from the availability, quality and timeliness of information, and administrative practices and policies that operationalized plans.

That is, operational implementation factors. They are estimated in Figure 3 by $\hat{I}$ $=e^{\hat{B}G}$.
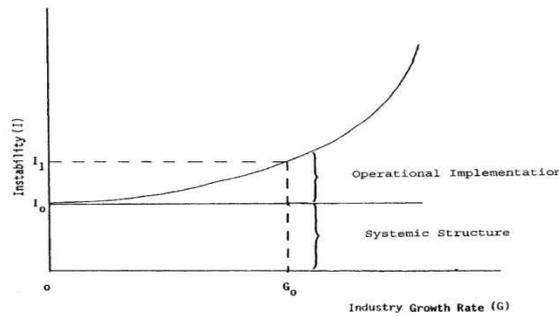
Figure 3: A Decomposition of Instability: Sources

The first row of Table 3 presents the estimated instability of each country under zero growth, that is, the intercept. It is interesting to note that the amount of systemic structural instability varies substantially between countries, and that it was largest in some of the CPEs with the highest degree of state ownership and most rigidly controlled economies, for example, Romania and Bulgaria.

Table 3: Estimated Instability: Levels and Percentage Changes by Country

Growth Rates	Instability	Bulgaria	Czechoslovakia	GDR	Hungary	Poland	Romania	Yugoslavia
	I	21.91	15.59	15.89	11.67	18.40	29.42	18.91
G= 0.0%	%ΔI[a]	------	------	------	------	------	------	------
	I	27.14	21.97	21.69	17.54	24.49	34.41	24.82
G=2.5%	%ΔI[a]	23.87	40.92	36.51	50.31	33.05	16.96	31.28
	I	33.62	30.96	29.61	26.36	32.58	40.25	32.59
G=5.0%	%ΔI[a]	53.44	98.57	86.35	125.92	77.03	36.79	72.35
	I	41.65	43.63	40.42	39.62	43.35	47.07	42.78
G=7.5%	%ΔI[a]	90.08	179.82	154.39	239.58	135.55	59.99	126.26
	I	51.59	61.49	55.17	59.55	57.67	55.06	56.16
G=10.0%	%ΔI[a]	135.45	294.31	247.28	410.41	213.41	87.12	197.03

a %ΔI = the percentage change in instability is computed from a base of zero growth.

In Romania and Bulgaria there were few substantive changes in the degree of resource nationalization, the structural organization of institutions involved in production and investment, the autonomy of economic agents, and the components of incentive systems.(Ben-Ner and Montias, 1991; and Jackson, 1991). By comparison the instability derived from systemic structural factors was much less in Hungary, the most reformed economy. As Noti (1987) stated, "the guiding principle of reform in Hungary has been the decentralization of power." The concentration of resource ownership and power was diminished in Hungary, resulting in more initiative at local levels, more competition, more flexibility and moderation in the choice of activity levels and directions, and increasing resource productivity (Hare, 1991).

The instability created by systemic structural factors was lower than expected in the GDR, but higher than expected in Yugoslavia. The mechanism of East Germany, despite hopes for the New Economic System (1963), was not reformed much more than those of Romania and Bulgaria. However, in an effort to balance supply and demand they implemented a contract system and institutionalized slack plans (Keren, 1973). This created lower growth rates and reduced the debilitating effects of the system that probably would have been observed under more taut plans. Additionally, the data of East Germany was more highly aggregated than for other countries and this tends to smooth actual variations and diminish measured instability.

One might have expected to observe a lower level of systemic structural instability in Yugoslavia than was estimated (Horvat, 1971). Yugoslavia, beginning in 1952, progressively took steps to allow individuals and enterprises greater economic freedoms and opportunities, greatly reduced the role, scope, and size of planning bureaucracies, and implemented incentive systems and price signals that encouraged efficiency (Estrin, 1991). However, two important aspects of the Yugoslav economic system may have diminished the stabilizing effects of these reforms. First, though many aspects of a market economy existed in Yugoslavia, their markets were very imperfect and highly regulated (Sacks, 1973). Second, the institution of workers' management substantially changes the distribution of power and information in economic decisions (Estrin, 1982). This creates a more complex decision environment, affects risk taking behaviors, and the timeliness of economic actions. It seems plausible that these two conditions of the Yugoslav system may have reduced its ability to manage scarcity and complexity and to make timely corrective adjustments under high growth rates.

Table 3 also presents estimates of expected instability under various growth rate scenarios, and their associated percentage change relative to G=0. For growth rates that were probably sustainable over the long run, that is, 2.5%≤G≤5.0%, there is substantial difference in estimated instabilities across the CPEs. In this range of growth rates, the rank order of CPEs from the least to the most instable (estimated) was: Hungary, GDR, Czechoslovakia, Poland, Yugoslavia, Bulgaria and Romania. The

incremental instability from a "no growth" base is associated with the abilities/inabilities of enterprise units to implement tauter plans. This required resource coordination, available resources and policies that encouraged productivity improvements, information for coordination and optimization, flexibility and early signals of imbalances. All countries, regardless of their structural organization of economic institutions and activities experience output volatility (Horvat, 1984). The question is, "Were there processes, administrative systems, managerial empowerments, information and flexible decision making that facilitated timely corrections?"

It is interesting to note that while Hungary and Czechoslovakia had low systemic structural instability, they had the largest incremental variation in industry growth rates from G=0 to G=5%. Both had undergone and achieved much greater success with reforms, had less labor slack in peasant agriculture and were more advanced industrial nations with more complex interdependencies and supply chain linkages to administer.

Table 4 presents the percentage of each country's instability derived from systemic structural versus operational implementation sources, respectively, for alternative growth rates. The market oriented, more decentralized CPEs tended to derive more (less) of their instability from the operational implementation of plans (systemic structure and organization) then did the more rigidly planned, command economies. It is clear that the opportunities to reduce instability through systemic structural reforms was greater in Romania and Bulgaria. Indeed, it appears that each could have had much more stable output levels, with reasonably high growth rates, if those reforms had been undertaken. However, those reforms may have increased the instabilities associated with the operational implementation of plans based on the experience of Hungary and Czechoslovakia. It is unclear as to whether there were tradeoffs between the two, where decreases in one increased the other.

Table 4: A Decomposition of Instability [a]

Growth Rates	Bulgaria		Czecho-slovakia		GDR		Hungary		Poland		Romania		Yugoslavia	
	System (%)	Policies (%)	System (%)	Policies (%)	System (%)	Policies (%)	System (%)	Policies (%)	System (%)	Policies (%)	System (%)	Policies (%)	System (%)	Policies (%)
G= 0.0%	100.0	0.00	100.0	0.00	100.0	0.00	100.0	0.00	100.0	0.00	100.0	0.00	100.0	0.00
G=2.5%	80.73	19.27	70.96	29.04	73.25	26.75	66.53	33.47	75.16	24.84	85.50	14.50	76.17	23.83
G=5.0%	65.17	34.83	50.36	49.64	53.66	46.34	44.26	55.74	56.49	43.51	73.10	26.90	58.02	41.98
G=7.5%	52.61	47.39	35.74	64.26	39.31	60.69	29.45	70.55	42.45	57.55	62.51	37.49	44.20	55.80
G=10.0%	42.47	57.53	25.36	74.64	28.80	71.20	19.59	80.41	31.91	68.09	53.44	46.56	33.67	66.33

[a] System (%) + Policies (%) = 100.0.

8. Conclusions

Every society aspires to a higher standard of living and wishes to enjoy its benefits sooner rather than later. In market economies, the pace of these developments depends very substantially on the inherent motivations, incentives, and abilities of individual economic agents and, therefore, more nearly follows a natural rate. In the former CPEs, state politicians and planners defined the system and its institutions, and established policies, priorities and standards. They directly intervened in the direction and rate of economic activity. For many different reasons, their pursuit of economic growth was frequently overzealous and at rates that could not be sustained over the long run. Eventually, growth rates were corrected downward and instability resulted.

In this study, we have found compelling empirical evidence that instability in industrial production in the former CPEs increased at an increasing rate with output growth rates during the crucial years of socialism and central planning. Instability increased by over fifty percent in all countries, except Romania, as the output growth rate increased from zero to five percent, that is, a sustainable or near sustainable level. This implies that an intensification of production efforts (tauter plans) was associated with very substantial costs resulting from excessive slack or shortage of resource inputs and product outputs, an underutilization of labor and capital, excessive inventories, and unfulfilled consumer aspirations. The economic system, under central planning, was not indifferent to the tautness of activity levels, and it appears that it was not capable of self correcting adjustments that would relieve and/or accommodate the stress of higher growth rates. That is, the processes, policies and administrative systems and practices used to operationalize plans were incapable of creating higher, but sustainable growth rates without substantial instability and higher costs. These costs had a hidden but substantial impact on the actual value of the income and product stream if it had been discounted by the cost of instability, which was increasing at a faster rate than output.

Equally interesting were the results of a decomposition of instability based on its sources: systemic structure versus operational implementation. There were substantial differences between countries in the estimated amounts of instability associated with each. It appears that the more market oriented economies, such as Hungary and Czechoslovakia, had considerably less instability derived from their fundamental structures, organization and institutions, but as much or more resulting from their operational implementation of plans and directives. By comparison, for an output growth rate of five percent, it is estimated that sixty-five percent or more of total instability in industrial production was derived from systemic structural factors in countries such as Romania and Bulgaria. Furthermore, it appears from these findings that opportunities indeed did exist for some countries to substantially reduce their instability through system reforms and that some countries, for example, Hungary and Czechoslovakia, benefited from their

reforms. As they made substantial changes in the economic structure, organization, incentives, ownership and flexibilities given economic agents, they lowered the costs of instability and, thereby, raised the value of income and product created by industry.

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