

10-15442444

**USING RGDP AND EDI:
A REALISTIC COMPARISON OF THE PAST YUGOSLAVIAN
ECONOMIC PERFORMANCE WITH OTHER COUNTRIES**

*Jovan V. JOVANOVIĆ**

ABSTRACT

The methodology developed by the International Comparisons Project (ICP) is extended and applied to Yugoslavia. A formula allowing computation of the Exchange-rate Deviation Index (EDI) for non-benchmark years is derived. The EDI for Yugoslavia is computed, extrapolating from the 1975 benchmark year backwards to 1955 and forward to the middle of 1990. Comparison with other determinations of the EDI for 1955-1985 period is made. Results show that during most of the past 35 years, the purchasing power of the Yugoslav dinar inside the country has been much greater than it appeared to be when the dinar was exchanged into US\$ using the official bank exchange rates.

A realistic comparison of Yugoslavian past economic performances with other countries is made. The results show that the Real Gross Domestic Product (RGDP) of Yugoslavia and the efficiency of energy use have been always considerably higher than they appeared to be when calculated in US\$ using the World Bank Atlas method.

An overall conclusion is reached that the ICP method of estimating real GDP of various countries is superior to the World Bank Atlas method, and that the Atlas method should be replaced with the ICP method. Furthermore, the procedure developed here could be used to determine the RGDPs for those recent time periods for which the full ICP results have not yet been made available.

A. INTERNATIONAL COMPARISONS PROJECT (ICP)

As long ago as 1775, Samuel Johnson pointed out (KRAV 82) that it is incorrect to compare costs of goods and services in two coun-

* Physics Department, University of Manitoba, Winnipeg, Canada.

tries, each one having its own currency, by converting from one currency unit into the other in the conventional manner. The reason is that the purchasing power of local money may be quite different in these two countries.

Recognizing the need for realistic comparisons of gross domestic product (GDP) and purchasing power of currencies in today's highly interdependent world, the so-called International Comparisons Project (ICP) was organized at the end of the 1960s under the joint responsibility of the United Nations Statistical Office, the World Bank and the International Comparisons Unit at the University of Pennsylvania. Its goal was to establish the real values (Purchasing Power Parities — PPP) of various national currencies and the "international prices" for various products, whether they were tradable or non-tradable. In this way a "real" gross domestic product (RGDP) for all countries under study could be estimated and their economic outputs realistically compared.

In the first phase of this project (KRAV 75) ten countries were compared, and in the second phase, sixteen (KRAV 78). In the third phase a detailed analysis of purchasing power parities in 34 countries was performed (KRAV 82) for 1975. In this third phase, Yugoslavia was included together with four of its neighbours, Italy, Austria, Hungary and Romania. Using 1975 as a benchmark year and certain approximate procedures, Summers and Heston (SUMM 84) have extended this study to 124 countries giving time series for the RGDP per capita and several other economic parameters for the 1950—1980 period.

In the fourth phase of the ICP (KRAV 87, SUMM 88) various approximate procedures have been improved, the benchmark studies were extended to 60 countries and the time series for the 1950—1985 period were presented for 130 countries.

A.1 *I\$ and RGDP*

In the ICP, the Real Gross Domestic Product (RGDP) of all countries is expressed in terms of a theoretical currency called International Dollar (I\$) which was chosen to be equal or very close to the United States Dollar (US\$). The international dollar is defined and explained in (KRAV 82, Ch. 1).

The concept of the I\$ can perhaps be best understood by a simple example. When expressed in I\$, one kilogram of sugar costs the same in all countries of the world. By attaching the same price in I\$ to 151 groups of goods and services, and by multiplying each of these prices with the amount of these goods consumed and services performed in the whole country, the RGDP in I\$ is calculated. Appropriate corrections for export, etc. are also applied.

The I\$ is not an absolute and unchangeable currency. Whenever a benchmark (reference) year is changed, the value of I\$ will also change. The reason is that the I\$ is related to the US\$, thus subject to inflationary changes. Also, over time the world prices for many

products change relative to each other. The international price for crude oil is an obvious example. Thus, I\$ can refer to the current prices, or to the constant prices as they were in a particular benchmark year.

A.2 US\$ and GDP

Every modern country has a national statistical office and computers every year (month) its Gross Domestic Product (GDP), Gross National Product (GNP), or Gross Material (Social) Product (GMP) in Centrally Planned Economies, in the own national currency corrected (or not corrected) for domestic inflation. In order to compare GDP for any two countries, a practical and hopefully "realistic", correspondence between their national currencies must be first established. The international financial market establishes a practical relationship between any two national currencies that are "convertible" and whose trading is not restricted by various rules and regulations of national governments. In those countries that do not have convertible and freely floating national currencies, their governments establish bank exchange rates by a decree.

For all practical purposes, using the existing Bank Exchange Rates (BER), whether they are determined freely on international financial markets or by a government decree, any national currency can be converted into the US dollars. As a result, using these BERs, the economic outputs of all countries in the world can be expressed in the US\$. After this conversion is done, the outputs can be compared with each other. This procedure is used by many financial institutions around the world. For simplicity we shall call it the "BER method".

It is, of course, well known that BERs are not very stable and can change overnight by substantial amounts. In order to smooth out these fluctuations, in many statistical analyses, the BERs are averaged over certain time period. In (KRAV 82) the averaging was done over one year. On the other hand, the World Bank (WORL VY, WTAB VY) averages BERs over a three year period. This special procedure (see for instance WORL 87, p. 268) is called the "World Bank Atlas (WBA) method" and it appears as a special case of the more general "BER method". As it will be seen later, in this paper we shall use the "BER method" with averaging done over three years (as in WBA method), over one year (as in KRAV 82), and over one month only (as in Sec. B.2).

A.3 Using GDP or RGDP?

Converting national currencies into US\$ using the BER method or WBA method is obviously very easy and for purposes of international financial transactions very practical. For instance, if a country has a certain debt expressed in US dollars, and has to pay it back by

exporting, say, sugar, then the only price that matters is the price of sugar in US\$ on the international market, and not its price (that could be either subsidised or taxed) on the domestic market expressed in national currency. If this example of sugar is extended to hundreds of other goods and services that a country is exporting, then, for purposes of international trade and finance, it does make sense to express a nation's gross domestic product in US\$ using well defined and easily available bank exchange rates.

On the other hand, when one wishes to compare how well people live in two countries (to compare standard of living), to compare their economic growth or the "efficiency" of energy use, then expressing GDP in US\$ by using BER or WBA method may give grossly incorrect results if, for whatever reason, the national currency is unstable, under-valued or over-valued on the international financial market, and does not correctly reflect its actual purchasing power in its own country. For instance, when talking about the standard of living, it does not matter much what is the price of sugar expressed either in national currency or in US\$, but how much sugar (and other goods and services) is (are) consumed in that country. The total amount of sugar consumed can be represented either in kilograms, or in I\$, as both kilograms and I\$ are directly proportional to each other and defined in the same way in all countries around the world.

The extension of this particular example to hundreds of other goods and services is obvious. (The question of quality of various products complicates enormously this kind of comparison. Sugar is a particularly simple example as it has the same quality the world over. The problem of quality was discussed at great length in (KRAV 82) and resolved in a reasonably satisfactory manner.) Thus, when comparing standard of living in two different countries, the RGDP expressed in I\$ not GDP in US\$, should be taken into the account.

The consumption of industrial energy (mainly coal, oil, gas, hydro and nuclear) is always expressed in physical units, like consumption of sugar. For many purposes, it is important to compare the "efficiency" of energy use in various countries. This is usually done by computing the ratio of the economic output produced to the energy consumed. What measure of the economic output should be used in this case, GDP in US\$, or RGDP in I\$?

It is rather obvious that the RGDP in I\$ should be used for this purpose. For instance, if sugar on the domestic market, when expressed in the US\$, is five times cheaper than on the international market (for instance, because the export is restricted or domestic price is subsidized) then the efficiency of energy use in making that sugar will be apparently five times lower when using its national price converted into the US\$, then when using its price in I\$. As the price in I\$ is directly proportional to the physical amount of sugar expressed in kilograms, it is obvious that the "real" efficiency of energy use can be obtained only when gross national product is expressed in I\$.

Another example of inappropriate use of GDP in US\$ is when correlations between standard of living and various vital coefficients (longevity, fertility, infant mortality, etc.) in various countries are

made and compared (e. g. WORL 84, Figure 4.4 and 4.5). Clearly, when a central bank of a country decides to devalue overnight its currency for, say 30%, or if this happens on the international financial market over a period of six months, the real impact on fertility and life expectancy will be nil, although the correlation with GDP will be affected for 30%. Of course, the correlation with the RGDP expressed in I\$ would not be affected.

In this paper, using Yugoslavia as an example, evidence is presented that greatly strengthens the above qualitative argument that RGDP and I\$, not GDP and US\$, should be used for international comparisons.

A.4 Exchange-rate-deviation index (EDI)

Kravis et al. (KRAV 82, pages 9 to 14) have defined the Exchange-rate-Deviation Index (EDI) as a ratio of one country's economic output expressed in I\$ and to that expressed in US\$ calculated by converting a country's GDP expressed in national currency into US\$ using the annual average market exchange rates (for details, see KRAV 82, Table 1—1). This index is a good measure of how much real GDPs of certain countries are understated (or overstated) relative to the United States.

The EDI for 34 countries studies for benchmark year 1975 have been calculated in (KRAV 82). Their results, reproduced in Figure 1 (see also Sec. B. 1), show that in general the more undeveloped is a country the greater EDI is. In contrast, for industrial countries of Western Europe and Pacific, the EDI was always to within 20% equal to one.

A.5 Calculating EDI for non-benchmark years

In the studies by Kravis et al. (KRAV 82) and Summers and Heston (SUMM 84, SUMM 88), first the RGDP for a number of countries for a particular benchmark year were calculated. Then using certain approximate procedures and inflation corrected GDP in national currencies, they produced time dependent series of the RGDPs. In Phase III of their work (SUMM 84), 1980 is the last year of their series, and in Phase IV, it is 1985. For all these past years, it is relatively easy to produce time series for EDI by dividing GDP in US\$ calculated routinely by various financial institutions, with RGDP (in fact with CGDP — real gross domestic product in *current* international prices (SUMM 88)) as computed by ICP. The disadvantage of such a procedure is that, due to a great complexity of the ICP methodology, the RGDPs (or CGDPs) and the EDIs are available only with a great delay.

For various reasons it is useful to know how the EDI changes in real time, sometimes on a month to month basis. In this section we develop a formula that can be used to compute EDI as a function

of time for non-benchmark years, or current time for which the ICP results have not yet been made available.

The EDI for a benchmark year was defined (KRAV 82, pages 9 to 14) as a ratio of the Real Gross Domestic Product (RGDP) in International Dollars (I\$) to the Gross Domestic Product in US Dollars, $GDP_{US\$}$. The last quantity was computed by dividing in the year under consideration the national Gross Domestic Product in national currency, GDP_{nc} , with the average Bank Exchange Rate (BER) for that year expressed as a number of national currency units needed to exchange them into one US\$. (Note that this definition is valid in any particular year, implying that the GDP_{nc} is expressed in current national currency units, thus, it is not corrected for inflation.) With these definitions for a benchmark year, t_o , we can write

$$EDI(t_o) = RGDP(t_o)/GDP_{US\$}(t_o) \quad (1a)$$

$$= RGDP(t_o)/\{GDP_{nc}(t_o)/BER(t_o)\}. \quad (1b)$$

In order to calculate the EDI for a non-benchmark year (or month), t , we should use the same expression except that the RGDP must be replaced with CGDP, the Real Gross Domestic Product in *current* I\$. (For a benchmark year, t_o , RGDP and CGDP are by definition equal to each other). Thus

$$EDI(t) = CGDP(t)/GDP_{US\$}(t) \quad (2a)$$

$$= CGDP(t) / \{GDP_{nc}(t) / BER(t)\}. \quad (2b)$$

The reason why RGDP has to be replaced with CGDP is because GDP_{nc} is normally computed in current local currency, and current BER is used to convert GDP_{nc} into $GDP_{US\$}$. Thus, $GDP_{US\$}$ is also expressed in current US\$. The EDI(t), as defined in eq. (2b), takes automatically into account the inflation in I\$ and possible rearrangement of international prices that may be very important in case of some countries. (For instance, CGDP for Kuwait depends very strongly on the international prices for crude oil, while RGDP does not).

In (SUMM 88) the time series for CGDP for 130 countries were given for the period 1950—1985. Therefore, by taking $GDP_{US\$}$ (say from WTAB 90), or GDP_{nc} and BER from national statistical data, the time series for the EDI could be easily produced.

Unfortunately, CGDPs are calculated with a delay of several years. Often, it is desirable to know how the EDI (and thus CGDP), changes on a month to month basis. As CGDPs are not known, we have to use some approximations in calculating CGDP for those years that are not given by the ICP.

The ratio of CGDP and RGDP for any non-benchmark year is equal to the inflation of I\$ relative to the benchmark year. As the I\$ are in the first approximation equal to the US\$, it seems reasonable to assume that the inflation of I\$ is equal to that of US\$. With this approximation, we can write

$$CGDP(t) = RGDP(t) \frac{I_{I\$}(t)}{I_{I\$}(t_0)} = RGDP(t) \frac{I_{US\$}(t)}{I_{US\$}(t_0)}, \quad (3)$$

where $I_{I\$}$ and $I_{US\$}$ are the inflation indices, like the consumer price index (CPI) or the GDP deflator for the I\$ or US\$.

If RGDP is known for a benchmark year, t_0 , using national data for the GDP expressed in current national currency, GDP_{nc} , and the national inflation index, I_{nc} , the RGDP(t) for any non-benchmark year is equal to

$$RGDP(t) = RGDP(t_0) \times \frac{GDP_{nc}(t) / I_{nc}(t)}{GDP_{nc}(t_0) / I_{nc}(t_0)}. \quad (4a)$$

By substituting for RGDP (t_0) from eq. (1b) we have

$$RGDP(t) = EDI(t_0) \times \frac{GDP_{nc}(t) / I_{nc}(t)}{BER(t_0) / I_{nc}(t_0)}, \quad (4b)$$

and by substituting eqs. (3) and (4b) into (2b) we get

$$\begin{aligned} EDI(t) &= \frac{RGDP(t) [I_{US\$}(t) / I_{US\$}(t_0)]}{GDP_{nc}(t) / BER(t)} \\ &= EDI(t_0) \times \frac{GDP_{nc}(t) / I_{nc}(t)}{BER(t_0) / I_{nc}(t_0)} \times \frac{I_{US\$}(t) / I_{US\$}(t_0)}{GDP_{nc}(t) / BER(t)} \\ &= EDI(t_0) \times \frac{BER(t)}{BER(t_0)} \times \frac{I_{US\$}(t)}{I_{US\$}(t_0)} \times \frac{I_{nc}(t_0)}{I_{nc}(t)} \end{aligned} \quad (5)$$

This expression depends only on the inflation indices and the bank exchange rates, quantities that are normally available on a month to month basis, and do not depend at all on any estimates of economic output. It should be noted that this expression for EDI is very similar to an expression in (KRAV 82, eq. 8.1), where the purchasing power parities are related to the inflation indexes.

It is important to realize that the derivation of formula (5) from the EDI definition in formulas (1a) or (2a) is mathematically exact, except for the approximation that the inflation of I\$ is equal to that of US\$. The goodness of this approximation is discussed in Section B.2.

B. SOME ICP RESULTS

The latest set of results from (SUMM 88) gives Real Gross Domestic Product in both constant (RGDP) and current (CGDP) international dollars for 130 countries. Whenever the statistical data were available the results were presented for a 36-year period ending with 1985. It has been estimated by the authors that the accuracy of the ICP comparisons for industrialized market economies was of the order of a few percent. For developing market economies and for centrally planned economies the uncertainties were estimated to be much larger.

This extensive set of data enables many comparisons of realistic economic outputs to be made with various other statistical indicators in a manner that is independent of generally volatile and often unrealistic bank exchange rates. In this section results of some calculations as related to Yugoslavia are presented. The results obtained clearly demonstrate the superiority of the ICP method over the WBA method when determining and comparing economic outputs of different countries.

B.1 1985 Exchange-rate deviation index (EDI) for several countries

Kravis et al. (KRAV 82, Table 1—2 and Figure 1—1) have determined EDI for 34 countries. Their results for the RGDP per capita in the 1975 I\$, relative to the US, and the EDIs, are reproduced in columns 2, 3 and 4 of Table 1 respectively. In column 5, the gross domestic product (GDP) per capita for 1985, expressed in the 1985 US dollars, is given. These data were taken from (WORL 87, Table 1, p. 202) and were obtained using the World Bank Atlas (WBA) method. In column 6, the RGDPs per capita for 1985 in current (i. e. 1985) international prices (CGDP) are listed as taken from column 9 of country tables in (SUMM 88). In the next column, the same data relative to the US are presented. In column 8 the EDI for 1985 are computed as the ratio of CGDPs in column 7 and GDPs in column 6. The countries have been arranged in order of their decreasing relative CGDP per capita for 1985. The position of Yugoslavia is highlighted. The 1985 GDP data for Iran, Luxembourg and Romania were not given in (WORL 87).

In Figure 1 the EDIs for 1975 and 1985 from Table 1 have been plotted against the relative (to the US) CGDP per capita. The points for Yugoslavia are highlighted. The data for 1975 are the same as in Figure 1—1 in (KRAV 82) while those for 1985 have been computed as explained above.

Figure 1 reveals, as was observed in (KRAV 82), that on average the less developed a country is the more its national currency understates its GDP with respect to the US\$ and currencies of other industrialized countries. Furthermore, comparing EDIs for 1985 with those of 1975, one can see that for all countries, including the industria-

lized ones, the EDI was in general somewhat higher, except for Sri Lanka, Hungary, Yugoslavia and Poland where it was about twice as high as in 1975.

B.2 EDI for Yugoslavia from 1955 to 1990

By using formula (5) the EDI can be computed for times other than the benchmark years. Yugoslavia is an interesting country to test this procedure as the EDI has fluctuated greatly over years.

In Figure 2 the official bank exchange rates (BER) are plotted in dinars for one US\$, and two inflation indices, CPI, consumer price index (SGJU 84, Table 102—33) and the GDP deflation index (INTE 88, p. 478—9). Due to high inflation during the 1980s, the BERs and the CPI inflation index are plotted also on a monthly basis (BILT VY, EKPO VY INTE 90, POLI 90).

In Figure 3 the EDI for Yugoslavia is shown as computed using formula (5) with 1975 being taken as a reference (benchmark) year. For the US, the CPI inflation index and the GNP implicit price deflator were taken from (HIST 75, Series E135 and E1; STAT 88, Table Nos. 762 and 732, and ECON 90). The EDI was computed twice, using the CPI and the GDP deflator for both the US and Yugoslavia. As can be seen, there are differences between the EDIs computed using these two indices, but they are not major. The black triangle at 1975 is the reference point ($EDI(t_0)$ in eqn. (5)), taken from (KRAV 82).

How good is this extrapolation of EDI from one benchmark point in 1975 all the way back to 1955 and forward to 1990?

The accuracy of this extrapolation depends (1) on the approximation that the inflation in I\$ is equal to that in US\$ (see eqn. (3)); (2) on the way inflation indices for the US and country under consideration are determined; and (3) on the bank exchange rates (BER) used.

In Figure 4 the ratio of inflation indices for I\$ and US\$ are plotted. This graph shows that over the period under consideration the error due to the assumption that inflation in I\$ is equal to that in US\$ was good to within 1% for a few years around the 1980 benchmark year, and always smaller than 5%. BERs are, of course, accurately known, but because all these quantities under study (RGDP, EDI, inflation indices, etc.) refer to some time periods (usually a year) BERs have to be averaged over the same periods. Some errors (hardly larger than a few percent) can occur due to various averaging procedures. Therefore, the overall accuracy in extrapolating EDI from the benchmark year will be always to within few percent as good as the inflation indices are.

In order to further test the validity of results presented in Figure 3, the EDI was also computed for years prior to 1985 using the World Bank GNP estimates in US\$, and the Yugoslavian GNP estimates in current dinars. The results are shown in Figure 5.

In several of its publications (WORLD VY, WTAB VY), the World Bank has been reviewing, among many other statistical indices, the

GNP per capita values expressed in US\$ for almost all countries of the world. The GNP estimates were made using the World Bank Atlas (WBA) method. This procedure computes the GNP numbers in US\$ by taking the GNP estimates in national currencies and divides them with BERs averaged over three years (the current and two preceding years) in order to smooth out (sometimes very large) fluctuations (for details see, for instance, WORL 78, pages 245 and 246). The GNP figures thus obtained in US\$ are commonly used by the World Bank itself and throughout the world whenever the GNPs of various countries are compared.

The original definition of EDI, as stated in formula (2), allows us to compute the EDI directly as a ratio of CGDP in I\$ from (SUMM 88) and the GNP in US\$ as estimated by the World Bank. (This is exactly how the EDI for the 1975 benchmark year was calculated in (KRAV 82)). Unfortunately, the World Bank has two sets of numbers for GNP in US\$. One set starts with 1976 and is contained in various issues of the World Development Report (WORL 78 to WORL 90). The second set is contained in (WTAB VY) where the GNP values in current US\$ are given for a period of 20 years previous to the current year. In this second set some GNP estimates are recalculated. In the case of Yugoslavia, there are considerable differences, particularly for 1979, 1980 and 1981, between the two sets of the GNP values. Thus, the EDI was computed twice, once from 1976 to 1985 inclusive (CGDP data are not available for 1986 and later years), using data from (WORL VY) and the second time from 1967 to 1985 using data from (WTAB 88). The results are presented in Figure 5 as black and open squares respectively. The differences and similarities between these data and the EDIs computed using formula (5) are apparent. At least one part of the differences stems from the fact that the WBA method averages BERs over three years, a procedure which, from a mathematical point of view, can be justified only if BERs and inflation indices do not change substantially over the averaging period. In the case of Yugoslavia, in the period between 1976 and 1985, this certainly was *not* the case.

The EDI was also computed from Yugoslav statistical data using formula (2b) in the following manner. For the $GDP_{nc}(t)$ were taken the "social product" estimates in current dinars from (SGJU 88, Table 102—11, p. 94) while the same BERs as above were used. In (SUMM 88) only the RGNP were given for the centrally planned economics, thus in order to obtain CGDP needed in formula (2b), the available RGNP figures were multiplied by the ratio $CGDP/RGDP1$ for the United States which is, as we saw above, approximately equal to the inflation index for I\$ calculated relative to 1980. The EDI so computed for 1975 is equal to 1.89, rather than 1.56 as obtained in (KRAV 82). It is possible that this difference has its origin in the fact that the Yugoslav statistics give the "social product", not commonly used GNP, and that the conversion from the "social product" to the GNP performed in (KRAV 82) is responsible for smaller EDI value. In this paper such a correction was not made. The EDI calculated using eqn. (2b) is plotted in Fig. 5 as a thin line with small crosses.

The disagreement between the EDIs computed using eqn. (5) (heavy line) and the World Bank—2 EDIs (open squares) for years 1980 to 1985 requires some explanations. For these years the BERs were increasing faster than the inflation indices (see Fig. 2). As the WBA method makes an average of BERs for the current and two previous years, the lower EDIs for these years and higher EDIs for 1970 to 1980 period appear as a direct consequence of the mathematical procedure used in WBA method.

It should also be noted that for 1975, the benchmark year, the EDI from the World Bank data, which uses the three year averaging procedure (WTAB 88), does not agree with the EDI from (KRAV 82) that did not use this averaging procedure.

B.3 *Economic output of Yugoslavia*

In Figure 6 the economic output per person for Yugoslavia is represented in six different ways. Black triangles represent the "social product" in constant 1972 dinars, the Yugoslav national currency (SGJU 88, Table 201—10). Open circles, the result of the ICP estimates, were taken from (SUMM 88) and represent RGNP in 1980 I\$. Open squares represent the World Bank GNP estimates from (WTAB 88 and 89) expressed in 1980 US\$. (WBA numbers were corrected for inflation using the GDP deflation index for the US (INTE 88, p. 478—9).). Crosses were obtained using the "social product" values in current dinars (SGJU 88, Table 102—11, p. 94), dividing them by current BERs and correcting them for the US inflation in the same way as the World Bank data were corrected. Therefore, these numbers also represent GNP per person in 1980 US\$. The small black squares were calculated by multiplying the World Bank data (open squares) with the EDI defined by eq. (5) and plotted in Figure 3. The GNP values so obtained should be close to the RGDP in I\$. Similarly, the open diamonds were obtained by multiplying crosses with the EDI.

The similarities and differences between six different quantities for the economic output are obvious. The RGDP and GMP(din) points are in excellent agreement, as far as both the shapes and the slopes are concerned. Transformation from the GDP expressed in constant dinars to the RGDP in I\$ did not introduce any significant distortions in the growth rates over the whole period under consideration, thus, when talking about growth rates, any of these two curves can be taken for reference. (Note that there are some differences in slopes after 1980).

The open squares and crosses giving GNP in US\$ computed using the WBA or simple BER methodology introduces gross distortions. Prior to 1980, the growth of GNP appears to have been faster than when expressed in dinars, while from 1980 to 1985, the growth changes sign and the GNP decreases by about a factor of two. The WBA and BER methods convert a quite smooth GNP curve in national currency to a very rugged one. The origin of this distortion can be easily traced to unequal growth in BERs and CPIs, as obviously

visible in Figure 2. The black squares and open diamonds are the result of multiplying the above GNP figures by the EDI computed using eqn. (5). As the points show, the correction did not smooth out the WBA GNP values enough to be comparable in shape to the GNP data in national currency. The origin is obviously generated by the discrepancy between various EDIs from Fig. 5, that is in the three year averaging procedure used in the WBA method.

B.4 Efficiency of energy use in Yugoslavia

Figure 7 illustrates the efficiency of energy use by using the economic output calculated in six different ways, as explained in the previous section. The energy consumption was taken from (IAEA 88).

The similarities and differences between six sets of data are obvious. As can be expected, when GNP is expressed in dinars, output per energy consumed is a smooth function of time, independent of any conversion ratios between dinar and either I\$ or US\$. These data (black triangles) show a small increase in efficiency from 1957 to about 1982, followed by a small decrease. When economic output is expressed in 1980 I\$ (open circles) the GNP to energy ratio shows a slight decrease from 1950 to about 1965, a slight increase from 1965 to 1982 and a small decrease from 1983 to 1985. (Note that the vertical scale is logarithmic, thus year-to-year variations look smaller than on a linear plot — see also Figure 11.). The differences between two sets of data are fairly small.

When economic output is expressed in US\$ using the WBA (open squares) or simple BER (crosses) method, it appears that the efficiency of energy use has more than doubled from 1957 to 1979, in order to decrease by more than a factor of two during the next five years, wiping out all efficiency gains that were seemingly achieved during the previous 23-year period. If these data are observed in isolation, then the relatively fast rise in efficiency use can perhaps be accepted as real, but the steep decline after 1979 with a jump in 1986 would be the most difficult to understand. On the other hand, the time dependence of EDI as depicted in Figure 3, would, of course, create such temporal dependence artificially. And indeed, when GNPs in US\$ are multiplied by the EDIs, the up-and-down behaviour in the efficiency of energy use disappears for the BER data (open diamonds) completely, but not for the WBA data (black squares). This should, of course, be expected keeping in mind the way different estimates of GNPs in US\$ were made.

This example clearly illustrates that changes in efficiency of energy use should not be studied by expressing the economic output in US\$, but only either in national currency or in the I\$ on basis of the ICP studies. Of course, only the use of I\$ enables a realistic comparison to be made between different countries.

C. REALISTIC COMPARISONS OF YUGOSLAVIA WITH OTHER COUNTRIES

From the previous considerations it follows that the only way to compare realistically the economic performance of various countries is to express the economic output in a "realistic" common currency. At present, the international dollar (I\$), as determined by the International Comparisons Project (ICP) appears as the best available. In this section, the RGNP and the overall efficiency of energy use in Yugoslavia are compared with other countries.

C.1 Comparing RGDPs

C.1.a Comparing Yugoslavia with Its Neighbours: Period 1950—1985

On Figure 8 is plotted RGDP1 (or RGNP) per capita in 1980 I\$ (SUMM 88) for Yugoslavia, all its neighbours except Albania, the U. S., Turkey and Egypt for the 1950—1985 period. Several interesting features follow from these graphs.

First, one can notice that the U. S., the most developed country, exhibited in the observed 35-year period on average (with some oscillations) a uniform RGDP per capita growth of about 1.8% per year. Yugoslavia and most of its neighbours have achieved faster growth rates, thus closing the gap between themselves and the U. S. At the beginning of this period, the RGDP per capita for these countries was 3 to 7 times below that of the U. S., and at the end of period, only 1.4 to 2 times below.

The growth rates for Yugoslavia, Austria and Italy have been about the same over the whole 35-year period, with all three countries exhibiting a slowdown after 1980.

Romania, Bulgaria and Greece have had about the same growth rates as Yugoslavia (some points are not visible because of overlap) up to the second half of the 1970s. Since about 1976-7, the growth in these three Yugoslav neighbours slowed down more than in Yugoslavia, so that by 1985, Yugoslavia has caught up with Bulgaria, and has overtaken Romania and Greece for about 10—15%.

At the beginning of this period, RGDP in Hungary was about twice as high as in Yugoslavia, but by 1985, Yugoslavia had caught up with Hungary to within 20%.

The growth in Turkey has been about as slow as in Hungary. Thus, while Yugoslavia was only about 20% ahead of Turkey in 1950, by 1985 this difference increased to a factor of two. On average, the growth in Egypt has been about the same as in Turkey. It should be also emphasized that in these graphs the economic output *per capita* is plotted and that Turkey and Egypt have had rather fast population growth.

C.1.b Comparing Three Yugoslav Regions with a Few Selected Countries: Period 1953—1987

On Figure 9, the comparison of RGDP per capita in 1980 I\$ is made between three regions of Yugoslavia (Slovenia, Serbia without the autonomous provinces of Kosovo and Vojvodina, and Kosovo), the United States, Japan, Austria (the most affluent of Yugoslav neighbours), Turkey (a country that occupied part of Yugoslavia, including the province of Kosovo, until 1912) and Egypt, a rather undeveloped country. The three Yugoslav regions selected represent the most and the least affluent regions and a region about equal to the Yugoslav average. The economic output per person in 1972 dinars was obtained by taking the ratio of the social product for the whole of Yugoslavia and its eight regions (SGJU 88, Table 201—10) and the population (SGJU, Table 201—5). The conversion into the RGDP per capita in 1980 I\$ was done by multiplying all data expressed in 1972 dinars with 0.1277, the ratio of economic output for 1980 expressed in 1980 I\$ (open circles in Figure 6) to that in dinars (black triangles). The data for the U. S., Austria, Turkey and Egypt are the same as in Figure 8.

The results presented in Figure 9 exhibit some interesting and unexpected results. Slovenia being substantially behind Austria in 1952, exhibited a very fast growth and overtook Austria in early 1970s. IN 1979 it came to within 80% of the U. S. (!) in order to stagnate since then. During most of the 1950s, Serbia was together with Turkey. Since 1958 Turkey considerably slowed its growth while Serbia did not. By 1980, Serbia achieved twice as high RGDP per capita as Turkey, but it did fall somewhat behind Slovenia in the same period. During these 35 years Kosovo fell further behind both Serbia and Slovenia, but maintained about the same per capita growth as Turkey. (It should be mentioned that Kosovo, just like Turkey, had a substantial growth in population in that epriod, which, of course, decrease the per capita economic growth rates.) It is also interesting to notice that both Slovenia and Serbia exhibited essentially no growth only in the 1979 to 1987 period, while Kosovo slowed down its growth as early as 1975.

It certainly looks surprising that Slovenia's per capita economic output came in 1979 to within 20% of the United States and overtook Japan and Austria by about the same amount. Thus, it would be worthwhile to discuss this result.

First, we have to notice that a comparison is made here between a relatively small (population of about 2 million) but the most developed open region of a medium developed country, with the averages of the most developed (United States), and two highly developed (Japan and Austria) countries. Clearly, regional discrepancies exist in all countries; thus, if Slovenia were compared with, say, "Silicon Valley" in California, the differences would be, obviously, much larger. But we have also to examine the methodologies used in obtaining this result in order to see if they might have artificially created.

As far as Yugoslav statistics are concerned, if an error exists it must be in the *relative* position of various regions. Although the same statistical procedures are used for all regions, there are large differences in the economic structure between some regions (different mix between manufacturing, service industries, resource industries and agriculture) as well as an imperfect market which has a tendency to keep prices higher in more developed regions (the data used (SGJU 88) were not corrected for differences in regional prices), thus artificially boosting the GNP of Slovenia, and lowering it in Kosovo.

Summers and Heston (SUMM 84 and SUMM 88) discuss the reliability of their (ICP) estimates. Keeping in mind that full benchmark comparisons were made for Yugoslavia in 1975 and 1980, this error should not be larger than 5% to 10% in either direction. On the other hand, Yugoslavia uses the statistical procedures of centrally planned economies (using "social product" instead of GDP), and thus conversion from one methodology to another may introduce additional errors.

It is beyond the scope of this article to try to resolve this unexpected, or even apparently wrong, result. Another, more elaborate study is needed to find a definitive answer.

C.1.c *Comparing Yugoslavia with all Other Countries: Selected Years*

Real gross domestic product at both current (CGDP) and constant (RGDP) international prices are presented for 130 countries, large and small, in (SUMM 88). For 70 of these countries, time series start at 1950, while for others sometime during the 1950s or 1960s. Table 2 summarizes their results for a few selected years.

In columns 1 and 2 are given the names of the countries and their 1985 population in millions. Columns 4, 5, 6 and 7 list their CGDPs (real gross domestic product in *current* I\$) for 1950, 1960, 1973 and 1985. Then last four columns give the "growth indexes", equal to the ratios of real economic outputs for 1960 and 1950, 1973 and 1960, 1985 and 1973, and finally for 1985 and 1950. These ratios were calculated in the following manner. First, for each of these four years, a ratio of each country's CGDP (columns 4 to 7) to that of the United States was calculated. Then, the ratio of ratios for years being compared was calculated. This ratio of ratios is a measure of the real economic growth per capita when expressed in current international prices as compared to that of the United States. If this ratio of ratios is larger than one, a particular country has been catching up (on a per capita basis) with the US. If it were smaller, then it would have been falling behind. In order to get a measure of real economic growth on a *per capita* basis, not relative to the US, these ratios of ratios were multiplied by the ratios of RGDPs (in constant 1980 I\$) for US for the selected years. These ratios for US are given in line 62 in Table 2. They represent a measure of the real per capita growth in the US. The ratios listed in the last four columns could have been computed using RGDPs in constant I\$, in which case they

would have been obtainable from graphs like those in Figures 8 and 9, but were not. The reason is that using current international prices gives a more realistic measure of one country's real economic output than using constant prices, assuming that inflation in I\$ has been corrected for. The procedure used has corrected for this inflation by implicitly making the assumption that the inflation in I\$ is equal to that of US\$. This assumption has been discussed in Sec. B.2 with results presented in Figure 4.

In (SUMM 88) the CGDPs for centrally planned economies were not given. They were calculated here from the RGNPs listed there by multiplying them with the CGDP to RGDP1 ratios for the US in years under consideration.

After computing the growth indexes, the rows in Table 2 were ordered according to the 85/73 ratios. Finally, the cumulative population (running sums) in billions for all countries was computed and presented in column 3. In Figure 10 the growth index for 85/73 (column 10) is plotted versus the cumulative population (column 3). The positions of Yugoslavia and the US are highlighted. Two long horizontal stretches of heavy line are due to China and India.

Figure 10 reveals at a glance some interesting results. In the 1973—85 period, a period characterized by high energy prices and usually considered as a period of economic stagnation, out of 4.7 billion people, 4.3 billion have increased their economic output *per capita*, and of these, 3.8 billion have done so faster than the US. Clearly, although it is generally considered that the gap between the rich and the poor countries has been increasing, this figure shows that this has not been so. Although this 12 year period includes 6 years of economic stagnation in Yugoslavia, only 1.4 billion people in the world have done better, and 1.1 of them live in China.

Table 2 reveals a number of interesting features. It shows that the growth index for Yugoslavia was near the top not only for the 1973—85 period, but also for the 1960—73 and 1950—60 periods. In 1950 China and India have been about equally poor, but during the past 35 year period, in spite of all social upheavals, China has performed considerably better than India. Further inspection of the table shows that in the 1973—85 period both OECD and East European countries have shown moderate economic growth without a clear distinction as to whether they were market or centrally planned economies. (It should be kept in mind here that the GDP measures *gross* product, including military and social services, and does not give a heavy weight to the availability of popular consumer goods.) Those countries that have done better are mainly from the Far East and the Middle East (oil producing) regions and those that have done poorer are mainly in Africa. Some of these African countries, Zaire in particular, are obviously heading for an economic disaster.

C.2 Comparing Efficiency of Energy USE

On Figure 11 the ratio of the RGDP produced (in 1980 I\$) and industrial energy consumed (in GJ — gigajoules) is plotted for Yugoslavia and several major industrialized countries. The data for Yugoslavia are the same as open circles in Figure 7, except that there data were plotted logarithmically, while in this figure linearly.

On this linear plot changes in the efficiency of energy use are easier to observe than in Figure 7. Data for Yugoslavia show a rather steady, about 20% decrease in the efficiency of energy use during 1950 to 1965 period and then a similar increase from 1965 to 1982 with some decrease in 1983—1985 period. It is interesting to observe that the 1973 energy crisis did not produce any changes in general trends.

Japan exhibits a similar trend as Yugoslavia except that the minimum in the RGDP1 to energy ratio appears around 1973 and that slopes for periods before and after 1973, are much steeper. The U. S., U.K. and FRG all show a rather constant ratio before 1973 (except for FRG which has two "bumps") and a significant increase in energy efficiency after 1973. The Soviet Union exhibits a constant decrease in energy efficiency and has not been affected by the 1973 oil crisis, a fact that is easy to understand as the USSR has enough of its own energy resources.

All these data taken together show that Yugoslavia is producing much more goods and services per unit of energy consumed than both the U. S. and the USSR, and in the middle of the 1980s about the same as F.R. Germany and the U.K. On the other hand, if Yugoslavian and other GDPs in the 1980s are calculated using the World Bank Atlas method, then it would appear that Yugoslavia in the 1980s was using energy about 2.5 to 3 times less efficiently than FRG, U. K. and Japan. Such a result would be artificially created because the EDIs for these three countries is close to one (see Table 1), while it is not for Yugoslavia.

D. CONCLUSION

The results presented in this paper show that whenever the economic output of a country is converted from a national currency into another currency for the purposes of comparing GDP or efficiency of energy use among various countries, this conversion should not be done using the World Bank Atlas (WBA) method, as this method can produce grossly incorrect results. The origin of these inaccuracies can easily be understood in terms of the Exchange-rate Deviation Index (EDI). Whenever this index deviates from one, the errors equal to the deviation of the EDI from one are made. Therefore, in all these cases the ICP method of estimating the Real Gross Domestic Product (RGDP), a method that takes into account the different purchasing power of national currencies, should be used.

One of the major difficulties that impedes the widespread use of the ICP method is its complexity and the fact that independent RGDP

estimates have been available only with a delay of several years. A rather simple formula is proposed in this paper that allows good estimates of the Exchange-rate Deviation Index (EDI) to be made by extrapolating from the last benchmark year up to the present time. Computed in this way, the EDIs can be used as an up-to-date indicator of the overall Purchasing Power Parities (PPP) of national currencies, as well as to express any country's real economic output in terms of International Dollars in a manner independent of fluctuating and often unrealistic Bank Exchange Rates. If the EDI is computed using inflation indexes that refer to a particular sector of economy, for example (tourist) services or housing, then it would be possible to make also the specific up-to-date sectoral comparisons of the PPPs.

The EDI extrapolation procedure (method) proposed here was applied to Yugoslavia and a comparison of the ICP (International Comparison Project) and the WBA (World Bank Atlas) methods of estimating GDPs and "efficiency" of energy use was made and the EDI was calculated for the past 35 years. A conclusion was reached that the dinar, the Yugoslav national currency, has always had a higher (overall) purchasing power inside Yugoslavia than outside. In the time period between 1955 and 1972, the purchasing power was for 2 to 2.5 higher inside than outside, but at the end of the 1970's, it decreased to as low as 1.2. During the 1980's, the EDI was unstable, climbing up in the middle of 1985 to about 3.4, in order to fall down to about 2.1 two years later, to climb up again to 2.8 in 1989, and finally in 1990 to fall down to about 1.5, the value it had in 1975. As a result, the real GDP of Yugoslavia and the efficiency of energy use were always (except at the end of the 1970s) considerably higher than they appeared to be when the official bank exchange rates (World Bank Atlas method) were used to express the Yugoslav economic output in the US\$.

The existence of RGDP values in a common world currency enables realistic comparisons between various countries to be made. In Section C, the past economic performance of Yugoslavia is compared with 128 other countries. For Yugoslavia an overall optimistic picture emerges as it places past Yugoslavian economic growth ahead of most other countries in the world (c.f. Table 2 and Figure 10). In spite of this overall good performance on a per capita basis, this fast average growth has not been equally shared by all regions in Yugoslavia. As far as efficiency of energy use is concerned, the picture is also optimistic. The ICP results show that Yugoslavia is using energy about as efficiently as Western Europe and Japan.

ACKNOWLEDGEMENTS

This research has been partially supported by a grant received from the Department of Energy, Mines and Resources Canada. The author is greatly indebted to Dr. Ivo Novak from the Economics and Planning Division of the International Atomic Energy Agency for providing him with the latest IAEA energy data on a PC compatible diskette. These data were used in Figures 7 and 11.

The author also acknowledges several useful comments from the unknown referee, comments that have spurred him to add Figures 4 and 5 to the original draft, and to improve or expand the text in several places.

Received: 3. 05. 1990

Revised: 29. 03. 1991

REFERENCES

- (BILT VY) Bilten Narodne Banke Jugoslavije, Year X, № 11—12, Nov—Dec 1983, page 68 and Year XVII, № 12, Dec 1988, published by Narodna Banka Jugoslavije, Bulevar Revolucije 15, Beograd.
- (ECON 90) Economic Indicators, June 1990, US Congress, 2d Session, Prepared by the Council of Economic Advisors, US Government Printing Office, Washington (1990).
- (EKPO VY) "Ekonomaska Politika", weekly magazine, Beograd (Various Issues).
- (HIST 75) Historical Atlas of the United States: Colonial Times to 1970, Part 2, U. S. Department of Commerce, Bureau of the Census, 1975, republished by Kraus International Publications, White Plains, N. Y. (1989).
- (IAEA 88) International Atomic Energy Agency, "Energy and Economic Tables, 1950—1987", and the IAEA energy data bank, Vienna (1988). The author is grateful to Dr. Ivo Novak from the IAEA for diskettes containing these data.
- (INTE 88) International Financial Statistics, International Monetary Fund, Yearbook 1988.
- (INTE 90) International Financial Statistics, International Monetary Fund, Vol. XLIII, № 8 (August 1990).

- (KRAV 75) Irving B. Kravis, Zoltan Kenessey, Alan W. Heston, and Robert Summers, "A System of International Comparisons of Gross Product and Purchasing Power", John Hopkins University Press, Baltimore, Md (1975).
- (KRAV 78) Irving B. Kravis, Alan W. Heston, and Robert Summers, "International Comparisons of Real Product and Purchasing Power", John Hopkins University Press, Baltimore, Md (1978).
- (KRAV 82) Irving B. Kravis, Alan Heston and Robert Summers, "World Product and Income: International Comparisons of Real Gross Product", published for the World Bank by The John Hopkins University Press, Baltimore and London (1982).
- (KRAV 87) Irving B. Kravis, Alan Heston and Robert Summers, "World Comparisons of Purchasing Power and Real Product for 1980", United Nations, New York, (1987).
- (POLI 90) Politik: The International Weekly, № 19, Year I, 28 July 1990, p. 3. Data were reproduced as reported by the Federal Bureau of Statistics.
- (SGJU 88) Statistički Godišnjak Jugoslavije 1988, Savezni Zavod za Statistiku, Beograd (1988).
- (STAT 88) Statistical Abstract of the United States 1988, 108th Edition, U. S. Department of Commerce.
- (SUMM 84) Robert Summers and Alan W. Heston, "Improved International Comparisons of Real Product and its Composition: 1950 — 1980", Review of Income and Wealth, page 201, 1984.
- (SUMM 88) Robert Summers and Alan Heston, "A New Set of International Comparisons of Real Product and Price Level Estimates for 130 Countries, 1950—1985", Review of Income and Wealth, March 1988, pages 1—25.
- (SURV 90) Survey of Current Business, U. S. Department of Commerce and Bureau of Economic Analysis, Vol. 70, № 8 (August 1990).
- (WATB 89) World Tables, 1988—89 Edition. Published for the World Bank by The John Hopkins University Press, Baltimore and London (1989).
- (WORLD VY) World Development Report, Various Years, Published for the World Bank by The Oxford University Press, New York (Yearly since 1978).

Table 1

1975 and 1985 Exchange-rate-Deviation Indexes (EDI) for 34 countries.

1	Iran	2705	0.377	1.70				
2	Luxenburg	5883	0.820	0.91				
3	Romania	2387	0.333	1.37				
4	Malawi	352	0.049	2.55	170	478	0.030	2.81
5	Zambia	738	0.103	1.49	390	691	0.043	1.77
6	Kenya	470	0.065	1.95	290	727	0.045	2.51
7	India	470	0.065	3.23	270	955	0.059	3.54
8	Pakistan	590	0.082	3.12	380	1450	0.090	3.82
9	Philippines	946	0.132	2.51	580	1710	0.106	2.95
10	Sri Lanka	668	0.093	3.65	380	1995	0.124	5.25
11	Jamaica	1723	0.240	1.23	940	2155	0.134	2.29
12	Thailand	936	0.130	2.61	800	2310	0.144	2.89
13	Colombia	1609	0.224	2.83	1320	3221	0.201	2.44
14	Korea	1484	0.207	2.54	2150	3734	0.233	1.74
15	Syria	1794	0.250	2.50	1570	3741	0.233	2.38
16	Brazil	1811	0.252	1.58	1640	3979	0.248	2.43
17	Malaysia	1541	0.215	1.98	2000	4050	0.252	2.03
18	Uruguay	2844	0.396	2.17	1650	4219	0.263	2.56
19	Mexico	2487	0.347	1.70	2080	4739	0.295	2.28
20	Poland	3598	0.501	1.39	2050	6295	0.392	3.07
21	Yugoslavia	2591	0.361	1.56	2070	6487	0.404	3.13
22	Ireland	3049	0.425	1.14	4850	6556	0.408	1.35
23	Hungary	3559	0.496	1.68	1950	7387	0.460	3.79
24	Spain	4010	0.559	1.36	4290	7879	0.491	1.84
25	Italy	3861	0.538	1.12	6520	9230	0.575	1.42
26	U. K.	4588	0.639	1.11	8460	10874	0.677	1.29
27	Netherlands	5397	0.752	0.89	9290	11067	0.689	1.19
28	Japan	4907	0.684	1.10	11300	11176	0.696	0.99
29	Austria	4995	0.696	1.00	9120	11319	0.705	1.24
30	Belgium	5574	0.777	0.88	8280	11580	0.721	1.40
31	France	5877	0.819	0.91	9540	12492	0.778	1.31
32	Germany	5953	0.830	0.88	10940	12831	0.799	1.17
33	Denmark	5911	0.824	0.79	11200	13519	0.842	1.21
34	U. S.	7176	1.000	1.00	16690	16057	1.000	0.96

Table 2
*Real gross domestic product in current international dollars
 (CGDP) for 1950, 1960, 1973 and 1985 and the ratios of real
 economic outputs for years indicated.*

	Country	Pop(85)	cum. pop.	CGDP(50)	CGDP(60)	CGDP(73)	CGDP(85)	(60/50)	(73/60)	(85/73)	(85/50)
1	Oman	1.23	0.001			1182	9149			3.55	
2	Trinidad & Tob.	1.17	0.002	513	919	1865	9047	1.39	1.32	2.21	4.06
3	Singapore	2.56	0.005		726	2339	11183		2.10	2.21	
4	Lesotho	1.52	0.006		116	308	1504		1.73	2.15	
5	China	1078.28	1.085	127	274	660	3131	1.60	1.57	2.12	5.31
6	Indonesia	162.21	1.247			352	1550			2.09	
7	Hong Kong	5.42	1.252		712	2625	11297		2.40	1.97	
8	Malta	0.36	1.253		559	1648	6741		1.92	1.88	
9	Saudi Arabia	11.34	1.264		487	1937	7838		2.59	1.86	
10	Korea, South	41.06	1.305		286	915	3734		2.12	1.85	
					16	931	3741		1.46	1.82	
11	Syria	10.37	1.316		449	648	2513		1.21	1.82	
12	Algeria	21.94	1.337		310	740	2906		0.95	1.79	
13	Jordan	3.49	1.341		529	1174	4422	2.68	2.33	1.76	10.96
14	Taiwan	19.26	1.360	99	381	1808	6487	1.63	1.73	1.63	4.61
15	Yugoslavia	23.12	1.383	327	628	733	2596		1.46	1.61	
16	Tunisia	7.17	1.390		358	1162	4050		1.65	1.59	
17	Malaysia	15.67	1.406		467	1887	6413		1.60	1.56	
18	Barbados	0.25	1.406		766	4596	15563		1.70	1.56	
19	Norway	4.15	1.411		1779	570	1992	1.22	2.08	1.55	3.22
20	Swaziland	0.76	1.411	1116	172	1446	4897		2.00	1.53	
21	Iran	46.01	1.457		419	582	1995	1.14	0.91	1.52	1.57
22	Sri Lanka	15.84	1.473	278	406	437	1444	1.05	1.38	1.52	2.20
23	Egypt	48.24	1.521	147	215	691	2225		2.10	1.49	
24	Botswana	1.07	1.522		2	401	1261			1.47	
25	Yemen	7.96	1.530			2778	8877			1.46	
26	Bahrain	0.42	1.531		31	764	2432	1.10	1.16	1.45	1.84

	Country	Pop(85)	cum. pop.	CGDP(50)	CGDP(60)	CGDP(73)	CGDP(85)	(60/50)	(73/60)	(85/73)	(85/50)
60	Mauritania	1.70	3.581		113	185	490		1.07	1.20	
61	Niger	6.42	3.587		129	6207	16057	1.15	1.43	1.19	1.96
62	US	238.98	3.826	1899	2855	5219	13519	1.27	1.66	1.19	2.49
63	Denmark	5.11	3.831	1252	2077	5697	14544	1.13	1.63	1.18	2.17
64	Canada	25.38	3.856	1551	2200	3068	7879	1.57	2.00	1.18	3.69
65	Spain	38.60	3.895	497	1075	2257	5703	1.56	2.56	1.18	4.70
66	Greece	9.94	3.905	291	512	1508	3832		1.61	1.17	
67	Surinam	0.39	3.905		671	1912	4739	1.37	1.43	1.16	2.26
68	Mexico	78.93	3.984	498	892	1090	2706		1.44	1.15	
69	Iraq	15.78	4.000		457	4847	12118	1.27	1.61	1.15	2.35
70	Sweden	8.35	4.008	1193	1957	4657	11580	1.28	1.73	1.14	2.52
71	Belgium	9.86	4.018	1063	1754	2659	6556	1.30	1.64	1.14	2.43
72	Ireland	3.55	4.022	633	1070	715	1710	1.51	1.26	1.13	2.15
73	Philippines	54.73	4.077	190	360	331	788		0.83	1.11	
74	Haiti	5.49	4.082		211	265	667		0.82	1.11	
75	Nepal	16.53	4.099		273	862	2127	1.27	1.51	1.11	2.12
76	Dominican R.	6.25	4.105	223	348	4772	11387	1.27	1.89	1.10	2.62
77	Iceland	0.24	4.105	998	1683	2627	6295	1.30	1.58	1.09	2.25
78	Poland	37.19	4.142	644	1001	4660	11067	1.31	1.79	1.09	2.55
79	Netherlands	14.49	4.157	1009	1777	406	987		0.96	1.09	
80	Senegal	6.56	4.163		299	5697	13411	1.34	1.49	1.09	2.16
81	Switzerland	6.46	4.170	1444	2487	4623	10953	1.00	1.60	1.08	1.73
82	Australia	15.75	4.186	1454	1863	204	499		0.82	1.08	
83	Mali	7.54	4.193		155	1515	3556		1.51	1.07	
84	Fiji	0.70	4.194		664	5592	12937	1.40	1.61	1.07	2.40
85	Luxembourg	0.34	4.194	1253	2276	3558	8208	1.47	2.38	1.06	3.70
86	Israel	4.23	4.198	511	973	1469	3341	1.52	1.42	1.05	2.28

	Country	Pop(85)	cum. pop.	CGDP(50)	CGDP(60)	CGDP(73)	CGDP(85)	(60/50)	(73/60)	(85/73)	(85/50)
87	Costa Rica	2.52	4.201	338	616	2043	4601	1.57	2.16	1.05	3.55
88	Portugal	10.23	4.211	297	608	214	513		1.29	1.03	
89	Tanzania	22.24	4.233		143	214	521	1.17	0.98	1.03	1.17
90	Uganda	14.70	4.248	94	105	357	727	1.19	1.14	1.03	1.40
91	Kenya	20.41	4.268	138	298	218	478		1.45	1.01	
92	Malawi	7.14	4.276		00	299	572		0.97	0.99	
93	Cent. Afr. R.	2.59	4.278		266	2168	4583	1.12	1.46	0.99	1.62
94	S. Africa	32.40	4.311	674	973	226	561		0.85	0.98	
95	Guinea	6.08	4.317		152	4635	9761	1.17	1.40	0.97	1.59
96	New Zealand	3.25	4.320	1422	2102	536	1059	1.12	1.16	0.96	1.25
97	Honduras	4.38	4.324	215	345	619	1216		1.17	0.95	
98	Zimbabwe	8.39	4.333		335	1966	4071	1.45	1.13	0.94	1.53
99	Venezuela	18.07	4.351	615	1105	2079	4132		1.35	0.92	
100	Chile	12.07	4.363		1024	2086	4219	1.26	0.95	0.92	1.11
101	Uruguay	3.01	4.366	875	1460	569	1175		1.43	0.91	
102	Ivory Coast	10.12	4.376		274	416	724		1.56	0.89	
103	Gambia	0.76	4.377		152	1345	2506	1.48	1.34	0.88	1.74
104	Nicaragua	3.18	4.380	339	690	1345	2556	1.34	1.49	0.88	1.74
105	Peru	18.66	4.399	334	584	1009	1957	1.19	1.13	0.88	1.17
106	Guatemala	8.38	4.407	378	586	6492	12337		0.74	0.87	
107	Kuwait	1.75	4.409		5604	261	499		0.83	0.85	
108	Somalia	5.35	4.414		298	1000	1722		1.64	0.81	
109	Papua	3.39	4.417		387	2393	4164		1.31	0.80	
110	Argentina	30.53	4.448		1133	844	1449	1.26	1.27	0.79	1.26
111	El Salvador	5.15	4.453	267	492	376	698		0.84	0.78	
112	Sudan	21.78	4.475		209	940	1567	0.94	1.20	0.78	0.89
113	Guyana	0.82	4.476	418	582	380	624		1.36	0.78	

	Country	Pop(85)	cum. pop.	CGDP(50)	CGDP(60)	CGDP(73)	CGDP(85)	(60/50)	(73/60)	(85/73)	(85/50)
114	Togo	3.04	4.479		152	762	1328	0.96	1.41	0.77	1.04
115	Bolivia	6.38	4.485	285	3						
116	Ethiopia	42.23	4.527	78	123	196	390	1.25	1.04	0.75	0.98
117	Benin	4.04	4.531		248	397	663		1.04	0.74	
118	Madagascar	10.16	4.542		299	398	628		0.87	0.74	
119	U. A. Emir.	1.37	4.543			9188	14496			0.72	
120	Nigeria	99.75	4.643	147	267	415	681	1.36	1.01	0.71	0.98
121	Liberia	2.21	4.645		221	424	638		1.25	0.70	
122	Ghana	13.51	4.658		214	321	411		0.98	0.69	
123	Jamaica	2.35	4.661		1257	1426	2155		0.74	0.67	
124	Sierra Leone	3.66	4.664		146	333	552		1.49	0.66	
125	Angola	8.61	4.673		330	619	726		1.22	0.60	
126	Chad	5.02	4.678		209	250	313		0.78	0.59	
127	Mozambique	14.08	4.692		352	644	661		1.19	0.46	
128	Zambia	6.70	4.699		323	679	691		1.37	0.43	
129	Zaire	33.49	4.732	53	105	206	212	1.43	1.28	0.36	0.65
130	Afghanistan	18.14	4.750		294	371			0.82		

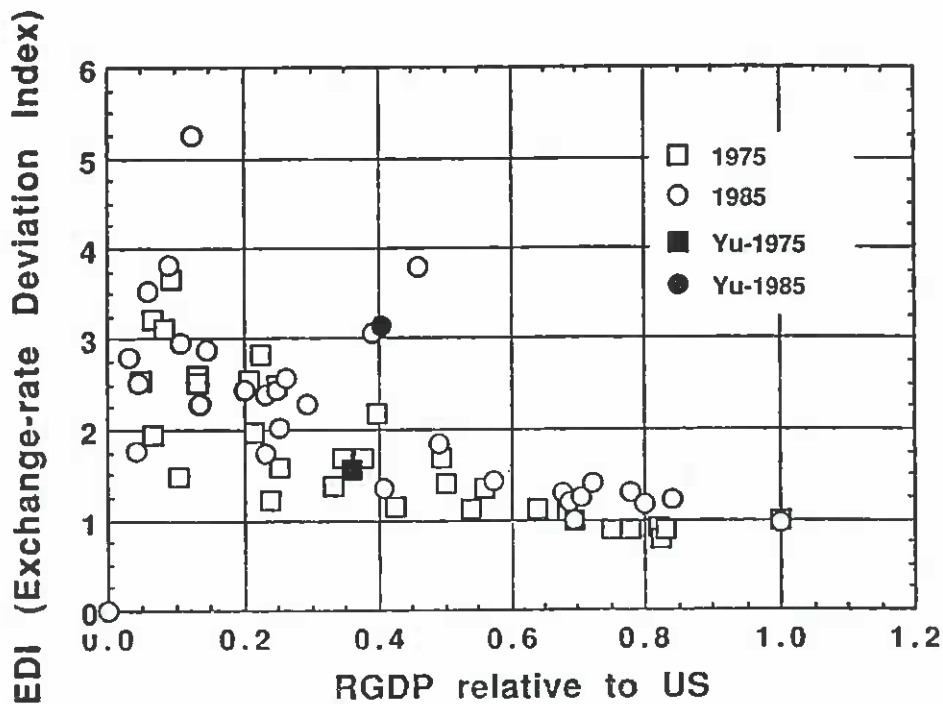


Figure 1. The EDI for 1975 (squares) and 1985 (circles) have been plotted against the RGDP (CGDP) per capita expressed relative to that of the US for 34 countries studied in the phase 3 of the ICP. The correspondence between points and countries can be established with the help of Table 1. The points for Yugoslavia are highlighted.

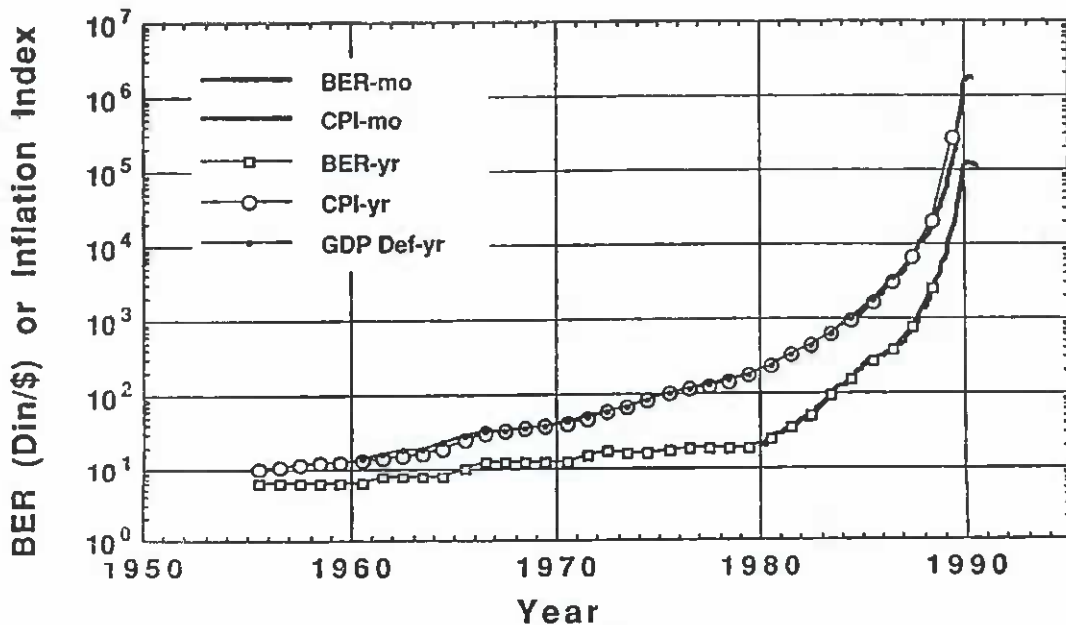


Figure 2. Official bank exchange rates (BER) in dinars per one US\$ (squares) and two inflation indexes, the CPI (circles) and the GDP deflator (black points), are plotted on yearly and monthly (heavy lines) basis. Thin lines connecting points are made to guide the eye. All points are plotted at the middle of each period.

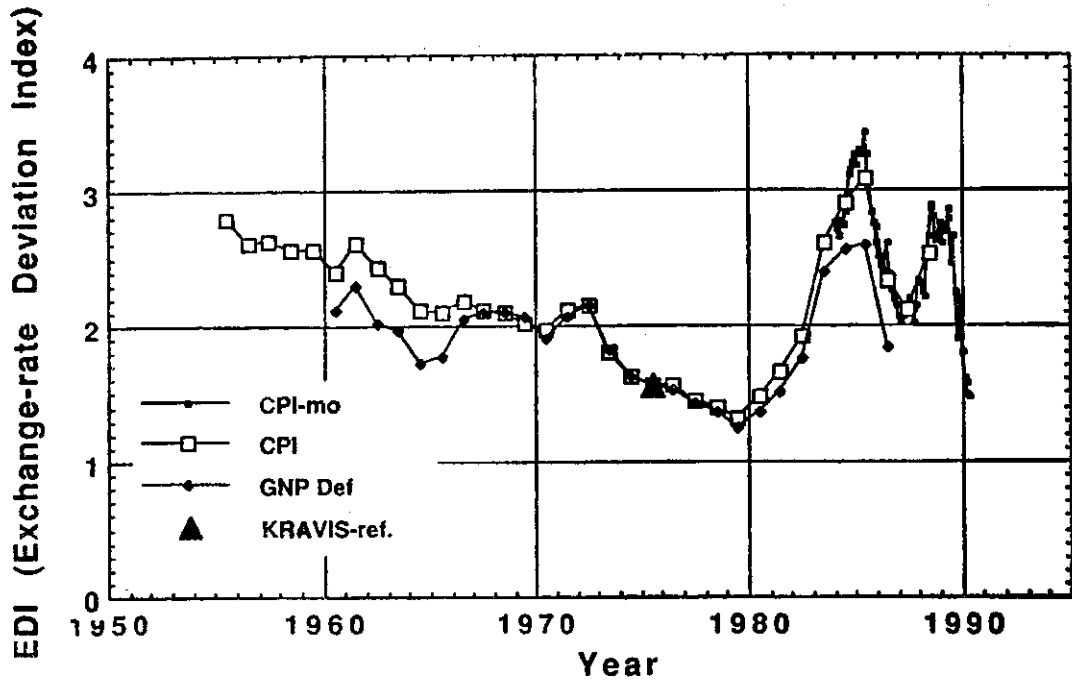


Figure 3. Exchange-rate-Deviation Index (EDI) is plotted from 1955 until May 1990, on yearly or monthly basis. Open squares represent the EDI calculated using the consumer price indexes (CPI) and black diamonds using the GDP deflators. Thin lines connecting points are made to guide the eye. Small black squares since the beginning of 1984 represent monthly data calculated using the CPI indexes. The black triangle is the EDI for 1975, the benchmark year. All points are plotted at the middle of each period.

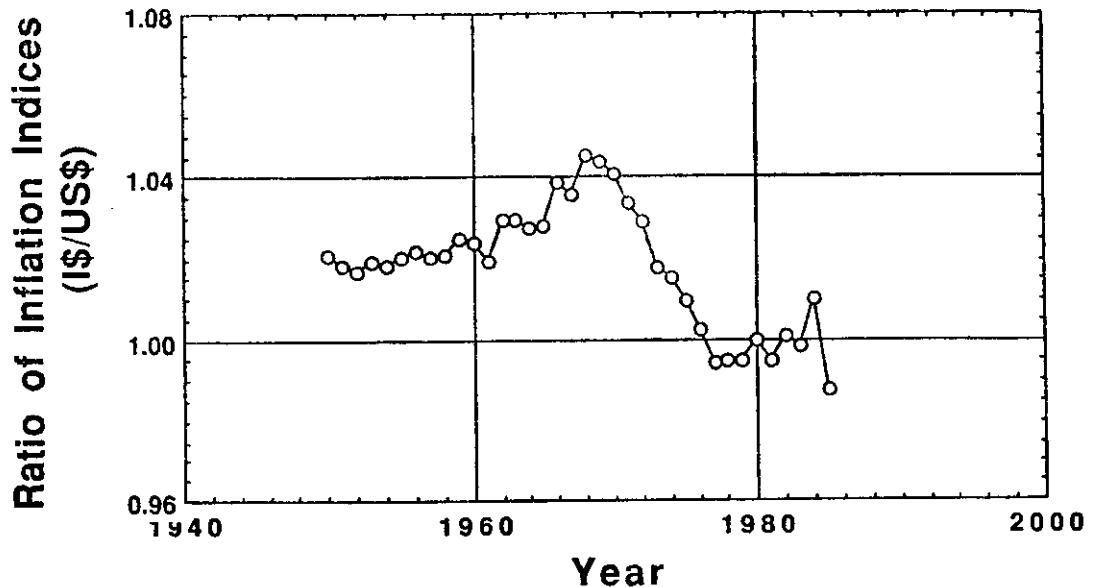


Figure 4. The ratio of inflation indexes for I\$ and US\$ are plotted for the 1950 to 1985 period with 1980 taken as a reference year. The ratio of CGDP to RGDP for the US (SUMM 88, Table 104, columns 9 and 3 respectively) was taken as a measure of inflation in the I\$ and the GNP implicit price deflator (HIST 75, Series E1) and (STAT 88, Table No. 732) as a measure of the US inflation.

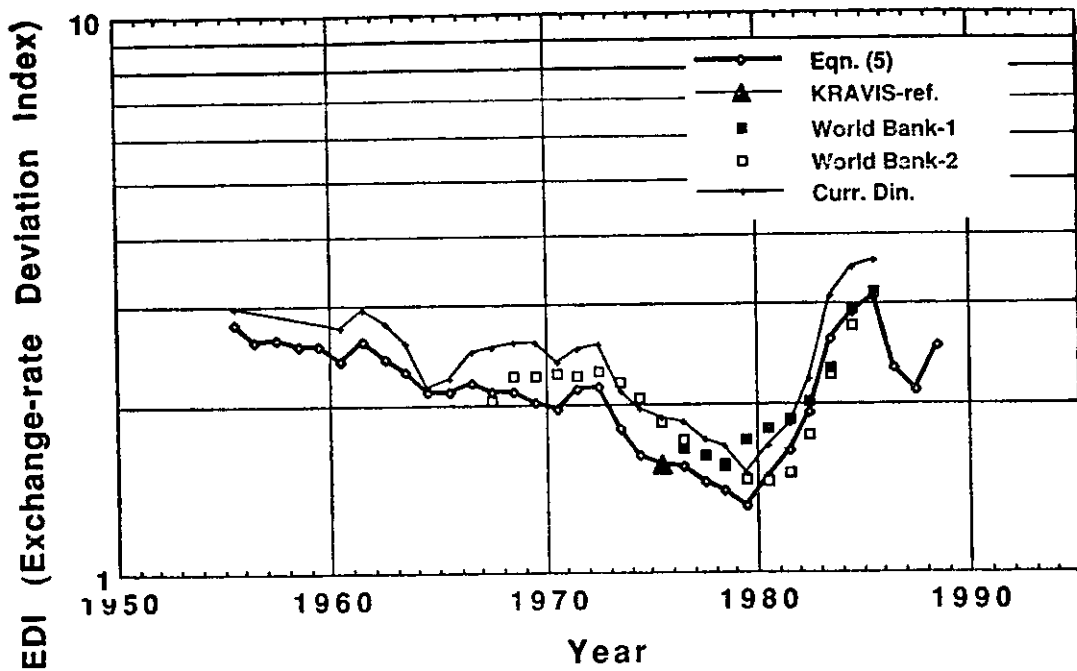


Figure 5. The EDIs calculated in several different ways are plotted on a logarithmic scale. The heavy line represents the same EDI as given by open squares in Figure 3. The black triangle at 1975 is the reference point from (KRAV 82). Black and open squares are the EDIs computed using two sets of the World Bank GDP values. The light line with small crosses is the EDI computed using the "social product" values in current dinars and corresponding BERs. It should be noticed that the shape of heavy and light lines is almost the same, except during the middle and late sixties. If the light line is multiplied by $1.56/1.89 = 0.839$, the ratio of two EDIs for 1975, the light line overlaps almost completely the heavy line. All points are plotted for the middle of each year.

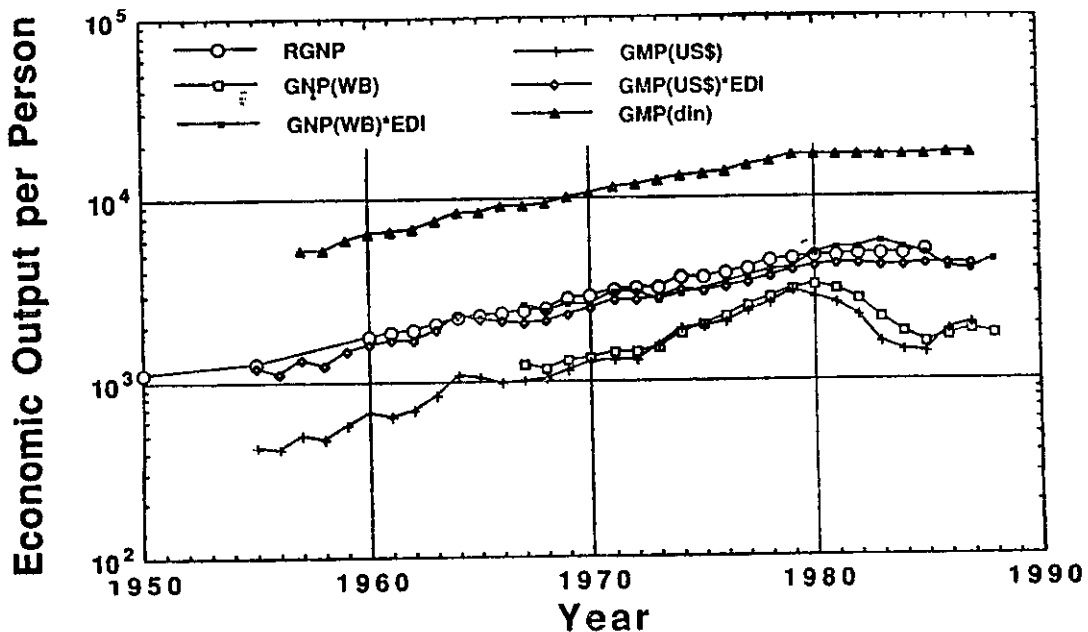


Figure 6. The economic output per capita for Yugoslavia is expressed and plotted in six different ways. Black triangles represent the social product in 1972 Yugoslav dinars (SGJU 88, Table 201-10). Open circles give the RGNP in 1980 I\$ (SUMM 88). Open squares and crosses represent the GNP in 1980 US\$ calculated as explained in the text. Black squares and open diamonds are the product of the GNP in US\$ and the EDI from Figure 3 calculated using the CPI.

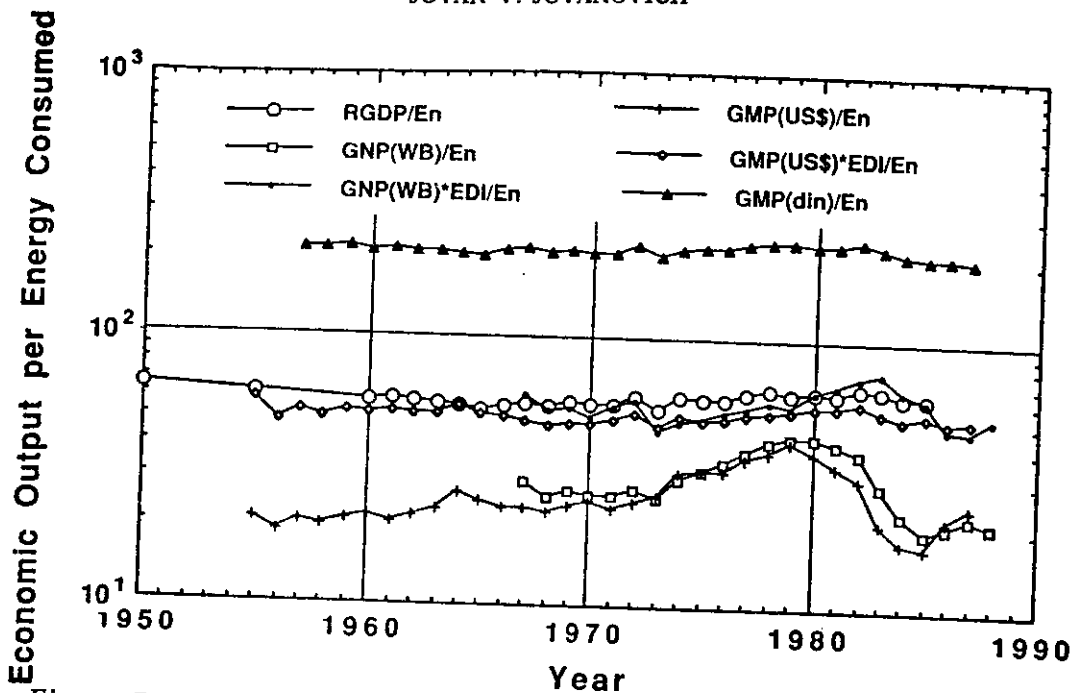


Figure 7. The efficiency of energy use, defined as economic output produced per unit of energy consumed, is presented using six different estimates of economic output from Figure 6. For black triangles, the economic output per unit of energy is expressed in 1972 dinars per gigajoule (GJ), for open circles in 1980 I\$/GJ and for four other sets in 1980 US\$/GJ.

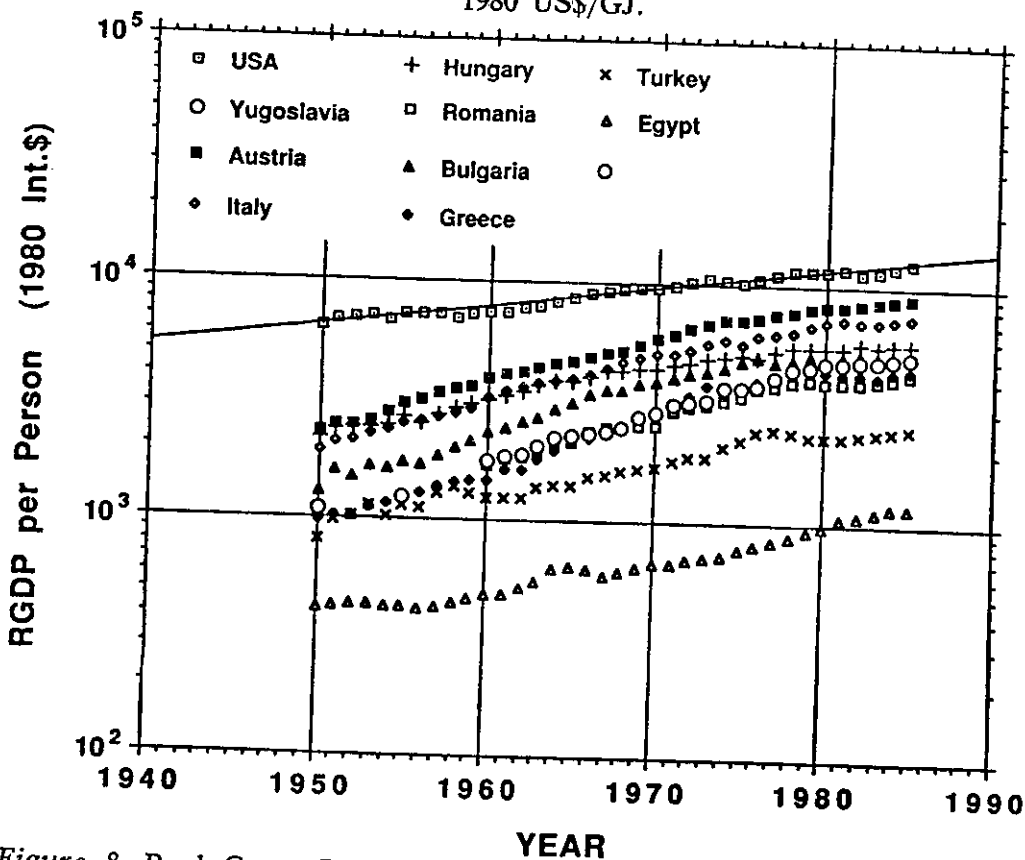


Figure 8. Real Gross Domestic Product (RGDP1) per capita in international dollars (I\$) is plotted for Yugoslavia, its neighbours (except Albania), the United States, Turkey and Egypt. All data were taken from (SUMM 88) without any modification.

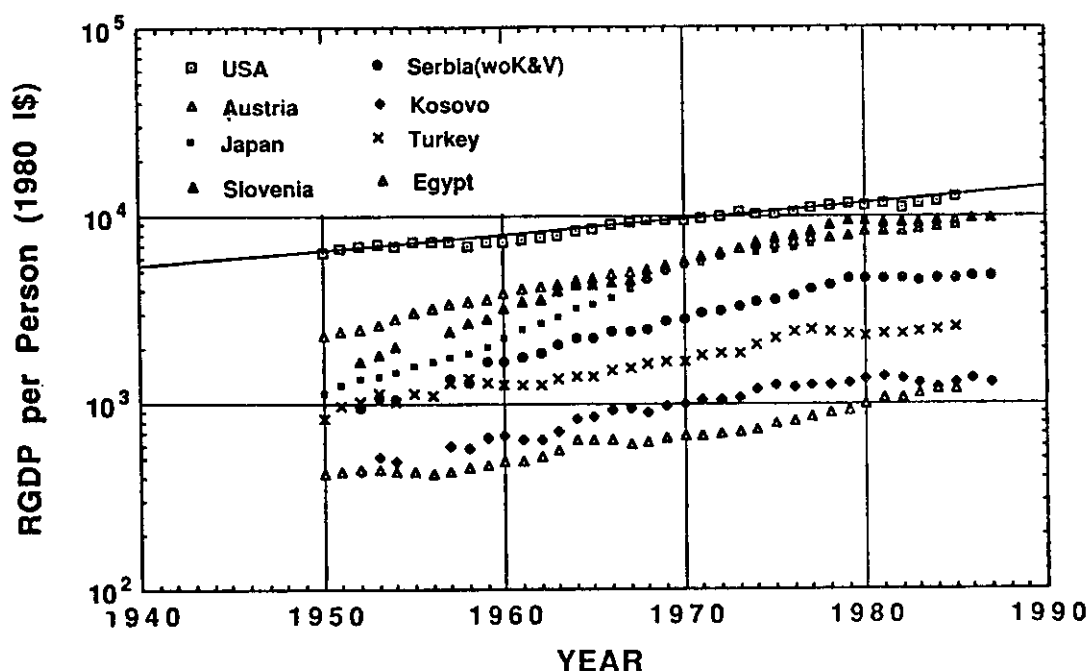


Figure 9. Real Gross Domestic Product (RGDP) per capita in international dollars (\$) is plotted for three Yugoslav regions (Slovenia, Serbia without the autonomous provinces of Kosovo and Vojvodina, and Kosovo), the United States, Austria, Turkey and Egypt. Data for Yugoslavia were taken from (SGJU 88), Tables 201—10 and 201—5). Conversion from the Yugoslav national currency, dinars, into I\$ is explained in the text.

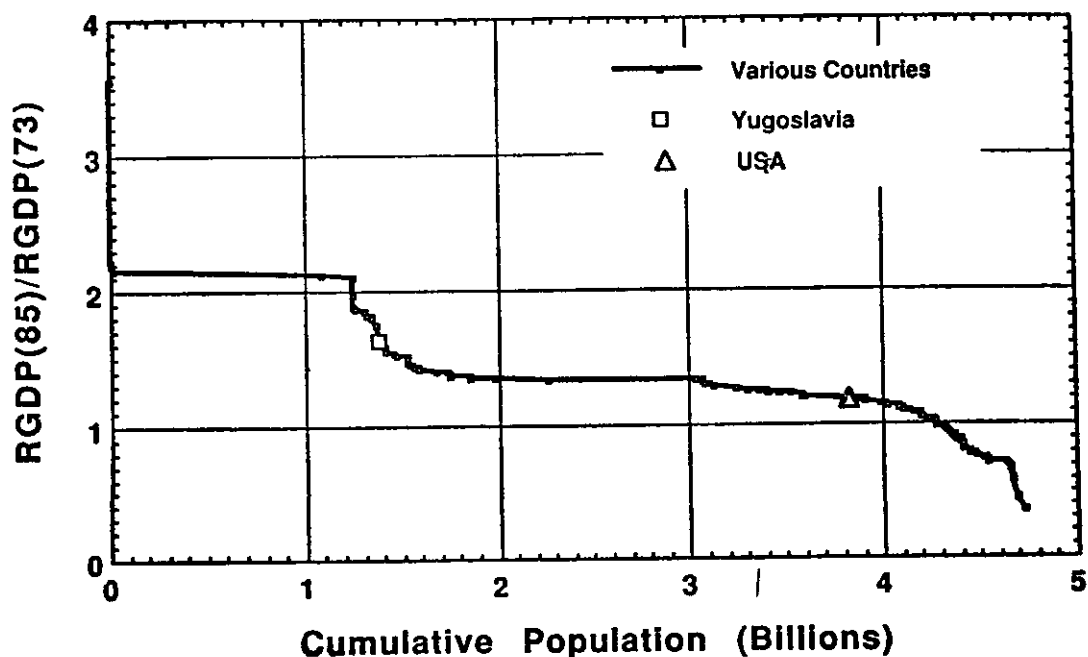


Figure 10. The growth index (ratio of two real gross domestic products per capita) comparing 1985 with 1973 (column 10 in Table 2) is plotted in its decreasing order for 129 countries as a function of cumulative population (column 3 in Table 2). The positions of Yugoslavia and the US are highlighted.

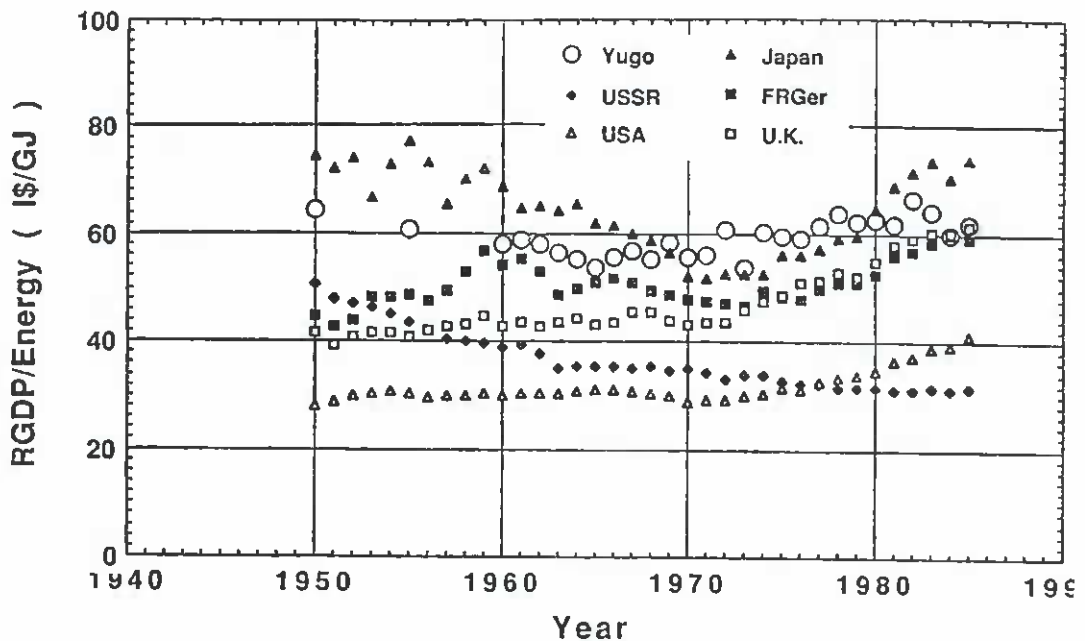


Figure 11. The efficiency of energy use expressed as a ratio of the Real Gross Domestic Product (RGDP) in International Dollars (I\$) to the energy consumed in gigajoules (GJ) is plotted for Yugoslavia and five large industrialized countries.

**KORISTEĆI RGDP I EDI:
REALISTIČNO POREĐENJE PROTEKLE JUGOSLOVENSKE
EKONOMSKE PERFORMANSE SA DRUGIM ZEMLJAMA**

Jovan JOVANOVIĆ

Rezime

Metodologija razvijena od strane Projekta međunarodnog upoređivanja (ICP) proširena je i primenjena na Jugoslaviju. Izvedena je formula koja omogućava izračunavanje Indeksa odstupanja kursa (EDI) za nestandardne godine. Indeks kursne devijacije za Jugoslaviju je izračunat ekstrapoliranjem od standardne 1975 godine unazad do 1955. i unapred do sredine 1990. Učinjeno je poređenje sa drugim determinacijama EDI za period 1955—1985. Rezultati su pokazali da je tokom većine proteklih 35 godina kupovna moć jugoslovenskog dinara u zemlji bila mnogo veća nego što je to izgledalo kada je dinar bio manjan sa US dolarom po zvaničnom bankarskom kursu.

Sačinjeno je realističko upoređenje protekle jugoslovenske ekonomske performanse sa drugim zemljama. Rezultati pokazuju da su realni društveni dohodak Jugoslavije i efikasnost korišćenja energije bili zauvek znatno veći nego što je izgledalo kada se izračunalo u US dolarima upotrebljavajući Atlas metod Svetske banke.