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NATIONAL COUNCIL FOR SOVIET AND EAST EUROPEAN RESEARCH

TITLE: EFFECTIVE PURCHASING POWER: MEASUREMENTS OF SHORTAGE FOR THE
GERMAN DEMOCRATIC REPUBLIC, HUNGARY, POLAND, ROMANIA AND YUGOSLAVIA

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EXECUTIVE SUMMARY

Project Title: Effective Purchasing Power: Measurements of Shortage for the German Democratic Republic, Hungary, Poland, Romania and Yugoslavia

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OVERVIEW

This report presents econometric estimates of the extent and pattern of shortages faced by consumers in the centrally planned economies of the German Democratic Republic (GDR), Hungary, Poland and Romania. In addition similar estimates have been calculated for the market socialist economy of Yugoslavia. The existence of shortages in these economies is shown to have important consequences for cross-national comparisons of consumption levels and purchasing power.

Constrained only by market prices and household income, consumers in a market economy are free to consume as they please. In contrast, consumers in Eastern Europe have much less freedom of choice. Households are still free to spend as they choose but only on those goods and services which are available. Consider the case of housing. When housing rents are below market clearing levels, an average household would still desire to acquire more housing than it has. This excess demand for housing results in demand spilling over into other kinds of spending, e.g., alcoholic beverages, tobacco products. The difficult research task is how to quantify the mismatching of the supplies of consumer goods and services with the demands of consumers.
Effective purchasing power is an average measure of the extent of shortages, much as the rate of inflation may be regarded as an average measure of price changes. Effective purchasing power is determined from the answer to the following hypothetical question:

What is the most an average East German, Hungarian, Polish, Romanian or Yugoslavian household would pay for the right to purchase at existing prices without any supply constraints?

The effective purchasing power gap is defined as the reply to this question expressed as a percent of total consumption expenditure.

**MAJOR THEORETICAL AND METHODOLOGICAL FINDINGS**

- Conventional indexes of real consumption and purchasing power typically used for cross-national comparisons of living standards are demonstrated to be potentially misleading whenever shortages are significant in one of the economies being compared.

- With additional information on the structure of household preferences, adjusted indexes of purchasing power can be calculated to obtain meaningful indexes of real consumption and shortage. The additional information on household preferences may be obtained from standard econometric demand systems estimated for market economies.

A demand system estimated from West German family budget data is used in this report to examine East German household expenditure and consumer price data for evidence of shortages. Similarly another demand system was estimated for U.S. and West European per capita consumption expenditures and purchasing-power-parity indexes from the International Comparison Project to interpret the observed pattern of consumption in Hungary, Poland, Romania and Yugoslavia.
MAJOR EMPIRICAL FINDINGS

• In the absence of shortages, the purchasing power of the GDR Mark for an East German family of two adults and two children in 1985 would have been almost one third greater than the purchasing power of the DM for an identical West German family. However about half of that additional purchasing power was lost due to microeconomic shortages experienced by households in the GDR.

• The 17% rise in household net-income in the GDR over the period 1977 to 1985 was accompanied by an apparent drop in real consumption. The extent of shortages as measured by the size of the effective purchasing power gap did not show any dramatic change over the period. Hence the fall (at best stagnation) in living standards between 1977 and 1985 can be attributed entirely to the average increase in prices of 22%.

• A distinct positive relation between the extent of shortages felt by a household and its income was found for the GDR. A 10% increase in real income is associated with an approximately 1% increase in the estimated effective purchasing power gap. This finding is consistent with a common observation of economic life in East Germany—people with lower incomes complain much less about having too much money but not enough goods to buy than do those with higher incomes.

• Estimated effective purchasing power gaps for Romania and Poland in 1975 are significant and larger than those calculated for Hungary and Yugoslavia. While the estimated Hungarian effective purchasing power gap was "large" relative to control calculations for Western market economies, it was approximately equal in magnitude to the control figure calculated for Denmark. Only the effective purchasing power gap for Yugoslavia was found to be "small" as to be expected, given the much larger role of markets in the Yugoslavian economy.

• The pattern of demand spillovers and excess demands by expenditure categories reveals overwhelming agreement. For the centrally planned economies of Hungary, Poland and Romania the difference between actual and desired spending has the same
numerical sign in 13 of 18 detailed expenditure categories. For 9 of the 18 categories of expenditure Hungary, Poland, Romania and Yugoslavia show the same direction of excess demands and spillovers.

**IMPLICATIONS FOR POLICY**

- The accurate assessment of relative living standards and economic conditions in socialist economies must take into account the existence of shortages. The careful collection of comparable price and expenditure data needs to be supplemented with an index number methodology such as that presented in this report which explicitly addresses the problem of shortages.

- For the methodology of this report to be applied systematically, it is of critical importance to collect consumer price and expenditure data on a regular basis for all of the socialist economies, preferably following the International Comparison Project classification (e.g., the study for Soviet consumption in 1976 by Gertrude E. Schroeder and Imogene Edwards, *Consumption in the USSR: An International Comparison*, Joint Economic Committee, 1981).

- A demand system estimated from family budgets for a market economy in Central Europe (either West Germany or Austria) would be a valuable alternative for generating a second, independent set of estimates of the extent and pattern of shortages in Eastern Europe using family budget data from those countries.
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INTRODUCTION

Being both producers and consumers of measures of relative economic performance, economists have a double stake in the appropriateness of their methodology of comparison. The interpretation of conventional Laspeyres and Paasche indexes of real consumption or relative cost-of-living for two or more market economies or for a single market economy over time involves substantive issues in economic theory.\(^1\) The interpretation of such indexes when economic systems fundamentally differ is much more problematic.

This general point is widely recognized in principle. However, it is only on the production side that this has been reflected in Western statistical practice. In comparisons of output levels across economic systems, Bergson's adjusted factor-cost standard is regularly employed for valuation purposes rather than the established prices of the centrally planned economies.\(^2\) This is because of the extent and variability of turnover taxes and subsidies as well as the existence of differential profit rates across sectors in the centrally planned economies which prevent established relative prices in those economies from reflecting objective (technical) production trade-offs between goods.

In contrast, conventional indexes of real consumption and relative purchasing power across economic systems have been typically calculated without adjustment as though one were comparing market economies. Such has been the practice from West

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\(^1\)See Samuelson and Swamy (1974) for a survey of economic index numbers and bibliography. The economic interpretation of Laspeyres and Paasche quantity indexes and their relation to certain exact indexes can be shown quite elegantly using geometry. The paper by Moorsteen (1961) represents a seminal contribution to the comparative economic analysis of output levels. Moorsteen's approach has been extended by Bergson (1971). For a complementary geometric exposition which emphasizes the welfare interpretation of index number calculations see Samuelson (1974 and 1984) and the comments by Keren and Weinblatt (1984) and Swamy (1984) as well as Collier (1987b).

Berlin and Vienna to Philadelphia.\textsuperscript{3} Since the choice of which country's prices or quantities to use for weighting appears arbitrary, Laspeyres and Paasche indexes are usually blended into some type of average. As shown below, such evenhandedness is not appropriate when quantity constraints are present in one of the economies.

This report presents statistical estimates of the magnitude of quantity constraints faced by consumers in the centrally planned economies of the German Democratic Republic (GDR), Hungary, Poland and Romania. For purposes of comparison identical calculations have been made for the market socialist economy of Yugoslavia as well. The existence of quantity constraints is significant for the methodology of intersystem comparisons of consumption levels as well as the meaning of relative purchasing power.

Part I of the report presents the economic theory of the consumer confronted by quantity constraints and microeconomic shortage. It begins with a short, nontechnical introduction to the methodology of shortage measurement. This is followed by a formal exposition of the index number problems which result from adding the complication of quantity constraints to the traditional budget constraint faced by households. In Part II the underlying data on prices and expenditures as well as the econometric procedures for generating the estimates of shortage are discussed. Previous work on the GDR economy by the principal investigator, Collier (1986), has been expanded in Part III to a series of estimates of consumer disequilibrium for 4-person (2 adults and 2 children) East German households by household net-income for the years 1977, 1981, 1983 and 1985. In Part IV the International Comparison Project data (Kravis, Heston and Summers (1982)) for 1975 have been used to obtain similar measurements of microeconomic disequilibrium faced by

\textsuperscript{3}For the two Germanys see Bundesministerium für innerdeutsche Beziehungen [BMB], (1987, pp.511-519. For comparisons of Austria with Poland and Czechoslovakia see Askanas and Laski (1985) and Havlik (1985), respectively. For Romania, Poland, and Hungary compared to the rest of the International Comparison Project's (ICP) sample see Kravis, Heston and Summers (1982).
households in the Eastern European countries which participated in ICP. Of methodological interest are the experiments conducted in Part IV to determine the sensitivity of these measures of disequilibrium to the choice of sample and level of expenditure aggregation.

PART I—THEORETICAL CONSIDERATIONS

1. AN ELEMENTARY GUIDE TO THE MEASUREMENT OF SHORTAGE

The measurement of shortage and disequilibrium is a relatively young branch of applied economics. The estimates of intermarket spillovers and the summary measure of shortage presented in Part III and Part IV below are best understood with reference to the economic theory which guided the calculations. This section of the report provides a self-contained introduction to the economic interpretation of the structure of consumption expenditure and consumer prices for households facing significant, non-monetary constraints on the quantities of goods and services which they are able to acquire.

Let us consider the case of a household which consumes only two goods, beer and housing. Possible combinations of beer and housing can be represented geometrically by points plotted on a graph, see Figure 1a where quantities of beer (liters) are measured

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4 The calculations of Tables 8 and 9 in Section 4 are the product of joint research with Dr. Manouchehr Mokhtari of the University of Houston—Downtown.

5 An important international conference "Modelling of Disequilibrium and Shortage in Centrally Planned Economies" was recently held at the University of Birmingham (England) in April 1987. The papers of that conference will be published in Davis and Charemza, eds. (forthcoming). For the economics of shortage generally, the reader is referred to the seminal work of János Kornai (e.g., Kornai 1980 and 1982). The bibliography by Quandt (1987) contains many references to disequilibrium modelling of socialist economies.

6 Combinations of goods acquired by households are interchangeably referred to as market baskets or consumption bundles.
along the horizontal axis and quantities of housing (square meters) are measured along the vertical axis. The task of consumer theory is to explain observed household consumption bundles, i.e., to predict how the consumption bundles chosen by households would change with changes in the constraints limiting household choice. Consumer theory views household choice as the result of the interplay of subjective preferences (tastes) and objective constraints.

**Household Preferences.** In Figure 1a consumer tastes are represented using the device of indifference curves which are analogous to the contour lines of a topographic map. The preference map in Figure 1a displays the contour lines of a household's "utility mountain". Combinations of housing and beer generating the same level of satisfaction are located along a level line on the preference map of Figure 1a. A household whose tastes are represented by such a preference map is considered to be indifferent among all the combinations of beer and housing which fall along any particular level line, hence the name "indifference curve". The assumption that households are utility maximizers means that any household would prefer to move to a higher level of utility, say, from I₂ to I₃. What makes household choice an economic problem is the existence of constraints which prevent households from climbing arbitrarily high on the utility mountain.

The economic reason for the negative slope of indifference curves is that goods are substitutes for each other in producing household utility. The slope of an indifference curve at a particular consumption bundle represents the subjective rate at which households would trade-off additional housing for beer (the marginal rate of substitution). The curvature reflects the economic assumption that the more of a good a household has, the more of that good it would be willing to trade in exchange for another good.

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⁷Also referred to as utility, real income or living standard.
Figure 1a
Indifference curve representation of consumer preferences.

Figure 1b
Budget-constrained choice set of consumers.
Most important for economic analysis is the assumption that tastes (i.e., the contour lines of Figure 1a) are stable. The behavior of consumers can of course differ because consumer preferences differ. However, economists generally prefer to leave merely a residual role for taste differences in explanations of consumer behavior. The preferred candidates for explaining differences in consumer behavior are differences in the constraints which limit choice.8

**Budget Constraints.** In a classic market economy households are regarded as sovereign economic agents subject only to a budget constraint, i.e., total consumption expenditures are limited by the wealth or income of the household.9 The budget constraint may be written algebraically as

\[ Y \geq p_b q_b + p_h q_h, \]

where \( p_b \) and \( p_h \) are the prices and \( q_b \) and \( q_h \) are the quantities of beer and housing, respectively. The products of price and quantity — \( p_b q_b \) and \( p_h q_h \) — are the respective household expenditures for beer and housing. The geometric representation of the budget constraint inequality is found in Figure 1b. The shaded area (plus border) represents the market baskets of beer and housing which are affordable within a budget \( Y \).10

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8As Paul Samuelson (1974) has expressed the assumption of uniform tastes, "...a rich fool is merely a poor fool with more real income."

9This report ignores possible spillovers into additional saving caused by shortages. Such spillovers are a potential macroeconomic problem resulting in an imbalance between disposable income and the aggregate supply of consumer goods. The macroeconomic problem of so-called repressed inflation (too much money chasing too few goods with prices stuck) has dominated the empirical disequilibrium literature (see the papers in Davis and Charemza). Macroeconomic disequilibrium is quite distinct from the problem of whether prices and the structure of consumption are in harmony.

10Why the choice set happens to be the particular triangle of Figure 1b can be seen by considering the vertices of the shaded triangle. The horizontal intercept represents what would happen if the household budget were entirely spent on beer (\( q_b = Y/p_b \) and \( q_h = 0 \)). Analogously the vertical intercept would mean the entire budget were spent on housing (\( q_h = Y/p_h \) and \( q_b = 0 \)). Finally, the empty market basket (\( q_b = 0 \) and \( q_h = 0 \)) is always affordable. The rest of the triangle represents all possible mixtures of those three extreme, affordable cases.
The choice set will change as the objective constraints facing the household change. The choice triangle for the household will get larger (greater quantities become affordable) if prices fall and/or if the budget increases. The slope of the top side of the choice triangle represents the (objective) rate in the market to trade a unit of housing for a unit of beer.\(^{11}\)

Unlike a household's preference ordering, the budget constraint (which is determined by the values of \(Y, p_h\) and \(p_b\)) and the actual consumption bundles \((q_h, q_b)\) are directly observable. These data form the raw material of applied demand analysis.

**Household Equilibrium (Budget Constrained)** In Figure 2a household preferences and the budget constraint have been combined to determine household demands for beer and housing, \(q_b\) and \(q_h\). Simple inspection of Figure 2a reveals that household utility will be maximized if the household selects the point where an indifference curve is tangent to its budget constraint.\(^{12}\) Any other affordable market basket would leave the household on a lower indifference curve. Market demands \(q_h\) and \(q_b\) are equilibrium choices for the household in the sense that, barring change in the choice set (caused by a change in the total budget or prices) or change in preferences, the household will not change its consumption behavior from \(q_h\) and \(q_b\).

\(^{11}\)The absolute value of the slope of the budget line is equal to the price of beer divided by the price of housing. This can be seen by rewriting the budget constraint as an equality and dividing both sides of \((1)\) by the price of housing and rearranging to obtain:

\[ q_h = \left[ \frac{Y}{p_h} \right] - \left[ \frac{p_b}{p_h} \right] q_b \]

where \(\left[ \frac{Y}{p_h} \right]\) is the vertical intercept and \(-\left[ \frac{p_b}{p_h} \right]\) is the slope of the budget constraint drawn in Figure 1b.

\(^{12}\)The fact that there is only one such tangency point comes from the presumed curvature of indifference curves (assumption of diminishing marginal utility).
Figure 2a
Consumer's utility maximizing choice for a given budget and prices.

Figure 2b
Observed quantities, budgets and prices. Unobserved indifference curves to be estimated.
The tangency condition which results from the combination of the utility maximization assumption and the simplicity of the budget constraint provides the crucial link between observed consumer behavior and unobserved consumer preferences in a market economy. At the equilibrium consumption bundle the subjective trade-off of housing for beer (the slope of an indifference curve at a point) is equal to the objective trade-off between the two (the slope of the budget constraint which equals the relative price of beer, $p_b/p_h$).

Applied Demand Analysis. The basic approach of the applied economist for estimating the contour lines of the unobservable preference ordering in Figures 1a and 2a is to exploit the theoretical insight that the observed budget line will be a linear approximation to the particular indifference curve which passes through an observed consumption bundle. By observing household consumption choices under a variety of price and income situations and employing statistical methods to join the linear "pieces" in a manner consistent with further assumptions of economic rationality, the empirical economist is able to construct a model of the "utility mountain". The purpose of such a model of the preference ordering is to predict which consumption bundle would be chosen for an arbitrary, not yet observed choice set.

Before proceeding to the complications introduced by shortage, a restatement of the combination of assumption, observation and inference involved in conventional demand analysis is in order. The three critical assumptions are utility maximization (i.e., tangency of indifference curve and budget line at the market basket chosen by the household); stability of preferences\(^\text{13}\); and solely budget determined choice set (i.e., the choice set looks like Figure 1b). Applied demand analysis is a two-step process: in the first step

\(^{13}\)Fortunately the same methodology which is employed below to capture the effect of quantity constraints on consumption patterns can be used to check the appropriateness of assuming similar preferences across the countries of the ICP sample. The similarity of preferences in East and West Germany would seem as safe an assumption as one could ever make in statistical demand analysis. For a critical discussion of the assumption of preference invariability see Spechler (1982).
observed budget lines (determined by both prices and nominal budgets) and the corresponding consumption bundles chosen by consumers are used to estimate the unknown indifference map; in the second step the estimated indifference map is combined with a new budget line to predict the consumption bundle which would be chosen on that budget line (Figure 2a).

*Quantity Constraints and Notional Demands.* Much of the simplicity of applied demand analysis is lost when quantity constraints become co-determinants of the choice set of households.\(^{14}\) Consumer sovereignty is diminished. In this case households are unable to obtain the quantities of certain goods they wish to buy at existing prices. However they remain sovereign in the limited sense of being free to choose between saving the money they cannot spend due to shortages or spending more money on those goods which are available.

For the simple two good example above, suppose there is a shortage of housing. In Figure 3a this is represented by a maximum quantity of housing \(H^*\) which households can obtain. Instead of the entire triangle below the budget line (Figure 1b), the choice set has been reduced to the shaded trapezoid of Figure 3a. What makes \(H^*\) a binding quantity constraint is that the consumption bundle labelled "notional demand" lies above the housing constraint \(H^*\).\(^{15}\) The highest indifference curve such a household could climb to would be at the corner of the budget and quantity constraints, i.e., where the household is consuming the maximum available housing \(H^*\) and spending the rest of its budget on beer. The budget and quantity constrained equilibrium is at the consumption bundle in Figure 3a labelled "actual".

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\(^{14}\)The term "quantity constraints" is used throughout this report to include all forms of non-price rationing, e.g., formal rationing with coupons and allocation by waiting lists, queues, elbows, etc.

\(^{15}\)Notional demand is the quantity of a good consumers would be willing to buy at existing prices and income without the interference of quantity constraints. When actual purchases exceed notional demands, there is spillover demand. When actual purchases are less than notional demands, there is excess demand.
Figure 3a
Quantity constraint for housing. Actual consumption differs from notional demands.

Figure 3b
Effective purchasing power as difference between actual expenditure and minimum expenditure required to remain at same level of utility without quantity constraints.
Unlike the simpler, solely budget constrained case, as a general rule there will be no tangency between the budget line and the indifference curve at the observed consumption bundle in the quantity constrained case. This is significant for the analysis of the pattern of consumption expenditures because it is no longer possible for an economist to use observations on incomes, prices and quantities to estimate the unobserved preferences of households in those economies where quantity constraints are known to be significant.\(^\text{16}\) Thus it would appear that the measurement of disequilibrium by comparing notional demands with actual consumption is an impossible task since the existence of disequilibrium precludes the use of actual consumption expenditures for estimating the indifference curves needed for determining notional demands.

One solution to this problem is to seek information on consumer preferences elsewhere. In a pioneering paper the Polish economist Leon Podkaminer (1982) "imported" estimates of the parameters of utility functions for Ireland and Italy to examine disequilibrium in Polish consumer markets. Similarly Collier (1986) estimated a demand system for West German households in order to estimate notional demands for quantity constrained households in the GDR. The same approach has been used to calculate the measures of shortage presented in Parts III and IV of this report.

\textit{Quantity Constraints and Effective Purchasing Power.} Effective purchasing power may be regarded as a summary measure of the extent of microeconomic disequilibrium in consumer markets. Effective purchasing power is motivated in Collier (1986) as the answer to the following hypothetical questions:

\(^{16}\text{While it is possible to observe the effects of shortage such as queues and waiting lists and to collect evidence of an anecdotal variety concerning the existence of colored markets and waiting times for the delivery of automobiles or obtaining an apartment, most often quantity constraints will have to be measured indirectly.\}
How much could the total budget of a household in a quantity-constrained economy be lowered in exchange for a complete elimination of quantity constraints for that household without lowering its utility?

Equivalently,

What is the most an average East German, Hungarian, Polish, Romanian or Yugoslavian household would pay for the right of attaining notional demands at existing prices?

This sum of money expressed as a percent of actual total consumption expenditure is defined to be the gap between the effective and notional purchasing power of the currency in a quantity-constrained economy. In Figure 3b this gap can be seen as the difference between the observed budget and a hypothetical budget which would be the minimum expenditure at existing prices (for a solely budget-constrained household!) required to attain the level of utility associated with the actual quantity-constrained bundle.

2. EFFECTIVE PURCHASING POWER AND INDEX NUMBER THEORY

Conventional Laspeyres and Paasche indexes of quantity and price are defined in this section as are so-called "exact" distance-function and money-metric indexes. It will be shown that meaningful economic interpretation of some of these indexes is severely compromised due to the fundamental difference in the nature of the constraints faced by households in market and centrally planned economies. For ease of exposition the notation in this section will reflect the comparison of East and West German consumer expenditure which follows.

17 The reader is encouraged to make a mental note of his or her a priori estimate of this percentage gap for any or all the Eastern European countries discussed in this report to compare with the estimates presented in Parts III and IV.
Variables for the Federal Republic of Germany (FRG) and the GDR have been given the subscripts "w" (west) and "e" (east), respectively. Expenditure variables valued in East German Marks (EM) will be designated with an asterisk (X*), unadorned expenditure variables (X) are measured in DM. To reduce subscript clutter, a commodity group index will be suppressed whenever possible. Boldface type is used to refer to an entire vector of prices, quantities or expenditures.

**Conventional Laspeyres and Paasche index numbers.** The following information is available to calculate Laspeyres and Paasche index numbers: a vector of West German expenditures by commodity group valued in DM, \( X_w \); a vector of East German expenditures by commodity group valued in East German Marks, \( X_e^* \); and a vector of commodity-specific purchasing power parities, \( \text{PPP} \), where \( \text{PPP}_i = p_{ei}/p_{wi} \) for \( i=1,\ldots,n \) commodity groups.\(^{18}\) West Germany will arbitrarily be assigned the role of base country in the indexes to be calculated, i.e., West German quantities are assigned to the denominator of quantity indexes and the denominators of price indexes are measured in DM.

The familiar Laspeyres and Paasche quantity indexes, \( Q_L \) and \( Q_P \), are defined by the first equalities in (1) and (2):

\[
(1) \quad Q_L(q_e, q_w; p_w) = \frac{\sum p_w q_e}{\sum p_w q_w} = \frac{\sum \left(\frac{p_w}{p_e}\right) p_e q_e}{\sum p_w q_w} \approx \frac{\sum X_e^* \text{PPP}}{\sum X_w} = \frac{\sum X_e}{\sum X_w}
\]

\(^{18}\)As discussed below, the \( \text{PPP}_i \) are themselves price indexes and not ratios of individual prices. Hence the method used to generate the estimates in this report necessarily misses quantity constraints which result in demand spillovers falling completely within a commodity group, e.g., expenditure shifting from quantity-constrained brown shoes to available black shoes leaving total shoe expenditure unchanged. The only remedy for this shortcoming is to gather price and expenditure data as disaggregated as possible.
Corresponding to these quantity indexes are the Paasche and Laspeyres PPP (price) indexes, \( P_p \) and \( P_L \), defined by the first equalities in (3) and (4):

\[
\sum_{p_e} q_e = \frac{\sum_{p_e} q_e}{\sum_{p_w} q_w} = \frac{\sum_{p_e} q_e}{\sum_{p_w} q_w} \approx \sum_{X^*_e} \frac{X^*_c}{\sum_{X^*_w}} = \sum_{X^*_c} \frac{X^*_c}{\sum_{X^*_w}}
\]

Since it is impossible to collect every single \( p_i \) and \( q_i \), in practice these indexes are calculated by combining estimates of the structure of expenditure by aggregate categories of expenditure for each of the countries with a sample of prices or quantities. Hence in addition to the choice of country weights, one can imagine choosing between those indexes calculated by sampling from prices (deflation) and those calculated by sampling from quantities (called the "building-block method" in the comparative defense literature). In both cases budget or cost shares are used for weighting. Shown in (1) through (4) after the "approximately equal" symbol \( (=) \) are the indexes based upon the deflation method used in this report. \(^{19}\)

\(^{19}\) Similarly the International Comparison Project (see Kravis, Heston and Summers (1982), pp. 27-28) relied on indirect quantity comparisons from the deflation of detailed expenditure data using PPP indexes. In contrast, western recalculations of time series for the national accounts of the Soviet Union and Eastern Europe are primarily based upon quantity series rather than deflated expenditure series. See the CIA estimates of Soviet economic growth in Joint Economic Committee (1982 and 1986) and the growth estimates by Alton and his associates for the Eastern European economies, Alton (1985).
True and approximate distance-function indexes. Following Deaton (1979) the distance function, \( d(u, q) \), is defined for a reference vector of quantities \((q)\) and a reference utility level \((u)\), where the preference ordering is represented by the direct utility function

\[
(5) \quad u = U(q),
\]

assumed identical for both Germanys. The equation which defines the distance function is

\[
(6) \quad U\left(\frac{q}{d(u, q)}\right) = u.
\]

The distance function has the nice geometric interpretation of being a scalar deflator if \( d(u, q) > 1 \) (inflator if \( d(u, q) < 1 \)) which transforms the reference commodity vector into a new vector which lies on the reference indifference surface indexed by \( u \). For a binary comparison it is natural to consider two particular values of the distance function \( d_L = d(u_w, q_e) \) and \( d_P = d(u_e, q_w) \) which are analogous to the Laspeyres and Paasche quantity indexes respectively. The distance-function analogues can be rewritten \( d_L = d(U(q_w), q_e) \) and \( d_P = d(U(q_e), q_w) \). As in the case of Laspeyres and Paasche quantity indexes, \( d_L \) and \( d_P \) will be identical when \( q_e \) is a scalar multiple of \( q_w \).

For a binary comparison of ideal market economies, i.e., where households are solely budget constrained, \( d_L \) and \( d_P \) are not just analogues of \( Q_L \) and \( Q_P \) but indeed the latter are approximations to the former. This interpretation of Laspeyres and Paasche quantity indexes in comparisons of real product can be found in the geometric argument of Moorsteen (1961) and Bergson (1961). An identical interpretation for comparisons of real consumption can be easily seen algebraically. First we note that the East German consumption bundle divided by the Laspeyres quantity index lies on the West German budget constraint,
Comparing (7) with (6), one can see the analogous roles played by $Q_L$ and $d_L$: the distance function is the scalar factor to inflate (since $d(u, q_e) < 1$) the East German consumption bundle to reach the West German indifference surface; the Laspeyres quantity index is the scalar factor which expands $q_e$ to reach the West German budget plane. Since West German households are presumed to be solely budget constrained (and utility maximizers), the budget plane will be a linear approximation to the indifference surface at $q_w$. Hence for similar structures of consumption, $d(u_w, q_e)$ is approximately equal to $Q_L$, with $d(u_w, q_e) < Q_L$ because of the convexity of preferences.

Combining (1) and (3) we obtain the well-known relationship between the Laspeyres quantity index and the Paasche quantity index

\begin{equation}
(8) \quad P_P = \left( \frac{\sum X^*_w}{\sum X_w} \right) \cdot \left( \frac{1}{Q_L} \right) < \left( \frac{\sum X^*_w}{\sum X_w} \right) \cdot \left( \frac{1}{d(u_w, q_e)} \right)
\end{equation}

where the inequality is due to $Q_L > d(u_w, q_e)$, i.e., the convexity of preferences. Hence $P_P$ overstates the true purchasing power of the EM understood as the implicit deflator corresponding to the exact distance-function index $d_L$. To the extent that $Q_L$ can serve as an approximation to $d_L$, $P_P$ approximates a true distance-function measure of PPP. However the convexity of preferences causes $Q_L$ to overstate the relative position of the GDR and $P_P$ to overstate the relative purchasing power of the EM.\(^{20}\)

\(^{20}\) This "Moorsteen-Bergson (MB) bias" is distinct from the better known Gerschenkron-Gilbert-Kravis (GGK) effect. The GGK effect in a binary comparison is the empirical law that each country's relative position looks better when the prices of the other country are used for valuation, i.e., $Q_L > Q_P$. For each of the 561 possible binary comparisons from the International Comparison Project sample of countries, $Q_L > Q_P$. See Kravis, Heston and Summers (1982, Table 7-3). The MB bias is due to the error which results from approximating a curved surface with a plane, whereas the GGK effect is due to the observed negative correlation between price and quantity ratios when two countries are compared.
Thus far nothing has been said which would reflect against the proper use of a Laspeyres index for real consumption (1) or a Paasche index of PPP (3) in an intersystem comparison where the market economy has been designated the base country. However, the other two indexes which hold the West German consumption bundle fixed, (2) and (4), do not share the property of being an approximation to a distance-function index. This is because of quantity constraints on the availability of some goods and services in East Germany. Households in East Germany find themselves at the intersection of an indifference surface and budget plane rather than a tangency. GDR households would prefer an affordable point on a higher indifference surface, however shortages or rationing prevent them from attaining their notional demands. Hence the East German household's indifference surface cannot be approximated by the budget constraint in the neighborhood of actual expenditure. Without further information on the quantity constraints themselves, one is unable to establish the direction of the error. Furthermore, one cannot say whether it is even feasible for East German households to shift the composition of their expenditures along their budget constraints in order to match the proportions of the West German consumption bundle.

Money-metric real consumption and Konüs-PPP. There is yet another sense in which $Q_L$ is an overstatement of GDR relative consumption. Giving an East German household sufficient DM to purchase its home market basket in West Germany would result in overcompensation, since the GDR household's utility could be increased through the substitution of relatively cheaper goods, e.g., pocket calculators, for those goods which are relatively more expensive in the West, e.g., food. Allowing for such substitutions, the money-metric index of real consumption ($M_w$) answers the natural question, "What is the minimum DM expenditure needed by an average East German household to maintain its standard of living at West German prices?" Using expenditure functions the money-metric index of real consumption with reference to West German prices is defined:
Unfortunately, the information set sufficient for calculating Q_L and P_p is inadequate for calculating the numerator of (9) for which knowledge of the German utility function is required.

Just as P_p corresponds to Q_L, corresponding to the DM money-metric index of real consumption, M_w, is a Konüs (1939) index of PPP, K_e, defined: 21

\[
(10) \quad k_e(p_e, p_w; u_e) = \frac{E(u_e, p_e)}{E(u_e, p_w)}
\]

The existence of quantity constraints in the GDR means that neither the numerator nor the denominator of the Konüs index in (10) can be calculated without further information. However the real problem with the Konüs index in this case is interpretive. To see the role of quantity constraints, it is useful to decompose the Konüs index:

\[
(11) \quad k_e(p_e, p_w; u_e) = \frac{\sum x^*_e}{E(u_e, p_w)} \cdot \frac{E(u_e, p_e)}{\sum x^*_e} = \frac{\sum x^*_e}{E(u_e, p_w)} \cdot \text{EPP}^*
\]

where actual EM expenditure is now distinguished from the minimum EM expenditure required to maintain the East German standard of living. As seen in Table 1 the estimated average value of EPP* (the coefficient of the effective domestic purchasing power of the East German Mark) for a 4-person GDR household of two adults and two children was about 87%. Since the usual motivation for generating an index of purchasing power parity is to obtain a factor for converting consumption expenditures from EM to DM, the ratio of \(\sum x^*_e\) to E(u_e, p_w) on the right hand side of (11) and not the Konüs index is the appropriate conversion factor. Thus the adjusted Konüs-PPP index is defined: K_e/EPP*.

21Both Q_L and P_p use the East German consumption bundle valued at West German prices, \(\sum x_e\). Analogously both M_w and K_e use the minimum DM expenditure to achieve the East German level of utility, E(u_e, p_w).
Neither the EM money-metric index of relative consumption nor the Konüs-PPP index for $p_e$ have obvious economic content. When more than just the budget constraint determines the opportunity set of households, the minimum expenditure needed to attain a target level of utility cannot be determined without knowledge of the other constraints of the household as well.

If additional information on consumer preferences is available so that both money-metric and distance-function indexes could be calculated, $M$ is more attractive as an index of relative consumption than $d_L$. The reason is that it is far more logical to compare two consumption bundles which would be chosen at West German prices than two bundles which according to economic theory neither country's households would choose.

If the data were limited to the observed expenditures in the two Germanys, $X_w$ and $X^*$, and the vector of purchasing power parities, PPP, then the index number problem would really not be much of a problem. Only the indexes based upon a valuation of the East German consumption bundle at DM prices ($Q_L$ and $P_P$) possess any meaning. It follows that the practice of averaging Laspeyres and Paasche indexes is at most only half correct for comparisons involving quantity constrained households.

There is yet another consideration which reduces the usefulness of $Q_L$. It is not the index of choice for chaining indexes to obtain an indirect binary comparison of East Germany with a third country. Suppose we have only two binary comparisons for three countries and Laspeyres and Paasche indexes of real consumption are available for each of the comparisons. Which (if any) of the four possible combinations of the available indexes can be linked to derive meaningful indirect comparisons of consumption levels?

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22 Suppose one wanted to derive a U.S. dollar estimate of East German consumption. From Kravis, Heston and Summers (1982) one has an excellent US-FRG binary comparison and as described below the German Institute for Economic Research (DIW) in West Berlin has estimated the relative purchasing power of the Mark compared to the DM by categories of expenditure, BMB (1987), which can be used to calculate a binary GDR-FRG comparison.
As originally argued in Moorsteen (1961), the appropriate method of combining a comparison of economies A and B with a comparison of B and C for indirectly comparing A and C is to use the quantity indexes which hold B's quantities fixed. In this way A and C are measured against a common standard, B's vector of quantities. Thus to calculate a dollar estimate of East German consumption by linking a US/FRG comparison with a FRG/GDR comparison, one would compare: a) the GDR/FRG real consumption index based upon the proportions of the West German consumption bundle with b) the FRG/US real consumption index also based upon the proportions of the West German consumption bundle. Unfortunately because of quantity constraints in the GDR, a GDR/FRG Paasche index of real consumption cannot be legitimately calculated.

Such considerations might lead one to abandon the search for a meaningful comparison of consumption levels or purchasing power across economic systems. A more constructive approach is to relax some of the informational constraints on the analysis. There is no fundamental reason to limit the data to those required for the computation of $Q_L$ and $Q_P$. Indeed once one goes beyond these data, then the above justification of $Q_L$ as an approximation to an exact distance function index loses much of its appeal. If the utility function in (5) were "known", it would be possible to compute

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23 The idea is to use the distance function for the only consumption vector the two binary comparisons happen to have in common (i.e., the West German) and to measure the distance along that vector to the U.S. and East German indifference surfaces. Critical for using conventional $Q_P$ indexes of course is the assumption that the indifference surfaces are approximated by the observed expenditure planes.

24 For one such (over-)reaction, see the nihilistic attack on the DIW estimates of the relative purchasing power of the East Mark by a former East German economist now living in West Berlin. "It is evident to anyone that neither hard work nor ambitious mathematical models can compensate for the lack of substantive comparability in [the DIW] intergerman purchasing power comparison...The calculation of an intergerman consumer purchasing power parity must be rejected on political-economic grounds." Schneider (1984), p. 951 (translation by ILC). While Schneider's recognition of the importance of systemic differences cannot be faulted, his extreme position on the matter led him to reject the extremely valuable economic information which can be found in the disaggregated DIW data.

25 This is not intended to understate the difficulty or expense in obtaining even these most basic data for intersystem comparisons. Rather the point is that the complication introduced by combining quantity and budget constraints demands further information.
E(u_e, p_w) and derive the money-metric index of relative consumption M_e and the corresponding adjusted Konüs-PPP index.

The proper application of the techniques of demand analysis for estimation of the parameters of the underlying preference ordering requires either a) some observations of solely budget constrained East German households or b) detailed information on quantity constraints. For the same reason that Q_p and P_L can fail, it would be inappropriate to attempt to estimate a demand system using East German expenditure and price data alone.

The solution is as obvious as it is simple. As was mentioned at the end of the elementary guide above, assuming that tastes are identical in the two Germanys one could estimate the parameters of the "German" utility function from West German household budgets and price data. This additional information together with the expenditure data and PPPs for the conventional index numbers is sufficient to estimate M_e, K_e/EPP*, and d_L.

In Collier (1987a) calculations using the parameters of West German preferences from Collier (1986) provide an illustration of the theoretical points just raised. The consumption of a four person household in the GDR in 1977 was estimated to have been 55.3% of that of a corresponding four person FRG household according to Q_L. The corresponding Paasche PPP index was .895 EM/DM. The "exact" distance-function measure of relative consumption (d_L) was estimated to have been only 34.2% which is considerably less than Q_L. The reasons for this large discrepancy are that income effects are significant and the difference in the levels of real income between East and West Germany is large. The interpretation of a Laspeyres index as a local approximation to the distance-function index does not mean that it is a particularly good approximation for large changes in the structure of consumption. The money-metric index of East German
### TABLE I—INDEXES OF PURCHASING POWER PARITY
GDR 4-Person (2 Adults and 2 Children) Wage and Salary Employee Households
1977-1985

<table>
<thead>
<tr>
<th>Year and Household</th>
<th>Monthly Net-Income</th>
<th>( \Sigma x_i )</th>
<th>( \ell(x_i p_0) )</th>
<th>( \ell(x_i p_0) )</th>
<th>Adjusted ( K_e )</th>
<th>Geometric Mean DIW-PPP</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>(Marks)</td>
<td>(Marks)</td>
<td>(DM)</td>
<td>(3)+(1)</td>
<td>Mean DIW-PPP</td>
</tr>
<tr>
<td>1977</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>All 4-Person Households</td>
<td></td>
<td>1303</td>
<td>1133</td>
<td>1366</td>
<td>1.048</td>
<td>1.054</td>
</tr>
<tr>
<td>800-1200 M</td>
<td></td>
<td>925</td>
<td>835</td>
<td>993</td>
<td>1.074</td>
<td>1.070</td>
</tr>
<tr>
<td>1200-1600 M</td>
<td></td>
<td>1211</td>
<td>1057</td>
<td>1269</td>
<td>1.048</td>
<td>1.047</td>
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<tr>
<td>1600-2000 M</td>
<td></td>
<td>1514</td>
<td>1315</td>
<td>1595</td>
<td>1.054</td>
<td>1.053</td>
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<tr>
<td>&gt;2000 M</td>
<td></td>
<td>1946</td>
<td>1611</td>
<td>1973</td>
<td>1.014</td>
<td>1.012</td>
</tr>
<tr>
<td>1981</td>
<td></td>
<td>1443</td>
<td>1252</td>
<td>1598</td>
<td>1.107</td>
<td>1.102</td>
</tr>
<tr>
<td>All 4-Person Households</td>
<td></td>
<td>1443</td>
<td>1252</td>
<td>1598</td>
<td>1.107</td>
<td>1.102</td>
</tr>
<tr>
<td>&lt;1200 M</td>
<td></td>
<td>954</td>
<td>872</td>
<td>1093</td>
<td>1.146</td>
<td>1.151</td>
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<td>1167</td>
<td>1484</td>
<td>1.110</td>
<td>1.114</td>
</tr>
<tr>
<td>1600-2000 M</td>
<td></td>
<td>1637</td>
<td>1416</td>
<td>1821</td>
<td>1.112</td>
<td>1.115</td>
</tr>
<tr>
<td>&gt;2000 M</td>
<td></td>
<td>1862</td>
<td>1578</td>
<td>2037</td>
<td>1.082</td>
<td>1.082</td>
</tr>
<tr>
<td>1983</td>
<td></td>
<td>1417</td>
<td>1240</td>
<td>1647</td>
<td>1.162</td>
<td>1.163</td>
</tr>
<tr>
<td>All 4-Person Households</td>
<td></td>
<td>1417</td>
<td>1240</td>
<td>1647</td>
<td>1.162</td>
<td>1.163</td>
</tr>
<tr>
<td>&lt;1600 M</td>
<td></td>
<td>1258</td>
<td>1107</td>
<td>1463</td>
<td>1.163</td>
<td>1.163</td>
</tr>
<tr>
<td>1600-2000 M</td>
<td></td>
<td>1535</td>
<td>1350</td>
<td>1801</td>
<td>1.173</td>
<td>1.173</td>
</tr>
<tr>
<td>1985</td>
<td></td>
<td>1521</td>
<td>1315</td>
<td>1744</td>
<td>1.147</td>
<td>1.147</td>
</tr>
<tr>
<td>All 4-Person Households</td>
<td></td>
<td>1521</td>
<td>1315</td>
<td>1744</td>
<td>1.147</td>
<td>1.147</td>
</tr>
<tr>
<td>&lt;1600 M</td>
<td></td>
<td>1241</td>
<td>1110</td>
<td>1460</td>
<td>1.176</td>
<td>1.176</td>
</tr>
<tr>
<td>1600-2000 M</td>
<td></td>
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<td>1350</td>
<td>1833</td>
<td>1.151</td>
<td>1.151</td>
</tr>
<tr>
<td>&gt;2000 M</td>
<td></td>
<td>1858</td>
<td>1584</td>
<td>2119</td>
<td>1.140</td>
<td>1.140</td>
</tr>
</tbody>
</table>
consumption ($M_e$) in 1977 was estimated to have been 49.3% of FRG consumption which corresponds to an adjusted Konüs-PPP index of 1.005 EM/DM. While it is somewhat ironic that the arithmetic mean of the Paasche and Laspeyres indexes of PPP for 1977 (Otto-Arnold 1979, p. 565) happened to equal 1.00 EM/DM, nonetheless one would prefer to be right for the right reasons. Another irony worth noting is that in that particular set of calculations $Q_L$ was found to be closer to $M_e$ than it is to $d_L$ which $Q_L$ "approximates".

Table 1 shows the equation (11) decomposition of the Konüs-PPP index for GDR 4-person households by income class over the past decade. The first column gives the actual total consumption expenditure of GDR households estimated from family budget and income distribution data from the East German Statistical Yearbook (SJDDR). To maintain consistency with Tables 2-7 in Part III, the "all-German" demand system estimated for this report, described in Part II, was used to calculate the hypothetical minimum Mark (column 2) and DM (column 3) totals required to attain the level of real income associated with the observed East German expenditures at GDR and FRG prices, respectively. Columns 4-6 present the decomposition of $K_e$. The final three columns reproduce the DIW calculations of the GDR Mark's PPP (dimensionality DM/M). It is interesting to note that the adjusted Konüs PPP index (column 4) is closer to the (Paasche) PPP-index which uses GDR weights. In other words, the coefficient to convert Mark consumption expenditures into equivalent DM expenditures is about 9% larger than the geometric mean of conventional Laspeyres and Paasche PPP indexes (1.147 DM/Mark vs. 1.051 DM/Mark).

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26 Careful readers will note that this differs from the 1.048 reported in column (4) of the first row of Table 1. There are several reasons which could account for the difference. Of foremost importance is the difference in the number of categories for the estimated demand system (15 vs. 12 categories here). In Collier (1986) budgets from middle-income 4-person West German households over the period 1964-1981 were used to estimate the parameters of the FCD demand system. In this report budgets from higher-income 4-person West German households have been added to the middle income budgets. In addition the sample period has been extended to cover the period 1964-1985.

27 DIW researchers calculate a simple arithmetic mean of the Laspeyres and Paasche PPP indexes. The usual practice (e.g., ICP) to take the geometric mean of the two indexes à la Fisher was used to calculate column 9.
Without quantity constraints the purchasing power of the GDR Mark for a family of two adults and two children in 1985 would have been almost 1/3 greater than the purchasing power of the DM. However the calculations in Table 1 indicate that about half of that additional purchasing power in 1985 was really lost because of microeconomic shortages experienced by households in the GDR.

PART II—DATA SOURCES AND SPECIFICATION

1. EAST AND WEST GERMAN DATA.

The data base for the GDR shortage estimates in Part III was assembled from three basic sources: official East German family budgets and income distribution data from the statistical yearbook (Statistisches Jahrbuch der Deutschen Demokratischen Republik, abbreviated SJDDR); purchasing-power-parities estimated by the German Institute for Economic Research (Deutsches Institut für Wirtschaftsforschung, DIW) in West Berlin published in BMB (1987); and annual family budgets and consumer price indexes published in the West German statistical yearbook (Statistisches Jahrbuch für die Bundesrepublik Deutschland, abbreviated SJBRD).

Official GDR family budget and income distribution data. Published data on East German consumer expenditures are not available at anything like the detail of the 107 consumption categories of the International Comparison Project for Hungary, Poland, Romania and Yugoslavia. The GDR Statistical Yearbook only publishes household budget shares for about fifteen categories of expenditures for several household sizes and income classes. Because the published GDR expenditure classification is so course as to

28 According to a GDR economic statistics textbook, Lange and Lange (1978), monetary expenditure data for about 160 categories are gathered from approximately six thousand households on a regular basis.
be the largest single obstacle in merging East and West German consumption data, both the DIW purchasing-power-parity data as well as West German family budget and consumer price statistics have been reaggregated to the greatest extent possible following the GDR classification.29

The budget shares for four person wage and salary employee households consisting of two adults and two children have been multiplied by estimated household net-incomes derived from the results of the family income survey in SJDDR. This survey of approximately 30,000 households is conducted usually every two years in order to determine household income for August. The GDR statistical yearbook reports the distribution of household net-income by size and number of children in the household.

DIW purchasing-power-parities. In comparison to the International Comparison Project discussed below the collection of East German consumer price data by the DIW has been much narrower in focus, modest in scale and conducted without any cooperation from the GDR statistical authorities. Until 1981 the collection of comparable consumer price data for East and West Germany by the DIW was largely the result of the work of a single researcher, Charlotte Otto-Arnold.30 The PPP data used in Part III are assembled in BMB (1987, p. 516).31

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29 The DIW (see sources cited below) presents estimates of the share of food and beverage expenditure in restaurants and the like in its calculations of GDR PPP. These shares are not available for the breakdown by income classes, and it was decided to stay as close to the published breakdown for this report in order to minimize the additional error which is inevitable as one decomposes spending within published expenditure categories. Also, the proper allocation of West German expenditure data between the categories of "household goods" and "electrotechnical goods" proved to be particularly problematic and it was decided that collapsing the two kinds of expenditure into a single category was necessary. Similarly, repairs and other services have been collapsed into a single category. The DIW PPP's have been adjusted for these categories.

30 For a complete bibliography of the relevant DIW publications on the relative purchasing power of the GDR Mark see Keren (forthcoming).

31 The principal investigator gratefully acknowledges useful discussions with Messrs. Melzer and Vortmann at the DIW in West Berlin during August 1986.
Since the DIW has been unable to rely on data delivered by a cooperative State Central Administration for Statistics in the GDR\textsuperscript{32}, the collection of price data from the GDR has been limited mostly to scavenging statistical yearbooks, catalogues and press reports. Given the importance of these data for intergerman comparisons, a translation of the relevant passage from Otto-Arnold which represents the \textit{sole} published account of DIW procedures is provided:

"A systematic observation of GDR prices is not possible. [Published] official price statistics when compared to West Germany's are extraordinarily meager (85 items). For this reason comparable price data were assembled using a variety of methods:

Officially reported prices have been used [whenever available]. In addition catalogues of the "Consumer Mail-Order House" for different periods were available from which it was found that prices of identical items as a rule have not changed; furthermore the Winter 1975 catalogue provided a rather complete picture of product assortment and range of qualities available. From the sense of GDR prices acquired from this source, efforts to assemble price information from press reports and other sources were intensified at the beginning of 1977. For comparison West German prices have been taken from official statistics whenever appropriate, though frequently prices have also been taken from the leading mail-order catalogue of the Federal Republic (Quelle). [Otto-Arnold 1979, pp. 27-28. Emphasis added]"

While the GDR price data are of somewhat uncertain, indeed mysterious origin\textsuperscript{33}, it is the belief of the principal investigator that the individual price comparisons used by DIW researchers are quite reliable, since prices paid for goods and services by the East German population, unlike prices for producer goods, require no privileged access to special price lists.

\textsuperscript{32}The DIW is not alone. In 1982 the World Bank contacted the national statistical offices of eight centrally planned economies requesting cooperation with the Bank's research project directed by Paul Marer on methods for computing the levels and growth rates of the GNPs of those economies. Bulgaria, Hungary, Poland and Romania positively responded to the World Bank's request. The GDR did not respond to the request. See Marer (1985, p. xii).

\textsuperscript{33}In the last three comparisons of FRG and GDR prices published by the DIW since Otto-Arnold (1979), the GDR price collection procedures are "described" with the same (indeed for the last two comparisons, \textit{identical}) brief statement: "GDR [prices] have been culled from official statistics and miscellaneous sources, e.g., press reports." cf., Otto-Arnold and Vortmann (1982, p.49), Vortmann and Schwartau (1984, p. 193) and later Melzer and Vortmann (1986, p, 260).
The research effort devoted to purchasing power comparisons at the DIW has been growing over time probably in response to the clear tendency of prices to increase for non-basic items since late 1979: the PPPs for 1977 from Otto-Arnold (1979) were calculated from slightly more than 400 individual price comparisons. The 1981 purchasing power comparison, Otto-Arnold and Vortmann (1982), was based upon about 550 prices. Vortmann and Schwartau (1984) used roughly 700 prices for their 1983 comparison. In the latest DIW comparison, Melzer and Vortmann (1985) report that over 800 individual prices were compared.

When the PPPs for individual expenditure categories are combined with the corresponding price index for West Germany, one is able to obtain a Mark-price index for each of the GDR categories. For several categories rather implausible price declines were found in the indexes thus calculated (almost all "occur" between 1981 and 1983). This has been treated as a measurement error problem. The true Mark price series are assumed to have moved along simple linear or quadratic trends over the eight years for which the DIW has collected four observations. For six of the twelve categories used in Part III, the implausible GDR price series have been smoothed either using linear or a second-order polynomial regression of the series on time.

Family budgets and consumer price indexes from the FRG. All the price and expenditure data used to estimate "German" preferences come from the Federal Statistical Office of the FRG which publishes family budgets on a continuing basis as well as indexes of consumer prices. These data are published in the West German Statistical Yearbook (Statistisches Bundesamt 1965-1986). For the purpose of reallocating expenditures as well as aggregating consumer price indexes, detailed expenditure weights have been taken from the consumer price index published in Rasch (1973 and 1979).34

34The weights for the West German consumer price index come from the family budget surveys of 1970 and 1976 (and 1980 for which the detailed expenditure weights were not published in Wirtschaft und Statistik).
2. DATA FROM THE ICP FOR HUNGARY, POLAND, ROMANIA AND YUGOSLAVIA

International Comparison Project. Without a doubt the most comprehensive collection of consistent price and expenditure data for a large number of countries has been the result of the collaboration of Irving Kravis, Alan Heston, Robert Summers of the University of Pennsylvania and their associates of the International Comparison Project. From its initial comparison of six countries for Phase I (1967), the ICP expanded to 34 countries in Phase III (1975). Of particular interest for this report is the inclusion of Hungary, Poland, Romania and Yugoslavia in Phase III. The ICP was financially supported by the Statistical Office of the United Nations and the World Bank. National statistical authorities and international agencies such as the Statistical Office of the European Communities cooperated with the ICP in the collection, collation and transmission of the enormous volume of data required for this project.

The number of individual price comparisons used by the ICP research team in Phase III to calculate purchasing-power-parities for the 151 standard categories of expenditure of per capita gross domestic product varied across countries in the sample. At the high end of the spectrum were Austria and Hungary which provided almost 600 price comparisons for consumer goods and at the low end Denmark and the U.K. with just over 350 consumer prices for the ICP. Enormous efforts were made by the ICP to assure that the price comparisons were made for goods of similar quality. The particular ICP data

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35 For a complete description of the data, procedures and methodology used in the International Comparison Project see Kravis, Heston and Summers (1982).

36 Purchasing power parity is defined by Kravis, Heston and Summers (1982, p. 383), "The number of currency units required to buy goods equivalent to what can be bought with one unit of the currency of the base country..." The base country for the ICP data used in this report was the U.S.

37 Kravis, Heston and Summers, Table 2-2 (1982, p. 45).
used for the estimates of Tables 8 and 9 have been taken from the augmented binary comparisons of the other 33 ICP countries with the U.S.\textsuperscript{38}

Differences between the German and ICP data. Before proceeding to the empirical results of Parts III and IV, it is important to list the major differences between the merged German data sets and the ICP data for Hungary, Poland, Romania and Yugoslavia.

- In the ICP consumption data government subsidies to private consumption expenditure are included whereas the expenditure data for the GDR are valued in actual market prices paid by consumers.
- The expenditure data for the ICP have been computed on a per capita basis. In contrast, both the GDR and West German expenditure data refer to family budget data for wage and salary employees.
- Medical expenditures are included in the ICP but have been excluded from the German demand system.
- The item "Gross Rents" in ICP includes imputed rents for owner-occupied housing and there is almost certainly no such adjustment in GDR expenditures for this item.
- The expenditure data of the US and European countries in the ICP are of excellent quality (with the probable exception of Romania) and consistency. Transforming official West German expenditure categories and DIW purchasing-power-parities to correspond to East German statistical practice necessarily involves a considerable element of judgment, indeed some arbitrariness.
- The FCD demand system estimated for Hungary, Poland, Romania and Yugoslavia has the interpretation of representing average U.S.- (Western) European tastes.

\textsuperscript{38}Expenditure and PPP data used in this report were taken from Appendix Tables 7-1 through 7-33 in Kravis, Heston and Summers (1982).
The FCD demand system estimated for the GDR represents average tastes of a German household made up of two adults and two children.

Because of these important differences the empirical findings for the GDR are reported separately from those for Hungary, Poland, Romania and Yugoslavia.

3. FLEXIBLE-COBB-DOUGLAS DEMAND SYSTEM

The Flexible-Cobb-Douglas (FCD) specification of the direct utility function used in Parts III and IV is motivated in Collier (1985). While each indifference surface of the FCD utility function is linear in the natural logarithm of quantities (hence Cobb-Douglas), the specification is flexible in allowing the slope terms of indifference planes in log-quantity space to change as utility increases, i.e., budget shares are flexible with respect to differences in real income. The estimated demand system only requires \(2N - 2\) parameters to be estimated for \(N\) categories of expenditure and it can be easily estimated by ordinary least squares.

FCD utility is defined implicitly:

\[
U = \prod_i (q_i) \beta_i
\]

where the budget shares \(\beta_i\) in turn depend upon \(U\)

\[
\beta_i = \frac{\alpha_i U^{\gamma_i}}{\sum_j \alpha_j U^{\gamma_j}}
\]

Commodity groups are indexed by \(i, j = 1, \ldots, n\). It must be emphasized that the \(\beta_i\)'s are the notional budget shares, i.e., the budget shares observable for solely budget constrained, utility maximizing households. The observed budget shares for quantity constrained households are entirely distinct from the notional shares of (13) which is why it is necessary to use observed expenditure patterns and prices from market economies with similar preferences in order to estimate the unknown \(\alpha\)'s and the \(\gamma\)'s of the model.
Exploiting the symmetry of the expenditure share equations, each of N-1 category equations in equation (13) is divided by the equation for the Nth category:

\[ \frac{\beta_i}{\beta_n} = \frac{\alpha_i U^{\gamma_i}}{\alpha_n U^{\gamma_n}}. \]

By taking logarithms of both sides of (14), one obtains the N-1 equations for estimation,

\[ \ln(\beta_i) - \ln(\beta_n) = \ln(\alpha_i/\alpha_n) + (\gamma_i - \gamma_n)\ln(U), \]

where ln(U) is calculated as the weighted average of the natural logarithms of the observed quantities consumed with observed budget shares as weights (by eq. (12)) and the left-hand-side of (15) is simply the logarithm of the ratio of the observed budget share of the ith category divided by the observed budget share of the nth category. With the estimates of the constant terms, ln(\(\alpha_i/\alpha_n\)), and the slopes, \(\gamma_i - \gamma_n\), of the N-1 linear regressions for (15), it becomes possible to analyze the observed consumption patterns and prices in a quantity-constrained economy. For further details the reader is referred to Collier (1985 and 1986).

PART III—ESTIMATES OF SHORTAGE FOR THE GDR

Tables 2-6 provide information on disequilibrium in the markets for consumer goods and services for East German households of four persons (two adult and two children) broken down by income classes for the years 1977, 1981, 1983 and 1985. The organization of these five tables is identical. Average actual monthly expenditure in the first row of Tables 2-6 is taken from the first column of Table 1. A measure of real-income, East German money-metric utility at 1985 West German prices, is given in the second row of these tables.\(^{39}\) The third row displays the summary measure of consumer

\(^{39}\) In the notation of Part II, \(E(u_e, p_w)\).
disequilibrium, the effective purchasing power gap (expressed as a percent of actual total
Mark expenditure) and is equal to 1 - EPP* from Table 1. Tables 2-6 share the same last
column which gives an indicator of the performance of the Flexible-Cobb-Douglas demand
system over the West German sample for which it was estimated. The average estimated
EPP percent gap in sample (a measure of goodness-of-fit, assuming no quantity constraints
for sample observations) of .4% is very small compared to the estimates of EPP in the
GDR for all years and income groups. The accuracy of within-sample predictions for the
twelve categories of expenditure are reported as root-mean-square-percent-error (RMSPE)
for each category.\(^{40}\) This gives a benchmark to assess the significance of estimated excess
demands (when negative) and spillover demands (when positive) for a given year or
income class.\(^{41}\)

\[^{40}\]Sample root mean square percentage error is calculated according to the formula:

\[
100 \times \sqrt{\frac{1}{n} \sum \left( \frac{X_i - \hat{X}_i}{X_i} \right)^2}
\]

where \(X_i\) and \(\hat{X}_i\) are the actual and fitted values for a particular expenditure category in market economy i.
For Tables 2-6, \(n=44\) (22 years of observations for middle and high income West German households of
four persons).

\[^{41}\]At this point a warning must be inserted that the association of positive numbers with spillover
demand and negative numbers with excess demand is an oversimplification. The simultaneous existence of
both spillover and excess demand is possible and not just because of aggregation. For instance one could
imagine that there exists spillover demand which cannot be met which in turn generates a second-order
spillover--thus we observe a GDR household spending more on a category, say household, electrical and
electronic goods, than would be expected given East German prices and incomes but the household is still
quantity constrained for such a category. Also one could easily imagine that the strong complementarity
between housing and utilities/heating and a binding quantity constraint for housing could lead to a spillover
into greater home energy use (for smaller units) though with utility/heating consumption still lower than
would be expected given prices and income. Apparently vinegar was one item which was always available
for spillover demand in Poland even during 1980-81, see Podkaminer (forthcoming).
### TABLE 2—EFFECTIVE PURCHASING POWER GAP AND EXCESS DEMANDS
4-PERSON (2 ADULTS AND 2 CHILDREN) WAGE AND SALARY EMPLOYEE HOUSEHOLDS, GDR 1977-1985

<table>
<thead>
<tr>
<th></th>
<th>1977</th>
<th>1981</th>
<th>1983</th>
<th>1985</th>
<th>RMSPE&lt;sup&gt;a&lt;/sup&gt;</th>
</tr>
</thead>
<tbody>
<tr>
<td>Monthly consumption</td>
<td>1303</td>
<td>1443</td>
<td>1417</td>
<td>1521</td>
<td></td>
</tr>
<tr>
<td>expenditures (Marks)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Real monthly</td>
<td>1819</td>
<td>1798</td>
<td>1714</td>
<td>1744</td>
<td></td>
</tr>
<tr>
<td>expenditures</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>(1985 DM prices)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>EPP percent gap</td>
<td>13.0</td>
<td>13.3</td>
<td>12.5</td>
<td>13.5</td>
<td></td>
</tr>
<tr>
<td>Excess demands [-],</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>percent:</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Food</td>
<td>9.1</td>
<td>4.8</td>
<td>.1</td>
<td>-2.3</td>
<td>6.3 &lt;sup&gt;b&lt;/sup&gt;</td>
</tr>
<tr>
<td>Coffee, tea,</td>
<td>41.3</td>
<td>43.2</td>
<td>42.8</td>
<td>44.3</td>
<td>7.4 &lt;sup&gt;b&lt;/sup&gt;</td>
</tr>
<tr>
<td>alcoholic</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>beverages and</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>tobacco</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Shoes, purses,</td>
<td>18.1</td>
<td>16.4</td>
<td>22.0</td>
<td>30.0</td>
<td>6.6 &lt;sup&gt;b&lt;/sup&gt;</td>
</tr>
<tr>
<td>wallets, etc.</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Textiles and</td>
<td>20.1</td>
<td>13.7</td>
<td>16.8</td>
<td>13.3</td>
<td>13.1 &lt;sup&gt;b&lt;/sup&gt;</td>
</tr>
<tr>
<td>clothing</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Furniture</td>
<td>30.5</td>
<td>12.1</td>
<td>28.5</td>
<td>23.2</td>
<td>16.7 &lt;sup&gt;b&lt;/sup&gt;</td>
</tr>
<tr>
<td>Household, electrical</td>
<td>23.3</td>
<td>23.7</td>
<td>42.8</td>
<td>40.0</td>
<td>7.9 &lt;sup&gt;b&lt;/sup&gt;</td>
</tr>
<tr>
<td>and electronic</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>goods</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Other goods</td>
<td>17.4</td>
<td>29.4</td>
<td>20.2</td>
<td>25.5</td>
<td>6.0 &lt;sup&gt;b&lt;/sup&gt;</td>
</tr>
<tr>
<td>Transportation</td>
<td>-15.8</td>
<td>-28.5</td>
<td>-30.4</td>
<td>-64.9</td>
<td>13.9 &lt;sup&gt;b&lt;/sup&gt;</td>
</tr>
<tr>
<td>services</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Housing</td>
<td>-338.4</td>
<td>-315.9</td>
<td>-294.1</td>
<td>-314.0</td>
<td>12.0 &lt;sup&gt;b&lt;/sup&gt;</td>
</tr>
<tr>
<td>Utilities and all</td>
<td>-201.8</td>
<td>-207.4</td>
<td>-185.0</td>
<td>-187.4</td>
<td>16.2 &lt;sup&gt;b&lt;/sup&gt;</td>
</tr>
<tr>
<td>heating</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Recreation, education</td>
<td>-22.0</td>
<td>-31.8</td>
<td>-17.0</td>
<td>-20.5</td>
<td>6.8 &lt;sup&gt;b&lt;/sup&gt;</td>
</tr>
<tr>
<td>and other leisure</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Other services</td>
<td>-.3</td>
<td>-10.2</td>
<td>1.7</td>
<td>7.0</td>
<td>8.5 &lt;sup&gt;b&lt;/sup&gt;</td>
</tr>
<tr>
<td>(incl. repair work)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

<sup>a</sup>Root-mean-square-percent-error of West German sample 1964-1985.

<sup>b</sup>Average goodness-of-fit of FCD demand system for West German sample 1964-1985.
Table 2 provides a historical survey of consumer disequilibrium in the GDR for the eight year period 1977-1985. One of the most striking patterns to be seen in Table 2 is that the 16.7% rise in household net-income over the period was accompanied by an apparent drop in real consumption. The average measure of disequilibrium does not show any dramatic change over the period. Hence the drop in living standards can be seen to be the result of an average increase in prices of 21.8%. At the disaggregated level of individual categories of household expenditure, increased spillover spending appears to have occurred in the categories: shoes, purses, wallets, etc.; household, electrical and electronic goods; and other services (including repair work). A trend towards greater excess demand appears in the categories of food and purchased transportation services.

Tables 3 through 6 present disquilibrium estimates broken down by household net-income for each of the years separately. In all of these tables one can see a distinct positive relation between the size of measured EPP gap and household income. This finding is consistent with a common observation of economic life in the GDR—people with lower incomes complain much less about having enough money but not enough goods to buy than do those with higher incomes (lower income families also complain about not having enough money). In Figure 4 this positive relation is shown in the plot of estimated EPP gap and level of real income taken from Tables 3-6.

Excess demands/spillovers at the disaggregated level of expenditure also change with household income. For several categories of spending, deviations between actual and notional expenditure can be seen to grow with income. Spillover demand grows with household income for three categories: "coffee, tea, alcoholic beverages and tobacco", "textiles and clothing", and "household, electrical and electronic goods". Excess demand for housing and utilities/heating appear to get worse with rising incomes.

42 This is of course to be expected since the EPP gap is a summary measure of the micro-deviations between actual and notional expenditure.
<table>
<thead>
<tr>
<th>Household net-income (Marks)</th>
<th>800-1200</th>
<th>1200-1600</th>
<th>1600-2000</th>
<th>&gt;2000</th>
<th>RMSPEa</th>
</tr>
</thead>
<tbody>
<tr>
<td>Monthly consumption</td>
<td>925</td>
<td>1211</td>
<td>1514</td>
<td>1946</td>
<td></td>
</tr>
<tr>
<td>expenditures (Marks)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Real monthly expenditures</td>
<td>1313</td>
<td>1688</td>
<td>2131</td>
<td>2648</td>
<td></td>
</tr>
<tr>
<td>(1985 DM prices)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>EPP percent gap</td>
<td>9.8</td>
<td>12.8</td>
<td>13.1</td>
<td>17.2</td>
<td>.4b</td>
</tr>
<tr>
<td>Excess demands [-], percent:</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Food</td>
<td>12.8</td>
<td>10.7</td>
<td>12.5</td>
<td>14.5</td>
<td>6.3</td>
</tr>
<tr>
<td>Coffee, tea, alcoholic</td>
<td>35.7</td>
<td>44.9</td>
<td>42.4</td>
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<td>7.4</td>
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<tr>
<td>beverages and tobacco</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Shoes, purses, wallets, etc.</td>
<td>15.5</td>
<td>16.5</td>
<td>16.5</td>
<td>15.4</td>
<td>6.6</td>
</tr>
<tr>
<td>Textiles and clothing</td>
<td>7.4</td>
<td>18.1</td>
<td>20.6</td>
<td>18.3</td>
<td>13.1</td>
</tr>
<tr>
<td>Furniture</td>
<td>35.3</td>
<td>38.2</td>
<td>26.0</td>
<td>30.6</td>
<td>16.7</td>
</tr>
<tr>
<td>Household, electrical and</td>
<td>-15.6</td>
<td>24.7</td>
<td>27.8</td>
<td>36.3</td>
<td>7.9</td>
</tr>
<tr>
<td>electronic goods</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Other goods</td>
<td>20.6</td>
<td>11.3</td>
<td>16.6</td>
<td>24.5</td>
<td>6.0</td>
</tr>
<tr>
<td>Transportation services</td>
<td>-6.4</td>
<td>-16.0</td>
<td>-17.2</td>
<td>-26.2</td>
<td>13.9</td>
</tr>
<tr>
<td>Housing</td>
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<td>-337.6</td>
<td>-440.9</td>
<td>12.0</td>
</tr>
<tr>
<td>Utilities and all heating</td>
<td>-132.1</td>
<td>-185.4</td>
<td>-182.7</td>
<td>-235.1</td>
<td>16.2</td>
</tr>
<tr>
<td>Recreation, education and</td>
<td>-34.6</td>
<td>-33.1</td>
<td>-22.2</td>
<td>-65.3</td>
<td>6.8</td>
</tr>
<tr>
<td>other leisure</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Other services</td>
<td>-22.9</td>
<td>-7.3</td>
<td>-18.3</td>
<td>-24.7</td>
<td>8.5</td>
</tr>
<tr>
<td>(incl. repair work)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

aRoot-mean-square-percent-error of West German sample 1964-1985.

bAverage goodness-of-fit of FCD demand system for West German sample 1964-1985.
<table>
<thead>
<tr>
<th>Household net-income (Marks)</th>
<th>&lt; 1200</th>
<th>1200-1600</th>
<th>1600-2000</th>
<th>&gt;2000</th>
<th>RMSPE(^a)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Monthly consumption expenditures (Marks)</td>
<td>954</td>
<td>1337</td>
<td>1637</td>
<td>1882</td>
<td></td>
</tr>
<tr>
<td>Real monthly expenditures (1985 DM prices)</td>
<td>1227</td>
<td>1669</td>
<td>2051</td>
<td>2296</td>
<td></td>
</tr>
<tr>
<td>EPP percent gap</td>
<td>8.6</td>
<td>12.8</td>
<td>13.3</td>
<td>16.2</td>
<td>6.3 (^b)</td>
</tr>
<tr>
<td>Excess demands [-], percent:</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Food</td>
<td>13.8</td>
<td>6.8</td>
<td>12.1</td>
<td>7.1</td>
<td>6.3</td>
</tr>
<tr>
<td>Coffee, tea, alcoholic beverages and tobacco</td>
<td>39.5</td>
<td>46.2</td>
<td>46.1</td>
<td>47.5</td>
<td>7.4</td>
</tr>
<tr>
<td>Shoes, purses, wallets, etc.</td>
<td>20.6</td>
<td>21.5</td>
<td>19.9</td>
<td>15.7</td>
<td>6.6</td>
</tr>
<tr>
<td>Textiles and clothing</td>
<td>.9</td>
<td>13.3</td>
<td>12.4</td>
<td>16.5</td>
<td>13.1</td>
</tr>
<tr>
<td>Furniture</td>
<td>-182.1</td>
<td>-20.2</td>
<td>22.4</td>
<td>2.8</td>
<td>16.7</td>
</tr>
<tr>
<td>Household, electrical and electronic goods</td>
<td>1.6</td>
<td>23.4</td>
<td>12.9</td>
<td>38.5</td>
<td>7.9</td>
</tr>
<tr>
<td>Other goods</td>
<td>19.5</td>
<td>24.5</td>
<td>23.3</td>
<td>28.7</td>
<td>6.0</td>
</tr>
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<td>Transportation services</td>
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<td>-51.5</td>
<td>-36.9</td>
<td>-33.5</td>
<td>13.9</td>
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<td>Housing</td>
<td>-177.7</td>
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<td>-322.4</td>
<td>-388.5</td>
<td>12.0</td>
</tr>
<tr>
<td>Utilities and all heating</td>
<td>-153.8</td>
<td>-192.6</td>
<td>-203.6</td>
<td>-226.8</td>
<td>16.2</td>
</tr>
<tr>
<td>Recreation, education and other leisure</td>
<td>-70.9</td>
<td>-25.1</td>
<td>-39.4</td>
<td>-62.4</td>
<td>6.8</td>
</tr>
<tr>
<td>Other services (incl. repair work)</td>
<td>-1.0</td>
<td>-3.7</td>
<td>-11.3</td>
<td>-16.9</td>
<td>8.5</td>
</tr>
</tbody>
</table>

\(^a\)Root-mean-square-percent-error of West German sample 1964-1985.  
\(^b\)Average goodness-of-fit of FCD demand system for West German sample 1964-1985.
TABLE 5—EFFECTIVE PURCHASING POWER GAP AND EXCESS DEMANDS
4-PERSON (2 ADULTS AND 2 CHILDREN) WAGE AND SALARY EMPLOYEE
HOUSEHOLDS BY HOUSEHOLD NET-INCOME, GDR 1983

<table>
<thead>
<tr>
<th></th>
<th>&lt;1600</th>
<th>1600-2000</th>
<th>&gt;2000</th>
<th>RMSPE\textsuperscript{a}</th>
</tr>
</thead>
<tbody>
<tr>
<td>Monthly consumption</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>expenditures (Marks)</td>
<td>1258</td>
<td>1535</td>
<td>1735</td>
<td></td>
</tr>
<tr>
<td>Real monthly</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>expenditures</td>
<td>1521</td>
<td>1875</td>
<td>2074</td>
<td></td>
</tr>
<tr>
<td>(1985 DM prices)</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>EPP percent gap</td>
<td>12.0</td>
<td>12.1</td>
<td>14.4</td>
<td>\textsuperscript{b}</td>
</tr>
<tr>
<td>Excess demands [-], percent:</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Food</td>
<td>4.6</td>
<td>6.6</td>
<td>2.3</td>
<td>6.3</td>
</tr>
<tr>
<td>Coffee, tea, alcoholic</td>
<td>46.7</td>
<td>46.5</td>
<td>43.8</td>
<td>7.4</td>
</tr>
<tr>
<td>beverages and tobacco</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Shoes, purses, wallets,</td>
<td>19.3</td>
<td>24.0</td>
<td>24.6</td>
<td>6.6</td>
</tr>
<tr>
<td>etc.</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Textiles and clothing</td>
<td>1.2</td>
<td>24.9</td>
<td>17.4</td>
<td>13.1</td>
</tr>
<tr>
<td>Furniture</td>
<td>27.9</td>
<td>-17.4</td>
<td>43.2</td>
<td>16.7</td>
</tr>
<tr>
<td>Household, electrical</td>
<td>48.8</td>
<td>33.9</td>
<td>43.9</td>
<td>7.9</td>
</tr>
<tr>
<td>and electronic goods</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Other goods</td>
<td>14.3</td>
<td>14.4</td>
<td>17.9</td>
<td>6.0</td>
</tr>
<tr>
<td>Transportation services</td>
<td>-33.9</td>
<td>-26.9</td>
<td>-51.8</td>
<td>13.9</td>
</tr>
<tr>
<td>Housing</td>
<td>-273.6</td>
<td>-274.5</td>
<td>-337.3</td>
<td>12.0</td>
</tr>
<tr>
<td>Utilities and all heating</td>
<td>-171.0</td>
<td>-202.8</td>
<td>-200.7</td>
<td>16.2</td>
</tr>
<tr>
<td>Recreation, education</td>
<td>-46.8</td>
<td>-13.0</td>
<td>-35.4</td>
<td>6.8</td>
</tr>
<tr>
<td>and other leisure</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Other services</td>
<td>7.5</td>
<td>-17.3</td>
<td>8.9</td>
<td>8.5</td>
</tr>
<tr>
<td>(incl. repair work)</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

\textsuperscript{a} Root-mean-square-percent-error of West German sample 1964-1985.

\textsuperscript{b} Average goodness-of-fit of FCD demand system for West German sample 1964-1985.
**TABLE 6—EFFECTIVE PURCHASING POWER GAP AND EXCESS DEMANDS**

4-PERSON (2 ADULTS AND 2 CHILDREN) WAGE AND SALARY EMPLOYEE HOUSEHOLDS BY HOUSEHOLD NET-INCOME, GDR 1985

<table>
<thead>
<tr>
<th>Household net-income (Marks)</th>
<th>&lt;1600</th>
<th>1600-2000</th>
<th>&gt;2000</th>
<th>RMSPE&lt;sup&gt;a&lt;/sup&gt;</th>
</tr>
</thead>
<tbody>
<tr>
<td>Monthly consumption expenditures (Marks)</td>
<td>1241</td>
<td>1592</td>
<td>1858</td>
<td></td>
</tr>
<tr>
<td>Real monthly expenditures (1985 DM prices)</td>
<td>1460</td>
<td>1833</td>
<td>2119</td>
<td></td>
</tr>
<tr>
<td>EPP percent gap</td>
<td>10.5</td>
<td>13.3</td>
<td>14.8</td>
<td>.4&lt;sup&gt;b&lt;/sup&gt;</td>
</tr>
<tr>
<td>Excess demands [-], percent:</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Food</td>
<td>6.5</td>
<td>3.6</td>
<td>2.5</td>
<td>6.3</td>
</tr>
<tr>
<td>Coffee, tea, alcoholic beverages and tobacco</td>
<td>44.8</td>
<td>48.2</td>
<td>47.3</td>
<td>7.4</td>
</tr>
<tr>
<td>Shoes, purses, wallets, etc.</td>
<td>29.1</td>
<td>31.4</td>
<td>33.4</td>
<td>6.6</td>
</tr>
<tr>
<td>Textiles and clothing</td>
<td>7.9</td>
<td>6.3</td>
<td>17.8</td>
<td>13.1</td>
</tr>
<tr>
<td>Furniture</td>
<td>-3.0</td>
<td>-29.6</td>
<td>33.1</td>
<td>16.7</td>
</tr>
<tr>
<td>Household, electrical and electronic goods</td>
<td>5.7</td>
<td>39.1</td>
<td>42.7</td>
<td>7.9</td>
</tr>
<tr>
<td>Other goods</td>
<td>19.5</td>
<td>25.5</td>
<td>19.8</td>
<td>6.0</td>
</tr>
<tr>
<td>Transportation services</td>
<td>-41.4</td>
<td>-44.4</td>
<td>-80.7</td>
<td>13.9</td>
</tr>
<tr>
<td>Housing</td>
<td>-267.0</td>
<td>-311.9</td>
<td>-356.9</td>
<td>12.0</td>
</tr>
<tr>
<td>Utilities and all heating</td>
<td>-147.7</td>
<td>-176.6</td>
<td>-170.8</td>
<td>16.2</td>
</tr>
<tr>
<td>Recreation, education and other leisure</td>
<td>-8.6</td>
<td>-27.5</td>
<td>-38.3</td>
<td>6.8</td>
</tr>
<tr>
<td>Other services (incl. repair work)</td>
<td>11.8</td>
<td>-4.8</td>
<td>-4.1</td>
<td>8.5</td>
</tr>
</tbody>
</table>

<sup>a</sup> Root-mean-square-percent-error of West German sample 1964-1985.

<sup>b</sup> Average goodness-of-fit of FCD demand system for West German sample 1964-1985.
Figure 4—Effective Purchasing Power Gap by Real Expenditure
GDR 4-person Wage and Salary Employee Households 1977-1985

EPP Gap
(percentage)

Household Real Consumption
(1985 DM expenditure/month)
There is no single category of spillover expenditure which compares in magnitude to excess demand for housing. Relative to the RMSPE for the West German sample, the largest spillover category would appear to be "coffee, tea, alcoholic beverages and tobacco". Also relatively large positive deviations can be seen for "household, electrical and electronic goods" and for the residual category "other goods". Especially for the later years the deviations for food expenditure are seen to be quite small.

The estimates of EPP gaps and excess notional demands/spillovers in Tables 3-6 have been tested for a systematic relation with real income and a time trend in the ordinary least squares regressions reported in Table 7. It can be seen from the first regression that the relationship between real income and the size of the EPP gap is significantly positive. The estimated coefficient on the natural log of real expenditure shows that a 10% increase in real income is associated with approximately 1% increase in the EPP gap. Confirming the pattern of a roughly constant EPP gap of 13% over the period as seen in Table 2 for all 4-person households, the coefficient for the time trend is very small and not statistically significant. The pattern of statistical significance for the real income variable in the
TABLE 7—CONSUMER DISEQUILIBRIUM IN THE GDR 1977-1985
OLS REGRESSIONS ON REAL EXPENDITURE AND TIME TREND

<table>
<thead>
<tr>
<th>Dependent variable:</th>
<th>Coefficient estimates for dependent variables:</th>
<th>Adj. R²</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Constant</td>
<td>ln[XDM-85]</td>
</tr>
<tr>
<td>EPP percent gap</td>
<td>-62.64*</td>
<td>10.07*</td>
</tr>
<tr>
<td></td>
<td>(7.49)</td>
<td>(99)</td>
</tr>
<tr>
<td>Excess demands (-), percent:</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Food</td>
<td>38.25</td>
<td>-3.34</td>
</tr>
<tr>
<td></td>
<td>(24.63)</td>
<td>(3.27)</td>
</tr>
<tr>
<td>Coffee, tea, alcoholic beverages and tobacco</td>
<td>-27.50</td>
<td>9.25*</td>
</tr>
<tr>
<td></td>
<td>(21.06)</td>
<td>(2.79)</td>
</tr>
<tr>
<td>Shoes, purses, wallets, etc</td>
<td>8.11</td>
<td>.857</td>
</tr>
<tr>
<td></td>
<td>(30.70)</td>
<td>(4.07)</td>
</tr>
<tr>
<td>Textiles and clothing</td>
<td>-159.79*</td>
<td>23.27*</td>
</tr>
<tr>
<td></td>
<td>(51.24)</td>
<td>(6.80)</td>
</tr>
<tr>
<td>Furniture</td>
<td>-961.18</td>
<td>129.59</td>
</tr>
<tr>
<td></td>
<td>(509.28)</td>
<td>(67.58)</td>
</tr>
<tr>
<td>Household, electrical and electronic goods</td>
<td>-419.00*</td>
<td>57.96*</td>
</tr>
<tr>
<td></td>
<td>(125.01)</td>
<td>(16.59)</td>
</tr>
<tr>
<td>Other goods</td>
<td>-37.36</td>
<td>7.54</td>
</tr>
<tr>
<td></td>
<td>(47.68)</td>
<td>(6.33)</td>
</tr>
<tr>
<td>Transportation services</td>
<td>-49.63</td>
<td>3.87</td>
</tr>
<tr>
<td></td>
<td>(172.80)</td>
<td>(22.93)</td>
</tr>
<tr>
<td>Housing</td>
<td>1587.3*</td>
<td>-255.43*</td>
</tr>
<tr>
<td></td>
<td>(248.13)</td>
<td>(32.92)</td>
</tr>
<tr>
<td>Utilities and all heating</td>
<td>641.29*</td>
<td>-110.49*</td>
</tr>
<tr>
<td></td>
<td>(155.97)</td>
<td>(20.70)</td>
</tr>
<tr>
<td>Recreation, education other leisure</td>
<td>22.50</td>
<td>-8.87</td>
</tr>
<tr>
<td></td>
<td>(185.16)</td>
<td>(24.57)</td>
</tr>
<tr>
<td>Other services (incl. repair work)</td>
<td>116.28</td>
<td>-17.85</td>
</tr>
<tr>
<td></td>
<td>(80.09)</td>
<td>(10.63)</td>
</tr>
</tbody>
</table>

Estimated standard errors are in parentheses. An asterisk identifies those coefficient estimates significant at the 5% level or better.
expenditure category regressions likewise confirms the pattern seen in Tables 3-6 and discussed above.

Trends at the category level correspond to those noted in the discussion to Table 2 with one additional category to report. There is a statistically significant increase in the spillover to the "coffee, tea, alcoholic beverages and tobacco" category not picked up in Table 2, though the size of the coefficient is rather small (eight years of the trend would increase the spillover by 5.3%—compared to the RMSPE for this category of 6.3%).

PART IV—ESTIMATES OF SHORTAGE FOR HUNGARY, POLAND, ROMANIA AND YUGOSLAVIA

Estimated effective purchasing power gaps and evidence of intermarket spillovers for the four socialist economies included in the International Comparison Project have been assembled in Tables 8 and 9. Because of the richness of the ICP data set, these measures of consumer disequilibrium have been subjected to sensitivity analysis for sample selection and level of aggregation. The sensitivity tests are not motivated by a lack of criteria for choosing the appropriate level at which to conduct the analysis. Rather it is to be expected that further empirical investigations along these lines will be severely data-constrained and there will be little choice of either aggregation levels or which constrained and unconstrained expenditure and price data sets will be merged together. The temptation to compare across investigations, e.g., within this report between Parts III and Part IV, is
very strong.\textsuperscript{43} Thus the purpose of the sensitivity analysis presented here is to give a first indication of how the calculated measures of shortage can indeed vary, if for no other reason than as a cautionary tale to those who would dare to compare across analyses.

All combinations of sample selection and aggregation level are not equally appropriate for the empirical analysis of quantity constraints. There are two principles which serve to guide the analysis of this report. The first principle is to avoid allowing unnecessary variation in tastes from clouding the calculations which by construction attribute all differences in consumer behavior to differences in the constraints. Only someone obsessed with increasing degrees of freedom or blind to differences in culture would insist that Syria, Iran, Korea, Thailand, Pakistan, India and Japan be included in a sample to estimate a demand system for the purpose of interpreting Eastern European behavior. The negative conclusions of Podkaminer, Finke and Theil (1984) about the significance of differences in the patterns of consumption expenditure in Hungary, Poland, Romania and Yugoslavia are largely explained by the global sample they chose for estimation.\textsuperscript{44} The second principle is that evidence of intermarket spillovers will be easier to find if the partition of consumption expenditure categories becomes less coarse. While one would hardly dispute the point that capturing the spillover in demand from quantity-constrained orange alarm clocks to green alarm clocks is of less value than would be capturing the spillover from housing to alcoholic beverages, it is hard to believe that there are significant diminishing returns to increased disaggregation in spending categories below

\textsuperscript{43}In Collier and Mokhtari (1987) we have attempted to reaggregate the ICP data for such a comparison.

\textsuperscript{44}Podkaminer \textit{et al.} concluded "there is no evidence that the world outside the CPEs [note: Yugoslavia is rather idiosyncratically classified as a centrally planned economy (CPE)] is characterized by a fundamentally different demand structure". There is really little surprise that the standard errors of the demand parameter estimates of Podkaminer \textit{et al.} are large compared to the change in parameter values which resulted from dropping the "CPEs" from a sample including the entire ICP sample with the exception of Jamaica and three African countries. Still there is probably an important lesson to be learned here about the relative importance of variability of tastes vs. variability of constraints in international comparisons!
Based on these considerations the conclusions of this report regarding the socialist countries of the ICP will be based upon the 18 category, U.S.—Western European FCD demand system.

In Figure 5 the estimated effective purchasing power gaps for Hungary, Poland, Romania and Yugoslavia are displayed along with the "gaps" calculated for the subset of ICP countries chosen to estimate the 18 category FCD demand system. The average of these "gaps" for the U.S. and Western European sample countries is used here (as in Tables 2-7 for the FRG sample) as an economically meaningful measure of the goodness-of-fit of the FCD demand system. It is obvious from inspection of Figure 5 that the EPP gaps of Romania and Poland are far beyond any deviations experienced within the sample. While the numerical value of the EPP gap for Hungary is over two standard deviations larger than the sample average, it appears no worse than the Danish outlier. Only the EPP gap for Yugoslavia is small, well within the estimated U.S.—Western European demand system.

Table 8 reports effective purchasing power gaps for Hungary, Poland, Romania and Yugoslavia from several different FCD demand systems together with statistical summaries of such "gaps" for the sample countries. Six different combinations of aggregation levels and samples can be seen in Table 8. Both the within sample "gaps" and the estimated EPP gaps for the Eastern European countries can be seen to grow with the number of categories of expenditure. However the EPP gaps increase more rapidly than the within sample "gaps". Hence the significance of microeconomic shortage, both in the economic sense of the numerical value of the gap and in the statistical sense of its size.

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45 This is the sort of proposition that can only be decided (if ever) through the accumulation of experience with such analyses.

46 Listed in order of ICP real consumption with the abbreviation used in Figure 5 the market economies chosen were: Ireland (IRE), Italy (ITA), Spain (SPA), United Kingdom (UK), Netherlands (NET), Austria (AUS), Belgium (BEL), West Germany (GER), France (FRA), Denmark (DEN), Luxembourg (LUX) and the United States (US).
Figure 5—Effective Purchasing Power Gaps
Hungary, Poland, Romania and Yugoslavia 1975
(percent)
### Table 8—Effective Purchasing Power Gaps: Hungary, Poland, Romania and Yugoslavia, 1975 by Level of Aggregation and Sample Size (percent)

<table>
<thead>
<tr>
<th></th>
<th>4 Categories</th>
<th>8 Categories</th>
<th>18 Categories</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>US-West 30 ICP countries</td>
<td>US-West 30 ICP countries</td>
<td>US-West 30 ICP countries</td>
</tr>
<tr>
<td>Hungary</td>
<td>.4 1.4</td>
<td>1.6 2.8</td>
<td>5.6 6.3</td>
</tr>
<tr>
<td>Poland</td>
<td>1.3 2.8</td>
<td>3.2 4.0</td>
<td>9.4 7.1</td>
</tr>
<tr>
<td>Romania</td>
<td>2.4 2.6</td>
<td>2.6 3.3</td>
<td>17.0 5.7</td>
</tr>
<tr>
<td>Yugoslavia</td>
<td>1.2 2</td>
<td>1.5 1.3</td>
<td>3.9 3.7</td>
</tr>
<tr>
<td>W.Europe and U.S. Mean</td>
<td>.5 .7</td>
<td>1.4 1.7</td>
<td>2.4 3.4</td>
</tr>
<tr>
<td>W.Europe and U.S. Standard deviation</td>
<td>.4 .3</td>
<td>1.0 1.1</td>
<td>1.3 1.5</td>
</tr>
<tr>
<td>30 ICP countries Mean</td>
<td>1.7</td>
<td>2.6</td>
<td>5.8</td>
</tr>
<tr>
<td>30 ICP countries Standard deviation</td>
<td>1.7</td>
<td>1.8</td>
<td>3.2</td>
</tr>
</tbody>
</table>

Flexible-Cobb-Douglas demand system estimated excluding the Eastern European countries of the ICP sample.
relative to the estimated error of the demand system, increases with the number of
categories of expenditure. For all levels of expenditure aggregation the estimated EPP gaps
for the four Eastern European countries from the thirty country FCD demand system do not
appear particularly large, falling within one standard deviation of the mean of the within
sample "gaps". This finding underscores the importance of restricting the sample to
economies where the presumption of similarity of tastes is appropriate. It is also interesting
to note that for all six variants of Table 8 Poland and Romania show larger EPP gaps than
do Hungary and Yugoslavia. Poland shows a larger gap than Romania for the 30-ICP
country sample while Romania has the larger gap for the restricted, preferred sample of
Western Europe and U.S (12 countries).

There are two senses in which the estimates of the effective purchasing power gap
in Table 8 appear small. From a casual survey of economists familiar with these economies
but unfamiliar with these calculations, the response to the hypothetical question about how
much consumers would be willing to pay to avoid quantity constraints was invariably
higher than the gaps reported here—more on the order of between a fifth to a quarter of
total expenditure. This could be due to the high level of aggregation used in demand
studies of this kind—there are economically significant intracategory spillovers that are
missed in the calculations. The EPP gaps in Table 8 also appear low in comparison to the
average gap of 13% reported for the GDR in Part III. It is not clear which of the several
differences listed at the end of the Part II between the ICP data and the merged DIW PPP
data and Federal Statistical Office Budget Studies of West Germany would account for this
large difference. This apparent discrepancy underscores the need for expanding the
collection of internationally comparable expenditure and price data along the lines of the
International Comparison Project.
Table 9—Actual Consumption Less Estimated Notional Demand (percent): Hungary, Poland, Romania, Yugoslavia in 1975
4-, 8- and 18-Category FCD Demand System, Western Europe and U.S. Sample of ICP

<table>
<thead>
<tr>
<th>Categories</th>
<th>4 Categories</th>
<th>RMSPE</th>
<th>8 Categories</th>
<th>RMSPE</th>
<th>18 Categories</th>
<th>RMSPE</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Hungary</td>
<td>Poland</td>
<td>Romania</td>
<td>Yugoslavia</td>
<td>Hungary</td>
<td>Poland</td>
</tr>
</tbody>
</table>
To generate the numbers in Table 9 FCD demand systems for three different levels of aggregation were estimated using price and expenditure data from the twelve market economies of the U.S. and Western European subset of ICP. Root-mean-square-percent-errors within this sample for each of the expenditure categories at each level of aggregation have been provided to gauge the deviations of consumption expenditure in Hungary, Poland, Romania and Yugoslavia from the predictions of the FCD system. The root-mean-square-percent-errors of this demand system estimated for the (U.S.—West European) market economies are larger than those for the FCD demand system estimated for West German family budgets. Hence the FCD map of U.S./West-European tastes is somewhat crude and caution is advised in the interpretation of Table 9.

The pattern of spillovers and excess demands (i.e., whether the deviations are positive or negative) in the four countries reveals overwhelming agreement. In 13 of 18 expenditure categories the centrally planned economies of Hungary, Poland and Romania all display deviations going in the same direction. For nine categories of expenditure the deviations of all four countries go in the same direction. The big difference between Yugoslavia and the other three countries occurs primarily in spending for private transportation (transport equipment and transport operation costs) in which Yugoslavia registered a positive deviation. Contrary to Podkaminer (1982 and forthcoming) there is no evidence of a significant spillover from undersupplied non-food to food. However, since these calculations involve a finer disaggregation than Podkaminer’s, the findings are not directly comparable.

Significant (i.e., compared to RMSPE) spillover expenditure appears to be concentrated in the categories of beverages (largely alcoholic) and clothing. Significant excess demands appear uniformly in expenditure on tobacco and private transport operation costs. Somewhat surprising in light of the findings for the GDR is the moderate size of the excess demand for the combination "gross rent, fuel".
In spite of the many differences between the ICP data used to generate the estimates in Table 9 and the East and West German data used for the estimates reported in Tables 2-6, the patterns of excess demands and spillovers are remarkably similar for the GDR and the socialist countries in the ICP. The only obvious difference occurs for the category of purchased transportation services where we see estimated notional demand to be below actual expenditure for the GDR but the reverse to be the case for Hungary, Poland, Romania and Yugoslavia.

Comparing the estimated deviations between notional and actual expenditure by level of aggregation in Table 9, one is reassured to find that the pattern of deviations at a high level of aggregation is generally reproduced when estimated expenditures at a lower level of aggregation are combined to match the higher level of aggregation. The pattern of estimated excess demands and spillovers for four categories of expenditure is duplicated when expenditures are reaggregated for the eight and eighteen category models. Romania displays the most inconsistencies between the patterns of the 8 category and reaggregated 18 category models (four of the categories show opposite signs!). All four countries show a sign reversal for the combined category "recreation and education". The within sample RMSPE hardly change as more subcategories are introduced.
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(1987b) "The Simple Analytics (and a Few Pitfalls) of Purchasing Power Parity and Real Consumption Indexes," manuscript, July.


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