Volume Title: Problems in the International Comparison of Economic Accounts

Volume Author/Editor: The Conference on Research in Income and Wealth

Volume Publisher: Princeton University Press

Volume ISBN: 0-870-14176-7

Volume URL: http://www.nber.org/books/unkn57-2

Publication Date: 1957

Chapter Title: Measuring Comparative Purchasing Power

Chapter Author: Dorothy Brady, Abner Hurwitz

Chapter URL: http://www.nber.org/chapters/c2686

Chapter pages in book: (p. 301 - 348)

4. Measuring Comparative Purchasing Power

DOROTHY S. BRADY AND ABNER HURWITZ
BUREAU OF LABOR STATISTICS

"Nous ne connaisson en toute lumière qu'une seule loi, c'est celle de la constance et de l'uniformité. C'est à cette idée simple que nous cherchons à réduire toutes les autres et c'est uniquement en cette réduction que consiste pour nous la science." POINSOT

The Basic Identity

THE FIRST WRITERS on a subject usually base their arguments on elementary definitions which are treated as matters of common knowledge. Generations of writers may develop and expand original ideas without questioning the basic logic. Only persistent differences between what an inherited system of concepts leads them to expect and what they actually observe will force them to trace the origin of their assumptions. In the younger empirical sciences, investigators must appraise basic definitions when they expand the area of their investigation. In economics, the extension of empirical studies beyond a single country, and the need to measure purchasing power of different national currencies for comparisons of national accounts, has raised questions about the elementary assumptions in this field.

The measurement of differences in price levels has received attention from more eminent scholars than has any other branch of economic statistics. Jevons, Marshall, Edgeworth, Walsh, Mitchell, and Keynes are among the many writers on the form and construction of price indexes. Fisher, Bortkiewicz, and Frisch contributed greatly to the formalization of conditions that determine the behavior of sequences of indexes of different types. The material prepared by Carroll Wright for the Aldrich Report and by Edgeworth for the British Association for the Advancement of Science brought a statistical approach to discussions of price ratios that has influenced debates on the measurement of comparative purchasing power ever since. The weighted average became an accepted technique as statistical data revealed that different categories of goods show quite different price changes. A voluminous and controversial literature has accumulated on methods of averaging and systems of weights, but the connection between statistical models, the basic limits of measurement, and economic interpreta-

tions of the phenomena of price variation is rarely mentioned and never examined completely. Price indexes compiled today do not differ essentially from those constructed in the early part of the century. Reports of the British Board of Trade in the years immediately preceding World War I offer as much insight into the meaning of price comparisons in different places as is provided by more current literature.[1]

Most methods of measuring differences in the price level require observations on prices of the same commodities and services in two or more situations. Although identification and equating of a number of objects (or activities) is fundamental, this first step has never been completely examined by statisticians and economists concerned with observing and interpreting the phenomena of price change and price variation. A loaf of bread, an Arrow shirt, a Chevrolet car have been treated as unchanged when transported from one setting to another in a price index.

Even proposed methods such as the Konüs "true" cost of living index, the double expenditure index of Frisch, Staehle's minimum absolute difference, and the Divisia continuous indexes require prices of identical goods and services in two situations. Precision in identification is left to the practical statistician, for these more esoteric procedures which attempt to select equivalent but not identical systems of weights are not easy to apply in the direct comparisons of situations where a complete matching of goods and services is practically impossible.

The strict identification of commodities for purposes of price comparison must have seemed obvious common sense even in the last decade of the nineteenth century. The most casual inspection of the list of goods for which prices were collected in those years creates a picture of the consumer who bought foods and other commodities for processing in the home. The increasing complexity of fabrication in the goods that are sold in the markets of the world has added considerably to the difficulties of defining the equivalence of commodities for price comparison purposes.

International comparisons have revived the original purpose of price indexes, but the diversity and complexity of goods in the market today do not permit the simple association between changes in prices and changes in the value of money that originated with Jevons.

[1] *Cost of Living in American Towns* and *Cost of Living in Belgian Towns*, both London, Board of Trade, Darling, 1911.

The Inequalities of Matching

The wide possible range of choice in matching commodities or services for price comparisons is seldom known even to the operating statisticians who make the decisions. The price of a commodity or service may be affected by many physical and psychological properties or by special conveniences and services attached to its sale. The matching of commodities or services in two or more situations, dates, or places, must be based on a selection and specification of a small set of variables from the total that could be used to describe the commodity or service. Identical matching of products is almost always impossible, and the practical problem becomes a matter of defining approximations to identity.

The magnitude of observed price differences depends on the degree of specification. The least detailed specification, such as the name of the commodity and the principal material used in its construction, leads, in general, to the largest differences in prices for the same commodity and the greatest range in the relative prices of different commodities from place to place or from time to time. In similar markets, and over short time spans, prices for commodities described by detailed specification tend to be similar, and the relative prices for commodities of the same general category vary within narrow limits. While there have been no experimental studies designed to measure the effect of the matching rules, comparison of index series using different rules for identifying the "same" product in two situations confirms these inferences. When the economic environments are dissimilar, price indexes definitely depend on the degree of specification used in the matching.

In general, sales of commodities of a particular category are inversely correlated with their prices. The effect of the matching rules can be examined most easily when this relation between the prices and the quantities sold resembles a demand function with unit elasticity. In this case the money value of sales is the same for all commodities within the category. If p_1 and q_1 represent the prices and quantities in one situation, and p_2 and q_2 in another situation, the expressions

(1) $$p_1 q_1 = K_1$$

and

(2) $$p_2 q_2 = K_2$$

describe this simple relation between prices and quantities. If the number n of commodities in the two situations is the same, the aggregate sales are

$$\sum p_1 q_1 = nK_1$$

and

$$\sum p_2 q_2 = nK_2$$

The Laspeyres index,

$$\frac{\sum q_1 p_2}{\sum q_1 p_1} = \frac{\sum q_1 p_1 (p_2/p_1)}{\sum q_1 p_1}$$

is, because of the equality in the value weights expressed by (1), a simple average of price ratios

$$\frac{\sum (p_2/p_1)}{n}$$

The same is true of the Paasche index. The simple average of price ratios obviously changes with the rule of matching. The lowest average value and the lowest dispersion result from matching in order along the scale of price or quantity. Random matching produces a higher average and a greater dispersion, and a completely inverse ordering of the pairs leads to the highest average and the greatest dispersion.

The relative difference between the Paasche index and the reciprocal of the Laspeyres index depends on the dispersion and is approximately equal to the square of the coefficient of variation of the price ratios, that is, to the relative variance. The matching scheme, accordingly, also determines the magnitude of the difference between the indexes referred to one or the other situation as a base. These generalizations may be made graphic through a simplified hypothetical illustration. If the prices and sales for some commodity made of three fabrics were as follows:

	Fabric A	*Fabric B*	*Fabric C*
Situation 1:			
Price in currency 1	8	5	4
Number sold	15	24	30
Situation 2:			
Price in currency 2	20	25	40
Number sold	20	16	10

the indexes resulting from different schemes of matching are:

Matching Rule	*Laspeyres*	*Paasche Reciprocal*
Identity of fabric	5.83	4.29
In order of prices	5.00	5.00
Mixed order	5.38	4.65

This example illustrates not only the effect of the matching rule on a summary index, but also the sampling biases that may result through the processes of identification and selection. The price comparison may start with a list of commodities selected and specified in one situation. If the specified commodity selected in the first situation is the one with the greatest volume of sales, and the rule of matching requires the same physical characteristics, the resulting indexes may frequently have an upward bias. In the example, the relation between quantity and price differs greatly in the two situations according to the fabric used. If a commodity made of fabric A had been chosen as a sample to "represent" the total group of comparisons, the result would be an index of 10, compared to a range between 4 and 6 in the indexes based on several commodities. Only the selection of a commodity with a fair volume of sales in both situations would yield indexes that represent the entire category in a sampling sense. It is difficult and often impossible, however, to select commodities that satisfy some rule of matching and that are, at the same time, representative of the market in two or more places for the purposes of an index.

All the difficulties of definition and measurement are greatly increased when the elasticities of the regression curves relating prices and quantities sold are not both unity in the situations to be compared. The analogue of equations (1), (2), and (3) in comparing two situations with price elasticities α and β leads to the following expressions for the Laspeyres and Paasche indexes:

$$L = \frac{\sum p_1^{1-\alpha}(p_2/p_1)}{\sum p_1^{1-\alpha}}$$

$$P = \frac{\sum p_2^{1-\beta}(p_1/p_2)}{\sum p_2^{1-\beta}}$$

The price ratios are weighted by a function of the prices in the base situation.

These generalizations do not apply simply to the selection and

matching of commodities in a narrow commodity grouping. They apply to the total list of goods and services covered in a comparison. Charts presented in *An International Comparison of National Products and the Purchasing Power of Currencies* by Gilbert and Kravis[2] showing the relation between the quantity ratios and price ratios for several European countries compared to the United States, suggest that the quantities and prices of all goods and services are inversely proportional to their prices in the United States, the United Kingdom, and possibly in France. In the case of Germany and Italy the regression curves apparently are much steeper. Accordingly, indexes prepared by different investigators using different rules in procedures would not vary as much from the results of the Gilbert and Kravis calculations in the case of the United Kingdom and France as they would in the case of Germany and Italy.

Explanatory Models

Summary measures of purchasing power can be constructed from price statistics in many ways, but very few have been submitted to empirical tests. Most price indexes have the form of simple weighted averages, and the weights used have a simple substantive meaning. Exploration of techniques and methods has seldom gone beyond the preparation of a table showing how the calculated averages vary according to the weight system used. Although other procedures for measuring factors responsible for price differences may never displace the weighted average for practical purposes, information required for their estimation would add greatly to empirical and theoretical knowledge of price behavior. The conversion of national accounts to a common price base may not immediately suggest such a factor analysis but attempts to make international comparisons will in time force the development of new procedures. These in turn will influence the methods now followed in eliminating the effect of price change from the accounts for different dates in the same country.

Most of the thinking about the measurement of the price level has been devoted to the preparation of indexes recording changes over time. The necessary sequence followed in calculating a time series of price indexes has channeled development of procedures

[2] Milton Gilbert and Irving B. Kravis, *An International Comparison of National Products and the Purchasing Power of Currencies*, Paris, OEEC, 1954.

into the groove called, by Gilbert and Kravis, the "binary" comparison. Comparison of the price levels in different places at the same time does not impose any such practical restriction on the investigator. Indexes for a number of countries can be prepared simultaneously and in such a way that many of the ambiguities of the binary comparison disappear. Just as in many problems in geometry the move from two to three or more dimensions reduces the number of indeterminate solutions, an increase in the scale of price comparisons might limit the number of answers to the same question.

The indexes required for a comparison of three or more situations can be treated as factors that "explain" specific price difference, and that can be combined in a statistical formula that permits their empirical determination. In international comparisons, the factors that explain the differences among countries and the differences among commodities can be described as country indexes and item indexes. These factors can be assumed to be simply additive—the most common assumption in the design of experiments—or simply multiplicative—the most common assumption in studies of prices. The estimation of the factors in the additive case could be modeled on procedures established in the analysis of variance. A particularly simple procedure for estimation of two factors in the multiplicative case has been developed by Smith and Jablon.[3] The model specifies that a price (or price ratio) p is, approximately, the product of a country index C and an item index I. That is,

$$p + e = CI \tag{1}$$

where e represents the difference between the observed price p and the expected price CI for a particular commodity or service. The procedure devised by Smith and Jablon prescribes successive approximations to the average indexes suggested by the solutions of this equation for C and I. Since in most comparisons the use of appropriate weights is indicated, the procedures of aggregating and averaging proceed from the identity

$$qp + qe = qCI \tag{2}$$

when q is the quantity of the particular commodity or service. When C is regarded as known, the solutions of this equation for I, added in the customary way, give an estimate of the average price of a

[3] The structure and concepts of this procedure are described in a master's thesis by John O. Coleman, "An Inquiry into the Problem of International Comparisons of Food Costs," The American University, June 1953.

particular commodity over all countries. When I is regarded as known, adding the solutions of equation (2) gives an estimate of the price level in a particular country compared to the average for all the countries included in the calculation.

The average solution of equation (2) for I is simply the sum of the prices for a particular commodity, deflated for variations in the purchasing power of currency and divided by the total quantity, that is, an average price as customarily defined. The average solution of equation (2) for C is an index of the customary form in which the quantities relate to the particular country and the base prices are the averages for all countries.

The first approximations to the country indexes are selected in any way. Then the succession of average solutions of equation (2) can be terminated when succeeding approximations no longer differ significantly. The simple procedure for the estimation of country indexes and item indexes is not limited to a single system of weights or to a common list of items in all countries. The inclusion of variations in lists of items and other factors that represent the actualities in all situations may even lead to greater precision in the estimation of these indexes. The procedure recommends itself by the fact that it leads to a unique result (or none at all) for comparisons of more than two situations.

The procedure for estimation can be illustrated with a simple example:

	A. UNITED STATES		B. UNITED KINGDOM		C. DENMARK	
ITEM	*Price (dollars)*	*Quantity*	*Price (pence)*	*Quantity*	*Price (kroner)*	*Quantity*
1. Light wool suit	53	2	3,660	1		
2. Man's cotton shirt	4	5	300	4	28	3
3. Wool dress			996	1	113	2
4. Leather gloves	5	1			21	2

The ratios 1:70:7 may be used as a first approximation to the relative value of the currencies. Then the prices become (in dollars):

	COUNTRY			
ITEM	*A*	*B*	*C*	AVERAGE
1	53.00	52.29		52.76
2	4.00	4.29	4.00	4.10
3		14.23	16.00	15.41
4	5.00		3.00	3.67

These average prices as base prices, and the country's weights, yield as a second approximation to the comparative purchasing powers indexes, in percentages, for country A, 101.01; country B, 98.95; and country C, 99.09. Deflating the prices by these indexes and repeating the operations leads to the following estimates:

	COUNTRY			
ITEM	*A*	*B*	*C*	AVERAGE
1	52.30	52.86		52.49
2	3.95	4.34	4.08	4.11
3		14.39	16.30	15.66
4	4.93		3.06	3.68
Index	101.39	98.92	98.02	1.00

These index ratios provide a correction for the first estimate of comparative purchasing power.

This method for determining indexes simultaneously, like any other price comparison, depends on the matching scheme and the rules followed in the selection of the commodities and services to be included in the calculation. A greater diversity of goods and services can be utilized in the determination than is possible in indexes requiring a fixed base, and the matching of identical goods and services can be limited to those with attributes that have the same meaning in two or more countries.

Indexes calculated in this way, like all averages, are valid estimates for the universe represented by the sample of price observations. The indexes would not necessarily remain the same if the geographic coverage in the calculation were expanded or contracted. At the present state of knowledge of international variations in price level and price structure, the addition of another country in such a comparison cannot be regarded simply as enlarging the "sample" of countries.

The joint determination of indexes for a number of countries offers an additional advantage over the binary comparisons in providing a systematic estimate of unexplained variation from the relationship assumed in the model. If, for some country, the absolute value (or the square) of the difference between p, the observed price, and the product CI of the country index and the item index is large, the accuracy of the determination of the index for that country is open to question.

The extension of this type of model to three or more factors defining sources of variation, although clearly feasible in the operational

sense, should not proceed before intensive examination of concepts and definitions. Experience has shown that fruitful refinements of concepts in empirical studies progress, in general, only as basic data are accumulated and analyzed. Calculation of country indexes for groups of goods and services is an obvious extension of this factor analysis. The statistical designs of all price indexes and estimates of comparative purchasing power among communities recognize variations in prices associated with classes of commodities. Yet the analytic advantages of a determination of indexes by the traditional categories for different places or different dates have never been convincingly displayed.

Sources of Price Differences

In the development of price comparisons, as in many other types of statistics, the stratification that is efficient for statistical estimation tends to be presented and accepted as a classification intended for interpretive study. The classification of consumer goods and services for consumer price indexes has followed a convention established by the first International Statistical Congress a century ago. The rough correspondence between the classification of commodities and types of retail business has quite naturally favored the continuation of the conventional classification scheme—food, clothing, etc., and accumulation of longer and longer data series does not augur any significant change. Although the standard grouping of goods and services roughly along functional lines may be adequate for comparisons of consumer behavior in different places or at different dates, its superiority for price analysis has frequently been questioned in recent years. The need for other groupings has been indicated by such recombinations as "all durable goods" or "all personal services."

There is real danger that the deflating of national accounts will be molded by the classification scheme now used to record consumption expenditures and capital outlays before the concepts underlying the procedures have been tested sufficiently. By influencing the formal sampling design for an index or deflator, the classification scheme could bias the whole process of measurement. The fact that estimators must usually work with small samples of commodities is at the very core of the problem of constructing an index of relative purchasing power in two or more different situations. Furthermore, the properties of the universe to be represented by a sample are, in a statistical sense, unknown. There will probably

never be a census of prices to use as a frame of reference in designing a sample for the measurement of differences in their general level. In the selection of a sample of commodities and services for an index, each item must represent a highly variable and ever-changing group, and the selection must be guided by general knowledge of the market and of the economics of price behavior.

In the actual collection of price statistics, the chances of selecting the most common, uniform, or standardized commodity to represent a group are so great that the validity of the sample of goods and services depends on the basic stratification. Long before the emergence of "sampling with probability proportionate to size" makers of index numbers began to select commodities ("blocks" or "primary sampling units" in the sampler's terminology) by methods that favor those with greatest volume of sales. If the distribution of sales within categories governs the selection, commodities of low relative importance within each category will scarcely ever appear in the sample. Such commodities may be important in the aggregate across all categories and subject to wide price variations from place to place or from time to time. In these circumstances the conventional index design is bound to yield biased estimates of comparative purchasing power, whatever formula or system of weights is employed.

There are good reasons, a priori, for expecting the price level in various countries to differ significantly among commodities and services grouped according to the production process. Fourastie concluded that in France one cannot avoid connecting technical progress with general price movements:

> Comment ne pas penser au progrès technique pour expliquer l'éventail qui se manifeste ainsi dans le mouvement général des prix. La baisse des prix des textiles débute avec la création des premières manufactures par Colbert; la baisse des épices est liée au progrès des voyages maritimes, au développement des établissements d'outre-mer; la baisse des prix des métaux est liée aux progrès dans l'extraction et le traitement des minerais. Le progrès technique agricole, non nul, mais très faible jusqu'en 1789, puisque la charrue à soc de fer n'était encoure pratiquement pas employée en France au moment de la Révolution, s'est développé sensiblement après 1810, tandis que l'exploitation du bois ne bénéficiait jusqu'à nos jours que de l'amélioration des transports.[4]

Gilbert and Kravis reached a similar conclusion that in European countries the relatively high prices are associated with products

[4] Jean Fourastie, *Machinisme et Bien-Etre, Paris*, Editions de Minuit, 1951.

requiring much capital and the relatively low prices with products requiring extensive labor services.[5]

A classification by degree of industrialization of the production process cuts across the conventional groupings used in price indexes and national accounts of consumer expenditures. A list of goods and services selected to represent such a classification might differ substantially from the samples chosen to represent the customary groups. Unfortunately, the collections of price statistics now available do not permit a definitive test of the influence of the classification scheme on the sampling operation. Nevertheless, more analysis of the distributions of prices or price ratios in current bodies of data could contribute greatly to an understanding of this problem.

A study of industrial prices in progress in the Bureau of Labor Statistics, the summary of the relation of quantity and price ratios in the Gilbert and Kravis study, and results of an experiment by the Royal Bank of Canada from a report in preparation, all suggest that the distributions of price ratios are J-shaped. According to the theory of sampling, the means of samples from such distributions follow the gamma function and are very skewed for small samples. Among samples of one distribution, from a universe with a given variance, two-thirds might underestimate the true mean; in samples of two, the corresponding proportion is six-tenths. The form of these distributions might be altered radically with other schemes of classification and appropriate changes in the blocking that guides the sample selection for the index. A classification that would tend away from combinations of shoes and ships and sealing wax within groups toward more uniformity of dimension in the grouping and blocking would be less vulnerable to the hazards of the small sample.

One or two homely examples can illustrate the whole problem. The products sold in variety stores, hardware stores, drug stores, and their counterparts in other countries have the lowest aggregate sales, item by item, within the customary groupings for classification. Within such classes as household goods, clothing and household textiles, health, and education, the commodities of this type do not form blocks large enough to merit the selection of representatives for the purposes of an index. Yet in the aggregate this type of product should have considerable influence on price comparisons. The classification of foods offers a number of instructive examples of the operation of the grouping, blocking, and matching

[5] *Op.cit.*

process. In countries with dietary patterns that are fairly similar to the American, there appears to be a tendency to allocate the same fraction of the food dollar to two groups of foods: outlays on meats, poultry, and fish claim between 25 and 30 per cent, and expenditures on desserts and beverages around 10 or 12 per cent. The standard classification includes the meat grouping, but sweets and many beverages are scattered through the cereal, dairy products, fruits, and sugar groups. Most price comparisons limit the representatives of this large group to the most uniform and standardized items. The varied foods from the bakeries and confectionaries, large and small, are seriously underrepresented in all price indexes.

In view of all the operational problems that are involved in matching and grouping for measurement of comparative purchasing power, it is important to evaluate methods that are not so dependent on judgments of the investigators and that can never be challenged without independent replication of the whole study.

Equivalent Groups of Commodities and Services

The literature on price indexes is filled with arguments about the weighting systems, but the controversial issues have centered on the choice of weights considered representative of each situation, or of a simple combination of the situations in a comparison. The fact that each situation could be represented by a whole battery of weight diagrams describing the entire range of consumption patterns from poverty to riches has been considered by very few investigators, and the fact that the average quantities or expenditures over this range within one situation are dependent on the income distribution has received practically no attention. The chief purpose of converting national accounts to real terms is to effect a separation of the price level and the income level in comparisons over time or over space. The need to compare significantly different economic situations will eventually raise the question of a third factor in the analysis—the income distribution.

Matching of groups of consumer goods and services for the measurement of comparative purchasing power almost automatically involves consideration of the variations in consumption pattern associated with economic level. To match by groups of commodities requires observation on more than one "market basket" in each situation, and the differences in market baskets that are correlated with economic resources are certainly susceptible of some kind of equating. Engel, Wright, and more recently Frisch, Staehle, and

Wold have tried to establish comparisons of consumption by income level to yield information on the comparative cost of living. When Engel wrote and Wright extended his ideas, "Consumption was practically a predetermined, constant factor in the economic scheme—a simple process of grasping for whatever food, clothing and shelter could be produced and making them last as long as possible. The process went on decade after decade without substantial change. No wonder economists found little to say about it."[6] Yet in comparing American communities with European, Wright, and after him the British Board of Trade, discovered an inexplicable paradox in the simple equating of food and food, housing and housing, and fuel and fuel in different situations.

Engel, Wright, and the British Board of Trade tried to equate through the percentage of total expenditures spent on the primary necessity, food. Frisch's and Staehle's procedures attempt to match the physical volume of consumption at various economic levels in two or more situations by price and quantity index methods. There is certainly merit in the notion of equating the same physical volume of consumer goods and services in two or more situations to gauge the relative cost of living, but the elaborate repricing of the whole pattern of consumption required by both Frisch's and Staehle's procedures severely limits the class of comparisons to what Frisch called "structurally equal markets." Aside from all the conceptual problems, which are those of the price or quantity index conventionally defined, the absence of data is the main obstacle to the utilization of such procedures. As the diversity of products multiplies and their complexity increases, a complete record of specifications, quantities, and prices becomes less and less realistic for family accounts as well as for national accounts.

Frisch, himself, was led by the absence of data required for price or quantity indexes to an exploration of other methods for defining equivalent sets of consumer goods and services.

> However, I could not get the problem off my mind, and struggling further with it, a new idea gradually took form. Was it possible to determine the lacking price indexes from the budget data themselves? At first sight, the idea seems absurd, since the budget material only contains expenditure data and no information about prices at all. On closer examination, however, the idea proved sound, both theoretically and in practice.[7]

[6] William H. Lough, *High-Level Consumption*, McGraw-Hill, 1935, p. 1.
[7] Ragnar Frisch, *New Methods of Measuring Marginal Utility*, Tübingen, J. Mohr, 1932, p. 6.

The power of this concept has not been realized even after two decades of accumulating observations that might permit its examination and testing. Perhaps the reason that such ideas are lost lies in the confounding of problems of concept and of estimation that all too easily dominates the empirical scientist. Frisch discusses the procedure as follows:

> We shall now consider the situation which arises when there are no data available regarding the prices p and P. In this case the food quantity curves are not known, but the food expenditure curves are. The purpose of the discussion in the present Section is to show that the shapes of the given food expenditure curves contain information which makes it possible to draw conclusions regarding the prices p and P, and thus derive the data necessary to determine the money utility curve. For reasons which will presently become obvious, this method will be called the translation method of measuring utility.[8]

It shows that he was forced to devote his attention almost entirely to the mechanics of the problem. In this study he did not consider the comparison of situations differing with respect to real income or culturally determined preference patterns. Even a method he proposed later[9] does not avoid the need for identifying sets of situations that differ only with respect to relative prices. In order to provide independent estimates of variations in purchasing power, procedures for matching bundles of goods and services must be free, in concept and in practice, from the need for imputing identity to particular commodities. Some characteristics of groups of commodities and services not dependent on the properties of the specific goods of which they are composed must be used to define equivalence in two or more situations. Frisch's methods and a proposal by Friedman[10] suggest that some quantity describing the progression of consumption patterns in two settings can provide the basic measuring rod.

Equating by the degree to which basic needs are satisfied is really a tautology at the core of most comparisons—of national income, national product, productive capacity, or consumption levels. The similarities in consumption patterns by income level have led many investigators, both before and after Engel, to the belief that the elimination of price and currency differences would produce even

[8] *Ibid.*, p. 42.

[9] Ragnar Frisch, "Methods of Measuring the Relative Cost of Living," mimeographed, 1937.

[10] Milton Friedman, "A Method of Comparing Incomes of Families Differing in Composition," *Studies in Income and Wealth, Volume Fifteen*, National Bureau of Economic Research, 1952.

more similarity from place to place or from time to time in the consumer's utilization of income. Lough and Clark[11] actually deflate by price indexes and exchange rates in the attempt to show uniformity in the distributions of consumer expenditures arrayed along a scale of real incomes.

The use of deflation assumes that correlations and comparisons between deflated quantities are valid and relatively invariant, and the practice is so widespread that this fundamental assumption has seldom been questioned. Frisch's method of deriving the price ratios through a procedure that results in a coincidence of the correlations between expenditures and income is just the converse of deflating. If the conditions that permit deflating are satisfied, the same assumptions justify interpreting the difference between two regressions as due to variations in the price level. If the assumptions are warranted, it is possible under certain circumstances to carry out an empirical determination of the price ratios.

The correlations or regressions are just a ranking of different bills of consumer goods along a scale of income. They are differentiated by some quantity that measures the degree of change over the range of incomes. Engel's law refers to one such quantity, the well-known ratio of food expenditures to total expenditures by income level. The percentages spent on a particular category of consumption goods at successive income levels can obviously be utilized to define equivalence between two situations. Such a definition states simply that the fraction of income devoted to a particular purpose establishes the identity between consumption levels in two or more places or at two or more dates. In general, equating by the Engel ratio yields a single determination of the relative purchasing power applicable both to the particular category of consumption and to total expenditures or total income.

There have been numerous investigations of family living expenditures in the postwar period. While they are not strictly comparable in population coverage and in the time span represented, they are so much more uniform in method than prewar studies that analysis of the comparisons can certainly contribute to our understanding of the problem. For the purposes of this paper many details of comparability are ignored for the sake of vivid illustration. Illustrative data for France, the United States, and India are described in the last section.

[11] Colin Clark, *The Conditions of Economic Progress*, London, Macmillan, 1951.

Matching income levels at which the same percentage of income was spent on food led to the following results:

	INCOME POSITION IN:		
FOOD EXPENDITURES[a] AS PER CENT OF INCOME	*France 1949 (1,000 francs)*	*India 1948 (rupees)*	*United States 1950 (dollars)*
70	290	460	1,000
60	360	660	1,300
50	550	980	1,600
40	810	1,530	2,600

[a] Among families averaging 3.5 persons.

The ratios of the corresponding income positions yield, on the average, 300 francs to the dollar and 0.54 rupees to the dollar. At the present time these estimates can be compared to other determinations only for France. Gilbert and Kravis found the ratio 313 francs to the dollar with United States quantity weights, and 223 francs to the dollar with European quantity weights.

Frisch's method of translation is not so restricted as the matching of Engel ratios. In effect his procedure matches the averages of two consumption curves and measures the relative purchasing power for the particular consumption category and for income by reference to the total scatter. The matching of the average incomes reflects assumptions of basic similarity in real income and preferences that are not valid in general, for comparisons between countries.

The Engel functions for different places could be deflated in many ways to form a single continuous and apparently homogeneous association between consumer expenditures and income. The additional assumption required—for a unique solution, i.e. a single transformation—is thus of considerable importance. It may be remarked that this generalization has serious implications for the usual deflating procedures. The fact that deflated quantities produce a statistically elegant correlation is no proof that the correlation has any real validity. In other words, many other correlations, just as satisfactory, might be produced by using other values for the deflators, and the choice among them would have to be made by some additional criterion determined a priori.

The choice of the additional criterion in matching consumption patterns by economic level is a matter for much further study. The effect of the choice can be illustrated only by using a property of

the food expenditure function examined in another paper.[12] All sufficiently comprehensive consumption studies have shown that Engel's law does not hold below a certain income. In fact, as Zimmerman noted years ago,[13] the proportion of resources devoted to food increases from the very lowest incomes up to an expenditure which apparently represents a first approximation to adequate nutrition. Later surveys have confirmed his conclusion. The study made in Java in 1939,[14] for example, shows clearly that once the food expenditure provides enough calories in the diet, it tends thereafter to decrease proportionately with increments of income. The standard form of presentation—consumption by broad income classes—obscures this transition even when the survey includes representation of the population in the lowest economic stratum. The point at which food expenditures shift from increasing to decreasing shares of income in the comparison of three countries to the United States can only be guessed from the data given. If these incomes were $750, 250,000 francs, 1850 kroner, and 480 rupees, the purchasing power of the currencies relative to the dollar would be as follows:

Country	*For Food*	*For All Commodities and Services*
France	248.	333.
Norway	2.33	2.47
India	.58	.64

No other category of consumer goods can so easily be assumed to have a universal meaning. Housing expenditures are affected by climate, ownership arrangements, and opportunities for building homes; clothing expenditures vary from place to place with the climate and the styles determined by the culture; and such reasons for differences in the relation between outlay and resources could be extended to all the other conventional groupings of expenditures. An extension of the analysis and interpretation of expenditures in relation to income started by Allen and Bowley[15]

[12] Dorothy S. Brady and Helen A. Barber, "The Pattern of Food Expenditures," *Review of Economics and Statistics*, August 1948.

[13] Carle C. Zimmerman, *Consumption and Standards of Living*, Van Nostrand, 1936.

[14] H. M. S. Hart and Netherlands Indies Koelie Budget Commissie, "Het Budgetonderzoek," mimeographed, Rapport No. 13, Rapport No. 23, 1940.

[15] R. G. D. Allen and A. L. Bowley, *Family Expenditure*, London, King, 1935.

was used by Miss Snyder[16] to classify expenditures on specific goods and services by the income elasticity to provide a basis for the estimation of relative purchasing power in two dissimilar situations.

If goods and services are classified according to whether the income elasticity is no greater than one or exceeds one, the apportionment of expenditures between these two groups can be used to estimate comparative purchasing power in different economic environments. This regrouping of expenditures can be carried out only when the survey data for specific goods and services are tabulated and published. The data available permit an estimate of this division of expenditures for two countries, Norway and the United States. The translation by the Engel ratio for all necessities of the expenditure curve for Norway to coincide with the curve for the United States requires a conversion ratio between 2.00 and 2.50 kroner to the dollar, a somewhat higher value than would result from the matching of the Engel ratio for food.

Matching Population Groups

The equating of groups of commodities and services by means of consumption functions is basically a matching of population groups arrayed by some measure of economic resources, such as income. In comparing communities that differ greatly in the distribution of the population by income and occupation, only the extremes of poverty and wealth offer an equivalence that is easy to defend on logical grounds. Though the rich and the poor are to be found in all large communities, unfortunately there have been few representative surveys of the population with very low incomes, and the data for the very well to do are virtually nonexistent. It is possible to make a few comparisons of the rural poor but not of other low-income groups or of the very wealthy classes. The equating of agricultural poverty is certainly appropriate to a comparison of two countries by matching groups at corresponding positions on the economic scale.

A recent study of lower castes in India[17] shows striking correspondence with the consumption pattern of sharecroppers in

[16] "A Method of Measuring Comparable Living Costs in Communities with Differing Characteristics," prepared by Eleanor M. Snyder, mimeographed, Bureau of Labor Statistics, October 1953.

[17] Shiva Kumar Chaturvedi, "Family Budgets of Some Lower Castes in District Farrukhabad," processed, University of Allahabad, 1949.

Georgia and Mississippi in 1935-1936.[18] If the surveys were equally representative of populations at the lowest extreme of the economic scale, the conversion ratio could be estimated by matching the mean income and the food expenditure of the families with incomes near the mean. In this case such an equating leads to a conversion of 0.90 rupees to the dollar for food expenditures and 0.94 rupees to the dollar for the total.

To show the contrasts between matchings of the extremes and the average it is necessary to use data for the United States at dates for which the cross-section data can be projected to represent the total range.

	RATIO OF EXPENDITURES, 1941 = 100			
DATE	*Low-Income Families*	*Average-Income Families*	*High-Income Families*	INDEX OF CONSUMER PRICES
1888-90	48	39	21	43-51
1918	n.a.	67	57	105
1935-36	75	95	105	95
1944	309	125	85	119
1950	230	198	143	163

The comparison of the expenditure ratios for high-income families suggests that these groups are combinations of families that had experienced recent increases in income and families with resources enough to permit maintaining the same scale of living from year to year. The comparison of expenditures of families with incomes near the average suggests the importance of the selection of weights in indexes representing the change in the price of goods and services purchased by the average family. The family with the average income, according to this comparison, has gradually increased the quantity and quality of the consumer goods it purchases in the market. As such changes occur over time, an index with fixed weight appears to grow less and less realistic.

Indexes constructed to compare different countries through the average consumption pattern of some one country present even more difficulties in the selection of the weighting diagram. Like the comparison of different dates in the same country, the indexes do not seem to correspond with experience. In addition, the average consumption in any country is a curious hybrid of the expenditure patterns prevailing among different population groups. The volume

[18] *Family Incomes and Expenditures*, Dept. of Agriculture, Misc. Pub. 465, 1941.

of particular goods and services included in the average is significantly influenced by the distribution of income, because expenditures on most goods and services follow a nonlinear relation to income. The average consumption underweights the commodities for which income elasticities are low and overweights those for which they are high. The more unequal the income distribution, the more weight is given to the goods and services purchased by the upper-income groups. If the consumption of upper-income groups is more comparable from time to time, or from place to place, as is suggested by the example above, this peculiarity of the average may be a definite advantage. The binary comparisons, such as those made by Gilbert and Kravis, will not vary so widely with the weighting diagram as when the weights follow the consumption pattern of some more narrowly defined population group.

"Reality is not what is logical but what it suits our purpose to treat as real."[19] The reality of indexes of purchasing power derives from their successful use in cooperative agreements, and therefore methods used in comparing the purchasing power of populations living at different times or in different places must be chosen with reference to the need they serve. The inferences drawn by Gilbert and Kravis can not all be justified by reference to indexes that put undue emphasis on the consumption pattern of the upper income groups. The practical needs for international comparison, according to Stone and Hansen,[20] have reference to taxation schemes. This purpose differs essentially from the circumstances that led to the compilation of consumer price indexes in most countries; the measurement of the cost of the same level of living for reference in wage agreements. The deflated national income or product for a single country may eventually be used to guide still other types of decision.

Appendix A. Distribution of Price Ratios

Prices of comparable goods and services in two places exhibit two types of correlation. The regressions may be fairly linear and come close to the origin, or they may be nonlinear, like demand curves. In either case there is a wide scatter which may be attributed in part to errors in matching, identification, and the determina-

[19] Frank H. Knight, *The Ethics of Competition*, Harper, 1935.

[20] Richard Stone and Kurt Hansen, "Inter-Country Comparisons of the National Accounts," *Income and Wealth*, Cambridge, Eng., Bowes and Bowes, Series III, 1953.

TABLE A-1

Variation in Price Ratios: Distribution of Prices of Comparable Goods and Services in New York and Selected Cities in Other Countries, and Average Price Ratios as Related to Unit Prices in New York, 1951 and 1952

City and Item	*Prices in Each City*				
New York:					
Range (dollars)	0.05-0.15	0.15-0.35	0.35-0.65	0.65- 1.35	1.35- 2.65
Midpoint (dollars)	0.10	0.25	0.50	1.00	2.00
Copenhagen:					
Range (kroner)	0.35-0.74	0.46-3.55	0.29-4.16	2.00-11.00	5.25-15.00
Midpoint (kroner)	0.54	2.00	2.22	6.50	10.12
Ratio to dollar	5.4	8.0	4.4	6.5	5.1
Number of prices	3	10	10	11	11
Geneva:					
Range (francs)	0.65-1.10	0.40-3.23	0.70-3.84	2.00-12.50	6.50-16.46
Midpoint (francs)	0.88	1.82	2.27	7.25	11.48
Ratio to dollar	8.80	7.28	4.54	7.25	5.74
Number of prices	2	16	26	14	13
The Hague:					
Range (guilder)	0.10-0.29	0.14-2.79	0.19-3.00	0.72- 3.15	2.30- 8.10
Midpoint (guilder)	0.20	1.46	1.60	1.94	5.20
Ratio to dollar	2.00	5.84	3.20	1.94	2.60
Number of prices	3	11	16	9	16
London:					
Range (pounds)	0.07-0.07	0.01-0.11	0.03-0.20	0.09- 0.54	0.13- 0.90
Midpoint (pounds)	0.07	0.06	0.12	0.32	0.52
Ratio to dollar	0.70	0.24	0.24	0.32	0.26
Number of prices	2	13	14	10	12
Mexico City:					
Range (10 pesos)	0.03-0.19	0.03-0.53	0.03-1.04	0.30- 1.50	0.80- 2.25
Midpoint (10 pesos)	0.11	0.28	0.54	0.90	1.52
Ratio to dollar	1.10	1.12	1.08	0.90	0.77
Number of prices	3	15	22	13	16
Paris:					
Range (1,000 francs)	0.02-0.16	0.02-0.21	0.05-0.45	0.13- 0.68	0.44- 1.62
Midpoint (1,000 francs)	0.09	0.12	0.25	0.40	1.03
Ratio to dollar	0.90	0.46	0.50	0.40	0.51
Number of prices	3	12	15	12	16
Rome:					
Range (1,000 lira)	0.04-0.13	0.06-0.50	0.12-0.68	0.25- 1.37	0.52- 2.20
Midpoint (1,000 lira)	0.09	0.28	0.40	0.81	1.36
Ratio to dollar	0.90	1.11	0.80	0.81	0.68
Number of prices	2	16	24	13	15

(*continued on next page*)

TABLE A-1 (continued)

City and Item	*Prices in Each City*			
New York:				
Range (dollars)	2.65- 7.35	7.35-12.65	12.65- 37.35	37.35- 62.65
Midpoint (dollars)	5.00	10.00	25.00	50.00
Copenhagen:				
Range (kroner)	8.00-53.00	27.27-47.00	58.00-113.00	177.00-255.00
Midpoint (kroner)	30.50	37.14	85.50	216.00
Ratio to dollar	6.1	3.7	3.4	4.3
Number of prices	13	5	6	4
Geneva:				
Range (francs)	9.17-36.55	29.15-54.37	49.83-123.70	164.55-272.60
Midpoint (francs)	22.86	41.76	86.76	218.58
Ratio to dollar	4.57	4.18	3.47	4.36
Number of prices	12	5	7	6
The Hague:				
Range (guilder)	2.66-33.50	18.45-37.25	30.00- 67.40	105.00-160.42
Midpoint (guilder)	18.08	27.85	48.70	132.71
Ratio to dollar	3.12	2.79	1.95	2.65
Number of prices	13	5	7	4
London:				
Range (pounds)	0.23- 1.87	1.44- 2.17	2.76- 5.87	5.28- 15.16
Midpoint (pounds)	1.05	1.80	4.32	10.22
Ratio to dollar	0.21	0.18	0.17	0.20
Number of prices	11	5	6	5
Mexico City:				
Range (10 pesos)	0.48- 7.80	3.03-10.70	11.64- 31.25	29.50- 56.67
Midpoint (10 pesos)	4.14	6.87	21.44	43.08
Ratio to dollar	0.83	0.69	0.86	0.84
Number of prices	12	5	7	5
Paris:				
Range (1,000 francs)	0.72- 4.53	2.86- 6.12	5.94- 17.66	15.55- 28.07
Midpoint (1,000 francs)	2.62	4.49	11.80	21.81
Ratio to dollar	0.53	0.45	0.47	0.44
Number of prices	13	5	7	4
Rome:				
Range (1,000 lira)	1.40- 4.57	2.92- 5.05	5.26- 14.33	18.32- 23.43
Midpoint (1,000 lira)	2.99	3.98	9.80	20.87
Ratio to dollar	0.60	0.40	0.39	0.42
Number of prices	13	5	7	6

TABLE A-2

Price Correlations: Average Prices for Comparable Goods and Services in New York and Rome, by Price Classes in the Two Cities

Price Class New York (dollars)	*Average Price New York (dollars)*	*Average Price Rome (1,000 lira)*	*Price Ratio (1,000 lira per dollar)*	*Price Class Rome (1,000 lira)*	*Average Price Rome (1,000 lira)*	*Average Price New York (dollars)*	*Price Ratio (1,000 lira per dollar)*
Under 1	0.41	0.30	0.73	under 0.25	0.14	0.27	0.53
1-2	1.50	0.97	0.65	0.25- 0.50	0.36	0.65	0.55
2-3	2.50	1.77	0.71	0.50- 0.75	0.57	0.86	0.66
3-4	3.61	2.29	0.63	0.75- 1.00	0.90	1.73	0.52
4-5	4.60	2.43	0.53	1.00- 2.00	1.32	2.17	0.61
5-10	7.17	3.41	0.47	2.00- 4.00	2.59	4.64	0.56
10-20	13.89	7.02	0.51	4.00-10.00	5.28	11.98	0.44
20-40	23.22	10.77	0.46	10.00-20.00	14.19	28.35	0.50
40 and over	57.93	27.33	0.47	20.00 and over	24.27	58.09	0.42

tion of the price data. Table A-1 shows the range in prices for comparable commodities in several cities corresponding to ranges of prices in New York which have the common units of currency as midpoints. The midpoints of the ranges in the various cities compared to the midpoints in New York provide the basis for estimating average price ratios for commodities and services arrayed by price per unit.

The greatest departure from a constant ratio appears in the comparison of Rome and New York. The purchasing power ratio for commodities and services with low unit price (such as foods, transit fares, drugs, and cosmetics) was nearly twice the ratio for the goods and services with relatively high unit price (such as heavy clothing, medical services, automobile repairs). The two regressions shown in Table A-2 indicate a curious dispersion in the paired comparisons of prices, which results only in part, if at all, from a stratification by degree of fabrication. The high price ratios relate to articles as diverse as bananas, whole ham, tea, cigarettes, gasoline and oil, frying chicken, sugar, canned peaches and peas, and lard; the low price ratios, to lamb chops, onions, felt hats, bath towels, haircuts, railroad fare, and wine. This enumeration suggests that the selection of the American list of goods and services has affected the whole comparison.

Appendix B. Note on International Price Comparisons[1]

Jean Fourastie

Studies connected with productivity indicate the fundamental importance of this factor in relation to the purchasing power of wages and the disparities in prices among nations.

For example, a pair of work shoes is worth about twenty-five hours' wages of an unskilled laborer in Paris, while it is worth four in the United States. On the other hand, a ticket to a neighborhood cinema, or a haircut by a barber, is worth about an hour's wages in both places. Thus a pair of work shoes is equal to more than twenty haircuts in France, while in the United States the pair of shoes is worth no more than four haircuts.

Such disparities are obviously explained by the fact that labor productivity in the ordinary shoe industry is about five times higher in the United States than in France, while it is about equal for barbers.

At present we have few of the data on wages and usual prices in different countries necessary to determine precisely and to illustrate these facts. For this reason, a questionnaire was sent to 100 persons residing in foreign cities who, it seemed probable, would be willing to reply.

This extremely simple questionnaire deals only with very common goods and services whose prices are easy to ascertain by direct observation. We attached a note briefly explaining the purpose of the inquiry, and, to indicate the precise quality of the goods listed, a filled-out questionnaire for Paris (see below).

The replies we received made it possible to calculate for twenty-nine countries the prices in hours of work of the fourteen commodities or services that appeared in the questionnaire. For three countries where the standard of living is fairly low and labor is paid by the day for a poorly defined length of time, it was possible to calculate only in days of work.

The unit used to convert the commodity prices into their wage equivalents is the hourly or daily wage for unskilled male labor, augmented by the social charges paid by the employer in order to take social benefits into account as far as possible.

The results of the inquiry were grouped in four tables:[2]

[1] Translated by Ellen V. Seiler.

[2] Tables 1 and 2 are included in this Appendix.

1. The prices in hours of work of the fourteen commodities or services for twenty-nine countries. (To this table was appended a table of the excesses of the highest over the lowest prices (a) for all the countries together and (b) for the twenty countries whose prices were nearest each other, in order to eliminate the extreme cases.
2. A classification of the twenty-nine countries according to the dearness of each of the commodities, with the least expensive country ranked first.
3. The prices in days of work for the three countries where laborers are paid by the day.
4. The wages and the social charges in the national currencies used to calculate wage equivalents of the prices.

The data we received were not entirely comparable, and note should be taken of the following points:

The prices of sugar, wheat, bread and milk often include taxes. Furthermore, e.g. in Japan, these commodities are sometimes rationed. It was not possible to indicate precisely which countries practice taxation or rationing because the replies did not always give the necessary information.

The price of a bedsheet means of a cotton sheet in Denmark, the United States, Hungary, New Zealand, and Sweden.

The price given for dungarees does not refer to the same article in all the countries. Sometimes it refers to overalls, sometimes simply to trousers.

The price for gas is for 1 cubic meter of piped gas except for Syria, where it is for a cubic meter of bottled gas.

The roughness of the figures used makes it impossible to draw precise conclusions from the results. Nevertheless, an examination of the first table brings out considerable variations in wage equivalents of prices. In fact, these equivalents vary progressively from 1 to 5 for the services of a cleaning woman for an hour, which is in itself surprising, to 1 to 80 for a kilogram of sugar.

These variations are very pronounced for industrial products, that is, economic products of technically advanced industries. They are smaller for services whose production techniques vary little from country to country. Thus sugar is twenty times more expensive in Indonesia than in the United States, while a ticket to the cinema is virtually the same price.

The same differences in behavior between prices of industrial products and prices of services are found when the countries are ranked. Indonesia, for example, is one of the most expensive countries for industrial and agricultural products and one of the cheapest for the cinema and haircuts. On the other hand, the United States, which ranks low in price for commodities, occupies seventeenth place for a haircut and only eighth for the cinema.

Prices in Francs of Fourteen Goods and Services, France, October 1950

Commodity	*Price*	*Observations*
Hour of unskilled masculine labor:		Parisian region in September 1950
Direct wage	80	
Social charge	30	
	110	
1 kilo of sugar (retail)	105	Taxed price
1 quintal of wheat	2,600	Price paid to farmers (taxed)
1 sheet (single bed)	2,300	1.9 x 3 meters (good-quality)
1 kilowatt-hour of electricity (light rate)	19.10	In Paris, full price (first period)
Radio for local stations (popular model)	10,000	2 wavelengths 5 tubes
Cloth dungarees (men's)	3,000	In Paris
Pair of work shoes (men's)	3,000	In Paris (leather-soled)
1 cubic meter of gas (kitchen rate)	20	In Paris, full price (first period)
1 liter of milk (retail)	39	Taxed price in Paris
1 kilo of bread (retail)	36	Taxed price in Paris
Public transportation (single fare)	15	Subway ticket, second class
Ticket to neighborhood cinema	90	Medium price in Paris
Haircut (men's)	120	In Paris, including tip (medium-quality barber)
Services of cleaning woman for 1 hour:		
Direct wage	80	In Paris in September 1950
Social charge		

TABLE B-1

Prices in Hours of Work (of a Male Street Sweeper)

Commodity	*France Paris*	*Austria Vienna*	*Belgium Brussels*	*Canada Ottawa*	*Chile*	*Denmark Copenhagen*	*East Germany Free Market*	*England London*	*Finland*	*Greece Athens*	*Hungary (taxed prices)*	*Iceland Reykjavik*	*Indonesia Jakarta*	*Italy Rome*	*Japan Tokyo*
Kilo of sugar	1	1.4	0.7	0.3	0.2	0.15	12	0.4	0.5	2.8	3.6	0.35	4	1	1.9
Quintal of wheat	24	35	21	6	12	18		22	31	28	38		200	26	87
Bedsheet	20	16	15	5	10	6	36	12	14	10	66		83	4	29
Kilowatt-hour of electricity	0.2	0.09	0.15	0.02	0.05	0.09	0.2	0.2	0.1	0.1	0.7	0.12	0.5	0.09	0.4
Radio	90	200	100	35	90	90	95	110	45	45	150		500	100	200
Dungarees	30	36	11	3.5	10	13	34	8	23	12	71		50	14	
Pair of shoes	25	42	26	10	13	12	23	16	23	16	103	14	50	24	57
Cubic meter of gas	0.2	0.15	0.15		0.08	0.07	0.2	0.1	0.1	0.25	0.4	0.07	1.2	0.11	0.6
Liter of milk	0.35	0.35	0.3	0.2	0.2	0.15	2	0.35	0.2	0.4	0.7	0.25	2.7	0.3	1.9
Kilo of bread	0.3	0.6	0.35	0.2	0.2	0.4	0.7	0.2	0.7	0.3	1.2	0.8	2	0.5	0.7
Public transportation	0.11	0.25	0.10	0.07	0.05	0.09	0.19	0.18	0.11	0.07	0.3	0.05	0.7	0.11	0.3
Cinema	0.8	0.45	0.6	0.5	0.5	0.6	1.2	0.75	0.8	0.85	1.65	0.45	0.4	0.5	2
Haircut	1.1	0.95	0.9	0.75	0.8	0.9	1.2	0.7	0.6	0.4	1.4	0.8	0.3	0.75	2.9
Cleaning woman for 1 hour	1	1	0.75	0.65		0.8	1	1	0.65	0.5	1.85	0.75	0.7	0.5	

(*continued on next page*)

TABLE B-1 (continued)

Commodity	*Low Countries*	*Luxembourg*	*New Zealand*	*Philippines Manila*	*Portugal Lisbon*	*Spain Madrid*	*Sweden Stockholm*	*Switzerland Bern*	*Syria Damascus*	*Trieste*	*Turkey Ankara*	*United States Washington*	*Uruguay Montevideo*	*West Germany Essen*
Kilo of sugar	0.6	0.65	0.3	0.7	1.45	2.85	0.35	0.4	2	2	4.75	0.2	0.5	1.2
Quintal of wheat	19	21	5		75	127	11	24	50	35	69	8	19	32
Bedsheet	15	11	7	13	30	56	10	15	25	30	64	5	5	10
Kilowatt-hour of electricity	0.2	0.2	0.04	0.1	0.6	0.4	0.04	0.15	0.3	0.2	0.7	0.04	0.2	0.35
Radio	130	85	100	125	500	380	70	70	375	260	330	20	100	75
Dungarees	12	7	12	45	25	56	10	15	42	43	53	4	24	14
Pair of shoes	20	25	13	27	50	48	11	18	50	46	80	4	12	16
Cubic meter of gas	0.05	0.15	0.11		0.45	0.3	0.05	0.1	5	0.2	0.4	0.07	0.3	0.2
Liter of milk	0.2	0.2	0.15	0.9	0.9	1.1	0.15	0.2	0.8	0.5	2.1	0.2	0.2	0.4
Kilo of bread	0.3	0.3	0.3	1.3	1.4	1.6	0.4	0.3	0.7	0.7	0.9	0.25	0.4	0.65
Public transportation	0.12	0.25	0.07	0.2	0.12	0.16	0.10	0.11	0.13	0.1	0.5	0.09	0.1	0.3
Cinema	0.8	0.45	0.6	1.5	2.1	1.6	0.9	0.65	1.7	0.75	2.6	0.6	1	1
Haircut	0.7	0.85	0.5	1.8	1.7	1.3	0.9	1	1.7	1.2	3	1	1	0.8
Cleaning woman for 1 hour	1	0.9	1.2	0.45	0.6	0.6	0.8	0.7	0.8	0.6	1.7	0.8	2	0.8

TABLE B-2

Classification of the Countries According to the Dearness of the Commodities and Services[a]

Country	Kilo of Sugar	Quintal of Wheat	Bed-sheet	Kilowatt-hour of Electricity	Radio	Dun-garees	Pair of Shoes	Cubic Meter of Gas	Liter of Milk	Kilo of Bread	Public Trans-portation	Cinema	Haircut	Cleaning Woman for 1 Hour
France	16	12	19	15	9	18	20	15	15	5	12	15	20	19
Austria	19	18	18	6	21	20	21	12	15	16	23	2	16	19
Belgium	14	9	15	13	13	7	18	12	13	11	8	8	13	11
Canada	4	2	2	1	2	1	2		4	1	3	5	7	7
Chile	2	5	7	5	9	11	6	6	4	1	1	5	9	
Denmark	1	6	5	6	9	5	4	3	1	12	6	8	13	13
East Germany	29		24	15	12	19	14	15	27	18	21	22	21	19
England	8	11	12	15	18	4	9	7	15	1	20	13	5	19
Finland	10	16	14	9	3	15	14	7	4	18	12	15	4	7
Greece	24	15	7	9	3	8	9	19	18	24	3	18	2	2
Hungary	26	20	27	28	20	27	29	22	21	26	25	25	24	26
Iceland	6			12			8	3	12	15	1	2	9	11
Indonesia	27	26	28	26	27	24	25	26	28	29	29	1	1	9
Italy	16	14	1	6	13	12	16	10	13	18	12	5	7	2
Japan	20	24	21	24	21		27	25	26	5	25	27	28	
Low Countries	12	7	15	15	13	8	13	1	4	5	16	15	5	19
Luxembourg	13	9	11	15	8	3	17	12	4	5	23	2	12	18
New Zealand	4	1	6	2	13	8	6	10	1	5	3	8	3	24
Philippines	14		13	9	19	23	19		23	25	22	23	27	1
Portugal	20	23	22	27	27	17	24	24	23	27	16	28	25	4
Spain	25	25	25	24	26	26	23	20	25	28	19	24	23	4
Sweden	6	4	7	2	5	6	3	1	1	12	8	19	13	13
Switzerland	8	12	15	13	5	14	12	7	4	5	12	12	17	9
Syria	22	21	20	22	25	21	25		22	18	18	26	25	13
Trieste	22	18	22	15	23	22	22	15	20	18	8	13	21	4
Turkey	28	22	26	28	24	25	28	22	27	23	28	29	29	25
United States	2	3	2	2	1	2	1	3	4	4	6	8	17	13
Uruguay	10	7	2	15	13	16	4	20	4	12	8	20	17	27
West Germany	18	17	7	23	7	12	9	15	18	17	25	20	9	13

[a] Least expensive country ranked first.

Appendix C. Transformation of Consumption Functions

If expenditures in relation to income can be represented by a logarithmic line and if the slope of this line is the same in two places, the consumption functions may be expressed as follows:

$$(1) \qquad y_1 = K_1 x_1^{a}$$

$$(2) \qquad y_2 = K_2 x_2^{a}$$

where y_1 and y_2 = expenditures on a particular group of goods and services
x_1 and x_2 = income
parameter a = income elasticity
K_1 and K_2 = measure of the level of curves

If the purchasing power of money in the second place relative to the first place is p for the commodity group and P for all commodities and services, the ratio of K_2 to K is equal to the ratio of p^a to P.

If p and P are equal, the ratio of K_2 to K is p^{a-1}. If the measures of comparative purchasing power are not equal, an additional condition is required to determine the separate values.

The data in Tables C-1, C-2, and C-3 were used to determine the purchasing power ratios described on pages 317 and 318. In the case of food expenditures, the income elasticity 0.5 characteristic of American communities was accepted for other countries. The values of the parameter K were as follows:

	Level K of Food Expenditures
United States, 1950 (dollars)	21.4
Norway, 1948 (kroner)	30.4
France, 1952 (1,000 francs)	0.5
India, 1944 (rupees)	15.7
Georgia-Mississippi sharecroppers, 1935-1936 (dollars)	13.5
Lower castes in Farrukhabad, 1949 (rupees)	12.5

The comparison of purchasing power through matching the groups with the same relative expenditure on food was made graphically.

TABLE C-1

Income and Expenditures of Non-Farm Families, United States 1950, Norway 1948, France 1952, and India 1944

INCOME CLASS	AVERAGE INCOME	AVERAGE EXPENDITURES				
		Food				
		Actual	*Adjusted to Average Family of 3.5*	*Housing*	*Clothing*	*All Other*
		United States[a] *(dollars)*				
2,000- 3,000	2,553	951	1,040	457	280	1,013
3,000- 4,000	3,537	1,181	1,217	563	400	1,426
4,000- 5,000	4,630	1,396	1,410	644	545	1,841
5,000- 6,000	5,595	1,602	1,587	740	668	2,347
6,000- 7,500	6,671	1,838	1,789	834	785	2,672
7,500-10,000	8,320	2,142	2,103	994	999	2,974
		Norway[b] *(kroner)*				
Under 1,800[c]	4,462	1,661	1,661	447	470	1,231
1,800- 2,529	7,041	2,765	2,765	783	981	2,406
2,530- 3,559	8,271	2,925	2,925	883	1,193	3,211
3,650- 4,999	9,934	3,134	3,134	1,019	1,531	4,502
		France[d] *(1,000 francs)*				
200- 300	265	176	216	24	29	75
300- 400	330	145	170	86	36	67
400- 500	425	250	235	107	51	84
500- 600	551	282	279	54	78	83
600- 700	627	289	277	103	76	91
700- 800	731	352	343	74	113	116
800- 900	841	341	319	103	103	114
900- 1,000	943	382	366	105	105	93
		India[e] *(rupees)*				
360- 480	408	295	310	85	56	54
480- 600	530	329	341	94	58	59
600- 720	646	396	396	102	66	74
720- 840	756	425	412	106	65	94
840- 960	887	484	463	114	77	95
960- 1,080	1,007	547	494	136	77	132
1,080- 1,200	1,118	608	560	131	77	155

[a] Preliminary tabulations of *Consumer Expenditure Survey*, Bureau of Labor Statistics, 1950.

[b] "Husholdningsregnskaper, mai 1947-april 1948," *Norges Offisielle Statistikk*, XI.23, Oslo, 1950.

[c] Income per consumption unit.

[d] "Enquête sur les budgets familiaux par carnets de comptes annuels à Marseilles (octobre 1951-septembre 1952)," *Bulletin de l'Institut National d'Hygiène*, Vol. 9, No. 2, April-June 1954.

[e] S. R. Deshpande, *Report on an Enquiry into Family Budgets of Industrial Workers in Delhi City*, Government of India, Dept. of Labour.

TABLE C-2

Income and Expenditures of Low-Income Rural Families, United States 1935-1936 and India 1948

INCOME CLASS	AVERAGE INCOME	AVERAGE EXPENDITURES			
		Food			
		Actual	*Standardized for Family Size*	*Housing*	*All Other*
		United States[a] *(dollars)*			
Under 250	186	129	129	7	64
250- 500	354	245	241	9	88
500- 750	572	376	364	13	143
750-1,000	812	519	468	18	218
		India[b] *(rupees)*			
Under 200	176	134	158	6	8
200- 300	257	189	192	9	20
300- 400	354	273	245	12	23
400- 500	448	317	272	12	17
500- 600	553	362	306	12	39
600- 700	646	446	356	18	51
700 and over	868	451	320	42	67

[a] *Family Incomes and Expenditures*, Dept. of Agriculture, Misc. Pub. 465, 1941, Tables 33, 35, and 37.

[b] Shiva Kumar Chaturvedi, "Family Budgets of Some Lower Castes in District Farrukhabad," Dissertation, University of Allahabad, 1949.

TABLE C-3

Income and Necessary Expenditures, United States 1950 and Norway 1948

INCOME CLASS	AVERAGE INCOME	EXPENDITURES ON NECESSITIES	
		Actual	*Ratio to Income*
	United States[a] *(dollars)*		
2,000- 3,000	2,553	1,800	70.5
3,000- 4,000	3,537	2,186	61.8
4,000- 5,000	4,630	2,421	52.3
5,000- 6,000	5,595	2,467	44.1
6,000- 7,500	6,671	2,335	35.0
7,500-10,000	8,320	2,038	24.5
	Norway[b] *(kroner)*		
Under 1,800[c]	4,462	2,904	65.1
1,800- 2,529	7,041	4,497	63.9
2,530- 3,559	8,271	4,772	57.7
3,560- 4,999	9,934	4,993	50.3

[a] Estimated from a preliminary tabulation of *Consumer Expenditure Survey*, Bureau of Labor Statistics, 1950.

[b] Estimated from data on expenditures of four-person families published in "Husholdningsregnskaper, mai 1947-april 1948," *Norges Offisielle Statistikk*, XI.23, Oslo, 1950.

[c] Income per consumption unit.

Appendix D. Joint Determination of "World" Price and Country Indexes

The prices of raw materials in international markets offer an interesting illustration of the measurement of comparative purchasing power of different national currencies. Table D-1 presents data on prices and quantities and Table D-2 shows the results of successive approximations in the fitting of the function $p_{ic} = IC$ to the prices.

Deflating the prices in Table D-1 by the country indexes, the fifth approximation, as shown in Table D-3, reduces the dispersion of prices for five of the seven commodities as follows:

Commodity	*Range of Prices*	*Range of Deflated Prices*
Cocoa	$190	$ 93
Copper	732	272
Jute	273	123
Lead	154	158
Newsprint	116	64
Tin	946	971
Wool	688	376

In general, the variation in the commodity prices, converted to United States dollars by exchange rates, is explained quite well by the country indexes. The relative differences between the "observed" and the "estimated" prices shown below for France are generally under 15 per cent.

Commodity	*Price in France*	*World Price Multiplied by Index for France*
Cocoa	$ 842	$ 948
Copper	902	801
Jute	511	573
Lead	534	575
Newsprint	208	174
Tin	3,006	3,090

TABLE D-1

Prices of Seven Raw Materials in Eight Countries, with Estimates of the Physical Volume of Imports, 1948

COUNTRY	COMMODITY						
	Cocoa	*Copper*	*Jute*	*Lead*	*Newsprint*	*Tin*	*Wool*
	Prices in December 1951 (dollars)[a]						
Canada						2,330	1,170
France	842	902	511	534	208	3,006	
India			338				
Italy		1,222		430	232	2,696	1,858
Netherlands		1,014			151		
Switzerland	700						
United Kingdom	672	568	416	438	119		
United States	652	490	458	380	116	2,060	1,480
	Quantities in 1948 (thousands of short tons)[b]						
Canada			19			6	
France	58	118	53	44	5	13	
India			493				
Italy		84		15	5	3	48
Netherlands		17			5		
Switzerland	700						
United Kingdom	124	490	75	196	14		
United States	279	490	75	276	366	87	298

[a] Foreign commodity prices converted in terms of United States dollars by International Monetary Fund according to prevailing exchange rates.

[b] Estimate of physical volume of imports for all countries except United States based on percentage of world imports in 1948 contained in *International Financial Statistics*, International Monetary Fund, February 1952 issue. United States imports derived from *Statistical Abstracts*, 1953.

TABLE D-2

Comparative Purchasing Power of Eight Currencies as Measured by the Variation in Prices of Seven Raw Materials, 1948

	SUCCESSIVE APPROXIMATIONS				
	1	*2*	*3*	*4*	*5*
Commodity:			*Average Price (dollars)*		
Cocoa	682	690	690	684	682
Copper	621	587	587	580	576
Jute	373	392	392	404	412
Lead	416	421	421	416	414
Newsprint	119	125	125	125	125
Tin	2,205	2,236	2,231	2,224	2,223
Wool	1,514	1,539	1,529	1,529	1,529
Country:			*Country Index*		
Canada	86.18	84.95	85.41	85.42	85.57
France	140.83	138.02	138.68	138.89	138.89
India	90.62	86.22	83.66	82.04	80.86
Italy	150.07	151.69	152.99	153.41	153.70
Netherlands	161.34	169.68	171.03	172.73	173.09
Switzerland	102.64	101.45	102.34	102.64	102.94
United Kingdom	96.07	98.67	99.54	99.95	99.18
United States	92.45	93.18	93.07	93.26	93.42

TABLE D-3

Prices of Seven Raw Materials Deflated by Estimates of the Comparative Purchasing Power of the Currencies of Eight Countries, 1948

(deflated prices, dollars)

	COMMODITY						
COUNTRY	*Cocoa*	*Copper*	*Jute*	*Lead*	*Newsprint*	*Tin*	*Wool*
Canada						2,728	1,370
France	606	649	368	384	150	2,164	
India			412				
Italy		797		280	151	1,757	1,211
Netherlands		587			87		
Switzerland	682						
United Kingdom	672	568	416	438	119		
United States	699	525	491	407	124	2,209	1,587

COMMENT

DONALD C. MACGREGOR, University of Toronto

At the outset it is well to recognize the limitations within which Dr. Brady and Dr. Hurwitz have worked. In conformity with their title, they have confined themselves to the design of consumers' price indexes and to certain problems in converting from one national currency and another. They do not deal directly with anything so broad or tendentious as comparisons of standards of living nor with establishing or comparing any of the various minima for nutrition, health, or decency. In seeking better comparisons of purchasing power, the authors imply, however, that some comparisons at least are admissible. To most readers this is probably a satisfactory position, but it stops just short of distinguishing those comparisons which can be accepted from those which cannot. For this we may be grateful, since there is enough to occupy us within the terms assigned, but important problems in what might be called the logic of comparison still call for attention especially in defining the inadmissible.

The paper deals mainly with a number of efforts to break away from what may be called the standard basket method of weighting retail price indexes. With a view to securing more reliable comparisons between one time and another, and one country or region and another, the difficulties and errors in matching (i.e. of choosing comparable items and weights) are first presented. From the number of authors cited, it is clear that the problem has attracted wide and at times distinguished attention in recent years. Whether significant results have yet been achieved is the main question suggested by the paper, and the answer seems to be in doubt.

The standard basket method has the merit of being simple, and if the basket or bill of goods is sufficiently representative, it may also be impersonal, but to devise a single basket which yields wholly satisfactory comparisons between countries is almost impossible. Thus an urban basket representative of Abyssinia would make nonsense in New York State, while even for nearby countries such as France and England, the United States and Canada, or adjacent provinces such as Ontario and Quebec, differences in weights and possibly in components are necessary. Again, historical comparisons within one country even between years as close as 1925 and 1950 call for similar differences if bias is to be avoided.

The authors hold that the standard basket method has survived in the retail field, notwithstanding these defects, mainly on the strength of its previous record in the simpler field of wholesale prices. In the latter field, where the method has been used with success for almost a century, it has served mainly to portray changes in the value of money, over rather short periods and within individual countries, when spent on standard commodities in wholesale markets. This is one of a number of valuable historical insights presented in the paper.

In the more complex field of retail prices, index numbers are often used for more specific purposes than hitherto, as in labor disputes or for international or long-term historical comparisons. For these purposes the authors hold that the standard basket is so unreliable that it should be abandoned. In place of formal identity they would substitute what might be called realistic equivalence.

The paper should, I believe, recognize more clearly the extent to which a method of equivalence has in fact been introduced in the course of successive revisions, for today's American basket probably differs as much from the American basket of 1900 as from that in use today in some European or South American countries. In revising the United States index many small mistakes have doubtless been made in choosing and weighting the modern counterparts of earlier articles of consumption. The mistakes need not all be in the same direction, however, and I would put more faith in the self-compensating character of random errors than the authors seem willing to do. Systematic error, in the form of an upward bias arising from inappropriate weights, is another matter, but I take it that it can be kept within bounds by successive revisions. For simultaneous international comparisons, however, the systematic error cannot be allowed for in this way and is a major problem to which we will return.

As the discussion of errors in matching proceeds, the authors assume more familiarity with their specialized language than most readers are likely to possess, and this in a field where not much jargon is necessary. It is not customary to remark on stylistic limitations of this kind, but I feel constrained to do so because a needlessly cryptic and technical style, though it may save words, may waste a good deal of the reader's time. Both the problem and the studies brought under review are important enough to merit something more lucid than "federal prose."

On the choice of items for an index, the authors believe that

failure to select comparable products often arises from neglect of the less tangible factors, especially when complex durable products are involved. All the variables implied in the term "product variation" should be held constant, such as merchandising services, the terms of sale, and arrangements for upkeep, but in practice this is a counsel of perfection even in revision of the components for a single country.

If, instead, the most nearly comparable items are not even superficially similar (e.g. northern vs. Arabian clothing), the difficulties reach another level no matter how precise the description. Here the authors' proposed method of equivalent groups, as opposed to identical or closely comparable items and weights, offers distinct advantages.

The authors go on to show that an important qualification (one might almost say a paradox) then arises in the following circumstance: if the price elasticity of demand for the whole of a selected group of items is unity, the choice of suitable weights for the individual components of such a group turns out to be of almost no importance. A simple algebraic proof shows that when there is unit elasticity of demand for the group of q's, the Laspeyre index,

$$\frac{\sum q_1 p_2}{\sum q_1 p_1},$$

which is that commonly employed, reduces to

$$\frac{\sum (p_2/p_1)}{n},$$

which is a simple or unweighted average of price ratios.

This is a nice demonstration, new to me, of why in certain cases weighting schemes have so little influence on the level of price indexes. The argument might also prove useful if it could be shown to be equally valid when inverted; thus if differences in weighting schemes prove to have an appreciable effect on the indexes, it might be inferred that the price elasticity of demand for the group departs considerably from unity. In fields where the data are insufficient for a direct attack on price elasticity of demand, this method deserves attention.

The next section, on explanatory models, illustrates the difficulty of reviewing what is essentially an office document when neither the materials under discussion (in the form of a number

of tables and manipulations) nor the papers which discuss them are before the reviewer or his audience. The paper argues that spatial comparisons impose fewer restrictions on the mathematical investigator than historical or temporal ones. It envisages the construction, for international comparisons, of estimating equations whose performance can presumably be tested. But tested against what? Against individual observed prices only, it seems. The problem of constructing a representative index for a number of items seems to stand where it was, except that something may be learned about the appropriate rates for converting currencies by studying the performance of estimating equations from different countries. As James Tobin is familiar with work in this field, I will leave the matter to him and limit myself to the naive observation that the mechanical procedure outlined in the example (for the United States, United Kingdom and Denmark), despite the advantage of flexibility as to components, seems on the surface to be influenced too much by the initial assumption as to exchange rates, which is the hardest thing to establish.

The next section, on "sources of price differences" (p. 310), might well be entitled "defects of prevailing practice: a note on coverage and classification." It is argued that the compilers of price indexes, by recording especially the items with a large turnover (as a short-cut to representing a large proportion of business) have not given sufficient attention to price changes in the great miscellany of minor products. It should be possible to establish the truth of the assertion quantitatively and the matter appeals to me as deserving study. Evidence may be quoted from recent fiscal history to show the importance of items once considered trivial which now receive the attentions of the exciseman, items such as cameras, fountain pens, cigarette lighters and a host of other articles. How to make a scientific sample of this ill-defined, miscellaneous universe I do not know. Large and unpredictable sampling errors might be expected, but I am attracted by the possibility of an experiment in random sampling, partly because sampling is less likely to solidify into routine prematurely.

This brings us to the authors' remark that there will probably never be a census of prices. Amen, and God forbid. But I am prepared to say something on the other side, and argue the case for broader and more intensive surveys of prices than presently available ones, especially if the results can be published at length. Such surveys would in the long run prove more useful than much of

the routine work on weekly and monthly indexes now being done. Here one may cite the continuing value of the large inquiries conducted before the war of 1914, not only in the United States but by the British Board of Trade and by the Board of Inquiry into the Cost of Living in Canada (1915).

Next, I can appreciate the authors' fear that a too rigid system of deflators will hamper revision of the national accounts in view of the inertia of large organizations with heavy commitments and limited staff. The present heavy demands on deflators seem quite out of proportion to their reliability, while the resulting series, purporting to be in constant dollars, are put to more important use than ever before.

Equivalent Groups. This section refers to comparisons between samples of family expenditure data. Employing a method which might be described as mathematical behaviourism, equivalence is inferred between groups of data which display similarity in purely mathematical terms. The simplest criterion of equivalence is equality of one or more of Ernst Engel's ratios of spending to income. Consider two buyers whose preferences and incomes differ, but whose weekly food baskets absorb the same proportion of their incomes. Such an equality in the food-income ratio may or may not indicate equivalence in other respects. If we study two samples of American families which display the same food-income ratio, one sample drawn in 1919 and the other in 1950, it will probably be found that the two groups differ considerably as to their hours of labor and manner of life, and the same might be said of a simultaneous comparison between buyers in the United States and some poorer country.

If such differences be ignored, a common food-income ratio might justify the statement that the budget of a skilled carpenter's family in Chicago bears a marked similarity to that of (say) a doctor's family in Brussels. This does not carry us all the way, however, for to reach a more meaningful comparison we still have to deal with the spread between the Brussels doctor and the Brussels carpenter, and this may be harder.

In the newer samples of family expenditure, which span a broader range of income and hence yield rough functional relations between spending and income, the study moves from the domain of arithmetic to that of calculus. More criteria of equivalence may now be sought, such as similarity in the values of the first or higher derivatives, in elasticity of the functions, in points of in-

flection, in zero values of certain components of outlay, e.g. saving, and in certain maxima or minima.

Although these similarities may be discovered by routine methods, they are not easy to interpret. One may isolate wage earners and farmers whose savings have an average value of zero, in the belief that the associated levels of income are somehow equivalent, and from this it might be concluded that x dollars of income on a farm equal x plus m dollars in a town. Enough was known about saving habits in farm and city a generation ago, however, to show that this form of analytical equivalence may not correspond to meaningful economic equivalence.[1] The fact that farmers commence saving at a lower level of money income than an urban population is not a short cut to equating levels of living but rather an indication of deep-seated differences in the conditions of earning an income. In short, resorting to a sort of naive mathematical behaviourism may prove of limited value. Not one but a number of aspects should be the same or nearly so if equivalence is to be established, and the family budget may not yield all the information required. Put in the broadest terms, it seems to be a good principle that reliable conclusions on the equivalence of complex situations cannot safely be drawn from equality of one or two variables or relationships.

I regret that I am unable to give proper weight to the contributions of Frisch, which have not been available to me except as they are mentioned in Henry Schultz's survey.[2] It appears that Frisch's criteria of equivalence are more complex and exacting than others, anticipating the criticism of the preceding paragraph.

The concluding paragraphs on the character of modern Engel's curves for food will attract wide interest. "Engel's law does not hold below a certain income." "The proportion of resources devoted to food increases . . . up to an expenditure which apparently represents a first approximation to adequate nutrition." Recognition of such a point, which is the point of inflection, is in marked contrast to the generalization of Allen and Bowley, in their volume on Family Expenditure, that the relation was linear. An important application of the point of inflection was developed by Dr. Brady in 1948, for placing successive American budget studies on a comparable basis.[3] Another application, about which she has been

[1] Cf. Maurice Leven, Harold G. Moulton, and Clark Warburton, *America's Capacity to Consume*, Brookings Institution, 1934, Chap. 8.

[2] *Journal of Political Economy*, February 1933, pp. 95-116.

[3] *Review of Economics and Statistics*, August 1948, pp. 198-206.

too modest, will be found in the well-known city worker's family budget.[4]

Imbedded in this section lies the clearest statement of the main thesis, to which I now return, as follows: "procedures for matching bundles of goods and services must be free, in concept and in practice, from the need for imputing identity to particular commodities (p. 315)." This is a pretty forthright declaration of independence, at any rate for the construction of national indexes designed mainly for domestic purposes. It is essentially a demand for broader powers of administrative discretion, powers which imply both advantages and pitfalls. In the right hands, greater freedom in choosing the new standard basket for periodic revisions of the index should produce a more realistic bill of goods and might reduce the upward bias resulting from unchanged components and weights. In the wrong hands, however, it could convert retail indexes to a fine art of something or other and might bring pressure groups, including those within government, embarrassingly close to the elbow of the statistician.

An index of an almost fixed basket has well-known limitations but, like the rule of law in a field where the law accommodates itself only very gradually to changed conditions, it has the merit of being impersonal and relatively unvarying, though admittedly imperfect. The errors in such an index share its virtues and defects; because they are on the whole impersonal, widely recognized, and not capricious they can be allowed for, and need not detract much from the prestige of the index. These are platitudes, and I make no apology for repeating them because they are an important ingredient in the design of social measurements. I hope the authors will agree that the freedom which they seek should be granted only after proper provision has been made to ensure fairness, publicity, and review and, further, that it should be used sparingly.

JAMES TOBIN, Yale University

The paper by Dorothy S. Brady and Abner Hurwitz is both very difficult and very stimulating for a reader who has previously devoted little study to the subject. The duties of a discussant compel him to pay most attention to the parts of the paper that gave him

[4] *Monthly Labor Review*, February 1948, pp. 133-179; *Workers' Budgets in the United States: City Families and Single Persons, 1946 and 1947*, Bull. 927, 1948; *Family Budget of City Worker, October 1950*, Bull. 1021, 1951; all Bureau of Labor Statistics.

the most difficulties, and I am afraid that my remarks may indicate a less favorable appraisal of the paper than I intend and than the paper as a whole merits. The problem the authors are tackling with considerable ingenuity and courage is in principle insoluble, and it is not surprising that their suggested solutions encounter criticism.

Price Index Numbers. The paper contains a great deal of wisdom, the product of careful reflection on long experience, concerning the construction of price index numbers relating two situations differing in time or in place. The authors show that alternative schemes of matching commodities between the two situations can lead to widely different values of the index.[1] They also point out the bias in index numbers which may result from choosing for each component category of the index the prices which are most representative in terms of volume of sales. Low-sales-volume items are never included in the sample of prices, but they may show systematic differences in price behavior from the large-volume items.

Factor Models of Price Differences. The use of models borrowed from statistical analysis of variance to explain price differences among countries and to estimate country price indexes is certainly an ingenious idea. We may expect to hear a great deal more of it in the future. Comment here is somewhat impeded by the unavailability at this time of the work of Smith and Jablon, on which Brady and Hurwitz base their account. The great advantage of the method is that it does not require a list of commodities common to all countries. This kind of model has also, as the authors point out, the advantage that unique indexes for a whole set of countries can be computed simultaneously. The conventional index number method requires a set of possibly inconsistent binary comparisons. The accompanying disadvantage of the suggested new technique is that the value of the index between any pair of countries is not independent of the set in which the pair are embedded.

The authors' main specific example is the multiplicative two-factor model, which says that, except for a random error, the price P of commodity j in country i may be expressed as $P_i\Pi_j$. P_i is a factor representing the price level in the country; for any one country i,

[1] Economists will be able to follow the argument better if they remember that what the authors call a "demand curve" is not a schedule of the amounts that would be taken of an identical commodity at alternative prices, but instead a scatter of points representing prices quoted and quantities taken for a variety of qualities of a commodity.

it is the same for all commodities. Π_j is a factor representing the average world price of a commodity; for any one commodity j, it is the same for all countries. I have the following comments and questions concerning this model:

1. If the model held exactly, without random error, then all price relatives between any pair of countries would be the same. All index number formulas would lead to the same result—there would indeed be no "index number problem."

2. Can departures from perfect fit to the model be viewed as random? Surely, the index number problem arises from systematic nonrandom departures from proportionality. The authors themselves argue that national differences in the structure of prices, not just in price levels, are inherent in differences in climate, resources, location, and technology. A statistical model that takes account of country-commodity interactions is a minimal requirement for a model, not an optional refinement.

3. Whatever model is hypothesized, the estimates that result from its application should be accompanied by significance tests of the hypotheses.

4. In the examples given in the paper, each commodity price in each country is weighted by the quantity of that commodity purchased in that country. This procedure carries the danger that a large country may so dominate the calculation of the Π_j that the model gives approximately a fixed-weight index with the large country's quantities as weights.

Other Measures of Equivalent Purchasing Power. In the last half of the paper, a number of other ingenious suggestions for finding purchasing power equivalents are set forth. These techniques have in common the convenient property of avoiding altogether the need for price observations. They depend instead on ascertaining the levels of income in the two countries at which households would behave in some equivalent way, and on identifying equivalence of this specific kind of behavior with equivalence of economic well-being. The authors' suggestions are:

1. Incomes at which households spend the same percentage of their incomes on food are equivalent.

2. The income level in one country at which the percentage spent on food reaches a maximum is equivalent to the income level in another country at which the percentage spent on food reaches a maximum.

3. Incomes at which households spend the same percentage of

their incomes on necessities are equivalent. Here necessities may vary from country to country; for each country, they are commodities which have in that country an income elasticity less than one.

4. The income levels of comparable social and occupational groups who have roughly similar consumption patterns may be considered equivalent. The author's example equates Georgia-Mississippi share-croppers in 1935-1936 to contemporary lower castes in India.

The first of these suggestions is the one the authors propose in greatest detail, and consequently the one that deserves the greatest discussion. Even for this method they provide little rationale. Why should two families be regarded as equally well off just because they spend the same percentage of their incomes on food? The physical quantity of the food, its nutritional content, the associated retail and restaurant services, the quality of the various items—all may be very different. Evidently, the implicit principle is that food is a regrettable necessity, and that freedom to dispose of income in other ways is a sign of well-being. The relation of food expenditure to subjective satisfactions is a cultural variable to which a nation's climate, traditions, and culinary skill are related. Is a French gourmet to be considered poverty-stricken because he chooses to spend his money on good food and drink instead of television and gasoline?

These doubts about the principle would be less serious if the income elasticity of food demand were in fact a universal cross-cultural constant. If it were, then it would also make no difference at what percentage of income we chose to match income levels. That is, the ratio of the United States income of which X per cent goes for food to the France income of which X per cent goes for food would be the same whatever value we take for X—70 per cent, 20 per cent, or any other percentage. Given such constancy, this ratio between the United States and France incomes would cry out for interpretation, although the conclusion that this equivalence means equivalence of standard of living would still require further justification.

The data in Appendix Table C-1 permit computation of income elasticities for the three countries and Norway, although in the absence of data on number of cases in each income class, it is not possible to compute optimal estimates. Weighting each income class equally, I compute an income elasticity of 0.59 for the United States, 0.82 for Norway, 0.52 for France, 0.57 for India. On this

basis the number of kroner to the dollar varies, over the four points presented by the authors on page 317, from 0.27 to 1.52; the number of francs from 336 to 417, the number of rupees from 0.67 to 0.73.

A thorough discussion of this method of estimating equivalences among currencies would have to consider many other details: the nature of the correction for size of family and its applicability to all nations, the exact definition of income used in each budget study, comparability of treatment of taxes and income in kind, comparability of definition of food, and so on.

Relative Income and Absolute Measure of Purchasing Power. Method 4 listed above proposes the matching of the income levels of those population groups in different countries who occupy similar positions in the internal distributions of economic and social status. This method comes dangerously close to begging the question. The authors state in their conclusion that the need for international comparisons of purchasing power arises from international quasi-taxation schemes. Both the rich and the poor are always with us. What the international agencies need to know is how much poorer, on some absolute scale, the poor of India are than the poor of the United States.

Mrs. Brady was a few years ago co-author of a brilliant article contending that the division of income between consumption and saving depends on relative income rather than absolute income.[2] To the extent that consumption patterns—the percentages devoted to various broad categories of consumption—depend on relative income and status rather than absolute income, the above criticism of method 4 applies also to methods that rely on finding income levels at which comparable consumption patterns occur. In short, so far as these methods give unique answers at all, they may tend to give the answer that average real incomes are everywhere the same.

[2] Dorothy S. Brady and Rose D. Friedman, "Savings and the Income Distribution," *Studies in Income and Wealth, Volume Ten*, National Bureau of Economic Research, 1947, pp. 247-265.