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Inflation Bias and Productivity Shocks in Transition Economies: The Case of the Czech Republic

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INFLATION BIAS AND PRODUCTIVITY SHOCKS IN TRANSITION ECONOMIES: THE CASE OF THE CZECH REPUBLIC[1]

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I. INTRODUCTION

Economists tend to view macroeconomic data as relatively reliable and not subject to frequent revision or to major changes in methodology. What changes do occur often reflect adjustments in preliminary data that are based on small samples as larger samples become available and are processed. Even when large scale methodological studies, such as the Boskin study of the measurement of inflation in the United States, suggest systematic bias in major macroeconomic aggregates, wholesale revision of macroeconomic data is slow to take place.[2] In part, this tendency is a tribute to the methodological sophistication of modern macroeconomic data collection and compilation and thus to the general reliability of macroeconomic data. Nevertheless, it also reflects the desire of economists and policy makers to believe that macroeconomic time series based on unchanging methodologies and using fixed or slowly changing weights for aggregation have the ability to capture the dynamics of the economy with a high degree of reliability.

Some observers have argued that achieving such longitudinal consistency in methodology and in the weights used to construct macroeconomic time series for transition economies has occurred at the cost of creating time series that badly distort real and nominal measures of economic activity, thus misleading both the public and policy makers in these countries about the true performance of their economies and seriously undermining academic research on the transition.[3]

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[2] In part, this is due to the fact that even widely accepted perceptions of bias, such the belief held by many economists and policy makers in the United States that the U.S. Consumer Price Index (CPI) overstates the rate of inflation, are open to considerable debate. See Moulton (1996) for a review of such debates.

[3] Lipton and Sachs (1990), Winiecki (1991) and Dyba (1999) are three such examples.

In the next section of this paper we briefly review the likely sources of bias in the macroeconomic data of transition economies, and we examine how such biases are likely to influence policy debates about monetary, fiscal and exchange rate policy in one transition economy, the Czech Republic. In Section III we develop a model of price formation that enables us to identify systematic and random productivity shocks to producer and consumer price indices in the Czech Republic. Using quarterly data for 1993-1998, we estimate the parameters of the model and extract the productivity shocks experienced by the economy over this period. The systematic component of the productivity shocks has declined over time, suggesting that the productivity-enhancing effects of restructuring have largely dissipated with the passage of time. The magnitude of the productivity shocks suggests that the inflation bias of the Czech Republic's producer price index (PPI) and consumer price index (CPI) is smaller than popularity thought and than suggested by other studies. This, in turn, suggests that price index biases may have been relatively modest in the first ten years of the transition and that the macroeconomic record provided by official statistics may be relatively accurate. It also suggests that macroeconomic policy was not, in general, misled by biased or distorted statistical information.

II. SOURCES OF BIAS AND ERRORS IN MEASURING MACROECONOMIC AGGREGATES IN TRANSITION ECONOMIES

The measurement of real macroeconomic aggregates in transition economies is subject to both errors and biases in the measurement of nominal aggregates and in the

construction of the price indices used to deflate nominal data. We briefly discuss the former and then turn our attention to the latter, which is the focus of this paper.

A. Nominal Aggregates

The measurement of nominal aggregates is subject to error and bias due mainly to the changeover from a socialist to a market economy. Under communism, most, if not all, output was produced by a relatively small number of large state-owned firms. Thus, monitoring the output of the economy was a relatively simple task. With the transition to capitalism, the statistical bureaus of these countries faced a much greater number of producers. In part, this was the result of privatization. Many state-owned firms were broken up in the process of being privatized due to a desire to create business units of a size more conducive to generating several competing bids from potential foreign investors. In other cases, local managers engaged in so-called "*nomenclatura* privatizations," which spun off some of the state-owned firm's assets to a newly organized firm owned by the manager. In other cases, managers of state-owned firms jettisoned loss-making units of their companies in an effort to ensure the survival of the profitable parts of the business. These trends were evident not only in industry but also in agriculture and services.

A second, and perhaps more problematic, development for statistical authorities was the emergence of newly founded private firms. Some of these were greenfield investments by foreigners, but most were founded by indigenous entrepreneurs (Brada, 1996). Many of these new indigenous firms were single-person entrepreneurships because, in many countries, many individuals turned to entrepreneurial activities such as renting rooms to tourists, catering and shop keeping. These trends were abetted by

the “small privatizations” that auctioned off the former state retail network to private owners. The provision of services, especially in transportation, and of construction largely became the domain of small firms and entrepreneurs.

These new entrepreneurs had no experience with record keeping and many reasons, such as high taxes on wages and profits, to under report their production. Even worse, the statistical authorities were generally unable to cope with this explosion of reporting units. Thus, early in the transition, it was not unusual for official statistics to report industrial production with the note that the measure was for “firms with 99 or more employees.” Aggregate output data were arbitrarily adjusted upward, as, for example, in Russia, where even now, officially reported GDP contains a 20% upward adjustment to account for unmeasured but presumably legal output. In the more advanced transition economies, the statistical net became finer, moving to cover all “firms with over 15 employees” and then starting to capture all producers, although, of course, with an unknown level of non- or misreporting.

B. Price Indices

However daunting the problems with measuring nominal output and other macroeconomic aggregates may be, even more serious problems are alleged to exist in the construction of price indices for transition economies. The first of these problems is the consequence of large changes in the composition of output and of consumption. In part, these changes in the composition of output were the result of increases in private consumption and declines in investment and, even more, in government consumption and of the consequent changes in output. Within each of these consumption categories there were also important changes in composition. These

changes were in part driven by the elimination of the shortage economy. In such an economy, the pattern of consumption was effectively imposed on households by the planners' decisions on the quantities of consumer goods available. With the emergence of a market economy, and particularly with the liberalization of foreign trade, consumers could, and did, shift their consumption patterns to better reflect their preferences. These demand shifts are clearly evident even in macroeconomic data, with services, for example, strikingly increasing their share of aggregate output. The collapse of trade with the Soviet Union and its successor states was also an important demand-side shock to the structure of production. Chang (1991) has argued that such an alteration of consumption and production from the planned to the market economy would be accompanied by a sort of reverse "Gerschenkron effect" in which the reliance on pre-transition prices and weights would tend to underestimate real economic growth or to overstate output declines.

Changes in the structure of consumption and production have also been driven by large changes in relative prices as prices were liberalized and market forces asserted themselves. Coorey, Mecagni and Offerdal (1998) and Pujol and Griffiths (1998) show that transition economies experienced large changes in relative prices both between broad categories of goods and services and within them as well. Because consumers and producers increasingly had the freedom to respond to these relative price changes, it seems reasonable to assume and easy to document from the data that the structure of the consumer's market basket changed dramatically during the course of the transition. These effects of relative price changes and the foregoing arguments describing the change in consumption patterns at a more aggregated level suggest that

the use of fixed or even gradually changing weights for the construction of price indices may well overstate the level of inflation actually experienced by consumers and producers.

The fact that inflation has proceeded largely by means of large changes in the prices of individual goods or narrow categories of goods (Christofferson and Doyle, 1998) suggests that techniques for eliminating outlier bias such as dropping very large upward or downward movements in prices from the computation of the index are inappropriate for transition economies because the large upside increases are a persistent and central part of the process feeding inflation in these economies.

A second source of potential bias is the alleged failure of statistical agencies to properly account for the growing price dispersion in the marketplace. In the socialist economy, the sale of goods by one firm to another took place at centrally set prices, and thus there was no price dispersion. Much the same was true for consumer goods; retail outlets did not compete on the basis of price. Indeed, they often had no control over their prices because, for many consumer goods, the retail price was printed on their label along with other information describing the product. Consequently, price sampling in the planned economy was rather simple, and, in many ways, price sampling could be done in the office using handbooks of centrally set prices and not on the basis of price samples obtained in the field. The emergence of a market economy, the concomitant collapse of the socialist wholesale network, and the emergence of new retail outlets ranging from mom-and-pop stores to foreign-financed hypermarkets mean that consumers, both households and firms, now face a range of prices. It is possible that the statistical offices of transition economies have not been able to track the effect of

growing price dispersion on price indices. If the price dispersion were symmetrical around the mean and there were no systematic bias in the retail outlets sampled, price dispersion would not be a cause of systematic bias. Filer and Hanousek (1998), however, argue that the over sampling of traditional outlets at the expense of newer, non-traditional outlets, biases the price index upward because it tends to miss those outlets that are at the forefront of price discounting, with consequent implications for the measurement of inflation.

Filer and Hanousek also argue that the transition from socialism to capitalism caused many new goods to become available to consumers and that there were significant lags in introducing these goods into the market baskets of goods used to compute price indices. The failure to incorporate new goods into the price indexes means that the over weighting of traditional goods gave biased estimates of inflation. In part, the introduction of new goods and services resulted from the liberalization of the domestic market. Under the previous regime, certain goods and services were simply not widely available to consumers. Examples of such goods are foreign cars and appliances, personal computers, fax machines, etc., which generally were reserved for sale to businesses and government agencies. The array of available goods and services was also expanded through the liberalization of trade and foreign investment. The socialist trade regime, which determined the quantities of goods to be imported regardless of domestic demand, was biased against the import of consumer goods and in favor of imports of technology and machinery. Trade liberalization undoubtedly allowed a wider range of western consumer goods to enter these countries; in some cases consumer markets that previously had not existed at all, such as for western

automobiles, emerged overnight. Foreign direct investment by western firms provided a host of nontradeable goods and services that had been unavailable previously. The explosion of cellular telephony is but one example of such rapid market growth for new services. Of course, equally important for the bias of the price index is the fact that prices of such previously unavailable goods declined as supply increased and competition among suppliers emerged. Less visible but nonetheless important was the increase in the range of inputs and services for the business sector. Firms were no longer constrained by the plan to purchase inputs from specific suppliers, and the privatization-induced decrease in the vertical integration of producing units opened the way for new materials and components, many of which were needed to make the products of transition economies competitive on western markets. Services previously irrelevant to state-owned firms, such as management consulting and marketing and financial services, grew rapidly in transition economies as well.

A fourth source of bias in measuring inflation was the dramatic increase in the quality of goods available on the market. The measurement of quality in price indices is, of course, a problem in market economies as well, but the change in the quality of goods in transition economies was so great and occurred within such a short period of time that many observers believe that the resulting bias must be many magnitudes greater than it is in developed market economies. Part of the improvement in quality came from the end of the “shortage economy”. Kornai (1997) shows that, at least in Hungary, the excess demand for goods disappeared quickly as the transition to market began. Firms were forced to improve the quality of their products to survive on a domestic market that suddenly became much more discriminating. Competition came

not only from other domestic firms but also from imports and from the products of foreign-owned firms operating within the transition economy. The importance of quality improvements to the survival of firms in transition economies and to the business strategies of foreign investors in these countries is well documented by case studies such as Brada and Singh (1998) and Estrin, Richet and Brada (forthcoming). The penalties for failing to improve quality are also quite evident. The Russian television industry's sales fell by 80%, replaced by foreign suppliers whose prices were two to three times higher, but whose quality and technical characteristics far surpassed those of indigenous production.

The quality of producers' goods also increased during this period. In part, this pressure came from the need to penetrate western markets, which were much more demanding of quality than had been the Council for Mutual Economic Assistance (CMEA) market. On the domestic market, firms not only sought to increase the quality of their output, but they also put pressure on their suppliers and subcontractors to increase the quality of parts and components. Foreign investors, in particular, placed great stress on improving quality in all segments of their supply chain, as so graphically described by Bohatá's (1998) description of Volkswagen's investment in the Czech auto maker Škoda and the subsequent pressure on Škoda suppliers to improve quality.

The final source of potential bias in the price indices of transition economies is due to the quality improvements in the retail network itself. Under socialism, wholesale distribution was the responsibility of the state, and the wholesale distribution network was cumbersome, bureaucratic and ineffective in meeting consumer needs. The retail network, also largely state owned, was underfinanced and better suited to rationing

available goods than to satisfying consumers' needs. Retail outlets were unattractive and there was little variety, either in the assortment of goods within a single retail establishment or between establishments. Sales clerks were underpaid, indifferent to customer needs, and often demanded bribes for supplying goods in excess demand. Stores offered no services such as credit for consumer durables purchases, delivery of goods, etc. As Kornai notes, in such a situation,

> "Every family has to devote hours of spare time to queuing and searching. Buyers are made to feel worse by their defenselessness. They experience rudeness from sellers; they must be humble to them, flatter them, or even try to bribe them." (Kornai, 1997, p. 39)

The move to a market economy destroyed the socialist wholesale and retail organization in most transition economies. The wholesale organization collapsed because of its inefficiencies, because it could not adapt to the needs of the market economy and because many of its units encountered financial difficulties. Producing firms in many cases had to develop their own wholesale distribution networks or to seek out new, private wholesalers. Most producers also expanded their sales staffs, presumably to provide better marketing services to their customers.

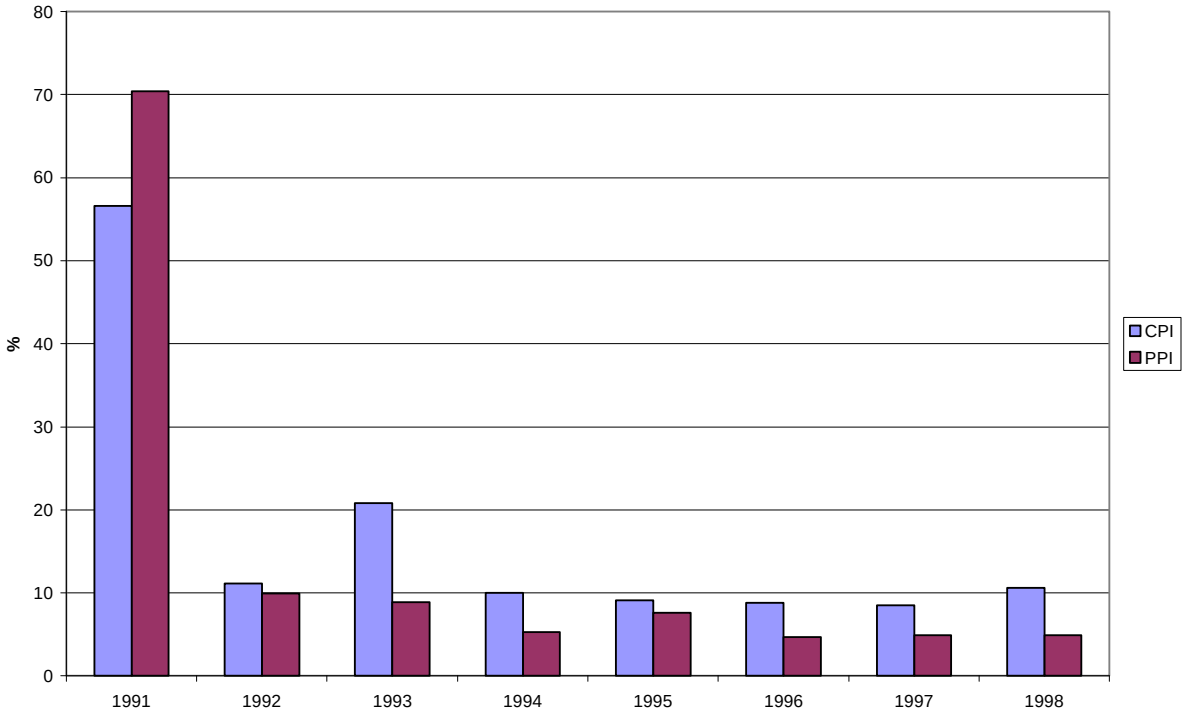
Retail stores were generally privatized early in the transition, and the freedom to start a private business along with the perceived shortage of effective retail outlets led many private entrepreneurs to try their hand at running a store. Of course, while some retail outlets were able to improve service, to spruce up their physical appearance and to stock a more attractive assortment of goods, others, due to a lack of business skills or capital, limped along as private firms much as they had as socialist ones. Gradually, and especially with the entry of new types of retail outlets such as supermarkets,

discount stores, etc., many of the unsuccessful retail firms disappeared. Nevertheless, overall, the vast improvement in the quality of service rendered by the retail sector, as well as by public catering, is one of the most remarkable and easily observed developments in transition economies.

The increase in employment in retailing and wholesale distribution and the inflow of other resources into the sector clearly increased the gap between producers' prices and consumers' prices. Figure 1 provides some evidence on the PPI-CPI spread in the Czech Republic. With the exception of 1990, when consumer prices were controlled while producers' prices were liberalized and production subsidies eliminated, the CPI has grown much more rapidly than the PPI. While this phenomenon is also evident in market economies, the size of the gap between the rates of growth of the two indices in the Czech Republic and in other transition economies is remarkable.[4] If the gap does represent added outlays on resources by retailers, some of the resulting improvement in services provided by the retail sector represents a quality gain to consumers that should not be seen as an increase in the CPI. If such gains in retail and wholesale service quality and quantity are not taken into account in computing the CPI, the price index will overstate inflation and understate the real gains from transition.

[4] A part of the spread between the CPI and the PPI may also be due to the fact that the CPI includes services. Changes in the quality of services and in service-sector productivity are alleged to be major sources of upward bias in the CPI in all economies. Because the PPI excludes services, its bias would be less than that of the CPI. The spread between the two indexes also reflect the effect of the introduction of a VAT and subsequent changes in its rate.

Fig. 1 Annual Changes in Czech Price Indeces



Filer and Hanousek (1998), Lipton and Sachs (1990), Winiecki (1991) and Kornai (1997) are among those who argue that the biases described above are potentially quite large. Filer and Hanousek estimate that in the Czech Republic such biases account for 20 to 50 percent of reported inflation during the 1990s. Such a degree of over reporting of inflation would, of course, imply much more rapid rates of economic growth, higher real wages and much less real appreciation of the exchange rate than would official estimates of the PPI and the CPI. They would also imply much higher growth of factor productivity than do official statistics, and such higher productivity growth would imply that restructuring in the transition economies was much more successful than we now judge it to have been. Whether such bias exists and whether

such a reassessment of the statistical record is warranted are the questions we examine in the next section.

III. Measuring Inflation Bias and Productivity Growth in the Czech Republic

One approach to understanding the biases in transition economy price indices is to develop estimates of the effect of each of the above mentioned sources of inflationary bias and to recalculate the price indices so as to eliminate the overestimation of inflation; that is the approach taken by Filer and Hanousek (1998). However, such an approach requires that the investigators make a number of assumptions whose appropriateness is open to question and also that the researchers have an intimate knowledge of the economy and of the procedures of its statistical office. The former issue leaves a certain measure of doubt about the estimates of inflationary bias, the latter issue makes it difficult to examine inflationary bias in a cross-section of transition economies.

In this paper, we utilize a different approach, one that relates inflation, as measured by movements in the CPI and PPI, to easily observable nominal variables whose measurement is much less subject to bias and to productivity shocks that mediate between increases in costs and the consequent increase in prices. These productivity shocks are unobserved, but, to the extent that there is a large inflationary bias to the CPI and PPI, the productivity shocks should appear to be unreasonably small.

A. A Model of the PPI and the CPI

We begin with a straightforward model of cost-based pricing into which we introduce both systematic and random productivity shocks. Following Dornbusch and Fischer (1993) we specify the growth of the PPI as:

$$ppi = a \bullet w + (1 - a) \bullet e + Y \qquad \text{Eq. 1}$$

Where

ppi = growth of the producer price index

w = growth of nominal wages

e = growth of nominal exchange rate—units of domestic currency per DM

Y = productivity shock.

In this model, the PPI increases with growing costs as measured by wages and by the exchange rate. Increases in costs translate into increases in the PPI unless they are offset by productivity shocks. An increase in productivity brought about by, for example, more efficient operations or changes in market competition would offset some or all of the inflationary effects of increasing wages or of exchange rate depreciation on the PPI. Note that a negative value for *Y* represents an improvement in productivity.

An obvious problem in the empirical application of Equation 1 is that simply estimating it by subsuming the unobserved productivity shocks into the residual would, besides the obvious econometric problems, lead to the economically nonsensical result that, over the sample, the productivity shocks would have a mean of zero by construction. Because we expect to observe large productivity gains during the course of the transition due to the restructuring of economic activity, constraining productivity shocks to zero over the sample period is inappropriate. Instead, we assume that, over

the period of the transition, there was some systematic growth of productivity. We call this component of the unobserved productivity shocks systematic productivity shocks (*S*) in that we can model *S* as a function of time according to a quadratic time trend:

$$S = b_1 + b_2 T + b_3 T^2 \qquad \text{Eq. 2}$$

where T = 1,2, 3,…. for successive quarters.

Finally, to account for simultaneity bias and to take into account lags in the adjustment of prices to nominal wages and to the delays in the pass through of exchange rate changes to domestic prices, we assume that, at the level of quarterly data, there is a one-period lag in the influence of wages and of the exchange rate on the PPI. Consequently, the estimated equation is:

$$ppi_t = a \bullet w_{t-1} + (1-a) \bullet e_{t-1} + b_1 + b_2 T + b_3 T^2 + u_t \qquad \text{Eq.3}$$

where u_t is a residual that reflects non-systematic productivity shocks and other random influences on prices.

We estimate Equation 3 using seasonally adjusted quarterly data for the Czech Republic for the period 1993-I to 1998-IV. The estimated parameters are based on heteroskedasticity- and autocorrelation-consistent standard errors of Newey and West (1987). We focused on the Czech Republic for two reasons. One is that the work on Czech price indices by Filer and Hanousek provides a form of benchmark for our own work. The other reason is that we were able to obtain quarterly data on employment and sales in the retail and catering sectors for the Czech Republic, and these data we thought would be important in estimating the CPI equation.

The coefficient b_1 proved to be insignificant, and we therefore reestimated Equation 3 without b_1 and obtained the parameter estimates reported in Table 1. Thus,

the effect of wage growth on PPI inflation is greater than that of the exchange rate, and there is a systematic productivity shock evident in the data.

Table 1

Parameter Estimates for Equation 3

Parameter	Value	Standard Error
a	0.717	0.044*
b_2	-0.0029	0.0008*
b_3	0.00123	4.08E-05*

* = significant at 1% level

We also developed a model of the CPI in which we viewed consumer prices as being influenced by three forces. One of these is the PPI, because the goods sold by the retail network will generally reflect the prices that the retail sector pays for the goods it sells. The second factor influencing the CPI is the costs of doing business in the retail sector because these costs determine to some extent the retail sector's markup over the PPI. For the retail sector, the major inputs are labor and capital. The latter variable consists to a large extent of structures or rent on facilities and inventories of goods to be sold. Thus, we model costs of the retail network as determined by wages and the nominal (lending) interest rate. The third factor influencing the CPI is the productivity change in the sector. As with the PPI, we attempted to specify a systematic component of productivity shocks.

The general model of changes in the CPI model can be expressed as:

$$cpi = c \bullet ppi + d \bullet w + (1-d) \bullet i + Z \qquad \text{Eq. 5}$$

where

cpi = growth rate of the CPI

i = change in the nominal interest (lending) rate

Z = productivity shock in the retail sector.

If we assume that there is full pass through of changes in the PPI to the CPI, meaning that the retail sector neither absorbs nor amplifies changes in the PPI, then *c*=1 and we can rewrite Equation 5 as:

$$cpi\text{-}ppi = d \bullet w + (1-d) \bullet i + Z \qquad \text{Eq. 6}$$

Based on the foregoing discussion of developments in the retail sector of the transition economies, we propose that productivity shocks should consist of the following elements:

Expanded retail services. In Section II, we discussed the rapid expansion of the retail network in the course of transition. Others and we have hypothesized that such an expansion should represent not genuine increases in the CPI but rather improvements in the quality of retail services received by consumers. Thus, increases in the resources employed in the retail sector as measured by employment or by the number of retail establishments should, by increasing retail margins and thus the spread between the growth of the PPI and CPI, be reflected in positive values for *Z,* the productivity shock in the retail sector. The existence of a positive relationship between resources in the retail sector and productivity shocks to the CPI would represent evidence that the failure to capture the value of improved retail services and the

inclusion of the costs of these resources in the CPI was a source of inflationary bias in the measurement of the CPI.[5]

Improved productivity. We also argued in Section II that the privatization of the retail sector early in the course of transition resulted in the creation of many small and undercapitalized retail outlets. In the course of time, new and more efficient retail establishments emerged, and competition increased as consumers became more service and price conscious. These and related sources of productivity gains should lead to a decline in the size of the retail margin and thus serve to moderate the growth of the CPI. Thus, in Equation 6, such measures of factor productivity should be associated with negative values of Z, that is, with productivity shocks that mitigate the growth of the CPI. We proxy the emergence of these more efficient retail outlets by the sales per retail employee, and we model the productivity shocks caused by increased competition and related factors as a quadratic time trend.

Using the same 1993-1998 time period as that used in estimating Equation 3, we explored a number of specifications of the general form:

$$cpi_t - ppi_t = d \bullet w_{t-1} + (1-d) \bullet i_{t-1} + g \bullet R_{t-1} + h \bullet P_{t-1} + v_t \qquad \text{Eq. 7}$$

where

R = measures of increased resource use in the retail sector

P = measures of increased productivity and competition in the retail sector

v = residual.

Neither increases in employment in the retail sector nor in the number of retail establishments proved to have any explanatory power in the specifications we explored.

[5] Recall that a positive value of Z means a worsening of productivity. An upward bias in the CPI would, *ceteris paribus*, increase the value of Z.

Thus our results offer no support for the hypothesis that increased and better service in the retail sector due to increased input use resulted in a higher retail margin and thus in the overestimation of the growth of the CPI.

After eliminating explanatory variables whose estimated coefficients were not significantly different from zero, we settled on the following specification:

$$cpi_t - ppi_t = d \bullet w_{t-1} + (1-d) \bullet i_{t-1} + h_1 \bullet (S/E)_{t-1} + h_2 \bullet T + h_3 \bullet T^2 + v_t \qquad \text{Eq. 8}$$

where

S/E = nominal retail sales per employee.

The parameter estimates are reported in Table 2. Thus, higher sales per employee, a measure of labor productivity in the retail sector, have a positive impact on the productivity shock, meaning that they lead to increases rather than to decreases in the growth of the CPI. The emergence of new, large retail establishments and the shakeout of small and inefficient retailers have done nothing to promote a decline in retail margins. There is a secular trend in productivity, although, as with the PPI, these productivity gains are declining over time.

Table 2

Parameter Estimates for Equation 8

Parameter	Value	Standard Error
d	0.820	0.128*
h_1	0.196	0.097***
h_2	-0.033	0.009*
h_3	5.79E-05	2.38E-05**

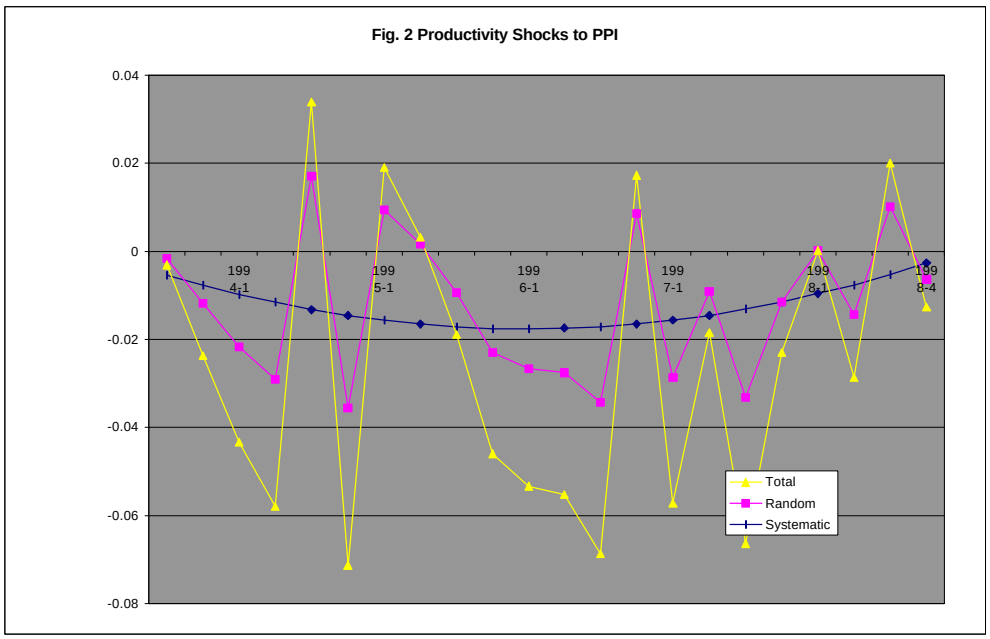
* = significant at 1% level

** = significant at 2.5% level
***= significant at 5% level

B. Productivity Growth and Inflation Bias

Using the regression results reported above, we estimated productivity shocks to the PPI and to the CPI. Recall that the growth of PPI, for example, depends on the weighted average of the growth of nominal wages and the exchange rate, both of which are relatively easy to measure. If the growth of PPI routinely exceeds that of wages and the exchange rate due to a bias in the measurement of the PPI, then in the absence of any changes in productivity, by Equation 1, *Y,* the productivity shock, would be positive. Indeed, any upward bias in the measurement of the PPI would serve to make *Y* larger.

Figure 2 reports the productivity shocks to the PPI over the sample period. We computed the systematic component, consisting of a quadratic time trend, from the time trend parameters reported in Table 1. Systematic productivity shocks were negative, meaning that these shocks tended to ameliorate the effect of nominal wage increases and of nominal depreciation on the growth of PPI over the sample period.



Productivity improvements were small in 1993-1994, then increased in magnitude through 1996 and finally declined again in 1997 and 1998. Such a pattern of productivity improvements is consistent with two explanations. One of these is the transition story. The mass privatization of 1993 created new and more efficient forms of corporate governance or at least focussed the attention of managers on improving their firm's performance. As managers made improvements in operating efficiency, productivity gains emerged with something of a lag. Subsequently, as the more easily obtained productivity gains from improvements in operations were exhausted, it became increasingly difficult to achieve the same pace of productivity growth. The other story consistent with the pattern of systematic productivity growth is the macroeconomic one. Real GDP grew by 0.6% in 1993, by 3.2% in 1994, by 6.4% in 1995, 3.9 in 1996, 1% in 1997 and fell by 2.5% in 1998. The growth of GDP, particularly coupled with stagnant or even declining employment and considerable excess capacity, could certainly have

brought about productivity gains of nearly 2% per quarter in 1996 and 1996. Because the two explanations are not mutually exclusive, we can not distinguish between them.[6]

We also report in Figure 2 the total productivity shock. This we take as the sum of the systematic productivity shock discussed above and the residual, which we identify with random and exogenous changes in productivity and which is labeled random productivity shock in Figure 2. By construction, the random shocks have a mean of zero over the sample period, but they do have a magnitude that is comparable to that of the systematic shocks. When the two move in the same direction, the total productivity shock per quarter can be quite large, as is shown by the line in Figure 2 labeled total productivity shock.

The systematic shock reported in Figure 2 is negative, meaning that, over the sample period, productivity shocks tended to ameliorate the effect of wage growth and exchange rate depreciation on the growth of the PPI. While we caution the reader against interpreting these productivity shocks with other measures of productivity growth such as the Solow residual, we do stress that any upward bias in measuring the PPI would imply a higher observed value for the productivity shock over the sample period. Thus, because the productivity residual is in fact negative, the existence of an upward bias in the reporting of the PPI would imply real productivity gains in excess of those reported here by the magnitude of the upward bias in the PPI. Our view is that real productivity gains of such a magnitude would be unrealistic, suggesting that there is not much upward bias in the PPI.

[6] Note that substituting real growth of GDP for the quadratic time trend is not appropriate because real GDP depends on the price index whose validity we are trying to investigate with this specification.

Our reasoning for the foregoing conclusion is based on the fact that Figure 2 suggests systematic productivity gains of nearly 2 percent per quarter, or 8 percent per year, for 1995-1996. Total productivity shocks for the period are even greater. If the PPI were biased upward, then measured productivity gains would, *ceteris paribus*, be more positive by the amount of the PPI bias. Thus an upward bias in the PPI would imply real productivity gains in excess of 8 percent per year in this period. In our view, gains of 8 percent per year seem sufficiently large; appreciably greater productivity improvements seem improbable. On the other hand, if we accept Filer and Hanousek's upper estimate of the price index bias of 50 percent, real annual productivity shocks would have to be adjusted upward by as much as almost 5 percentage points, suggesting annual productivity gains of 13 percent or more.

It would help to judge what sort of productivity gains are reasonable if we could calculate single factor productivity measures, but this is not possible because we can not use measures of real output based on deflation by price indices. One way around this problem that has been proposed by researchers is to use a physical measure of output or of economic activity. The most frequently proposed physical measure is electricity generated. Electrical power is homogeneous, its output is easy to measure, and its production is strongly linked to its consumption. It is well known that electricity output did not fall in the early transition period, a fact that led some economists to argue that this was evidence that real output declines during this period were overstated, perhaps due to biases in price indices. However, if this were indeed the case, then the relatively slow growth of electricity output thereafter would imply slower than observed growth of real GDP for two reasons. One is that, with a smaller fall in real GDP at the

start of the transition, the base against which subsequent growth would be measured would be larger, leading to slower growth of GDP. The second reason is that while electrical power generation did not decline in the early transition, neither has it grown faster than other sectors of the economy in subsequent years.

An alternative, although imperfect, approach is to examine total rather than single factor productivity in the Czech Republic. The imperfection stems from the fact that output is deflated by the official price index, which is possibly biased. Nevertheless, it is useful to see what orders of magnitude this method implies. Begg (1998) reports productivity in Czech industry based on Czech Statistical Office data. While he does not specify how this measure of productivity is calculated, an examination of the implied productivity growth of either large or large and small firms reported in Table 3 is generally consistent with the magnitudes of the productivity shocks reported in Figure 2. Since Begg's measures of productivity growth are likely based on the relationship between output and physical inputs while ours are based on the relationship between output prices and input prices, the similarity of the two sets of productivity measures lends some confidence to our estimates.

TABLE 3

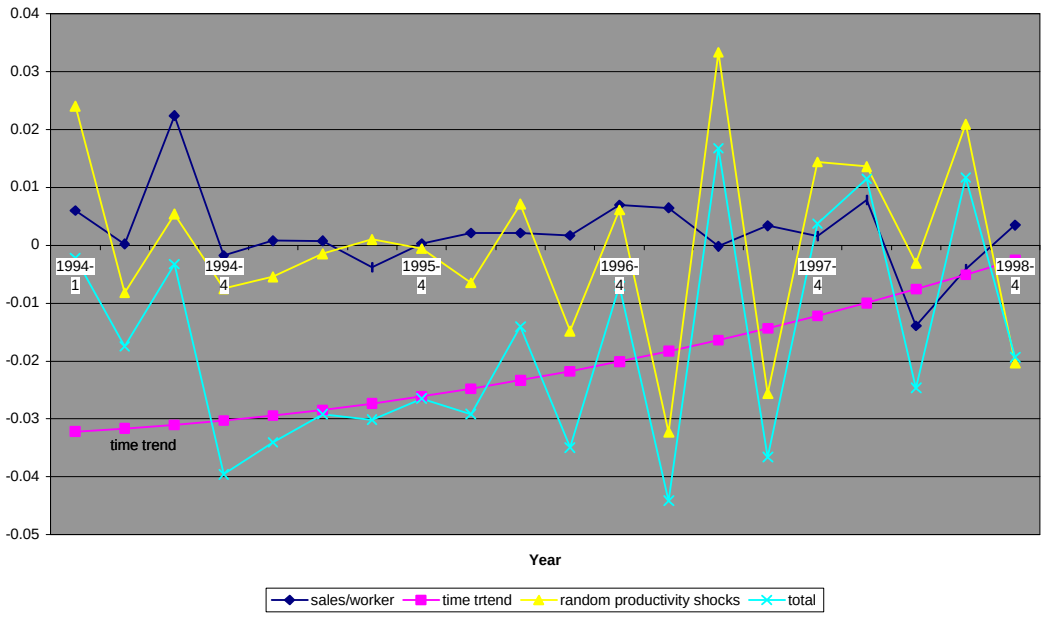
GROWTH OF CZECH INDUSTRIAL PRODUCTIVITY, 1993-1996
(in % per year)

	Year			
Growth of Industrial Productivity In:	1993	1994	1995	1996
Large firms only:	1.0	6.9	9.3	11.0
Including small firms:	-1.0	5.1	10.6	8.7

Source: Authors' calculations from Begg (1993), Table 2.

Figure 3 reports similar information for the CPI. Systematic productivity gains consist of a quadratic time trend that yields negative productivity shocks over the sample period, meaning that this component of productivity, which we identified with the emergence of competition in, and the rationalization of, the retail sector, served to reduce the growth of the CPI. Changes in sales per worker, which we identified with labor productivity in the retail sector, are a relatively small source of productivity shocks in the retail sector, and the mean of these shocks over the sample period is close to zero. Finally, the random or unexplained productivity shocks, the residuals in the regression equation, are somewhat smaller in magnitude relative to the other sources of productivity shocks, a relationship somewhat different from that found in the case of the PPI. In all, with a few exceptions, the productivity shocks, either systematic or total, for the CPI are negative and quite large. Thus, the argument that we made above regarding the large real productivity gains that would be required to offset the effect of significant upward bias in the measurement of the PPI is equally if not more appropriate for the case of the CPI.

Fig 3. Productivity Shocks to CPI



The CPI is subject to two kinds of exogenous shocks that are less relevant to the PPI. The first of these is changes in the tax system, which provided upward shocks to consumer prices due to the introduction of a value added tax and its subsequent revision (Czech National Bank, 1999). We attempted to account for these price shocks by means of dummy variables, but the coefficients for these variables proved not to be significantly different from zero. The second exogenous shock to the CPI comes from the periodic upward revision of controlled prices. Certain goods, including some rents, municipal services, some catering and other social services, and other goods, in all less than one-fifth of the market basket for the CPI, have their maximum price set by the authorities. From time to time, these prices are raised, causing the CPI to increase by amounts in excess of what the growth of wages and the devaluation of the koruna would imply. Such increases in the CPI can be interpreted as nonsystematic positive productivity shocks within the framework of our model. One way to deal with these

”known” shocks would be to subtract the effect of increases in regulated prices from the reported CPI. This is what the Czech National Bank does when it calculates so-called net inflation. We eschew such an approach because we note that, in those periods when controlled prices are not raised, the CPI increases by less than the amount implied by wage and exchange rate changes, creating offsetting negative productivity shocks.

IV. CONCLUSIONS

In this paper we have formulated models of the PPI and the CPI and estimated their parameters for the Czech Republic over the period 1993-1998. We find that productivity shocks during this period have largely served to reduce the inflationary pressures stemming from the growth of nominal wages and from nominal devaluation. The productivity gains are quite large in some quarters. We also argue that an upward bias in price indices would serve to lower the observed value of productivity shocks. The productivity gains observed are quite large, and it is therefore unlikely that they include additional productivity gains that are masked by a significant upward bias in the compilation of the PPI and CPI. From these results we conclude that the Czech Statistical Office appears to have overcome some daunting methodological problems and provided relatively accurate measures of the CPI and the PPI.

The policy implications of these findings are, therefore, relatively straightforward. The historical record of macroeconomic performance in the Czech Republic is generally correct as it stands. Economic growth has been modest, inflation has been at moderate but declining levels and there has been steady real effective exchange rate appreciation. Moreover, for most of the 1990s real interest rates have been positive.

Any criticism of the policies followed in the 1990s cannot be deflected by appeals to biased measurement of price indices, and future policies can be formulated with a sense of confidence that official measures of real macroeconomic aggregates and of the rate of inflation adequately represent the true economic situation of the Czech Republic.

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