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A USER'S GUIDE TO THE M.I.T.
WORLD ENERGY DEMAND DATA BASE*
- PART I OVERVIEW -
by
Demand Analysis Group**
M.I.T. World Oil Project
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I. INTRODUCTION

This document describes in some detail a large computerized data base that has been developed to perform an econometric study of the world demand for energy. The econometric models currently being constructed are, however, only one "output" of this research project; a second "output" is represented by the data base itself. As is often the case in empirical work such as this, a considerable amount of effort went into the construction of the data base, and we therefore hope that it might be used by other research groups as well as ours. We expect this to be the case for two reasons. First, no piece of research can be considered "scientific" unless the results can be duplicated by other researchers, and this of course requires access to the original data that were used. It is important that other researchers be able to corroborate our own results, and we therefore wish to make our data easily available to them. Second, we expect that other research groups performing their own independent studies of world energy markets would wish to take advantage of our existing data for their own work.

In order to make our data easily accessible, the entire data base has been installed on the TROLL system of the Computer Research Center of the National Bureau of Economic Research. TROLL is an interactive computer system that was designed for data base management and econometric modelling and simulation. TROLL can easily be accessed via time sharing by research groups anywhere in the United States, thus permitting direct access to our data. The purpose of this guide is to describe the data in enough detail so that other groups can easily access it, understand the meaning of each data series itself as well as the transformations and conversions used to put the data in a form amenable to econometric study, and easily refer back to the original references from which the data were obtained.

The organization of this guide is as follows. First we provide an introduction and overview of the data base, briefly describing its contents and explaining our motivations in collecting the particular data that we did. Next, all of the basic variables used in our econometric work are briefly defined, and an explanation is provided of how each variable is obtained. The third section contains a discussion of the use of purchasing power parities in making international price and expenditure comparisons. A detailed description of all the data series is provided on a country-by-country basis in section four, together with time bounds, sources, and an explanation of any transformations or conversions that were applied. The last section contains a detailed list of all of our data sources, including, where applicable, library references for each source in the MIT or Harvard libraries.

1.1 Overview of the Econometric Study

The econometric studies for which our data base has been constructed has two main purposes: first, to develop models for the demand for petroleum products on a sector by sector basis for most of the major oil consuming countries of the world, and second, to examine in some detail the characteristics of energy demand and interfuel substitution for the residential and industrial sectors of about 10 or 12 countries. We have therefore chosen a group of "primary" countries for which rather detailed data werecollected, and a second group of "secondary" countries for which less detailed data werecollected. Primary countries account for about 75 percent of non-Communist world oil consumption, and data for these countries is detailed enough to permit a full-scale econometric study of energy demand and interfuel substitution. Although less detailed data is available for secondary countries, enough is available to make it possible to estimate simple demand relationships for petroleum products. Primary and secondary countries together account for some 85% to 90% of non-Communist world oil consumption.

Our econometric study of residential demand for the primary countries involves a two-stage procedure, where first the consumption basket for each country is broken down into a set of commodity classes, one of which is energy. This first stage model will permit us to examine the residential demand for energy and the way that energy demand fits into the consumption basket in different countries. The second stage involves breaking energy demand down into the demands for alternative fuels (oil, gas, coal, and electricity). This two-stage approach thus permits us to analyze the impact of a price change (or change in any other exogenous variable) on the demand for oil in terms of the effect on total energy usage and the effect on fuel choice.

The expenditure breakdown study is being done using alternative model specifications, both consistent (in terms of additivity) and inconsistent. In particular, demand systems based on both static and dynamic versions of the indirect translog utility function, as well as the static and dynamic versions of the linear expenditure system, are being estimated. Alternative demand specifications are also being used to study interfuel competition in the residential sector. Static and dynamic translog systems are being estimated, as well as multinomial logit models.

Industrial demand is also being modelled using a two-stage approach. The first stage will consist of a model determining the total demand for energy as a derived factor input into industrial production. Translog production functions are being used that include capital, labor, and energy as factor inputs. Our objective here is to obtain estimates of the elasticities of substitution between these factors, and determine how these elasticities vary across countries. Interfuel competition in the industrial sector is also being modelled using static and dynamic translog models, as well as logit models.

As mentioned before, residential and industrial demand for petroleum products are being modelled in considerably less detail for secondary countries. Simplified models are also being estimated to explain the demand for petroleum products by the transportation, energy transformation, and "other" sectors in both primary and secondary countries. One of our longer-term objectives in this work is to obtain demand models for individual countries that determine the sectoral demand for petroleum products, and the "derived" demand for crude oil from producing countries. A typical demand model is shown graphically in Figure 1.

Figure 1. <u>Demand Model for Petroleum for an Individual</u>
<u>Country</u>
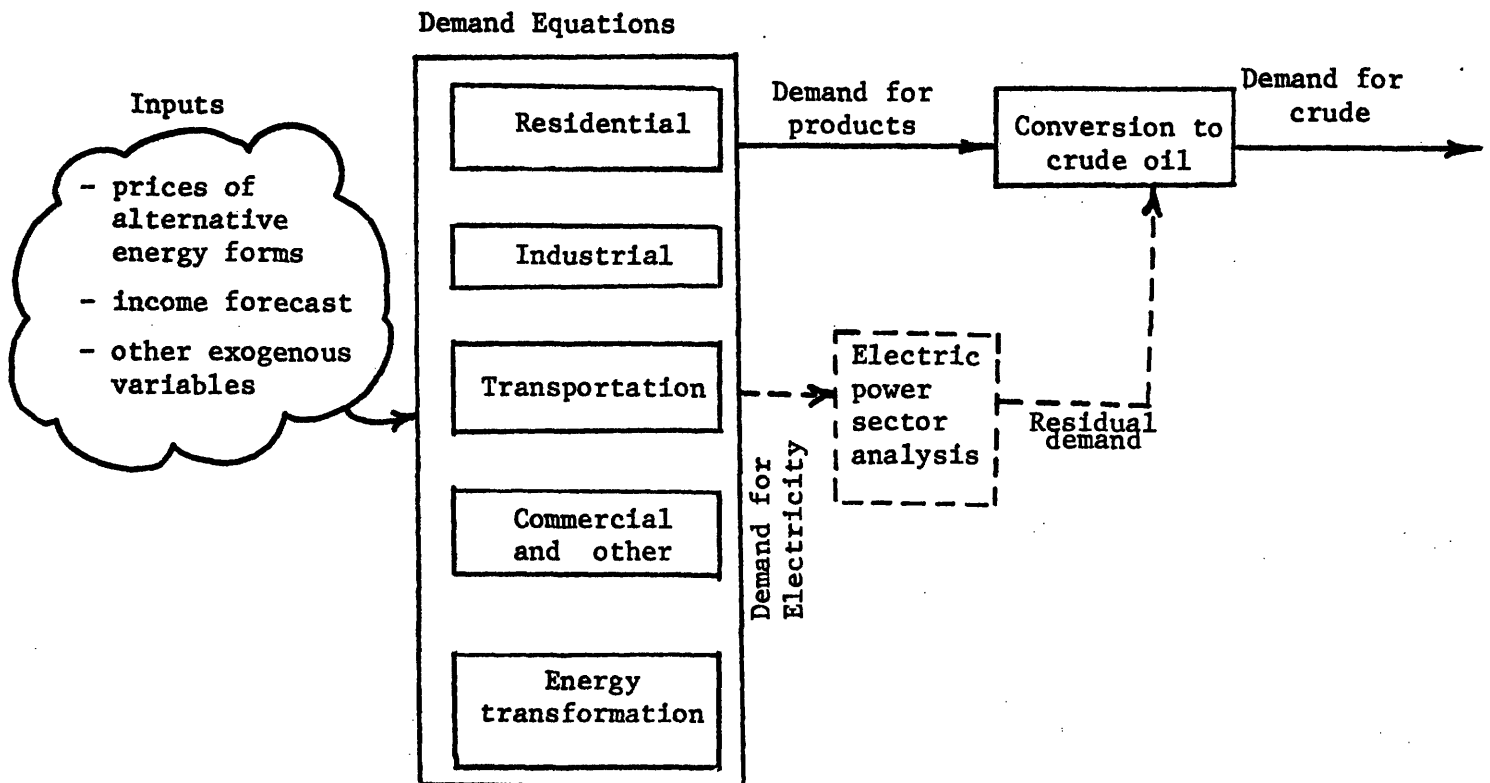
The current version of our data base concentrates largely on the residential and industrial sectors, although the data base will be enlarged in future months. A summary of the countries involved in our study, as well as the data items that have been collected, is given in Table 1 below.

COUNTRIES IN DEMAND MODEL FOR RESIDENTIAL SECTOR

Primary	Secondary
USA	Australia
Canada	Austria
UK	Denmark
France	Brazil
W. Germany	Venezuela
Italy	Argentina
Norway	Mexico
Sweden	India
Belgium	South Africa
Netherlands	Switzerland
Japan	Turkey
Spain	Finland

COUNTRIES IN DEMAND MODEL FOR INDUSTRIAL SECTOR

USA	Norway
Canada	Sweden
UK	Belgium
France	Netherlands
W. Germany	Japan
Italy	

DATA COLLECTED

Residential

1. -Consumption Breakdown
   Expenditures on and price series for
   food, alcohol, tobacco
   clothing
   housing
   consumer durables
   transportation
   energy

2. -Fuel Breakdown
   Expenditures on and price series for
   petroleum products
   coal
   gas
   electricity

3. -Miscellaneous
   temperature
   population
   personal income

Industrial

1. -Factor Breakdown
   Expenditures on and price series for
   capital,
   labor
   raw materials
   energy

2. -Fuel Breakdown
   Quantities of and price series for
   oil
   coal
   gas
   electricity

3. -Miscellaneous
   output of manufacturing sector
   value added of manufacturing sector
   bond interest rates
   depreciation rates

- TABLE 1 -

1.2 Residential Data

Collecting data for the residential sector usually involved going to the National Statistical Yearbooks of the individual country, since traditional data sources are weak in this area. For example, we needed the retail prices of petroleum products that consumers faced in each country, as well as the prices of the direct substitutes for petroleum - coal, natural and manufactured gas, and electricity. Quantities of each of these energy sources consumed by the residential sector are also necessary. The data available from the U.N. and OECD in these areas are very limited. For example, the OECD lumps agriculture, handicrafts, and residential consumption together. As a result, annual statistical yearbooks were needed to fill in these data gaps.

For our primary countries we would like to determine how changes in the relative price of energy affects the fraction of the consumer budget devoted to energy. For each primary country we therefore need total consumer expenditures broken down by category. A number of sources provide breakdowns of total consumer expenditures according to (I) Food, alcohol, tobacco; (II) Clothing; (III) Housing; (IV) Durables; (V) Transportation Services; and (VI) Energy. Price indices for all of these series on consumer expenditures could also be obtained from National Statistical Yearbooks. However, exact data series were not always available, and exceptions have been noted in the third section of this guide. For example, there were occasions where for a particular country data was available for expenditures on food, alcohol, and tobacco, while the only price index available was for food. In this case we used that price index for the total category since food was by far the largest component of the category. Such surrogates when used are described in detail in each instance.

The second stage of our residential model breaks energy expenditures down into expenditures on individual fuels. Thus for primary countries data is needed for both prices and expenditures for each fuel. This data is not available in any single publication for all of our primary countries. OECD publications lump residential consumption data in with that of government, agriculture, and a few other sectors, so that their published data was of little use to us for the residential sector.[1] As a result, most of our fuel expenditure data was obtained from SOEEC National Accounts and National Statistical Yearbooks.

Price data for oil, coal, gas and electricity for the residential sector was also available in National Statistical Yearbooks, as well as EEC publications. In most instances for our primary countries average nationwide retail prices for light fuel oil, hard coal, electricity and natural gas were available. In some cases, only prices in the largest population centers were available - and these were used. In the case of Canada electricity and gas prices were available for each of the five regions; for these two series we computed a national average by weighting the price in each region by the quantity consumed in that region.

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[1]The OECD does, however, have more extensive data available on a computer tape. where private household consumption for each of four fuels is listed. However, comparing that data for a few countries with the residential quantity data that we had collected from national sources indicated that the OECD figures were consistently higher by 30% to 50%. Although the OECD tape description did not define their term "private household," we soon realized that it was a broader concept than our "residential" and included other consumption by the commercial sector. However, since this OECD tape covered countries which we wanted to include in our detailed model and for which we had not been able to find residential data from national sources, we wanted to determine if it could still be used to provide figures on relative shares of each fuel. It appeared that the data for the OECD's more broadly defined category was highly correlated with the data for our more narrowly defined category; if the correlations were high enough then errors in relative shares would be low. We chose a few quantity series for which we had data both in the narrowly defined sense and the broadly defined OECD sense. For example, we had data on Swedish electricity consumption by the residential sector narrowly defined and as defined on the OECD tape. The correlation coefficient between the two series over the period 1960 to 1973 was over 99%. Similarly, the OECD figures for Italian electricity consumption had a 97% correlation with the corresponding figures collected from national sources. As a result we concluded that for two countries - Japan and West Germany - we could safely use the OECD data to compute relative expenditure shares for each fuel.

The units for each price are monetary unit/physical unit. To calculate elasticities within and across countries it is necessary to have common physical units for every price series. The obvious common physical unit is a measure of the heating value of the fuel. We chose to work with Tcals (1 Tcal = 10^9 Kcal). A table of conversions appears at the end of this guide.

Temperature data were also collected for each country. Average monthly temperature data for cities in all the countries we are studying is available from publications of the USA Meterological Service. We computed the average temperature from this data from the five winter months in the northern hemisphere (November to March) for the most industrialized city of each of our countries, and used that as the temperature figure for the country. For those countries which are large and have population centers spread out, such as the USA and France, we would take the average of two or more cities in diverse regions and use that average as the figure for the country.

Less detailed data is needed for secondary countries. Consumption of petroleum products is available for all OECD countries in OECD publications. Such data for non-OECD countries was gathered from National Statistical Yearbooks. National sources must also be used to obtain price data. Data collection for secondary countries is still in progress; this data is described in more detail later.

1.3 Industrial Sector

We define the industrial sector as including all manufacturing concerns not involved in extracting or transforming energy, thus excluding petrochemical complex, oil refineries, power plants, coal mines, etc. One of our objectives is to determine to what extent energy is a substitute for labor and capital in

the production process, so that data is needed for manufacturing output, as well as labor and capital input to manufacturing. Manufacturing output data is available from the UN or OECD sources. The industrial prices for the four energy sources can be found in NSY's and SOEEC publications, as is the case for residential prices. Labor input for a particular year is measured as that amount of remuneration which labor received in that year, and this data can be obtained from UN publications as well as National Statistical Yearbooks. The price of labor is obtained from weighted indices published in the statistical yearbooks. The price and quantity of capital services imputed is obtained as follows:

$$\text{capital services} = \text{gross output (at factor cost)} - \text{value added} - \text{wages and salaries.}$$

The price of capital is obtained from a 1958 book by Gilbert which contains data on the relative cost of capital equipment for a number of countries, e.g. $100 of capital in the USA in 1955 cost $65 in the UK in 1955, and $72 in West Germany in 1955. These numbers can be brought forward with the relevant producer durable price indices published by the OECD. To obtain the user cost of capital we multiply the previously obtained price of capital times (r & d) where "r" is taken to be the long run bond rate obtained from IMF sources and "d" is a simple straight line depreciation estimate based on the life of assets published in Denison's 1967 book, Why Growth Rates Differ. This approach allows us to include at least 10 countries in our detailed industrial demand model, all of which are OECD members. A summary of industrial data series and sources is given in Table 2.

Table 2
INDUSTRIAL SECTOR

Variables	Source
quantities of oil coal, gas, & elec. consumed	OECD Energy Statistics 1959-73
prices of oil, coal, gas and electricity	National Statistical Yearbooks; SOEEC price sheets
output of mfg sector	OECD national accounts 1960-72; UN national accounts
value added of mfg sector	National Statistical Yearbooks. UN - "Growth of World Industries"
wages & salaries for mfg. sector	UN "Growth of World Industries"
Bond interest rate	"Int'l Financial Statistics"
Depreciation rates	E. Denison - "Why Growth Rates Differ" (1967)
Relative price of capital services in 1955	M. Gilbert - "Comparative National product and price levels (1958)
Price indices for capital goods	construct from OECD National Accounts

2. VARIABLES INCLUDED IN THE DATA BASE

2.1 Residential Sector

This section contains a brief summary of the major economic variables used in our econometric work and included in the data base. More detailed information is provided on a country-by-country basis in Section 3. Most of the price series were transformed into a common currency unit using purchasing power parities. A discussion of the use of purchasing power parities, and data sources for purchasing power parities, is given in Section.3.

Price of Coal	Retail price of hard coal. Countrywide averages usually, but occasionally that of major city only. Source: National Statistical Yearbooks (NSY's), and SOEEC Energy Statistics. Units: PPP adjusted $'s/tcal.
Price of Electricity	Retail price of electricity. For countries with tariffs, the price level chosen was the average price facing an average size household. Countrywide averages usually, but occasionally that of major city only. Source: NSY's, and SOEEC Energy Statistics. Units: PPA $'s/tcal.
Price of Gas	Retail price of gas. For countries with tariffs, the price level chosen was the average price facing an average size household. When the price of manufactured gas was different from that of natural gas, an average of the prices weighted by the relative amounts consumed was calculated. Countrywide averages usually, but occasionally that of major city only. Source: NSY's and SOEEC Energy Statistics. Units: PPA $'s/tcal.
Price of Oil	Retail price of light fuel oil. Countrywide averages usually, but occasionally that of major city only. Source: NSY's and SOEEC Energy Statistics. Units: PPA $'s/tcal.
Expenditures on Coal	Total consumer expenditures on coal. This figure was usually given in NSY's or EEC National Accounts but occasionally had to be computed by multiplying the retail price of hard coal times the physical quantity of hard coal consumed. The physical quantity data was available on the OECD Energy Statistics tape, which contains slightly more disaggregated data than the OECD Energy Statistics book. Units: current local currency.

Expenditures on Gas	Total consumer expenditures on natural gas. This figure usually given in NSY's or EEC National Accounts but occasionally had to be computed by multiplying the retail price of gas times the physical quantity of gas consumed. The physical quantity data was available on the <u>OECD Energy Statistics</u> tape, which contains slightly more disaggregated data than the OECD Energy Statistics book. Units: current local currency.
Expenditures on Petroleum Products	Total consumer expenditures on petroleum products. This figure was usually given in NSY's or EEC National Accounts but occasionally had to be computed by multiplying the retail price of petroleum prod. times the physical quantity of petroleum products consumed. The physical quantity data was available on the <u>OECD Energy Statistics</u> tape, which contains slightly more disaggregated data than the OECD Energy Statistics book. Units: current local currency.
Expenditures on Electricity	Total consumer expenditures on electricity. This figure was given usually in NSY's or EEC National Accounts, but occasionally had to be computed by multiplying the retail price of electricity, times the physical quantity of electricity consumed. The physical quantity data was available on the <u>OECD Energy Statistics</u> tape, which contains slightly more disaggregated data than the OECD Energy Statistics book. Units: current local currency.
Total Consumer Expenditures	Total consumption expenditures by all households. Source: <u>OECD National Accounts</u>; SOEEC National Accounts; UN Yearbook of National Accounts. Units: current local currency.
Expenditures on Food, Alcohol & Tobacco	Total expenditures on food, alcohol and tobacco by all households. Source: OECD National Accounts; SOEEC National Accounts; UN Yearbook of National Accounts; SNY's. Units: current local currency.
Expenditures on Clothing	Total expenditures on clothing by all households. Source: <u>OECD National Accounts</u>; SOEEC National Accounts; UN Yearbook of Nat'l Accounts, and NSY's. Units: current local currency.
Expenditures on Durables	Total expenditures by all households on durable items such as furniture and automobiles. Source: <u>OECD National Accounts</u>; SOEEC National Accounts; UN Yearbook of National Accounts, and NSY's. Units: current local currency.
Expenditures on Transportation & Communication	Total expenditures on items classified as purchased local and intercity transportation and communication. Source: NSY's; SOEEC National Accounts; UN Yearbook of National Accounts, and <u>OECD National Accounts</u>. Units: current local currency.
Expenditures on Housing	Total expenditures, actual and inputed, on housing. This includes rental payments and estimates of the imputed rent for a house one owns. Source: <u>OECD National Accounts</u>; SOEEC National Accounts; UN Yearbook of National Accounts; NSY's. Units: current local currency.

Expenditures on Energy	Total expenditures by all households on energy - coal, petroleum products, electricity and gas. This figure was often directly attainable from NSY's, but sometimes had to be constructed by taking the quantities consumed by households of each of the four energy sources, multiplying each by its respective price,and then summing. Source: NSY's; SOEBC National Accounts; OECD Energy Statistics. Units: current local currency.
Expenditures on "Other"	Simply the difference between total consumer expenditures and the sum of the 6 expenditure categories we have broken out. Items such as expenditures on health are included here because things are not broken out consistently in more than a few countries' national accounts. Also, in a number of European countries consumers do not make direct choices on how much they will spend on health services since government insurance programs pay for it.
Price index for Food, Alcohol & Tobacco	Retail price index, or when not available, index of private consumption expenditure with 1970=100. For some countries the price series for only food was available, and in those cases it was used for this category. Source: NSY's or OECD National Accounts, either as a price series or as consumption expenditures in current and constant monetary units from which the desired series could be constructed.
Price Index for Clothing	Retail price index, or when not available, index of private consumption expenditure with 1970=100. Source: NSY's or OECD National Accounts, either as a price series or as consumption expenditures in current and constant monetary units from which the desired series could be constructed.
Price Index for Durables	Retail price index, or when not available, index of private consumption expenditure with 1970=100. Source: NSY's or OECD National Accounts, either as a price series or as consumer expenditures in current and constant monetary units from which the desired series could be constructed.
Price Index for Housing	Retail price index, or when not available, index of private consumption expenditure with 1970=100. Source: NSY's or OECD National Accounts, either as a price series or as consumption expenditures in current and constant monetary units from which the desired series could be constructed.
Price Index for Energy	Retail price index with 1970=100, constructed by means of an estimated translog aggregator from the actual prices for light fuel oil, hard coal, gas and electricity.
Price Index for Transportation and Communication	Retail price index, or when not available, index of private consumption expenditure with 1970=100. Source: NSY's or OECD National Accounts, either as a price series or as consumer expenditures in current and constant monetary units from which the desired series could be constructed.

Total Net Disposable Income	Total net disposable income of all households. For a few countries only total private income data was available. Private income is personal income plus income going to non-profit institutions. In these cases the private income figure was used for this category and was noted in the detailed description of that data. Source: OECD National Accounts, and UN Yearbook of National Accounts. Units: current local currency.
Temperature	The average temperature over the five winter months (Nov-Mar) in the principal city of the country. In large countries, with varying climates, an average temperature for two cities experiencing a different climate is used. Source: U.S. Weather Bureau, World Meterological Data. Units: degrees F.
Population	Total population of country. Source: U.N.Demographic Yearbook. Units: millions of people.
Exchange Rates	Price of other currency in terms of U.S. dollar. Source: International Financial Statistics.

2.2 Industrial Sector

Quantity of Oil
Consumed
Amount of fuel oil and "gas oil" used for burning by all manufacturing concerns not involved in extracting or transforming energy (thus all petrochemical complexes, oil refineries, power plants, coal mines, etc., were excluded). Source: OECD Energy Statistics, 1959-73. Units: Tcals.

Quantity of Coal
Consumed
Amount of coal consumed by all manufacturing concerns not involved in extracting or transforming energy. Source: OECD Energy Statistics, 1959-73. Units: Tcals.

Quantity of Gas
Consumed
Amount of both natural and manufactured gas consumed by all manufacturing concerns not involved in extractioning or transforming energy. Source: OECD Energy Statistics, 1959-73. Units: Tcals.

Quantity of Elec.
Consumed
Amount of electricity consumed by all manufacturing concerns not involved in extracting or transforming energy. Units: Tcals.

Price of Oil
Wholesale price of heavy fuel oil paid by the manufacturing sector - national average. Source: EEC energy publications and National Statistical Yearbooks. Units: PPPA $'s/tcal.

Price of Coal
Wholesale price of coal paid by the manufacturing sector - national average. Source: EEC energy publications and NSY's. Units: PPPA $'s/tcal.

Price of Gas
Wholesale price of gas paid by the manufacturing sector. When significant amounts of both natural and manufactured gas were consumed, a weighted average price was computed from the prices of each type of gas with weights being the amounts of each type consumed. Source: EEC energy publications and National Statistical Yearbooks. Units: PPPA $'s/tcal.

Price of
Electricity
Wholesale price of electricity paid by the manufacturing sector. Electricity in many countries is priced differently from other fuels; the marginal price of electricity is usually less than the average price. We felt that it would be too difficult to try to model this characteristic so we simply used an average price of electricity. Source: EEC energy publications and NSY's. Units: PPPA $'s/tcal.

Output of the
Manufacturing
Sector
The current value of gross output compiled on a production basis and comprising (a) the value of all products of the manufacturing sector as we have defined it, (b) the net change in the value of work-in-progress, (c) the value of industrial services rendered to others, and (d) the value of fixed assets produced during the period by the unit for its own use. Source: OECD National Accounts and U.N. National Accounts. Units: current local currency.

Value Added of Manufacturing Sector	The value of output less the current costs of (a) materials, fuels and other supplies consumed, (b) repair and maintenance work done by others, (c) goods shipped in the same condition as received. Source: UN: Growth of World Industries. Units: current local currency.
Wages and Salaries for Manufacturing Sector	Total remuneration including fringe benefits for employees in the manufacturing sector. Source: UN; Growth of World Industries. Units: current local currency.
Bond Interest Rate	Long-term government bond interest rate - yearly average. Source: International Financial Statistics.
1955 Price of Capital	The price in local currency in 1955 of the physical equivalent of $100 worth of capital goods in the USA in 1955. Source: Gilbert's Comparative National Product and Price Levels (1958).
Depreciation Rates	Denison's Why Growth Rates Differ contains estimates of the service life of a number of country's capital goods. By applying simple straight line depreciation to this data, rough depreciation figures can be arrived at. Countries included are: Norway, USA, Belgium, Italy, Germany, France, Netherlands, Denmark and U.K.
Price Indices for Capital Goods	The OECD National Accounts contains in current and constant monetary units the amount of investment in capital goods. From this data price series for capital goods can be constructed.
Price Indices for Labor	NSY's contain either price series for manufacturing labor or the remuneration to manufacturing labor in constant and current monetary units from which the desired series can be constructed.

Availability of industrial data for ten countries is summarized in Table 3.

TABLE 3: Industrial Data Availability

	Output of Manufacturing Sector	Wages & Salaries in Manufacturing	Value Added in Manufacturing	Price index for labor input	Hard coal consump. by mfg	All gas consump by mfg	gas oil and fuel oil by mfg.	Electricity consumption by manufacturing	Depreciation rates	Bond rate	Price index for capital goods
CANADA	60-73[1]	58-73[2]	58-73[2]	NSY	59-73[3]	59-73[3]	59-73[3]	59-73[3]	approximate by USA	50-73[5]	60-73[6]
USA	58-73[2]	58-73[2]	58-73[2]	NSY	59-73[3]	59-73[3]	59-73[3]	59-73[3]	see ref 4	50-73[5]	60-73[6]
JAPAN	60-73[1]	58-73[2]	58-73[2]	NSY	59-73[3]	59-73[3]	59-73[3]	59-73[3]	approximate by W. Germany	50-73[5]	NSY
BELGIUM	60-73[1]	58-73[2]	58-73[2]	NSY	59-73[3]	59-73[3]	59-73[3]	59-73[3]	see ref 4	50-73[5]	60-73[6]
FRANCE	60-73[1]	NSY	61-73[2]	NSY	59-73[3]	59-73[3]	59-73[3]	59-73[3]	see ref 4	50-73[5]	60-73[6]
W. GERMANY	60-73[1]	58-73[2]	58-73[2]	NSY	59-73[3]	59-73[3]	59-73[3]	59-73[3]	see ref 4	50-73[5]	60-73[6]
ITALY	60-73[1]	NSY	58-73[2]	NSY	59-73[3]	59-73[3]	59-73[3]	59-73[3]	see ref 4	50-73[5]	60-73[6]
NETHERLANDS	60-73[1]	58-73[2]	58-73[2]	NSY	59-73[3]	59-73[3]	59-73[3]	59-73[3]	see ref 4	50-73[5]	60-73[6]
SWEDEN	60-73[2]	61-73[2]	61-73[2]	NSY	59-73[3]	59-73[3]	59-73[3]	59-73[3]	approximate by W. Germany	50-73[5]	60-73[6]
U. K.	60-73[1]	*61-72[2]	*61-72[2]	NSY	59-73[3]	59-73[3]	59-73[3]	59-73[3]	see ref 4	50-73[5]	60-73[6]

SOURCES:

1. OECD National Accounts, 1960-70; 1962-73
2. UN Growth of World Industries (numerous annual volumes)
3. OECD Energy Statistics, 1959-73
4. Why Growth Rates Differ – Denison
5. "International Financial Statisitcs" (quarterly)
6. "UN National Accounts" (numerous annual volumes)

* a few years missing

√ use discount rate

2.3 Data for Secondary Countries

We are now in the process of collecting data for secondary countries.

Variables, definitions, and sources are listed below.

Population
: Population data for all secondary countries can be found in the Demographic Yearbook of the UN. The data is complete for all countries, years 1950-73.

GNP
: For South American countries data is available in the Statistical Abstract of Latin America. This data is in local currency, current and constant prices, so that a price index is available. The range of years available is generally 1953-71. Data is in US dollars. For European countries and Australia, data is available in National Accounts of OECD Countries. The GNP figures are in current and constant US dollars, so that a price index can be determined. The UN National Accounts Yearbook can be used for other countries. The UN data is in US dollars.

Consumption of Petroleum Products
: Consumption data is available from the OECD publications and tape, broken down into residential, industrial, transportation, and energy sectors. The years generally available are 1950-73, and the following products are included: patent fuel, crude petroleum, residual oil, refinery gas, liquified gases, aviation gasoline, motor gasoline, jet fuel, kerosene, gas oil for burning and fuel oil. The SOEEC Energy Yearbook also has consumption data for the industrial, transportation, and private sectors, up to 1973, for all petroleum products, motor gas, non-gaseous products, aviation gas, diesel oil, and residual fuel oil. The UN tape has consumption data. The data is for total national consumption of jet fuel, kerosene, fuel oils, and liquid fuels. The National Statistical Yearbooks also contain consumption data for various petroleum products.

Prices
: Retail prices for gasoline, kerosene, and bunker "C" oil is available from the US Bureau of Mines, Petroleum Annual. The price is in US cents/gallon, and data is quarterly. The available years are spotty, but every country we are interested in is included. This same information is available in the OPEC Annual Statistical Bulletin. Some retail gasoline prices are also available from SOEEC Energy Statistics, and the data is in local currency/100 liters. Retail prices and wholesalers' prices to retailers for petroleum products are available for South American countries in America en Cifras, 1965-71; probably more years are available. The following products are included: lubricating oil, regular gasoline, kerosene, petroleum fuel, diesel fuel.

Also, data supplied by James Griffen has prices of light fuel oil, auto diesel, domestic kerosene, and industrial fuel oil, for years 1955, '60, '65, and '69. <u>Statistiches Burdesamt</u> contains price data for a few countries, for some petroleum products.

For wholesale prices, the following are useful sources of information: European countries – <u>International Crude Oil and Products Prices</u>. South America – <u>OPEC Annual Statistical Bulletin</u> and <u>Petroleo y Otros Datos</u>.

Consumption of Other Fuels
The same sources cited for petroleum consumption contain consumption of other fuels.

Prices
The prices of other fuels are available in <u>America en Cifras</u>, <u>Statistiches Bundesamt</u>, <u>EEC Energy Yearbook</u>, the Griffen data, and NSY's, e.g. <u>Estudios Sobre la Electricidad</u>.

Temperature
We are using the average temperature of the 5 coldest months for the populous, industrial cities, the average weighted for population if several cities are used for the country. All data is available in <u>Monthly Climatic Data</u> of the US Weather Bureau and World Meterological Association.

3. Use of Purchasing Power Parities to Convert Nominal International Prices
to Constant U.S. Dollars

3.1 Methodological Problems in the Use of Purchasing Power Parities

There are three conceivable ways to generate international price and

expenditure comparisons:

    (i)   at official exchange rates
   (ii)   at purchasing power parities
  (iii)   at "free market" exchange rates.

A competent discussion of the merits and demerits of various methodologies can

be found in Samuelson (1974) and Chenery and Syrquin (1975), pp. 145-153. Method

(i),coonversion at official exchange rates, will receive no further attention

here since such rates are a priori inadmissable (due to distortions, rigidities

and controls) to deflate nominal to real values in an economically meaningful way.

Method (iii) may prove to be of some value. "Free market" rates between

individual countries may loosely be had for a large number of countries (i.e.

those with minimal tariff distortions and exchange controls) by selecting pairs

of countries with substantial trade balances and a time-period thought to qualita-

tively reflect "equilibrium" forces. Alternatively, estimates of the "effective

rate of protection" can be found for those countries with substantial distortions

and used to deflate to nominal values (see Schydlowsky and Syrquin, 1972). Such

estimates may be found in Balassa and Associates (1971) and Balassa (1965). But

there is little formal theoretical defense for such procedures and they, too, will

receive no further discussion.

The remaining option is to deflate nominal values by estimates of the relative

purchasing power of the various national currencies. There are three ways such

comparisons can be made...

(i) Implicitly: one can take a nominal national currency estimate of national product and base currency (such as U.S.$) estimate of the same national product and produce an implicit purchasing power deflator. Such a procedure is followed in Lluch and Powell (1975) and Lluch and Williams (1975).

(ii) Explicitly, making binary comparisons. A formula of the form

$$\Sigma P_A Q_A / \Sigma P_B Q_A = PPP_A$$

$$\Sigma P_A Q_B / \Sigma P_B Q_B = PPP_B$$

with P, Q, A, B, representing price, quantity, country A and country B respectively, gives the A and B weighted (Laspeyre and Paasche) price index numbers, PPP_A and PPP_B. As Samuelson (1974) points out, theoretically, and Kloek and Theil (1965) show empirically, there are good reasons to prefer a Fisher "ideal" geometric mean of these two numbers as a single index of relative purchasing power.

These binary comparisons, in turn, can be used to make multilateral purchasing power comparisons. While the use of a single "bridge" country to make these comparisons guarantees a transitive international ordering, such an ordering is not invariant with respect to changes in the choice of "bridge" country. It can also be argued that, in the case of incomplete data, the binary comparison of "included" prices neglects valuable information on "excluded" prices that could be utilized in multilateral price level comparison. Kravis, et.al, (1975) discusses these issues in Chapter 5.

(iii) Explicitly, making multilateral comparisons. Within a regression model, a variance components structure is used to estimate the purchasing power parity for a single category of expenditure, as a function of all other international price ratios. Such a formulation is both transitive and base-country invariant in the orderings produced. Kravis, et al., (1975) have implemented such an approach.

After we have obtained base-year parities, we are faced with the problem of constructing intertemporal conversion indices to deflate our time series data. To do this, note that such an exchange rate between countries A and B equals the relative prices, in the national currency, of some given market basket of goods, i.e.,

$$X_{AB} = P_A/P_B \text{ for some base year } b = P_A(b)/P_B(b)$$

and that

$$P_A(b+t)/P_B(b) = \frac{P_A(b+t)}{P_A(b)} \cdot X_{AB}.$$

Given a base-year purchasing power parity, and time series of the consumer price indices, we can easily construct the implicit ratio of relative inter-temporal purchasing powers in terms of the base-year numeraire.

3.2 Availability of Data

In all the following B denotes a bilateral PPP ratio, M a multilaterally estimated PPP ratio. Countries for which the comparisons have been made are listed. A* denotes that both home anf foreign country weighted (i.e. Laspeyne and Paasche) price indices have been constructed; otherwise assume that only the weights of the country (or author's country) of issue are used. "DET" indicates PPP ratios by detailed category of consumer expenditure are available; "INV" indicates a ratio for the gross investment deflator has also been constructed.

1. Implicit ratios [N.C.U. GNP]
   —————————————
   $ GNP

   [N.C.U. = national currency unit]

   (i) Lluch and Powell (1975)

Year = variable, generally in early '60's	Thailand	Greece	U.K.
	S. Korea	Panama	W. Germany
	Phillipines	S. Africa	Australia
	Taiwan	Ireland	Sweden
	Ecuador	Puerto Rico	U.S.A
	Chile	Italy	
	Jamaica	Israel	

   (ii) Lluch and Williams (1975)

year of comparison occasionally varies from above study.	Thailand	Greece	U.K.
	S. Korea		W. Germany
		S. Africa	Australia
	Taiwan	Ireland	Sweden
			U.S.A.
		Italy	
	Jamaica	Israel	

2. Explicitly calculated PPP series

    (i) Gilbert, et. al., (1954 & 1958) B

        Year = 1950, DET, INV

U.S. *	France *	Italy *
Denmark *	Belgium *	
U.K. *	Netherlands *	
Norway *	Germany *	

(ii) Watanabe & Komiya (1958)

        Year = 1952, DET, INV.   B   U.S.   Japan

(iii) Statistical Office of the European Economic Community (1962)

        Year = 1955-61   B

Germany *	Belgium *
France *	Saarland *
Italy *	
Netherlands *	

(iv) Statistical Office of the European Economic Community (1972) B

Germany *	Belgium *
France *	Luxembourg *
Netherlands *	

    (v) Economic Commission for Latin America (1963, 1968)

        Year = 1960, 62, DET, INV.   B

        All 18 Latin American countries*.

(vi) Salazar-Carrillo (1973)

        Year = 1968.   B

Argentina	Colombia	Peru
Bolivia	Ecuador	Uruguay
Brazil	Mexico	Venezuela
Chile	Paraguay	

(vii) Kravis, <u>et. al</u>, (1975)

    Year = 1970, DET, INV. B,M

Colombia *	India *	UK *
France *	Italy *	US *
Germany *	Japan *	
Hungary *	Kenya *	

    Year = 1967, DET, INV. B

Hungary *	Kenya *
India *	UK *
Japan *	US *

(vii) Statistiches Bundesamt (various years)

    Year = 1949-73, DET. B

Belgium *	Spain	Panama
Denmark *	Czechoslovakia	Paraguay
Finland *	Turkey	Peru
France *	Hungary	Uruguay
UK *	Ethiopia	Venezuela
Italy *	Ghana	India
Luxembourg *	Cameroun	Australia *
Netherlands *	Mauretania	New Zealand *
Norway *	Niger	
Austria *	Senegal	
Sweden *	South Africa	
Switzerland *	Tunisia	
USSR *	Chad	
Kenya *	Uganda	
Rhodesia *	Argentina	
Tanzania	Bolivia	
Canada *	Brazil	
US *	Chile	
Israel *	Costa Rica	
Poland	Dominican Rep.	
Greece	Guatemala	
Yugoslovia	Colombia	
Portugal	Mexico	

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3.4 Calculation of 1970 Base-year Purchasing Power Parities for Detailed Expenditure Classes.

We are currently using only the Fisher ideal values from the Statistiches Bundesant for our regression work. Later we will incorporate much of Kravis' data. For overall Purchasing Power Parities, we used all expenditures without rent, since rent figures are of dubious reliability. For detailed expenditure losses, two methods were used, depending on the availability of detailed expenditure indices.

A. Detailed Expenditure Class Indices Available

The final result we want is a 1970 base-year parity with the U.S. as the base country. (All U.S. Purchasing Power Parities = 1 by definition) è.g. for England, we want ₤ '70/$'70. The data available (see Table 4) from the Statistiches Bundesant is in the form of a purchasing power parity with Germany as base-country and with a base-year which varies for different countries and is usually not 1970. The first step in arriving at a U.S.-based Purchasing Power Parity will be to transform the Germany-based PPP's to 1970 base-year. An example, using Norway, which has a June '60 PPP (see table), follows:

$$\text{DM '70/₤ '70} = \text{PM June'60/₤ June'60} \times \frac{\text{DM'60/DM June'60}}{\text{₤'60/₤ June'60}} \times \frac{\text{DM'70/DM'60}}{\text{₤'70/₤'60}}$$

The two expressions on the right can be obtained from indices for the expenditure classes we used - apparel, durables, food, transportation and communication, and other.

To obtain the precise index value for a month and year, e.g. June '60, we simply extrapolated using the midyear point of the preceding year and the midyear point of the succeeding year as base points. That is, an index given for 1960 is

presumed to be an average for the 12 months. Since one has to pick a single

point in closest approximation, this index number is presumed to be that of

June 1, 1960 exactly. Thus, the index for August, 1960 would be extrapolated

2/12th of the way between the 1960 and the 1961 index.

Once the German-based 1970 PPP is obtained, the U.S. based PPP is simply

£'70 (or any currency)/$'70 = (DM'70/$'70)/(DM'70/£'70)

Since DM'70/$'70 = 3.32, this reduces to

$$(\text{US-based 1970PPP}) \frac{1970 \ LC'70}{\$'70} = 3.32/ \frac{DM'70}{LC'70} \ (\text{German-based PPP})$$

B. <u>General Expenditure Index Available Only</u>

In cases where indices for detailed expenditure classes were not available,

the following formula was used as the next best approximation (apparel is used)

$$\frac{DM'70}{£'70} \ (1970 \ PPP \ for \ apparel) = \frac{DM'70(apparel)/DM'72(apparel)}{£'70(general)/£'72 \ (general)} \ x \ \frac{DM'72}{£'72} \binom{1972 \ PPP \ for}{apparel}$$

All four terms in the middle expression above are expenditure indices.

Note that all the indices for Germany were available, whereas England is used

as an example of a country for which the index for apparel was not available.

Table 4
Residential Model: Purchasing Power Parities
unit native currency = DM
Private Expenditures (w/o rent)

Country	Date	Unit	Wt.	Food, Tobacco, Alcohol	Shoes & Clothing	Elec., Gas & Water	Other household	Transport	Health	Ed. & Entertainment	Personal & Other	Household All Expend. (w/o rent)
Belgium (Brussels)	Oct. 1972	100 bfrs.	G	8.01	6.17	6.23	7.47	7.97	8.87	6.32	8.66	7.48
France (Paris)	Oct. 1972	IFF	G	.68	.55	.65	.63	.59	.54	.56	.85	.63
			N	.74	.58	.68	.66	.65	.74	.61	.82	.70
			F	.71	.56	.66	.64	.62	.63	.58	.83	.66
Italy (Rome)	Oct. 1972	100 Lit	G	.57	.62	.66	.67	.61	.71	.58	.68	.61
			N	.69	.63	.73	.90	.72	1.01	.63	.76	.73
			F	.63	.62	.69	.78	.66	.85	.60	.72	.67
Netherlands	April'67	1 hfl	G	1.25	1.12	1.37	1.10	1.08	1.43	1.06	1.28	1.20
			N	1.39	1.16	1.41	1.27	1.21	1.47	1.35	1.24	1.33
			F	1.32	1.14	1.39	1.18	1.14	1.45	1.20	1.26	1.26
U.S. (Washington)	May '73	1 $	G	3.27	2.14	3.98	2.34	2.94	2.87	2.63	2.17	2.70
			N	4.00	2.34	4.81	2.54	4.03	3.85	3.06	2.75	3.57
			F	3.62	2.24	4.38	2.44	3.44	3.32	2.84	2.44	3.10
Spain	Dec 1966	100 rtas	G	7.40	6.09	6.07	6.43	6.14	7.15	5.25	6.12	6.67

in box DM = 100 Lit, nhr, etc.

G = German
N = Native
F = Fisher Ideal = $\sqrt{G \cdot N}$

Source: Statistiches Bundesant, 1974.

Table 4 (cont.)

PRIVATE EXPENDITURE (Including rent)

Country	Date	Unit	Wt.	Food	Alcohol Tobacco	Rent	Heat & Lighting	Household Durables	Clothing	Health & Sanitation	Entertainment Recreation
UK	April/May '61	1 £	G	11.50	9.79	10.68	15.75	10.05	10.65	11.71	9.97
			N	12.77	12.85	10.72	17.35	10.74	11.03	13.61	11.68
			F	12.12	11.22	10.70	16.53	10.39	10.84	12.62	10.79
Japan	Dec. '58	100Y	G	.80	1.58	.60	1.36	.99	1.34	.92	1.02
Canada	June '53	1 $	G	2.82	4.13	1.08	5.21	2.39	2.17	2.26	2.15
			N	3.58	5.75	1.08	5.81	2.58	2.95	2.38	2.26
			F	3.18	4.87	1.08	5.50	2.48	2.53	2.32	2.20
Norway	June '60	100 nkr	G	56.63	61.39	40.82	108.75	59.38	52.40	52.88	56.10
			N	63.79	56.80	40.75	176.61	71.05	54.59	53.47	58.22
			F	60.10	59.05	40.78	138.59	64.95	53.48	53.17	57.15
Sweden	Dec. '59	100 skr	G	83.31	86.90	41.51	102.47	78.56	71.69	65.98	73.13
			N	76.98	71.32	41.51	141.30	77.45	80.01	68.97	71.77
			F	80.08	78.73	41.51	120.33	78.00	75.74	67.46	72.45

Country	Date	Unit	Wt.	Transportation Communication	w/rent All	w/o rent All
UK	April/May '61	1 £	G	11.67	11.04	11.07
			N	12.34	12.47	12.61
			F	12.00	11.73	11.81
Japan	Dec. '58	100Y	G	1.82	.92	.98
Canada	June '53	1 $	G	3.24	2.36	2.73
				3.49	3.19	3.56
				3.36	2.74	3.12
Norway	June '60	100 nkr	G	67.76	55.70	58.07
				73.73	63.27	65.08
				70.68	59.36	61.48
Sweden	Dec. '59	100 skr	G	69.60	71.74	77.98
				75.87	75.81	79.53
				72.67	73.75	78.75

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Table 4 (cont.)

Secondary Countries

Household Expenditures, PPP
w/o rent

			G	N	F
Australia Canbera/Sydney	June '65	1 ℔ A	9.06	10.71	9.85
Mexico	Nov. '58	100 Mex.$	30.86		
Argentina (Buenos Aires)	April '66	100 $	2.00		
India	Dec. '57	100 ir	95.47		
Denmark	Mar. '58	100 dkr	68.75	71.09	69.91
South Africa	Aug. '57	1 SA ℔	11.75		
Switzerland (Bern)	Nov. '64	100 sfr	82.21	88.29	85.20
Austria	Aug/Sept '68	100 s	15.46	17.30	16.35
Turkey	June '58	100 TL	106.37		
Finland	Feb/Mar '61	100 Fmk	1.05	1.25	1.15
Venezuela	Apri. '59/Jan. '60	100 Bs	53.81		

PPP = Rent

			G	N	F
Belgium	July 1953	100 bfrs.	4.89	4.89	4.89
France	Oct/Nov'58	100 ffrs.	1.29	1.59	1.43
Italy	April '52	10,000 Lit	102.52	102.52	102.52
Netherlands	Nov. '60	1 hfl	1.52	1.54	1.53
United States	March '53	1 vs. $	1.17	1.17	1.17
Spain	April '53	100 Ptas.	14.43		

3.5 Computing the Relative Price in US $ of a Good in Another Country

Note that we have available:

1. PPP defined as $P_{LC}/P_{\$}$ (LC = local currency)

where P_{LC} is the price of a market basket of all goods in LC;

$P_{\$}$ is the price of the same basket of all goods in US$.

PPP can be interpreted as "the price of 1 U.S. dollar's worth of all goods

in terms of LC."

2. PPP_i defined as $P_{iLC}/P_{i\$}$

where P_{iLC} is the price of good i in LC;

$P_{i\$}$ is the price of good i in US$.

PPP_i can be interpreted as "the price of one US dollar's worth of good i in

terms of LC."

Thus to compute the relative price in US$ of good i in another country, given

PPP_i and PPP

PPP_i gives   the LC price of one US$ worth of i

X * 1/PPP gives   the overall purchasing power in US$ of X units of LC, so

PPP_i * 1/PPP gives   the overall purchasing power in US$ of the LC necessary

to buy one US$ worth of i.

Conclusion: PPP_i/PPP gives   the relative price in US$ of good i.

US price = 1 $ US.

Foreign price = PPP_i/PPP $ US.

To compute the relative price in US$ of good i in another country, given a price series for i in LC (P_{iLC}) and another price series for i in $ (in the US) (P_{iUS}), recall that

$$X * 1/PPP \text{ gives you the real value in US\$ of X LC, so}$$

P_{iLC}/PPP = real price in US$ of good i abroad;

P_{iUS} = real price in US$ of good i in US.

Finally, note that all of the above computations have assumed PPP's and price series are in a single constant year's currency units.

1. To convert P_{iLC} in nominal units to P_{iLC} in constant year units

   (a) normalize P_{LC} to 1 in desired base year t*.

      Call this $P_{LC}(t*)$.

   (b) let $P_{iLC}(t*) = P_{iLC}$ in constant year t* LC units.

      Then $P_{iLC}(t*) = P_{iLC}/P_{LC}(t*)$

2. To convert a PPP (or PPP_i) from base year t_1^* to base t_2^*

   (a) set $PPP(t_2^*) = PPP(t_1^*) \times$

   $$[\frac{P_{LC}(t_1)}{P_{LC}(t_2)} / \frac{P_{\$}(t_1)}{P_{\$}(t_2)}]$$

   (b) set $PPP_i(t_2^*) = PPP(t_1^*) \times [\frac{P_{iLC}(t_1)}{P_{iLC}(t_2)} / \frac{P_{i\$}(t_1)}{P_{i\$}(t_2)}]$.