Exchange Rates, Foreign Trade Accounting, and Purchasing-Power Parity for Centrally Planned Economies

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Dollar GNPs of the U.S.S.R. and Eastern Europe
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Washington, D.C., U.S.A.
Prior to the introduction of the World Bank Atlas, there were very few statistical data on centrally planned economies (CPEs). The World Bank has included statistical data in those of its publications that aim for universal coverage, such as The World Bank Atlas. Among these data, those relating to gross national product (GNP) and to GNP per capita are the most important, and the Bank also needs them for operational purposes for its member countries, which now include some CPEs.

In the CPEs prices are generally set administratively and are often loosely or not at all related to the relative scarcity and costs of production of goods and services. This is particularly true of the exchange rate. The World Bank normally uses exchange rates for converting GNP figures from national currencies into dollars (or into any other numeraire), an indispensable step for international comparisons. The choice of an appropriate conversion factor therefore poses particularly difficult problems for most CPEs. A further difficulty arises because the national accounts of the CPEs are based on the concept of net material product (NMP), which differs from the concept of GNP used in market economies. To derive the GNP numbers of those CPEs that compile only NMP accounts, various adjustments must be made. The data required for making these adjustments are not always fully available. Finally, a separate set of issues arises in relation to year to year comparisons within the same CPE. For these too and the corresponding growth rates, official data are not strictly comparable to growth rates of the market economies.
In early 1982 a research project sponsored and financed by the World Bank was undertaken to assess alternative methods of computing the per capita dollar GNP levels and growth rates of CPEs. It covered eight countries: Bulgaria, Cuba, Czechoslovakia, the German Democratic Republic, Hungary, Poland, Romania and the U.S.S.R. The purpose of this research project was to define the best among known methods that could be applied to CPEs as a group and make use of available data. It was not its aim to establish and define new computation methods whose application would have required many more years of effort, even if data had been available.

This research project has produced eleven reports, which are published simultaneously. The main report authored by the principal researcher for the project, Paul Marer, is published as a book, Dollar GNPs of the USSR and Eastern Europe (Johns Hopkins University Press, 1985). The eight country studies and two background papers are published separately in the World Bank Staff Working Paper series. The main report provides highly valuable insights into the problems related to the estimation and comparison of the GNPs and GNP growth rates of the CPEs. It also gives the author's best estimates of the actual values of these indicators for the majority of CPEs covered by the project, that is those for which there was some statistical basis for computing estimates or choosing between those already available.

The main report on the Research Project on CPEs concludes that adequate GNP data in national currencies can be derived for most CPEs by adjusting official information about net material product in the light of statistical and other information known to country experts. It further concludes that the best method generally applicable to CPEs for converting such GNP data from local currencies into dollars would use conversion rates based upon purchasing power parity (PPP) information. For comparison with
corresponding World Bank data on other World Bank members, these conversion rates should be adjusted to correct for the expected differences between the PPP rates and the actual official exchange rates (the "exchange rate deviation index"). The needed adjustments are estimated econometrically from the actual differences observed at each level of per capita GNP among the thirty-one market economies participating in Phase III (1975) of the International Comparison Project (ICP). For Hungary, Romania, and Poland, PPP information is derived from Phase III (1975) of the ICP, while for Czechoslovakia, the German Democratic Republic, and the U.S.S.R., it is derived from private bilateral comparisons chain-linked to the ICP data. This method yields a range of per capita GNP estimates: for example, $2,700 to $5,700 with a midpoint of $4,190, for the U.S.S.R. in 1980. No PPP estimate was available, and no GNP per capita figure in US dollars calculated, for Bulgaria and Cuba.

The main report also concludes that the official estimates of growth rates of the CPEs "tend to yield varying degrees of upward bias." For all countries except Hungary, the experts lean toward preferring alternative indices, constructed by outside experts with partial information, although these too present problems (especially for countries other than the U.S.S.R.) and the experts therefore fell short of endorsing them. The author of the study on Hungary leans toward preferring the official index at this time.

The country studies and background papers that are being issued in the World Bank Staff Working Paper series provide additional details on the CPEs studied and their exchange rates. Some of the country studies include the respective authors' estimates of per capita GNP in U.S. dollars. These estimates, however, are the individual authors' experimental computations, based on methods that may not be consistently applicable to CPEs generally.
There remain major uncertainties about GNP conversions by means of "adjusted PPPs." In addition to numerous remaining theoretical and practical problems associated with calculating PPPs within the framework of the centrally coordinated ICP, private estimates such as those used in this study for three CPEs still appear to be subject to a wide margin of error. Furthermore, there is no other way to estimate the exchange rate deviation index than to derive it from observation of the countries covered by the ICP (almost all of which are market economies). The applicability of an index derived in this fashion to the CPEs, whose economic structures are very different, remains subject to reservations.

The present study used ICP Phase III data relating to the year 1975, extrapolated to 1980. Phase IV ICP data already published shows estimates directly relating to 1980 for European countries, including Hungary and Poland; Romania, a participant in early phases of the ICP, has not provided the data needed for participation in Phase IV. It is noteworthy that Phase IV estimates of Hungary's and Poland's per capita GNP in 1980 are lower than the 1975 results extrapolated to 1980, used by the Research Report on CPEs. These differences are partly due to the greater attention paid in Phase IV to quality differences and to other methodological advances.

During the course of 1983 the Bank, with the help of a distinguished panel of experts, 1/ undertook a review of the methodological problems and issues related to the estimation of internationally comparable per capita GNP figures for all countries. The preliminary results of the research project on CPEs constituted an important input into that review, whose findings and

1/ Abram Bergson, Harvard University, Chairman; Andre Vanoli, Institut National de la Statistique et des Etudes Economiques; and Parmeet Singh, Commonwealth Secretariat.
recommendations were approved by the panel of experts. In light of the review, the Bank has decided that for the time being (that is, at least until data availability and other problems related to PPP information are resolved), official GNP information converted at official exchange rates should generally continue to provide the basis of the per capita GNP estimates published in *The World Bank Atlas*. Exceptions to this rule are to be made only when official GNP data, in national currency, is exceptionally bad or compiled in ways which diverge in an exceptionally large measure from the usual methods and standards, or when the official exchange rate is exceptionally far removed from the rate effectively governing foreign payments transactions. When there is a reason to believe that such exceptional circumstances prevail, and adequate information exists, appropriate adjustments are to be made. When adequate information does not exist and cannot be obtained, no estimates are to be published. At the time of writing this foreword, it seems likely that lack of information will for some time prevent the Bank from making estimates of the per capita GNP of most CPEs. Thus *The World Bank Atlas* published in early 1985 contains an estimate of the values of GNP and GNP per capita for only one European CPE, Hungary.

Following the review endorsed by the panel of experts, the World Bank has adopted calculation methods and obtained results which, for a few countries, are different from those of the research project of CPEs. The Bank's general methodology must be applicable to all its member countries, including most market economies and only a few CPEs; the Bank could demand that its member countries provide additional information when needed; and it could, and did, decide not to estimate the per capita GNP of countries for which a minimal, but still fairly extensive set of information could not be obtained. As noted earlier, however, the research project on CPEs has aimed
at defining a method consistently applicable to all CPEs and one that could make use of available information. These differences in aims and constraints readily explain the differences in results.

The research project on CPEs, whose major findings are published in the main report, has greatly enhanced the understanding of the CPEs' unique macroeconomic accounting frameworks and pricing systems. It has provided insight into many substantive issues, in particular the relationship of domestic and international prices. The individual country reports, published separately, shed much light on many important country-specific issues. The Bank will continue to build upon the valuable findings of the research project on CPEs in its future efforts to understand these important components of the global economy.

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The Estimation of Gross Domestic Product and Its Growth Rate for the German Democratic Republic.


Exchange Rates in Eastern Europe: Types, Derivation, and Application.

Exchange Rates, Foreign Trade Accounting, and Purchasing-Power Parity for Centrally Planned Economies.
ABSTRACT

The paper examines some of the major conceptual problems involved in converting the national product of centrally planned economies (CPEs) into U.S. dollar equivalents. Four sets of issues are addressed. First, the major sources of bias involved in using the official exchange-rate as a proxy for the relative price level (or "purchasing power parity") are analyzed. Second, it is shown that use of the so-called "Soviet" method of accounting for foreign trade in the national accounts, or estimation of GDP on the basis of "adjusted factor costs" without taking into account price distortions in tradeables, may yield a biased estimate of GDP in national currency units. Third, the International Comparison Project (ICP) methodology for constructing dollar estimates of different countries' GDPs is briefly outlined, and critiqued insofar as it is applied to CPEs. Some of the main findings of Phase III of the ICP regarding CPEs are also summarized. Finally, the relative merits of other approaches to generating comparable CPE income estimates are also briefly reviewed.

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The paper examines some of the major conceptual problems involved in converting the national product of centrally planned economies (CPEs) into U.S. dollar equivalents. Section II briefly reviews the major sources of bias involved in using the official exchange-rate as a proxy for the relative price level (or "purchasing power parity," PPP) in making such conversions. As shown there, even in market economies it will take a very special set of circumstances to ensure that the official exchange-rate will exactly reflect the relative purchasing power of two currencies in their respective markets. In addition to the usual stress on differences in the relative price of nontradeables across countries, as well as differences in expenditure weights (the so-called index number problem), section II also highlights the main sources of distortion in tradeable prices per se. Special attention is also devoted to the sources of tradeable price distortion in centrally planned economies (CPEs), including official exchange-rates which may be set more arbitrarily than in most economies.

As is well known, the Net Material Product (NMP) approach is used by CPEs in accounting for national economic activity, and NMP magnitudes must be "scaled up" to arrive at estimates for the various GNP-type categories. Among specialists on the CPEs it is also recognized that official exchange-rates in general do not approximate the ratio of traded goods prices in domestic and foreign currency prices respectively. This distortion, as well as differences in the amount of distortion as between imports and exports, has implications that go beyond the "sources of bias" discussed in section II. In one or more
CPEs, distortions between domestic and foreign currency prices for traded goods are accounted for in the national accounts in a way that is different from standard practice in market economies.

In section III we examine how these distortions and different accounting practices may affect the official estimate of NMP and consequently the base from which the "scaling" up is carried out. It is demonstrated that using either the "Soviet" approach to foreign trade accounting or the adjusted factor cost method of estimating GDP (without adding in the so-called net "price equalization" tax in foreign trade), will in general yield an income figure different from that obtained using the SNA approach. Similar problems may be encountered in estimating the domestic final uses of gross product.

Because the bias resulting from the use of official exchange-rates may be substantial, other approaches to the conversion problem have been developed. Perhaps the most notable of these has been the methodology used for the International Comparison Project (ICP). Section IV briefly summarizes the basic approach of the ICP and assesses its relevance to developing comparable estimates of CPE national products. Some substantive results from Phase III of the ICP pertaining to CPEs are also reviewed. Several aspects of the ICP methodology are critiqued as well, with some doubts being raised with respect to ICP accounting for CPE trade balances, and as to whether quality differentials for manufactures as between CPEs and market economies, are adequately taken into account.

As for most other lower- or medium-income countries, the three CPEs in the ICP study, Hungary, Poland and Romania, are found to have "real" per capital incomes in 1975 above those indicated by converting national currency GDP estimates into dollars using the official exchange-rate (so-called
"nominal" incomes). This is caused largely by their having, along with other countries at similar income levels, relative prices for nontradeables that are so low, that notwithstanding their lower expenditure weights, they yield on balance relative price levels which are below those suggested by their official (noncommercial) exchange-rates. Somewhat surprisingly, these three CPEs are found to have relatively high prices for capital goods, even compared to other countries at similar levels of income.

Of the CPEs examined in the ICP, Hungary has a particularly high exchange-rate deviation index, given its income level. In section IV it is shown that this is due to Hungarian tradeables being significantly underpriced domestically at the official exchange-rate, relative to foreign currency prices. This finding suggests that for some countries exclusive focus on the weighted ratio of internal prices (nontradeables to tradeables) may detract from full understanding of the determinants of their purchasing power parities.

Because it may not be possible to use the full ICP approach in estimating national products for other countries, various "shortcut" methods and the "reduced information" ICP approach are briefly reviewed in section V. A generally appealing approach might be to use econometrically established relationships for the ICP benchmark countries, between "real" (i.e., ICP estimated) and "nominal" incomes, to estimate real incomes for non-benchmark countries. Our finding regarding the sources of the difference between PPP and the official exchange-rate for Hungary, however, suggests that "real" incomes for non-benchmark CPEs might not be reliably "fitted" by ICP equations that include only combinations of "nominal" income levels and "openness" measures as explanatory variables. Because of significant distortions for
many CPEs in the tradeable sector alone, there is little reason to believe that econometric equations based largely on market economies will necessarily yield dollar GDP estimates for CPEs which are generally acceptable.
# CONTENTS

<table>
<thead>
<tr>
<th>Section</th>
<th>Page</th>
</tr>
</thead>
<tbody>
<tr>
<td>I. Introduction</td>
<td>1</td>
</tr>
<tr>
<td>II. Exchange-Rates and Purchasing Power Parity</td>
<td>2</td>
</tr>
<tr>
<td>III. Pitfalls in Accounting for Foreign Trade</td>
<td>10</td>
</tr>
<tr>
<td>IV. Relevance of the International Comparison Project</td>
<td>19</td>
</tr>
<tr>
<td>V. Shortcut Approaches</td>
<td>31</td>
</tr>
<tr>
<td>VI. Summary and Conclusions</td>
<td>38</td>
</tr>
<tr>
<td>Bibliography</td>
<td>43</td>
</tr>
</tbody>
</table>
Glossary of Abbreviations

CPE = Centrally planned economy
ECE = Economic Commission for Europe
GDP = Gross domestic product
ICP = International Comparison Project
ME = Market economy
NMP = Net material product
PIG = Physical Indicators Global
PPP = Purchasing power parity
SNA = System of National Accounts
UN = United Nations

Glossary of Symbols (In order of first use.)

e_p = Purchasing power parity
P = Price level in "home"
P* = Price level abroad
e_0 = Official exchange-rate
P_t = Home price level of tradeables
P*_t = Foreign price level of tradeables
e_t = P_t/P_t*
\lambda = e_t/e_0
\theta_t = Proportion of total home expenditure accounted for by tradeables
\( \beta_t \) = Proportion of total foreign expenditure accounted for by tradeables

\( P_n \) = Home price level for nontradeables

\( P_{n*} \) = Foreign price level for nontradeables

\( q \) = \( \frac{P_n}{P_t} \)

\( q^* \) = \( \frac{P_{n*}}{P_{t*}} \)

\( \beta_x \) = Proportion of total home expenditure on tradeables accounted for by exportables

\( \beta_x^* \) = Proportion of total foreign expenditure on tradeables accounted for by exportables

\( t_x \) = Ad valorem subsidy (tax) rate on home exports

\( a_x \) = \( (1 + t_x) \)

\( t_m \) = Ad valorem tax (subsidy) rate on home imports

\( a_m \) = \( (1 + t_m) \)

\( P_{x*} \) = Foreign currency price of home exports

\( P_{m*} \) = Foreign currency price of home imports

\( t^* \) = \( \frac{P_{x*}}{P_{m*}} \)

\( P_x \) = Domestic currency price of home exports

\( P_m \) = Domestic currency price of home imports

\( e_e \) = Equilibrium exchange-rate

\( B_t \) = Trade balance evaluated in domestic prices

\( Q_x \) = Quantity of exports

\( Q_m \) = Quantity of imports

\( B_t^* \) = Trade balance evaluated in foreign currency prices

\( B_t' \) = Trade balance in valuta prices

\( Y' \) = GDP (Standard SNA approach)

\( A \) = Domestic expenditure or absorption

\( Y \) = GDP (Textbook definition)
\[ T = \text{Net trade duties, or "gross output of foreign trade" according to the CPE "basic" method of accounting for foreign trade} \]

\[ T_s = \text{Soviet definition of "gross output of foreign trade"} \]

\[ Y_s' = \text{Scaled-up CPE GDP using the Soviet definition of "gross output of foreign trade"} \]

\[ \pi_i = \text{International price for the } i\text{th product category} \]

\[ Q_{ij} = \text{jth country's "notional" real expenditure on the } i\text{th product} \]

\[ C = \text{Aggregate consumption expenditure} \]

\[ I = \text{Aggregate investment expenditure, or capital formation} \]

\[ G = \text{Aggregate government expenditure} \]

\[ r = \text{"Real" income (ICP concept)} \]

\[ n = \text{"Nominal" income (ICP concept)} \]

\[ x = \text{Percentage increment to GDP arising from inclusion of unreported income in a CPE} \]

\[ x^* = \text{Percentage increment to GDP arising from inclusion of "unreported" income in the numeraire country.} \]

\[ e_p' = \text{Purchasing power parity after taking into account prices in the "unreported" sectors at home and abroad} \]

\[ OP = \text{Measure of the "openness" of an economy} \]
I. INTRODUCTION

This paper examines some of the major problems involved in converting the national product of centrally planned economies (CPEs) into U.S. dollar equivalents. Section II briefly reviews the major sources of bias in using the official exchange-rate as a proxy for the relative price level (or "purchasing power parity", PPP) in making such conversions. As shown there, only under very special circumstances will the official exchange-rate exactly reflect the relative purchasing power of two currencies in their respective domestic markets. Special attention is given in that section to the kinds of bias expected to arise in the case of CPEs.

As is well known, the Net Material Product (NMP) approach is used by CPEs in accounting for national economic activity, and NMP magnitudes must be "scaled up" to arrive at estimates for the various GNP-type categories. Among specialists on the CPEs it is also recognized that official exchange-rates in general do not approximate the ratio of traded goods prices in domestic and foreign currency prices respectively. This distortion, as well as differences in the amount of distortion as between imports and exports, have implications that go beyond the "sources of bias" discussed in section II. Furthermore, in one or more CPEs, distortions between domestic and foreign currency prices for traded goods are accounted for in the national accounts in a way that is different from standard practice in market economies. In section III we examine how these distortions and different accounting practices may affect the official estimate of NMP and consequently the base from which the "scaling up" is carried out.
Because the bias arising from the use of official exchange-rates may be substantial, other approaches to the conversion problem have been developed. Perhaps the most notable of these has been the methodology used by the International Comparison Project (ICP). Section IV briefly summarizes the basic approach of the ICP and assesses its relevance to developing comparable estimates of CPE national products. Some substantive results from Phase III of the ICP pertaining to CPEs are also reviewed.

Section V briefly evaluates the relative merits of other approaches to generating comparable CPE product estimates, including the so-called "short-cut methods" and "reduced information" ICP approaches. A brief summary, conclusions and remaining questions are presented in section VI.

II. EXCHANGE RATES AND PURCHASING POWER PARITY

This section attempts to highlight, in a simple way, the possible sources of bias when the official exchange-rate is used as a proxy for purchasing power parity. For simplicity we shall make a binary comparison, between "home" and some other country or region.

If we define \( e_p \) as purchasing power parity, or the ratio of the overall price levels of the two countries \( (P/P^* \), where the asterisk denotes prices in terms of foreign currency), the issue is whether \( e_p \geq e_0 \), where \( e_0 \) is the official exchange-rate, expressed as the home currency price of foreign exchange. Now define the ratio of the price levels for tradeable goods \( (P_t/P_t^*) \) as \( e_t \). Taking an expression from Officer (1976a) for \( e_p/e_0 \), but now allowing for the possibility that \( e_t \neq e_0 \) and simplifying, gives:
where $\beta_t$ and $\beta_t^*$ represent the proportion of total expenditure accounted for by tradeable goods at home and abroad respectively; $q$ and $q^*$ are the relative price levels for nontradeables at home and abroad respectively ($q = P_n/P_t$ and $q^* = P_n^*/P_{t^*}$, where the subscript "n" denotes nontradeables);

$$\lambda = \frac{\beta_x (1 + \alpha_x) + \alpha_m}{\beta_x^* (1 + \alpha^*_m)}$$

where $\beta_t$ and $\beta_t^*$ represent the proportion of total expenditure on tradeables in the respective countries accounted for by exportables; $t^*$ is the commodity terms of trade in terms of foreign currency (i.e., $t^* = P_{x^*}/P_{m^*}$, where the subscripts "x" and "m" refer to exportables and importables respectively); $\alpha_x = (1 + \tau_x)$, where $\tau_x$ is the explicit or implicit ad valorem subsidy (tax, if $\tau_x < 0$) rate on home exports; and $\alpha_m = (1 + \tau_m)$, where $\tau_m$ is the explicit or implicit ad valorem tariff rate on home imports. (Transport costs are assumed to be zero, for simplicity.)

If the relative price of nontradeables is the same in the two countries ($q = q^*$), expenditure weights are also identical ($\beta_t = \beta_t^*$; $\beta_x = \beta_x^*$), and there is no domestic distortion of tradeable prices ($\alpha_x = \alpha_m = 1.00$), $\lambda$ in expression (2) is unity and expression (1) yields $e_p = e_0$. In other words, the official exchange-rate is equal to purchasing power parity. This result could also occur if, despite two or more of the above conditions not being met, differences were exactly offsetting. Clearly, however, $e_p$ will equal $e_0$ only under very special circumstances.
Now we will consider briefly the impact on \( \frac{e_p}{e_0} \) of certain of these "special circumstances" not being fulfilled. First, continue to assume no distortions in tradeable prices and that expenditure weights are the same at home and abroad. The net trade distortion factor (\( \lambda \)) is still equal to 1.00, but now \( e_p > e_0 \) as \( q > q^* \). For example, if nontradeables are relatively expensive abroad (\( q > q^* \)), purchasing power parity will be less than the official exchange-rate.

The most frequently cited argument for why there might be non-negligible differences in the relative price of nontradeables across countries, given no distortion in tradeable prices, is the so-called "productivity differential" theory associated with Balassa (1964) and others. The essence of this argument is that productivity may differ substantially as between the tradeable sectors at home and abroad. Wage rates are assumed to be set in the tradeable sector, and intercountry productivity differences in this sector translate into differential wage rates across countries. International commodity arbitrage ensures, however, that the ratio of tradeable prices (\( e_t \)) will remain equal to the official exchange rate. If the productivity differential is not as great in the nontradeable (mostly services) as in the tradeable sector, yet the same wage differential applies to nontradeables as well, then the high-productivity country will tend to have a higher relative price for nontradeables. While intuitively appealing, this explanation of observed differences in relative nontradeable prices (see section IV) is not universally accepted. Officer (1976a), for example, argues that these measured differences could be accounted for by systematic under-statement of the relative "quality" of services in those countries with high relative nontradeable prices. The same author (Officer, 1976b) finds little
empirical support for the correlation of relative nontradeable prices with differential productivity across countries.

As a second case, again assume \( \lambda = 1.00 \), that \( q = q^* \), but that tradeables make up a smaller proportion of total expenditure at home than abroad \( (\beta_t < \beta_t^*) \). In this case, \( e_p > e_0 \) as \( q < 1.00 \). That is, whether the exchange-rate understates (overstates) the true relative purchasing power of home's currency depends on whether the price level for nontradeables is less (greater) than the price level for tradeables in the two countries. If nontradeables are equally less expensive than tradeables in both countries, for example, then the overall price level will be lower at home (than abroad) if tradeables are relatively less important in total consumption at home (than abroad), and the relative price level will be less than the official exchange-rate.

Finally, consider the case in which \( q = q^* \), expenditure weights are the same in both countries \( (\beta_t = \beta_t^*; \beta_x = \beta_x^*) \), and home exports and imports are subject to equal rates of price distortion, with the ad valorem tax on imports equal to the ad valorem subsidy on exports \( (\alpha_x = \alpha_m > 1.00) \).

Here, \( e_p > e_0 \) unambiguously, because even though the relative price levels and expenditure weights are equal in the two countries, the ratio of tradeable prices \( (e_t) \) is greater than the official exchange-rate. Thus the bias encountered by using the exchange-rate as a measure of relative purchasing power of two currencies, is dependent neither on the existence of nontradeables (and if they exist, on differential relative prices and/or expenditure weights), nor on the distortion of the internal terms of trade \( (P_x/P_m) \) from the external \( (t^*) \). Uniform nominal price distortions alone can cause \( e_p \neq e_0 \), because they cause \( e_t \neq e_0 \).
Up to now we have said nothing about how the "official" exchange-rate is determined, or whether it is an "equilibrium" rate. If we defined the equilibrium exchange-rate ($e_e$) as that which would ensure flow equilibrium in the foreign exchange market over some period, the "official" exchange-rate ($e_0$) could be equal to $e_e$ but $e_e$ (and $e_0$) might not be the same as if there were no "autonomous" capital flows. Provided there were perfect international commodity arbitrage, however, $e_0$ would still equal $e_c$ in the absence of price distortions on tradeables, and $e_p/e_0$ would still be equal to unity under the very special circumstances mentioned earlier.

Consider for a moment the case in which there is perfect international commodity arbitrage but $e_0$ is pegged below the equilibrium rate, and the excess demand for foreign exchange at $e_0$ is accommodated by a reduction in home's foreign-exchange reserves. Under the aforementioned special circumstances, we could of course still have $e_p = e_0$. If at some later time the exchange-rate were allowed to depreciate to its equilibrium level, $e_p/e_0$ would probably decline, and most certainly would if the demand for tradeables at home and abroad were at least unit elastic. Clearly then, fluctuations over time in official exchange-rates, because of international capital movements and/or changes in the degree of central bank intervention, could cause large changes in the $e_p/e_0$ relationship, both independently of and because of induced changes in the relative price of nontradeables and expenditure weights at home and abroad.

All of the foregoing applies to any country comparisons, regardless of economic system. All the possible sources of bias existing for market economies (MEs) exist as well for CPEs. Certain sources of bias, however, might be expected to be relatively more important in CPEs than in MEs.
Specifically, most CPEs historically have delinked domestic relative price structures from world market price relatives for tradeables. It seems reasonable to assume, in general, that \( \alpha_x \neq \alpha_m \) and that \( \alpha_x \) and \( \alpha_m \) will be \( \neq 1.00 \). Whether this causes the net trade distortion factor \( (\lambda) \) to be \( < 1.00 \), however, depends on the relative expenditure weights for exportables \( (\beta, \beta_x) \), the terms of trade, and both the absolute and relative degrees of price distortion for exportables and importables (see expression (2) above). Consequently, considerably greater price distortions for tradeables need not mean greater differences between purchasing power parity \( (e_p) \) and official exchange-rates for CPEs, as such distortions may be somewhat offsetting.

Given the pervasiveness of exchange control among CPEs, there is perhaps a reasonable presumption that their official exchange-rates are disequilibrium rates, and indeed tend to overvalue their currencies. As with market economies, devaluation by a CPE would tend to depress the \( e_p/e_0 \) ratio, but only because the denominator would be larger than before. Given the lack of linkage for most CPEs of domestic and foreign trade prices (see Wolf (1980)), a change in the official exchange-rate need have no effect on the numerator, \( e_p \).

It is questionable, however, whether for most traditional CPEs it makes sense to talk about the official exchange-rate over- or undervaluing the currency. Given the domestic price rigidity and the control over trade by planners who are more responsive to quantity targets than to domestic prices, the official exchange-rate is virtually irrelevant to the size or composition of real trade flows initiated by the socialized sector. (This generalization, of course, would be far less applicable to "modified" centrally planned
economies such as Hungary.\(^1\) There, the persistence of at least informal controls over hard currency imports suggests that the commercial exchange-rate has typically overvalued the forint.\(^1\) To the extent that households or other agents not subject to central planning could be considered as potential traders, however, then the disequilibrium nature of the exchange-rate would carry more meaning. In other words, at the non-commercial e\(_0\) there might well be excess demand by consumers for foreign exchange, and therefore exchange control is imposed so as to ration foreign exchange among these demanders as well as to allocate it among socialized enterprises.

In any event, quantitative planning of foreign trade and exchange control in effect eliminate (legal) international commodity arbitrage in a CPE. This means that in general our measures of tradeable price distortion (\(\alpha_x\) and \(\alpha_m\)) are not parameters, but are functions of (1) fluctuating foreign currency prices and (2) centrally administered domestic prices.\(^2\)

To see what effect this has on the relationship between \(e_p\) and \(e_0\), consider expressions (1) and (2) alternately for a ME and CPE, in each case making the \(e_p/e_0\) comparison against some third country. Assume that in both cases, for simplicity, \(\beta_t = \beta_t^* = 1.00\) (i.e., all goods are tradeables), \(\beta_x = \beta_x^*\), and that initially \(\alpha_x = \alpha_m = 1.00\) for both the ME and the CPE. Expression (1) simplifies to \(e_p/e_0 = \lambda\), where \(\lambda=1.00\). The ratio of each country's price level to that of the third country will be equal to its official exchange-rate for the third country's currency.

\(^1\) See Wolf (1980).
\(^2\) Ibid.
Now assume that prices in the third country double. The ME continues to apply no taxes or subsidies in trade and permits international commodity arbitrage. Domestic prices double if $e_0$ is fixed, or $e_0$ is halved if flexible, and $e_p/e_0=1.00$. If the CPE maintains fixed prices domestically, imports will now be implicitly subsidized and exports taxed, $\alpha_x = \alpha_m = 0.5$, and $\lambda(=e_p/e_0)<1.00$. As pointed out by Holzman (Chapter 4), this price insulation property of the classical CPE is similar to the insulating effects of a flexible exchange system in MEs.

Expressions (1) and (2) indicate that knowing the official exchange-rate ($e_0$) and having rough estimates for $\beta_t^*, q$ and $q^*$ is not sufficient for calculating $e_p$. We should also know the net trade distortion factor ($\lambda$), and indeed this factor may be, but need not be, more different from unity for a CPE than for a market economy. In attempting to estimate $\lambda$, it may be possible in some cases to use certain "foreign trade coefficients" employed by CPE planners themselves and sometimes mentioned in CPE foreign trade literature. Such coefficients, which are not to be confused with "shadow" exchange-rates, are sometimes also referred to as "internal" exchange-rates, and are equal to $\alpha_x = P_x/P_{x}^*e_0$ and $\alpha_m = P_m/P_m^*e_0$, for exports and imports respectively. Observe, however, that calculation of $\lambda$ still requires knowledge of $\beta_x^*$ and $\beta_x^*$, the proportion of total expenditure on tradeables in each country going for exportables. This is not at all the same, in general, as the proportion that actual exports bear to total trade turnover.

Having raised the issue of price distortions among tradeables in CPEs and how they may affect the usefulness of the exchange-rate as a proxy for purchasing power parity, we turn in the next section to an examination of how
such distortions may, under certain accounting approaches, bias CPE national income calculations as well.

III. **PITFALLS IN ACCOUNTING FOR FOREIGN TRADE**

Price distortions among tradeables are of course not restricted to CPEs. Most market economies have extensive structures of governmental taxes and subsidies on foreign trade, and these affect GDP both through their impact on relative prices and the effect that relative prices have on domestic production and consumption decisions. Moreover, the SNA approach is to include net taxes on foreign trade in GDP,\(^3\) apparently on the rationale that in imposing such taxes the government is contributing to domestic value added. The standard textbook definition of GDP usually ignores trade taxes:

\[
(3) \quad Y = A + B_L
\]

where \(Y\) = domestic value-added exclusive of duties, \(A\) is domestic absorption or expenditure, and \(B_L\) is the trade balance defined in domestic market prices.

Adding net government taxes on trade to \(Y\) yields the SNA definition of GDP:

\[
(4) \quad Y' = Y + T
\]

where \(T\) represents net trade duties, and is the sum of net export duties \((V'_x - V_x, \text{ or } (P_x e_o - P_x Q_x)\) and net import duties \((V_m - V'_m, \text{ or } (P_m - P_m e_o Q_m)\)), where the subscripts \(x\) and \(m\) refer to exports and imports and \(P\) and \(Q\) refer to prices and quantities respectively, an asterisk denotes the foreign currency price of a tradeable and a prime represents a foreign currency.

\(^3\) Based on United Nations (1971).
currency value converted into domestic currency at the official exchange-rate $e_o$. This sum can be rearranged to give:

$$ T = B'_t - B_t $$

where $B'_t$ refers to the foreign currency trade balance converted into domestic prices at the official exchange-rate and $B_t$ is, as before, the trade balance in terms of domestic market prices. Expression (5) is also the expression for the net profits in foreign trade from "price discrepancies", or the net "price equalization tax" imposed on foreign trade organizations.\(^4\)

Substituting (3) and (5) into (4) and simplifying gives an alternative expression for GDP according to the SNA:

$$ (4a) \quad Y' = A + B'_t $$

According to UN (1971), the "basic" method of accounting for foreign trade in CPEs, according to the MPS, is analogous to the SNA approach. This "basic" method defines $T$ as the "gross output of foreign trade", and if this were to be added to a "scaled-up" domestic value-added (i.e., $Y$), the result would be identical to (4) and (4a).

As pointed out long ago by Holzman (1974: Chapters 13, 14), the Soviet Union (and possibly some other CPEs as well) defines the gross output from foreign trade a bit differently. Specifically, value added generated in domestic material production activities is augmented by $T_g$, which is equal to $(B'_t a_x - B_t')$ when $B_t' > 0$ and $(B'_t a_m - B_t')$ when $B_t' < 0$, where $a_x$ and $a_m$

\(^4\) See Wolf (1980) for a detailed examination.
are defined as $V_x/V^{*}_x e_o$ and $V_m/V^{*}_m e_o$ respectively, or what we have called the internal exchange-rates for exports and imports.\footnote{5}

The logic of this approach seems to be as follows. Assume, for example, that the CPE's valuta trade balance ($B'_t$) is equal to zero, but that when evaluated in domestic prices imports exceed exports (i.e., $B_t < 0$). In this case the CPE has been able to obtain, for a given use of domestic resources, products from abroad with an even greater value, in terms of domestic prices. This is seen to represent a "gain" from foreign trade activities. Had it only been able to do this by running down its net reserves (i.e., $B'_t < 0$), however, then this amount, multiplied by the internal exchange-rate for imports ($\alpha_m$), would have to be subtracted from the gain (in domestic prices), presumably because future imports (valued in terms of domestic prices by means of $\alpha_m$) would have to be sacrificed.\footnote{6}

Soviet net material product is defined to include the gross output from foreign trade defined in this manner. If domestic value-added were "scaled-up", this Soviet approach would yield a GDP figure equal to:

$$\text{(6)} \quad Y'_s = Y + T_s$$

or, substituting (3) into (6) and simplifying:

$$\text{(6a)} \quad Y'_s = A + B'_t \alpha$$

The difference between the Soviet and SNA definition of GDP is therefore, subtracting (4a) from (6a):

\footnote{5}{This methodological point is well understood by most Western analysts concerned with comparisons of Soviet and U.S. national product and expenditures. See, for example, U.S. CIA (1978) and Edwards et al. (1979).}

\footnote{6}{See Holzman (1974, Chapters 13 and 14) for a detailed discussion of this issue.}
Whether the Soviet approach gives a significant "bias" to calculated GDP for the CPE, when comparing it to market economies, depends on the sign and size of the valuta trade imbalance and the degree of price distortion in either exports (when $B_t'>0$) or imports (when $B_t'<0$).

If GDP is estimated for a CPE using the adjusted factor cost approach/7, presumably an aggregate similar to $Y$ in identity (3) is calculated. The difference between this magnitude and the SNA definition of GDP is then, subtracting (4a) from (3):

(8) \[ Y - Y' = B_t - B_t' \]

or the negative of the net profit on price discrepancies. Using an adjusted factor cost approach to estimate Soviet GDP in recent years, when the Soviet net profit on price discrepancies has amounted to more than 10 percent of Soviet NMP, would appear to bias downward Soviet GDP relative to the market economies.

To summarize, calculation of CPE GDP using either the "Soviet" approach (see expression (7)) or the adjusted factor cost method (see expression (8)) will in general yield an income figure different from that obtained with the SNA approach.

T.P. Alton and associates have not only estimated GDP for a number of East European countries at adjusted factor cost (see Alton (1981b), they have also sought to estimate the domestic final uses of gross product (see Alton (1981c)). Before estimating the distribution of total domestic absorption ($A$) by major expenditure category, Alton et al. first "scale up" the official NMP

/7 Bergson (1961) and Alton (1981).
figures. Because in some cases official statistics clearly are not identical to those required, Alton et al. are careful to qualify their results. Indeed, specific reference is made to the possibly distorting effect of in some cases having to use $B_t'$ rather than $B_t$ figures.

In effect, total domestic expenditure is being estimated according to

$$A = Y - B_t$$  \hspace{1cm} \text{(9)}$$

which can be derived from (3) and which corresponds to the standard practice for market economies. The $Y$ estimates are scaled up from each country's official statistics. If a given East European CPE followed the (apparent) Soviet practice of including the gross output from foreign trade, $T_s$, in GDP however, the Alton calculations would actually give

$$A' = Y_s' - B_t$$  \hspace{1cm} \text{or, using (6):} \hspace{1cm} (10)$$

$$A' = A + T_s$$  \hspace{1cm} \text{(11)}$$

The difference between (11) and (9) is simply the "gross output from foreign trade", as defined in the "Soviet" approach, or $(B_t' - B_t)$. Whether this difference would tend to under- or overstate total absorption would, of course, depend on the size of the two trade balances and the pattern of price distortions among tradeables.

Another possibility is that the estimate of $B_t$ used in (9) includes "losses" of material product which make up part of the difference between national income "produced" and "utilized". Indeed, Alton et al. in some cases are forced to "estimate" $B_t$ by subtracting reported utilized income from reported income "produced" and assuming that losses equal zero.

Yet another possibility is that the $B_t$ taken directly from official statistics is really the valuta trade balance, $B_t'$. Alton et al. are forced
to resort to this approach in the case of the GDR. The nature of the bias here is shown in expression (12) in which $B_t'$ has been substituted for $B_t$:  

$$A'' = A + (B_t - B_t')$$

Combining the biases implicit in (11) and (12) gives:  

$$A''' = A + B_t'(\alpha - 1)$$

The recent ICP-type estimates by Kravis (1981) for GDP and expenditure for the People's Republic of China conceivably could also be subject to some of these same biases. The official estimate of 1976 GDP per capita used for 'scaling up' would be biased (from the point of view of typical ME practice) if NMP were defined according to the "Soviet" approach. Furthermore, when using expression (9) to estimate total domestic expenditure ($A$), Kravis was forced to assume that $B_t = B_t'$, because only a figure for the valuta balance was available. Even though such biases may exist, however, they may still be negligible relative to aggregate national income.

Thanks to recent work by Treml (1980) and Treml and Kostinsky (1982), we are able to say something about the degree of bias introduced by using the "Soviet" approach to foreign trade accounting. They have painstakingly revalued Soviet exports and imports over 25 years in terms of domestic prices, and this permits them to estimate annual values for $\alpha_x$ and $\alpha_m$, or the "internal" exchange rates. For 1978, the latest year in their series, their estimates are $\alpha_x = .81$ and $\alpha_m = 2.27$. The Soviet valuta trade surplus for 1978 was 1,116 million rubles, and according to official Soviet statistics, 1978 NMP equaled 426.3 billion rubles, while national income utilized amounted to 420.6 billion rubles. The difference between the Soviet and

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/8 Alton, et al. (1981c)
Western definition of Soviet NMP, using expression (7), would thus amount to negative 212 million rubles, or only .05 percent of official Soviet NMP./9

If other CPEs are following the Soviet approach, however, this "bias" might be significantly greater if their valuta trade balance and/or the degree of price distortion in exports (if a valuta surplus) or imports (if a valuta deficit) is large relative to NMP. For example, a country with a large valuta deficit \( B_t < 0 \) and import subsidization \( \alpha_m < 1.0 \) would report an upward-biased GDP figure if using the "Soviet" approach (see expression (7)).

Although it turns out that the Soviet methodology yields a NMP figure very close to that which would be calculated using standard Western practices, the Soviet case is still a bit unsettling. From Treml and Kostinsky (1982) we can calculate a domestic trade deficit of 49.5 billion rubles in 1978. In other words, the excess of imports over exports in domestic prices represented about 11.6 percent of officially estimated NMP. Because the valuta trade surplus was relatively negligible, and since by expression (6) we know that Soviet NMP adds the domestic value of the trade deficit to domestic value-added in the "productive sphere", this mammoth trade deficit significantly affected the level of NMP.

As Holzman (1974) has pointed out, the standard ME practice of including net foreign trade taxes in GDP is probably of only negligible importance for many countries, at least for those with either relatively small foreign trade sectors and/or very small average foreign trade tax rates. For others, however, it may represent an important addition to GDP. For example, consider a ME for which the value of imports amounts to 40 percent of domestic

\(/9\) Narodnoe Khoziaistvo (1979) and Vneshniasia Torgovlia SSSR (1979).
value-added, the weighted average price distortion on imports is ten percent and, for simplicity, there are no price distortions on exports. In this case the inclusion of import duties and other import price differentials will cause GDP (per expression (4)) to be 4 percent higher than if they were excluded from GDP.

In the Soviet case, as we have seen, a similar procedure yields an increment of about 13 percent to domestic value-added in the productive sphere for 1978. This is due largely to the implicit average ad valorem tariff rate of 127 percent on Soviet imports \((a_m - 1)\). In this case, therefore, we are facing an adjustment which at least in recent years has been of a very different order of magnitude than is probably found in most MEs. Does this mean that Soviet GDP estimates are in some fundamental sense biased?

The Treml and Kostinsky (1982) estimates for the Soviet Union may be, as the authors acknowledge, subject to considerable error. Inasmuch as that study is based primarily on a detailed examination of prices for 1972, estimates of \(Bt\) for the early seventies are probably more reliable than those for later years. Soviet domestic-price trade deficits as estimated by Treml and Kostinsky increase dramatically in the 1970s as does their size relative to national income. Consequently, the degree of any "bias" implicit in Soviet NMP statistics would have increased as well, although this increase may be exaggerated if the estimates for the domestic-price trade deficit are overstated for more recent years. If these estimates are reliable, however, then the growth of Soviet NMP, using official statistics, would be significantly affected, too. According to Soviet statistics, "national income produced" grew at an annual rate of about 5.5 percent from 1970-78. If we use Treml and Kostinsky \(Bt\) estimates to exclude the "gross output from foreign trade"
(see identity (6)), Soviet growth for this period slows to about 3.6 percent per annum which, incidentally, is roughly equivalent to Western estimates of Soviet GNP growth for this period calculated at factor cost.

This very substantial difference in levels of Soviet NMP and NMP growth rates is explained by the enormous terms of trade gains accruing to the USSR in its trade with the industrial West and the CMEA region in the 1970-78 period. This windfall gain was caused largely by the price explosion for petroleum and later for other energy carriers, which together make up such a high share of Soviet exports to these two regions. Although real exports grew in this period, real imports increased at a much more rapid rate. The terms of trade improvement permitted the valuta trade balance to fluctuate around zero, but the very rapid increases in real imports, valued at relatively high domestic prices \((a_m = 2.27\) in 1978) meant rising domestic trade deficits. In effect, real domestic absorption was growing at a much faster rate than was output in terms of domestic prices. Because this was not accompanied by growing external deficits (in valuta prices), this higher rate of growth of absorption may be reasonably interpreted as the rate of growth of real income.

Having examined both the sources of bias in using official exchange rates to convert estimated GDP for CPEs into dollars, and some possible problems arising from distortions in tradeables prices and the peculiarities of CPE accounting practices when deriving GDP estimates in national currencies in the first place, we turn in section IV to a discussion of the relevance of the ICP to centrally planned economies.

/10 Narodnoe Khoziaistvo (1979).
IV. RELEVANCE OF THE INTERNATIONAL COMPARISON PROJECT

The history and results of the International Comparison Project (ICP), undertaken by a unit at the University of Pennsylvania in collaboration with the U.N. Statistical Office and with the support of the World Bank, is described in detail in three volumes totalling almost a thousand pages./12 The main results have also been reported in a number of separate articles over the past decade./13 Our discussion of the ICP will be rather cursory, the main purpose being to focus on how the ICP approach and results might be directly or indirectly of use in developing comparable estimates of GDP for centrally planned economies.

One of the main accomplishments of the ICP has been to generate a basis on which a unique cardinal scaling of countries could be established with respect to the level of real income. This has involved the development of a system of multilateral comparisons which avoid the intransitivity characteristic of binary income comparisons. Thus, the cardinal ranking of individual countries in the ICP is not dependent on which country happens to be chosen as numeraire (by convention, the U.S. is usually so chosen). Because comparisons for the main components of expenditure are also desired, a matrix of real expenditure values is developed by country and expenditure category, so that quantities are directly comparable across countries and categories.

/12 See Kravis, Kenessey, Heston and Summers (1975), and Kravis, Heston and Summers (1978, 1982).

/13 See, for example, references to various articles by Kravis, Heston and Summers in the bibliography.
Final expenditures on GDP are classified according to 151 "categories", on a basis similar to the UN's System of National Accounts (SNA). The statistical offices of the respective countries included in the studies have supplied expenditure data for each category in national currency units. Price investigators in each country, following a more or less uniform methodology and specifications regarding individual products, have collected price data for hundreds and in some cases thousands of individual "items". Because prices for all items and categories (containing one or more item) are not available for all countries, these gaps are filled by means of the so-called "country-product-dummy" method. Category purchasing-power-parities (PPPs) for each country are then calculated on the basis of geometric averages of the individual price relatives within a category, with the U.S. as the numeraire country.

Aggregation of "category" quantity indices and PPPs is carried out in the following way. First, "notional" quantities are computed by dividing the jth country's expenditure on the ith category by that country's calculated PPP for that category. The resultant "quantity" is notional in the sense of being valued in U.S. prices.

Second, "international prices" are computed for each category. In this procedure, the international price for each category and individual countries' overall PPPs are calculated using a simultaneous equations technique developed by Geary and Khamis.\footnote{See Kravis, Heston and Summers (1982), Chapter 3, as well as the Phase I and II volumes, for a detailed description of these procedures.} The international price for the ith category is defined as:

\[ \text{international price} = \]
where \( \Pi_j \) is the jth country's overall PPP, \( \Pi_{ij} \) is its PPP for the ith category, and \( Q_{ij} \) is the jth country's "notional" real expenditure on the ith product.

The international price is meant to be, in effect, a weighted average price, where the weights are the relative expenditures by each country on the category. An "international dollar" has the same purchasing power over total U.S. GDP as a U.S. dollar. For the ith category, however, the purchasing power of an international dollar will not equal that of a U.S. dollar, because the former's purchasing power depends on the structure of average international prices, not on U.S. price relatives. Because international prices are meant to reflect prices throughout the world, and not just the prices of those countries which happen to be in the sample, \( Q_{ij}/\Sigma Q_{ij} \) in expression (14) is rescaled by the "supercountry" technique, which weights each jth country's notional real expenditure by the proportion that the "nominal" income of the "income class" which it represents bears to total world income.\(^{15}\)

Third, the value of the jth country's real expenditure on the ith category at international prices is calculated by multiplying its notional quantity \( (Q_{ij}) \) by the international price \( (\Pi_i) \). These values are then aggregated, across categories. GDP for the jth country in "international"

\(^{15}\) "Nominal" income is used here in sense it is used in the ICP studies--GDP in national currencies converted at official exchange-rates.
dollars is calculated by summing over all expenditure categories. This involves adding the net trade balance (in international prices) to total absorption, per expression (13). The expenditure totals reported in the ICP in effect sum to GDP, however, because the net trade balance is added to capital formation. In other words:

\[(13a) \quad Y = A' = C + I' + G = C + (I + B_t) + G\]

where \(A' = A + B_t\) and the ICP reports aggregate values for \(C\), \(I'\) and \(G\).

In revaluing the trade balance in international prices, the ICP first forms a notional quantity for the trade balance by dividing \(B_t\) (in national prices) by the official exchange-rate, where the latter is deemed to be the PPP for foreign trade. This notional quantity is then valued in international dollars, with the international price for this category being a (supercountry) weighted average of all countries' exchange-rate deviation indexes (defined later). One wonders whether the appropriate PPP for the net trade balance should really be the official exchange-rate \(e_0\). Indeed, expression (1) shows that \(e_0\) will in general be different from \(e_t\), and the difference can be considerable. For Hungary, for example, ICP data indicates that \(\lambda = e_t / e_0\) was only 0.84 in 1975. By using \(e_0\) as the trade balance PPP, the ICP may have understated the Hungarian trade deficit, in international prices, and therefore slightly overstated Hungarian GDP.

Finally, the \(j\)th country's PPP for any expenditure aggregate is found by dividing the ratio of total reported expenditures (in national currencies) for the \(j\)th and numeraire country by the ratio of the calculated values in international prices for the respective countries.

In discussing some of the main results of the ICP and possible methodological problems associated with it, we will focus on the relevance of
such findings or issues to the CPEs. The number of countries included in the ICP has increased from ten (Phase I) to sixteen (Phase II) to 34 in Phase III. Three CPEs have been included in the project: Hungary in all three phases, and Poland and Romania in Phase III. Price data for all three countries have been supplied by the respective price offices and in some cases were based on detailed surveys. In each case fundamentally the same methodologies have been applied to the CPEs as to the market economies. The "results" we discuss are all contained in the Phase III summary volume./16

Following the ICP, let us define "nominal" GDP per capita for the jth country converted into U.S. dollars (n), as \( Y/e_0 \), where \( Y \) is the national accounts definition of GDP per capita measured in the jth currency, and \( e_0 \) is the official exchange-rate. Then define "real" GDP per capita (r) for this country as \( \prod_{i=1}^{m} Q_{ij} \pi_i \), where \( Q_{ij} \) and \( \pi_i \) are defined as above and there are a total of m expenditure categories. Conceptually, this definition of real income per capita is equivalent to \( Y/e_p \) in a binary comparison (see expression (1), page 2). Consequently, the ratio of "nominal" to "real" income (n/r) is essentially equivalent to \( e_p/e_0 \) in expression (1).

The ICP defines \( r/n \) (or \( e_0/e_p \)) as the "exchange-rate deviation index", and finds a strong negative correlation in the ICP sample between this index and per capita real income. In other words, using the official exchange-rate to convert GDP per capita into dollars gives a greater degree of downward bias to the dollar estimate, the lower a country's "real" income level. The very poorest countries in the sample had in 1975 an unweighted exchange-rate deviation index equal to 2.64, whereas the average index for the

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/16 Kravis, Heston and Summers (1982).
highest income countries (other than the U.S.) was only 1.05. This negative correlation is not perfect, however, and indeed the relative standings of countries change in some cases when we move from a ranking based on \( r \) to one based on \( n \). The ICP Report therefore concludes that "nominal" GDP calculations do not even give reliable ordinal rankings.

For the three CPEs in the sample, the noncommerical exchange-rate was used as \( e_0 \). For the 1975 benchmark year, these rates were (per dollar) 20.66 forints for Hungary, 19.92 zloty for Poland, and 12.00 lei for Romania. The CPEs generally conform to the patterns described above, although Hungary's \( e_0/e_p \) of 1.68 was 20 percent higher than that for its income group, and indeed it has a higher index than Romania (=1.37), which was placed in a lower real income group. (Poland's \( e_0/e_p \) was 1.39.)

The ICP authors seem willing to ascribe the strong relationship between \( r/n \) and \( r \) to the productivity differential model briefly described in section II. Productivity is presumably higher in the higher per capita income countries, but if the productivity differential is less pronounced in nontradeables, particularly services, then nontradeable prices would be higher in the more developed countries, and this, recall from section II, leads \textit{ceteris paribus} to a higher \( e_p/e_0 \) ratio.

The Phase III volume of the ICP also contains detailed information on the relative prices of tradeables and nontradeables and their relative importance in total expenditure. Nontradeables (mostly services and construction) do indeed appear to be relatively low-priced in the lower-income countries, but there is not a monotonic relationship between these relative

\footnote{Ibid., p. 194.}
prices and per capita real income.\textsuperscript{18} Given the distorted price structures in CPEs, it is not clear why this pattern of relative prices should prevail for them, too, if the main cause is differential productivities across sectors and countries. It is perhaps noteworthy that in each of the three CPEs examined, average nontradeable prices are lower than the average for their respective income group.

We saw in section II that another basic determinant of the relationship between purchasing power parity and the exchange-rate is the relative share of expenditure going for each type of good (i.e., the $\beta_c$ and $\beta_c^*\). The ICP study shows that lower-income countries tend to devote a smaller share of income to nontradeables than do higher income countries, when expenditures are evaluated in national prices.\textsuperscript{19} As with the data on relative prices, the differences are particularly noticeable between the lowest (real per capita GDP averaging about 9 percent of the U.S.) and the middle three groups (23 to 52–percent of the U.S. GDP per capita), and again between the middle groups and the highest income countries.

Each of the CPEs spends a slightly smaller proportion of (officially estimated) total expenditure on nontradeables than the average for its respective income group. (Observe that this does not necessarily mean that the foreign trade sector is relatively large in CPEs. This is because tradeables include both actually traded goods and those that are potentially tradeable.) These differences become much more pronounced when construction

\textsuperscript{18} Ibid., pp. 195–96. No regressions of the relative price of nontradeables on per capita real income are discussed.

\textsuperscript{19} Ibid., p. 194.
is excluded and expenditure shares for "commodities" vs. "services" are compared. Indeed, the proportion of expenditure that all three countries spend on services (18-20 percent) is even below the average for the lowest income countries as a group. This indicates a lower expenditure share for services, at least in the official accounts, comes as no surprise to the student of centrally planned economies.

From above we know that services and non-tradeables more generally are relatively low-priced in these countries. When each country's real expenditures are revalued by "international" prices, however, the conventional wisdom that higher proportions of income are spent on services as income rises is disproven. The proportion of total expenditure going to tradeables (services) remains about the same across the entire income range. When so revalued, the expenditure shares for the three CPEs are not significantly different from the averages of their respective groups. Relatively low recorded CPE expenditures on non-tradeables, and particularly services, then, appear to be largely due to very low prices in these categories.

The Phase III summary study also contains computed price indices for each country's tradeable and non-tradeable goods relative to the U.S. In terms of our expression (1), the tradeable price ratio is $e_t/e_0 = \lambda$. Using expression (1) we can calculate the proportion of the exchange-rate deviation from purchasing power parity caused by (a) distortion of tradeable prices from

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/20 Ibid., p. 23 and p. 194.

21/ Ibid., p. 196.
those in the U.S. \((e_0 - e_t)/(e_0 - e_p)\), and (b) differences between the relative level of tradeable prices and relative overall price levels \((e_t - e_p)/(e_0 - e_p)\).

As indicated in Table 1, Hungary’s tradeable prices are below those of the United States at the official exchange-rate \((\lambda = 0.84)\). In fact, the distortion of tradeable prices alone accounts for 40 percent of the overstatement of Hungary’s overall PPP by the official exchange-rate. By contrast, tradeable prices in Poland and Romania are higher than those in the United States when converted at their official exchange-rates. The effect of the distortions in tradeable prices alone would therefore be to overstate the purchasing power of the zloty and the lei at the non-commercial exchange-rate. It is noteworthy that when the effect of tradeable price distortions is removed, the remaining deviation index, caused by differential internal price ratios and expenditure weights (i.e., \(e_t/e_p\), is very similar for these countries, ranging from 1.41 in Hungary to 1.55 in Romania.

Another major finding of the ICP is that capital goods tend to be relatively more expensive in the lowest income countries and less expensive in the highest income countries. This is balanced off by government, which tends to be relatively inexpensive (expensive) in the lowest (highest) income countries. The three CPEs in the study have relative prices for capital formation which are high relative to the average for their income group. This is somewhat surprising, given the conventional wisdom that capital goods have historically been underpriced in most CPEs. The result is perhaps not so surprising for Hungary, however, which by 1975 had permitted producer prices to rise substantially relative to those in consumption. In each country the PPPs for producer durables were particularly high, and in Romania the PPPs for
most producer durable categories were about twice as high as the official exchange-rate.

It is also of interest to compare the patterns of exchange-rate deviation indexes across major expenditure categories for these three ICP CPEs with indices derived from work by Schroeder and Edwards (1981) and Edwards et al. (1979) on binary U.S.-Soviet comparisons. It should be recalled, however, that because of different methodologies, the Soviet figures are not directly comparable. As Table 2 shows, the estimated Soviet exchange-rate deviation index for consumption is substantially below that for each of the other three countries. Capital formation, and government expenditures, at least in "administration", tend to be relatively inexpensive in the USSR, even compared to the other three CPEs. The geometric mean of the estimated Soviet GNP exchange-rate deviation index would be about 1.54, or about midway between the index for Hungary and those for Poland and Romania. Given that on a "nominal" per capita income basis the USSR is usually accorded a GDP ranking at roughly the same level as Hungary and Poland, this finding (although admittedly not directly comparable) conforms essentially to the general negative relationship found by the ICP between the exchange-rate deviation index and per capita incomes. Yet, given the different basis on which the official exchange-rate used in these calculations is set in each case, it is not clear that even this rough similarity of \( e_0/e_p \) ratios among these four countries is really meaningful.

/22 ICP estimates are derived from Ibid., p. 21.

/23 Binary comparisons for the GDR and the FRG appear in Wilkens (1981) and Otto-Arnold and Vortmann (1982). Also, various binary comparisons involving CPEs (e.g., Hungary-Austria) are contained in Kravis, Heston and Summers (1982).
How valid is the claim of the ICP to be measuring "real" as opposed to some "nominal" value of GDP? The authors of the ICP studies acknowledge that all methodological and data problems have not been resolved. Most of the outstanding issues appear to apply to more than just the CPEs. We shall very briefly note several possible problems, however, that could distort the CPE (as well as some other countries') estimates.

First, as is well known, there are some important issues regarding imputing the unit values for various services in such areas as education and health care. An entire chapter of the Phase III study is devoted to such problems and an adequate discussion of these issues would fall outside the scope of this paper.

Second, it is generally recognized that domestic prices in CPEs are distorted, in general, from foreign currency prices for tradeables and from underlying real costs of domestic production for both tradeables and non-tradeables. Even if these were market-clearing prices, they would still have the effect of distorting expenditure flows. This suggests that calculations of the distribution of expenditure in CPEs by commodity category should be interpreted cautiously. Whether the net result of generally distorted prices is to distort expenditure flows in these countries at more aggregate levels (consumption, government, capital formation) to a greater degree than in market economies, however, is an open question.

Third, many prices in CPEs must be considered disequilibrium prices, in the sense that excess demand prevails at given (fixed) prices. Repricing on the basis of estimated equilibrium prices would have the effect of raising individual PPPs but understating real expenditures, because official statistics presumably are based on the disequilibrium prices and actual
quantities sold through the socialized sector. (To some extent, however, the ICP has attempted to supplement price data from this sector with prices from private markets). The ICP appears to take the position that since actual purchasers' values (market prices) are in general the ones used to calculate expenditures, they are the most appropriate prices with which to estimate quantities.

If CPEs are characterized by relatively large proportions of "unreported" transactions, the ICP may be understating relative CPE GDPs. This understatement would be less significant, however, the greater the purchasing power parities for these activities relative to $e_p$ as calculated by the ICP. Specifically, inclusion of all unreported final expenditure at actual prices paid would increase a CPE's relative "real" income per capita $(r)$ only if:

\[
(15) \quad \frac{1 + x}{1 + x^*} > \frac{e'_p}{e_p}
\]

where $e'_p$ is the country's overall PPP after taking into account prices in the "unreported" sector, and $x$ and $x^*$ are the percentage increments to GDP (in national currency) arising from inclusion of this sector, for the CPE and the numeraire country respectively. For example, the effect of taking into account unreported sectors adding 20 and 10 percent to CPE and numeraire country GDP respectively would be totally neutralized in a GDP comparison in dollars if PPPs in the CPE's unreported sector were so high as to increase its overall PPP by 9 percent.

Finally, category PPPs for producers goods may be understated for developing countries and CPEs as well, if price investigators in those countries have little choice but to select simpler, more homogeneous products for price comparisons. In other words, the ICP may be unavoidably overstating the relative quality level of numerous machinery and other items in the lower and medium-income countries. That serious attention should be given to quality specifications in CPEs is suggested by Treml's (1981b) finding for the USSR that export-price supplements are necessary to compensate firms for the higher costs associated with meeting world market quality standards for machinery. Treml suggests that current Western estimates of ruble/dollar ratios for machinery should be adjusted upward by 40 percent to take this quality differential into account.

V. SHORTCUT APPROACHES

The ICP approach summarized in section IV is clearly the most comprehensive and possibly the methodologically most satisfactory way to obtain comparable dollar estimates of CPE national products. The approach is not without problems and as indicated some of its results may be biased, but most of these problems and biases are shared by alternative approaches.

Among other findings, the ICP demonstrates fairly persuasively that conversions at official exchange-rates cannot be relied on, in general, to give accurate dollar estimates of GDP, at least for medium and lower income countries. As we saw in section II, the official exchange-rate will equal a country's purchasing power parity only under very restrictive circumstances. For CPEs, which in many cases have quite arbitrary official exchange-rates
(e₀) and significant price distortions, there is little presumption that e₀ should closely reflect underlying purchasing power parity.

If full ICP-type studies are not feasible for additional CPEs, what alternative approaches exist for generating dollar estimates of their national products? Marer, in his workshop paper, discusses two basic types of approach. One is a two-step procedure that begins with the estimation of GDPs in national currencies on the basis of either an adjusted factor cost or "scaling up" technique. The second step would involve using benchmark ICP-type studies to estimate a general relationship between real and nominal incomes which could be used to convert the exchange-rate-converted national GDP estimates into "real" GDP approximations. In effect, the national-currency GDP estimates would be converted into dollars at estimated eᵰ rather than at e₀.

A second approach is what Marer calls "one step", in which no explicit conversion is made from national currencies to dollars. Several techniques are possible, including (a) "reduced information ICP", (b) the UN's "physical indicator global" (PIG) approach and (c) using ICP benchmark estimates for "real" per capita income to adjust for the possible bias in the PIG approach introduced by the use of official exchange-rates.

Ahmad (1980), in an earlier study for the World Bank, extensively discussed and evaluated a number of these so-called "shortcut" or "reduced information" approaches. Our discussion, therefore, will be cursory, and will be aimed at evaluating the usefulness of applying these procedures to the centrally planned economies.

As noted in section IV, the ICP does not find that (e₀/eᵰ) monotonically decreases with real per capita income, although the general
relationship is certainly clear. In attempting to explain why countries at the same income levels might have different exchange-rate deviation indexes, Kravis, Heston and Summers (1978b, 1982) hypothesize that in addition to rising (at an increasing rate) as relative per capita "real" income \( r \) increases, per capita "nominal" income \( n \) would be positively related to a country's "degree of openness". Their reasoning is that the more "open" a lower-income country (measured by the ratio of total foreign trade turnover to GDP), the higher will be the country's price level because these countries tend to trade with higher-income countries which have, as we have seen, higher price levels for both tradeables and nontradeables./26

An alternative way of interpreting this effect would be in terms of expression (1) on page 3. If openness is instead measured more generally by the proportion of total expenditure going to tradeables, then an increase in openness, ceteris paribus, would increase \( e_p/e_0 \) (in other words, increase "nominal" relative to "real" income) for lower income countries because the weight would be increasing for their relatively high-priced goods, tradeables. (From expression (1), the partial derivative of \( e_p/e_0 \) with respect to \( \beta_c \) equals \( \left[ \beta_c^* + q^*(1-\beta_c^*) \right]^{-1} \lambda(1-q) \), which is positive if \( q \), the ratio of the price level for nontradeables relative to the price level for tradeables, is less than 1.00, which it is likely to be in lower-income countries.)

Other variables are considered, too, but on the basis of alternative estimations Kravis et al (1982) prefer an equation of the form of (16) for extrapolation purposes, where \( r \) now becomes the dependent variable because in

/26 Kravis, Heston and Summers (1982), Chapter 8.
extrapolating to non-benchmark years or countries only \( n \), or "nominal" income, is observed:

\[
\ln r = a + b (\ln n) + c (\ln n)^2 + d (\ln OP)(\ln n)
\]

Here \( a \) is a constant, \( OP \) is the measure of openness, and the coefficients \( b, c \) and \( d \) can be thought of as constant elasticities. The authors find that \( b \), the elasticity of \( r \) with respect to \( n \), falls in the 0.35-0.45 range, and \( c \) is negative, suggesting that \( r/n (=e_o/e_p) \) falls as income levels rise. In predicting 1975 real incomes for the 15 countries added to the ICP in Phase III, the degree of fit for equations similar to (16) is quite good, with \( R^2 \) in the .98 to .99 range. The mean ratio of "predicted" to 1975 benchmark \( r \) for the best version of (16) was 1.05, with a mean deviation of only 0.12. Maximum deviations, however, ranged from -.19 to .40.

Real GDP for non-benchmark countries could be estimated, in two steps, by fitting (16) or similar equations to official exchange-rate converted (or "nominal") GDP estimates derived by the adjusted factor cost or "scaling up" methods.

The "reduced information ICP" method consists essentially of gathering price data on either a reduced number of items within categories, or collecting information for a reduced number of categories. If a certain few items (categories) consistently have PPPs which are representative of category (overall) PPPs, such an approach might significantly reduce the data collection cost associated with ICP-type studies. Ahmad (1980) reviews the statistical work which has been carried out in this regard, and tentatively concludes that deleting items within categories gives better results than deletion of categories. Whether a reduced information ICP study would be any more feasible than a full information approach in CPEs is an open question.
Also, one wonders whether the apparent success with which the reduced information approach was experimented with for the Phase II countries as a whole would carry over to individual CPEs.

The PIG approach, developed by the United Nations (1970, 1980), is another "one-step" method. The approach consists of cross-section regressions of individual OECD countries' nominal per capita GDPs on separate physical indicators, such as per capita steel production, meat consumption and hospital beds, for a given year. Each physical indicator is visualized as a measure of economic development or well-being. For each physical indicator an average bivariate relationship is estimated between it and GDP. A fitted value of each country's GDP is then calculated on the basis of the estimated cross-section relationship, for each physical indicator. The country's final, or PIG estimate of GDP is then calculated as the average of the fitted values for the 20 or so physical indicators.

"Fitted" values for CPE incomes are also calculated according to the average relationships established for the sample market economies. The structural relationships present in the West are thus imposed on the CPEs. In this way, however, PIG estimates of GDP for CPEs are generated without the necessity of any type of "scaling-up" exercise, or of even having to assume that the relationship between NMP and GDP in the CPEs must be identical to that calculated for Western Europe./27

The United Nations ECE Secretariat (1980) reports having tried both "nominal" and "real" (from the ICP Phase II) GDPs as dependent variables in

/27 This type of assumption is made, for example, in the development of the World Bank's published estimates of GNP per capita for the CPEs. See IBRD (1982).
the cross-sectional PIG regressions. Apparently the goodness of fit was no better using r rather than n. The authors appear to conclude that no significant bias is introduced, at least in terms of rankings, by continuing to use nominal GDP as a basis for the PIG estimates. Ehrlich and Partos (1979) have apparently recently found a statistically significant relationship between the ICP's r and the UN's PIG income estimates. (See Marer's paper for details.) Possibly this correlation could be used to estimate ICP-type "real" income for non-benchmark CPEs, using PIG estimates for these countries.

The ICP Phase III volume has indeed used both benchmark ICP results and PIG estimates to generate estimates for 1975 GDP for non-benchmark CPEs. PIG estimates from 1973 (UN(1980)) were extrapolated to 1975 using, apparently, growth indexes developed by Alton et al. These extrapolations were compared with 1975 ICP estimates for Hungary, Poland, Romania (and Yugoslavia), and averaged 101 percent of the ICP "real" incomes for that year. The other European CPEs' PIG estimates for 1973 were then similarly extrapolated to 1975 and divided by 1.01.

Ahmad (1980) experimented with various methods of predicting real income over time, including regressions including both physical indicators (letters) and ICP variables such as nominal income and "openness". If we take the final ICP Phase III real income estimates (which were unavailable to Ahmad at the time of his study) and rank each of the methods according to how close their 1975 predictions come to these estimates, for each of thirteen


/29 The deviation was -7 percent for Hungary and 14 percent for Romania; ibid, p. 344.
countries, the method with the least "bias" is found to be the combined "nominal-physical indicators" approach, closely followed by the reduced information method./30

In sum, each of the methods reviewed above would seem to hold some promise for generating improved estimates for national products of non-ICP countries in dollar equivalents. But while the "average" results of these methods are impressive, one still wonders whether one or more CPEs may be "atypical". Why should the arbitrary official exchange-rate of the Soviet Union, or the non-commercial rates of the three ICP CPEs, for instance, be related to PPP in essentially the same way as are the official exchange-rates in MEs, rates which many cases reflect to some degree prevailing conditions in the foreign exchange markets? If they are not similarly related, then using equation (16) to estimate "real" GDP for other CPEs could result in serious distortions.

Further reason for caution is suggested by our calculations in Table 1, which showed a strikingly similar pattern of weighted internal relative prices for each of the three ICP CPEs, but a marked difference between Hungary and the other two with respect to the distortion of tradeable prices from world market prices. This causes Hungary's exchange-rate deviation index to be atypically high given its medium level of "real" per capita income (49.6 percent of the U.S.) and its relatively high degree of openness. Extrapolation of ICP benchmark results to Hungary (pretending for a moment that it

/30 A more sophisticated approach would calculate a specific statistic, such as the mean deviation. Interestingly, the reduced information method scored high, although Ahmad (1980) notes that the Phase III price data used in the reduced information estimates were only preliminary.
was not a benchmark country), would probably tend to understate that country's GDP as well.

This suggests that as presently constituted, the "preferred" ICP extrapolation equations do not satisfactorily explain differences in the degree of distortion of tradeable good prices per se. One would like to find some variable which satisfactorily explains variations in $e_C/e_0$ across countries. Earlier work by the ICP group using a "price-insulation" variable in an equation similar to (11) was probably pointing in the right direction, but because of data problems this variable was neglected in the Phase III summary volume.

VI. SUMMARY AND CONCLUSIONS

Such a lengthy paper should be brought to a quick end, so our concluding comments will be brief. In section II we examined in some detail the main sources of bias arising when official exchange-rates are used as a proxy for purchasing power parity (PPP) for purposes of converting national products into a common currency. In addition to the usual stress on differences in the relative price of nontradeables across countries, as well as differences in expenditure weights (the so-called index number problem), section II also highlighted the main sources of distortion in tradeable prices per se. Special attention was devoted to the sources of tradeable price

\[/31\] Kravis, Heston and Summers (1978b).

distortion in centrally planned economies (CPEs), including official exchange-rates which may be set more arbitrarily than in most economies.

Distortions of CPE domestic prices for tradeables from their foreign currency prices also significantly complicate the accounting for foreign trade in CPE national accounts. Section III illustrated several ways in which estimates of CPE GDP in national currencies could be biased by either differences in foreign trade accounting practices or a lack of data on the trade balance evaluated in domestic prices and the degree of price distortions in foreign trade.

The International Comparison Project (ICP) and its methodology for directly estimating purchasing power parities and comparable GDP estimates, was briefly reviewed in section IV. Special attention was placed on the results of the ICP Phase III which bear on the generation of income estimates for CPEs. Several aspects of the ICP methodology were critiqued as well, with some doubts being raised with respect to ICP accounting for CPE trade balances and as to whether quality differentials for manufactures are adequately taken into account.

As for most lower- or medium-income countries, the three CPEs in the ICP study, Hungary, Poland and Romania, were found to have "real" per capita incomes above those indicated by converting national currency GDP estimates into dollars using the official exchange-rate (so-called "nominal" incomes). This is caused largely by their having, along with other countries at similar income levels, relative prices for nontradeables that are so low, that notwithstanding their lower expenditure weights, they yield on balance relative price levels which are below those suggested by their official (noncommercial) exchange-rates. Somewhat surprisingly, these three CPEs are found to have
relatively high prices for capital goods, even compared to other countries at similar levels of income.

Of the CPEs examined in the ICP, Hungary has a particularly high exchange rate deviation index, given its income level. In section IV we showed that this was due to Hungarian tradeables being significantly underpriced domestically at the official exchange-rate, relative to foreign currency prices. This finding suggests that for some countries exclusive focus on the weighted ratio of internal prices (nontradeables to tradeables) may detract from full understanding of the determinants of their purchasing power parities.

Because it may not be possible to use the full ICP approach in estimating national products for other countries, various "shortcut" methods and the "reduced information" ICP approach were briefly reviewed in section V. A generally appealing approach might be to use econometrically established relationships for the ICP benchmark countries, between "real" (i.e., ICP-estimated) and "nominal" incomes, to estimate real incomes for non-benchmark countries. Our finding (see Table 1) regarding the sources of the difference between PPP and the official exchange-rate for Hungary, however, suggests that "real" incomes for non-benchmark CPEs might not be reliably "fitted" by ICP equations that include only combinations of "nominal" income levels and "openness" measures as explanatory variables. Because of significant distortions for many CPEs in the tradeable sector alone, there is little reason to believe that econometric equations based largely on market economies will necessarily yield dollar GDP estimates for CPEs which are generally acceptable.
Table 1: ESTIMATED SOURCES OF BIAS IN CONVERTING GDP IN NATIONAL CURRENCIES AT OFFICIAL EXCHANGE RATES, 1975 (U.S. AS NUMERAIRE COUNTRY)

<table>
<thead>
<tr>
<th>Country</th>
<th>Exchange-Rate Deviation Indexes ($e_o/e_p$)</th>
<th>Net Trade Distortion Factor ($\lambda = e_t/e_0$)</th>
<th>Combined Effect of Different Ratios and Expenditure Weights</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Percentage of Distortion ($e_o-e_p$)</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Attributable to:</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Country Exchange-Rate Net Trade Combined Effect</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Deviation Distortion Internal Price Tradeable Prices</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Hungary</td>
<td>1.68</td>
<td>.84</td>
<td>1.41 40% 60%</td>
</tr>
<tr>
<td>Poland</td>
<td>1.39</td>
<td>1.03</td>
<td>1.43 -10 110</td>
</tr>
<tr>
<td>Romania</td>
<td>1.37</td>
<td>1.13</td>
<td>1.55 -49 149</td>
</tr>
</tbody>
</table>

Sources: Data from Kravis, Heston, Summers (1982), Chapters 1 and 6; calculations based on expression (1), page 3 of text.
Table 2: ESTIMATED "EXCHANGE-RATE DEVIATION INDEXES" FOR HUNGARY, POLAND AND ROMANIA (1975) AND THE SOVIET UNION (1976)

<table>
<thead>
<tr>
<th>Country</th>
<th>Consumption</th>
<th>Capital Formation</th>
<th>Government</th>
<th>GDP</th>
</tr>
</thead>
<tbody>
<tr>
<td>Hungary</td>
<td>1.86</td>
<td>1.18</td>
<td>1.93</td>
<td>1.68</td>
</tr>
<tr>
<td>Poland</td>
<td>1.51</td>
<td>1.02</td>
<td>1.76</td>
<td>1.39</td>
</tr>
<tr>
<td>Romania</td>
<td>1.58</td>
<td>0.93</td>
<td>1.79</td>
<td>1.37</td>
</tr>
<tr>
<td>Soviet Union</td>
<td>1.29(a)</td>
<td>1.59-2.07</td>
<td>4.63-4.99(b)</td>
<td>1.26-1.87</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>1.44-1.59(c)</td>
<td></td>
</tr>
</tbody>
</table>

(a) Based on geometric mean estimate for $e_p$.
(b) "Administration"
(c) "Defense and space"

Sources: Hungary, Poland and Romania calculated from Kravis, Heston and Summers (1982); Soviet Union calculations are based on Schroeder and Edwards (1981) for consumption and Edwards et al. (1979) for other categories and GNP. A ruble-dollar exchange-rate of .754 was assumed for 1976 (Vanous (1981)). Soviet estimates for the last three columns are the range indicated by using Soviet and U.S.-weighted $e_p$. 
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