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ECONOMICS

DISPARITIES IN INCOMES AND PRICES INTERNATIONALLY

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Abstract

The dispersion of the distribution of relative prices in poor countries is substantially higher than that in the rich. As in 130+ countries relative prices are closely related to incomes, we develop a model that shows that the prices of luxuries (necessities) rise (fall) with income growth. This model provides a link between price dispersion and incomes that leads to several interesting concepts, including minimum-variance income and dispersion-equivalent income, the income needed to compensate for higher dispersion, which are illustrated with data from the International Comparison Program. The paper also contains an analysis of the welfare cost of higher dispersion in poorer countries.

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1. Introduction

This paper investigates how and why economies differ. This is, of course, a large, multidimensional issue as economies differ with respect to incomes, factor endowments, overall scale, institutions and policy, as well as noneconomic attributes such as geography, climate and, possibly, the historical and cultural context. Many of these factors are linked in one way or another, but they need to be compressed to keep things manageable. We focus on differences across countries in incomes and the structure of relative prices and their interactions. While it is an exaggeration to describe incomes and prices as “sufficient statistics” for the economy, they do summarise much information in a compact, convenient and economically relevant way.

Perhaps the most famous approach to understanding cross-country differences in incomes and prices is the Balassa (1964)-Samuelson (1964) productivity bias model. Here, relative to poor countries, high-income countries are taken to be more productive in all commodities, but relatively more so in the tradeables sector, less so in nontradeables. The reason for the asymmetry is that tradeables (such as agricultural goods and minerals) are supposed to be more amenable to productivity improvement than nontradeables (services such as education and medical care). The higher marginal productivity of labour in the traded goods sector means higher wages are paid there and if labour is sufficiently mobile across sectors, wages are higher in the nontraded sector also. The higher costs in nontradables are passed on in terms of higher prices, while traded goods prices are fixed at world values. The result is that tradeables are relatively cheaper in rich countries, or nontradeables are more expensive. For more recent discussions of systematic patterns in prices across countries, see Bhagwati (1984), Bergin et al. (2006), Hsieh and Klenow (2007), Simonovska (2010) and Summers and Heston (1991).

In addition to the productivity bias hypothesis, there are two other streams of literature on the structure of relative prices internationally. First, Theil (1967, Chpt 5) uses Divisia-type concepts to measure how prices and quantities differ across six European countries/regions. This involves the comparison of the price of commodity i in country a with that in b , p_{ia}/p_{ib} , that leads to a bilateral index of the price level in a relative to b . For this purpose, Theil uses the weighted geometric mean, the logarithm of which is $\sum_{i=1}^n w_{i,ab} \log(p_{ia}/p_{ib})$, where n is the number of commodities and $w_{i,ab}$ is the weight that reflects the relative importance of commodity i in the two countries. Also considered is the analogous bilateral variance which measures the dispersion of the individual prices around the average. If prices in one country are proportional to those in another, the variance is zero and the structure of relative prices is the same in the two countries. For further developments along these lines, see Theil (1996, Chpt. 5).

The second stream of this literature is due to Kravis et al. (1982, pp. 104-109), who group countries on the basis of several criteria, one of which is the similarity of the structure of prices. They introduce a bilateral “similarity index”, defined as the weighted correlation coefficient between prices in two countries. Another similarity measure these authors use is the Paasche-Laspeyres spread, defined as the ratio of the Paasche to the Laspeyres price index (Kravis et al., 1982, pp. 105, 109-110). It can be shown that this spread increases with variance of relative prices and so is related to the correlation coefficient. Diewert (2009) presents an axiomatic approach to similarity indexes of prices across countries; see also Cuthbert (2009) and Sergeev (2009).¹

This paper advances both the theory and measurement of cross-country differences in incomes and prices. In Section 2, we first measure the dispersion of prices within a country by the cross-commodity weighted variance and then show in Section 3 how this concept is linked to the law of one price. Section 4 applies this dispersion measure to data from the International Comparison Program (2008) for 130+ countries, which leads to the “world” price distribution. An attractive feature of our approach is that the variance of the world distribution is simply the average of that in each country, with the “between country” effect vanishing. Next, in Section 5, we propose a simple pricing model that shows that under not unreasonable conditions the relative prices of luxuries (necessities) rise (fall) with income growth. We identify a systematic difference in pricing behaviour for rich and poor countries. This model provides a link between price dispersion and income that leads to several interesting concepts including the minimum-variance value of income and dispersion-equivalent income, the additional income that compensates for higher dispersion in the poor countries; these issues are explored in Sections 6 and 7. Section 8 analyses the welfare economics of price dispersion and Section 9 contains concluding comments.

2. The Distribution of Prices

This section introduces measures that summarise the distribution of prices in the form of its centre of gravity and dispersion.

For good i ($i = 1, \dots, n$) in country c ($c = 1, \dots, C$), let p_{ic} , q_{ic} and $w_{ic} = p_{ic}q_{ic}/M_c$ be the price, quantity consumed and budget share, where $M_c = \sum_{i=1}^n p_{ic}q_{ic}$ is total expenditure. Consider the probability distribution of the prices of the n commodities in country c , $p_{1c}, \dots, p_{nc}$. A simple way of summarising this distribution is by the first two moments. It is appropriate to use a weighting scheme that recognises that some goods are more important than others in terms of spending. We use the weighted geometric mean, using the budget shares as weights to represent the relative importance of each good. The logarithm of this mean is:

¹ For a recent study of patterns of relative prices across countries that emphasises the traded/nontraded goods distinction, see Thomas et al. (2011).

$$(1) \quad \log P_c = \sum_{i=1}^n w_{ic} \log p_{ic}.$$

As $\log P_c$ weights prices in proportion to expenditures, it is a cost-of-living index. This index has an attractively simple sampling interpretation (Theil, 1967, pp. 136–137). For convenience, write $\log p_{ic}$ as x_{ic} , and consider a discrete random variable X_c that can take the n possible values $x_{1c}, \dots, x_{nc}$. Regarding the probabilities attached to these n realisations, suppose the names of goods are drawn at random from this distribution such that each dollar of spending has an equal chance of being selected. This means that the probability of drawing x_{ic} is its budget share w_{ic} . Accordingly, the expected value of the random variable X_c is $E(X_c) = \sum_{i=1}^n w_{ic} x_{ic}$, which coincides with index (1). Thus, the index $\log P_c$ can be interpreted as the expected value of the (logarithmic) prices, so it is an appealing way of summarising the cost of the budget.

The above index is a weighted first-order moment of the cross-commodity distribution of prices. The corresponding second-order moment is

$$(2) \quad \Pi_c = \sum_{i=1}^n w_{ic} (\log p_{ic} - \log P_c)^2,$$

which, for country c , is a measure of dispersion of the distribution of prices. If each of the n prices coincide with the mean, then $\Pi_c = 0$.

3. Prices at Home and Abroad

This section considers aspects of the way in which prices are measured and their implications. We start with price comparisons within a country and then turn to bilateral relationships.

Expensive and Cheap Goods

In what sense is it possible to identify those goods that are expensive and those that are cheap? As the price p_{ic} is measured in terms of domestic currency units of country c per unit of good i , the use of this price in cross-country comparisons is unsatisfactory. The relative price $\log p_{ic} - \log P_c$ is a pure number, independent of currency units, but not independent of the units of measurement of good i . To see this, consider, for example, the case of $i = \text{food}$ and suppose we initially measure its volume (q_i^{old}) in terms of kilograms per year. This means that the corresponding price (p_i^{old}) is in terms of local dollars per kilo in order to satisfy the accounting identity $p_i^{\text{old}} \times q_i^{\text{old}} = X$, where X is given food expenditure (dollars per year). If we now switch to grams, then as $1,000\text{g} = 1\text{k}$, $p_i^{\text{new}} = p_i^{\text{old}} / 1,000$ and $q_i^{\text{new}} = q_i^{\text{old}} \times 1,000$, which satisfy $p_i^{\text{new}} \times q_i^{\text{new}} = X$. Furthermore,

the index of prices under the new measurement regime satisfies $\log P^{\text{new}} = \log P^{\text{old}} - w_i \log(1,000)$, so that the difference between the corresponding relative prices is

$$(\log p_i^{\text{new}} - \log P^{\text{new}}) - (\log p_i^{\text{old}} - \log P^{\text{old}}) = -(1 - w_i) \log(1,000).$$

For $0 < w_i < 1$, this difference is nonzero, which establishes a lack of invariance of relative prices to the choice of the units of measurement of the quantities.

The above problem can be resolved by fixing on the quantity units. One approach would be to measure the quantity consumed of good i as its value in US dollars, so that the corresponding price is the domestic-currency cost of one US dollar's worth of the good. In fact, as the currency unit is not present in the relative price $\log p_i - \log P$, this is not dependent on the US dollar as the base, so we could equally well use the euro for this purpose. Subsequently, we use the International Comparison Project (2008) data, where consumption of each of the n goods is expressed in terms of US dollars. An implication of measuring quantities in terms of US dollars is that the n prices $(p_{ic}, \dots, p_{nc})$ are directly comparable across commodities. That is, as p_{ic} is the domestic-currency price of a US dollar's worth of good i , if $p_{ic} > p_{jc}$, then good i is more expensive than j in country c . For comparisons of prices in different countries, currency units have to be removed and we can use the relative price $\log p_{ic} - \log P_c$. Good i is then relatively more expensive in country c than in d when $\log p_{ic} - \log P_c > \log p_{id} - \log P_d$.

The Law of One Price

In the context of prices in different countries, it is relevant to mention the law of one price (LOP). Here, arbitrage equalises prices across countries, when prices are expressed in terms of a common currency.² To examine the implications of the LOP, let S_c be the market exchange rate for c , defined as the domestic currency cost of one US dollar, so that an increase in S_c represents a depreciation of the currency of c , and let p_i^* be the cost of good i in the US in US dollars (the “world price”).³ If k_{ic} is the “spread” between the domestic and world price of good i that measures all factors that account for deviations from the LOP (trade barriers, pricing to market, non-traded goods, etc.), then we have $p_{ic} = k_{ic} \times S_c \times p_i^*$, with $k_{ic} = 1$ representing no deviations. When quantities are

² The literature on the LOP, and its close cousin purchasing power parity, is large and growing. For modern surveys, see Froot and Rogoff (1995), Lan and Ong (2003), MacDonald (2007), Rogoff (1996), Sarno and Taylor (2002), Taylor and Taylor (2004) and Taylor (2006).

³ This discussion is simplified in the interest of clarity. In fact, the ICP (2008) evaluate consumption at “international prices”, which are cross-country averages, expressed in terms of US dollars. Thus, strictly speaking, p_i^* is not the price in the US, but the international price measured in US dollars. This simplification does not affect the logic of the argument, however.

measured in terms of US dollars and prices the cost of one dollar's worth, the price of each good in the US is unity, so that $p_{ic} = k_{ic} \times S_c$, or

$$(3) \quad \log p_{ic} = \log k_{ic} + \log S_c.$$

Multiplying both sides of this equation by w_{ic} and then summing over $i = 1, \dots, n$ yields

$$(4) \quad \log P_c = \log K_c + \log S_c,$$

where $\log K_c = \sum_{i=1}^n w_{ic} \log k_{ic} = \sum_{i=1}^n w_{ic} \log(p_{ic}/S_c)$ is the average spread. The term $\log K_c$ can be interpreted as the degree to which the currency is mispriced: When $\log K_c > 0$ domestic prices are too high in relation to world prices, and the market exchange rate overvalues the currency by $100 \times (K_c - 1)$ percent, while it is undervalued if $\log K_c < 0$. A sufficient condition for no currency mispricing is when each of the n prices is equalised ($\log k_{ic} = 0$, $i = 1, \dots, n$), which could be termed the “strong form” of the LOP. The complete, or absolute, equalisation of the n prices is clearly a very stringent condition that is most unlikely to be satisfied in practice.

Subtracting both sides of equation (4) from (3) yields

$$(5) \quad \log p_{ic} - \log P_c = \log k_{ic} - \log K_c.$$

This states that the logarithmic relative price of i is the deviation of its spread from the average. The “weak version” of the LOP states that domestic prices are proportional to world prices, so that $\log k_{ic} = \log K_c$ and, from (5), $\log p_{ic} - \log P_c = 0$, $i = 1, \dots, n$. In this case, the price variance $\Pi_c = 0$. More generally, the (weighted) variance of departures from the LOP is

$$\sum_{i=1}^n w_{ic} [\log k_{ic} - \log K_c]^2 = \sum_{i=1}^n w_{ic} [\log(p_{ic}/S_c) - (\log P_c/S_c)]^2 = \Pi_c,$$

where Π_c is the variance of relative prices (2). It can, therefore, be seen that a measure of departure from the LOP in its weak form is the degree of dispersion of relative prices. Moreover, as the price variance involves relative prices, for which currency units play no role, the variance is comparable across countries.

4. Incomes and Prices in 132 Countries

We use data on the prices and per capita consumption of 12 commodities in 132 countries, from the International Comparison Program (2008). Tables 1 and 2 list the countries and commodities.⁴ Countries are listed in terms of decreasing real income per capita, defined as the total real volume of per capita consumption measured in US dollars, scaled such that US=100. As can be seen, there is great variation in income, which ranges from 100 in the US, the richest country, to 0.4 in the Democratic Republic of Congo, the poorest. Table 1 also contains the standard deviations of

⁴ For details of the data, see Appendix A1.

the prices $\sqrt{\Pi_c}$. There is a broad tendency for the standard deviation to be higher in low income countries – from the last two entries of the last column of the table, the standard deviation of prices is about twice as high in the poor group of countries as compared to the rich (61 vs 30 percent), but other than that, there is no clear pattern, most likely because noise in the price data is necessarily attenuated in any measure of dispersion.

In addition to the dispersion of n prices within a country, it is of interest to consider the dispersion across C countries,

$$(6) \quad \Pi = \frac{1}{C} \sum_{c=1}^C \sum_{i=1}^n w_{ic} \left[\log p_{ic} - \log P_c - \frac{1}{C} \sum_{c=1}^C \sum_{i=1}^n w_{ic} (\log p_{ic} - \log P_c) \right]^2.$$

Here, commodities are weighted by their budget shares to reflect their relative importance, while countries are unweighted to reflect the idea that we have C independent readings on the structure of prices. This world variance Π can be decomposed into within- and between-country components:

$$\begin{aligned} \Pi &= \frac{1}{C} \sum_{c=1}^C \sum_{i=1}^n w_{ic} \left[\underbrace{\log p_{ic} - \log P_c}_{\substack{\text{Relative price of good } i \\ \text{in country } c}} - \underbrace{\frac{\sum_{i=1}^n w_{ic} (\log p_{ic} - \log P_c)}{n}}_{\substack{\text{Mean for country } c}} \right]^2 \\ \underbrace{\hspace{1.5cm}}_{\text{Total variance =}} &= \underbrace{\hspace{1.5cm}}_{\substack{\text{Variance for country } c \\ \text{Mean variance over countries; "within" component}}} \\ &+ \frac{1}{C} \sum_{c=1}^C \left[\underbrace{\sum_{i=1}^n w_{ic} (\log p_{ic} - \log P_c)}_{\substack{\text{Mean for country } c}} - \underbrace{1/C \cdot \sum_{c=1}^C \sum_{i=1}^n w_{ic} (\log p_{ic} - \log P_c)}_{\substack{\text{Mean over all countries}}} \right]^2 \\ &\quad \underbrace{\hspace{1.5cm}}_{\text{+Variance across countries; "between" component}} \end{aligned}$$

As $\sum_{i=1}^n w_{ic} (\log p_{ic} - \log P_c) = 0$, the between-country variance vanishes and using equation (2), the following simple result emerges:

$$(7) \quad \Pi = \frac{1}{C} \cdot \sum_{c=1}^C \Pi_c.$$

Thus, the world variance is just the average of that in the C countries, which is a convenient result. Figure 1 presents histograms of relative prices of the $n=12$ goods for the two groups of countries. Consistent with the above approach, here prices are weighted by budget shares. As can be seen, prices are clearly less dispersed in the rich countries.⁵

Next, we investigate informally the dependence of prices on income. Let $\log(Q_c/\bar{Q})$ be income in country c relative to the geometric mean income for all countries. Figure 2 plots each relative price $\log(p_{ic}/P_c)$ against relative income for the 132 countries. As discussed above, p_{ic} is

⁵ Note that the standard deviations of the histograms, corresponding to $\sqrt{\Pi}$ with Π defined by equation (6), are close to the mean SDs given at the bottom of Table 1, but not identical. Identical results are obtained if we first square each country's SD in Table 1, average and then take the square root. That is to say, the results satisfy equation (7).

the price of one US dollar's worth of good i in country c , while P_c is the weighted geometric mean; accordingly, if $p_{ic}/P_c > 1$, then i is relatively expensive in c and $\log(p_{ic}/P_c) > 0$. The term “relatively more expensive” in this context means that a dollar's worth of i costs more than the average over all goods. It is to be noted that as $\sum_{i=1}^{12} w_{ic} \log(p_{ic}/P_c) = 0$, some of the logarithmic relative prices must be positive, others negative, averaging out to zero. Panel 1 of Figure 2 indicates that food prices exhibit three patterns. First, as most of the points lie above the zero horizontal line, food is relatively expensive in the majority of countries. The other panels of the figure show that housing, health and education tend to be cheap, while clothing, transport and restaurants are expensive. Second, food prices tend to become cheaper as income rises, as indicated by the negative slope of the regression line in the panel. Third, in a number of instances there is clear visual evidence of the dependence of prices on income, a topic explored further in the next section.

5. A Simple Model of Relative Prices

Suppose the quantity supplied of good i , (q_i^s) , is a log-linear function of its relative price (p_i/P) , while its consumption depends on the relative price and real income (Q) :

$$\log q_i^s = \phi_i^s + \eta_i^s (\log p_i - \log P), \quad \log q_i^d = \phi_i^d + \eta_i^d (\log p_i - \log P) + \theta_i \log Q,$$

where ϕ_i^s (ϕ_i^d) is the intercept of the supply (demand) function, $\eta_i^s > 0$ ($\eta_i^d < 0$) is the price elasticity of supply (demand) and θ_i is the income elasticity. Market clearing implies that

$$(8) \quad \log p_i - \log P = \alpha'_i + \beta'_i \log Q,$$

where $\alpha'_i = (\phi_i^d - \phi_i^s)/\Delta_i$, with $\Delta_i = \eta_i^s - \eta_i^d > 0$ the excess supply elasticity, and $\beta'_i = \theta_i/\Delta_i$. This reduced form is not a completely satisfactory formulation for the following reason. If good i is normal, then the income elasticity θ_i and the reduced-form income coefficient β'_i are both positive. If each of the n goods is normal, which is entirely possible, then equation (8) says that the impact of income growth is to increase all relative prices, which is logically impossible: As a budget-share weighted average of relative prices is zero, some would have to increase, while others decrease.

To rectify this problem, we proceed in two steps. First, we multiply both sides of equation (8) by the budget share of good i and add both sides over $i = 1, \dots, n$. As $\sum_{i=1}^n w_i (\log p_i - \log P) = 0$, we have $A + B \log Q = 0$, where $A = \sum_{i=1}^n w_i \alpha'_i$ and $B = \sum_{i=1}^n w_i \beta'_i$ are weighted averages of the coefficients of equation (8). Second, we subtract $A + B \log Q$ from both sides of equation (8) by then multiply both sides by w_i to give

$$(9) \quad w_i (\log p_i - \log P) = \alpha_i + \beta_i \log Q,$$

where $\alpha_i = w_i(\alpha'_i - A)$ and $\beta_i = w_i(\beta'_i - B)$ are weighted deviations from weighted means that satisfy $\sum_{i=1}^n \alpha_i = \sum_{i=1}^n \beta_i = 0$. According to model (9), growth in income leads a rise in the relative price of good i if its $\beta_i > 0$. As $w_i > 0$, this occurs when its $\beta'_i = \theta_i / (\eta_i^s - \eta_i^d)$ is larger than the average, B . Accordingly, income growth increases the relative price of i when the ratio of its income elasticity to the excess supply elasticity is larger than average, and vice versa. Dividing both sides of equation (9) by w_i , it can be seen that β_i/w_i is the income elasticity of the relative price of good i and that a budget share weighted-average of these elasticities, $\sum_{i=1}^n w_i (\beta_i/w_i)$, is zero, as required.

To analyse further the workings of model (9), suppose that the excess supply elasticity is the same for each commodity: $\eta_i^s - \eta_i^d = \Delta_i = \Delta > 0$. The income coefficient in (9) then takes the form

$$(10) \quad \beta_i = \frac{1}{\Delta} w_i \left(\theta_i - \sum_{j=1}^n w_j \theta_j \right) = \frac{1}{\Delta} w_i (\theta_i - 1),$$

where the second step follows from the requirement that a budget-share weighted average of the income elasticities is unity. As $1/\Delta$ and w_i are both positive, equation (10) reveals that the sign of β_i for goods that are luxuries ($\theta_i > 1$) is positive and negative for necessities ($\theta_i < 1$). Thus, under the stated conditions, income growth increases the relative prices of luxuries and decreases those of necessities, which is perfectly reasonable.

The variance of income elasticities of the relative prices is $\sum_{i=1}^n w_i (\beta_i/w_i)^2 = \sum_{i=1}^n \beta_i^2 / w_i$, which is a cross-commodity weighted variance and is exactly analogous to the price variance (2). From definition (10), this variance takes the form

$$(11) \quad \sum_{i=1}^n \frac{\beta_i^2}{w_i} = \frac{1}{\Delta^2} \sum_{i=1}^n w_i (\theta_i - 1)^2.$$

As a budget-share weighted mean of the income elasticities is unity, their weighted variance is $\sum_{i=1}^n w_i (\theta_i - 1)^2$. This is the third cross-commodity variance that we have encountered. Equation (11) shows that the variance of the income elasticities of prices, β_i/w_i , is proportional to the variance of the income elasticities of demand, θ_i , with proportionality factor $1/\Delta^2$. A greater diversity of the goods implies a larger dispersion of income elasticities and, from (11), a larger variability of the price elasticities. For example, when all goods are the same, the income elasticities are all unity and there is no dispersion among the price elasticities (each $\beta_i = 0$, so relative prices are independent of income).

We apply model (9) to the 12 commodities and 132 countries discussed in the previous section. To do this, we make three adjustments. First, to allow for excluded factors, we add a zero-

mean disturbance term for good i and country c , ε_{ic} , with $E(\varepsilon_{ic})^2 = \sigma_i^2$. Second, we recognise that there may be systematic differences in pricing patterns in rich and poor countries. For example, rich economies may have access to more advanced technologies, leading to lower costs of production. This implies a larger intercept of the supply function, ϕ_i^s , for those countries, which has a consequential impact on the intercept α_i in model (9). To allow for this possibility, we specify that this intercept takes different values for the rich and poor groups of countries. Third, for convenience, we measure income as a deviation from the geometric mean $\bar{Q}$ as was done in the previous section. Thus, we estimate a system of 12 equations, the i^{th} member of which is

$$(12) \quad w_{ic} \log(p_{ic}/P_c) = \alpha_i + \gamma_i D_c + \beta_i \log(Q_c/\bar{Q}) + \varepsilon_{ic}, \quad c=1, \dots, 132,$$

where $D_c = 1$ if c refers to a poor economy, zero otherwise.

The least-squares estimates of equation (12) for $i=1, \dots, 12$ are given in Table 2. These estimates (denoted by a circumflex) satisfy the aggregation constraints $\sum_{i=1}^{12} \hat{\alpha}_i = \sum_{i=1}^{12} \hat{\beta}_i = \sum_{i=1}^{12} \hat{\gamma}_i = 0$. As can be seen, 5 of the 12 coefficients of the poor-country dummy are significant, especially those for clothing and education; these coefficients indicate that in these countries clothing is more expensive and education cheaper, when incomes are held constant. The income coefficient of food is negative and highly significant, so that food becomes cheaper as affluence rises. As food is a necessity, the negative sign of this coefficient agrees with the discussion below equation (10). The third last column of the table shows that the income elasticity of the price of food is -0.19, so a doubling of income leads to approximately a 20-percent decline in prices. The largest income elasticity is 0.18 for housing prices (clothing is a close second).

Table 3 explores relation (10) by presenting the income elasticities of demand implied by the estimates of β_i from Table 2. To do this, the excess supply elasticity Δ is required and in columns 3-5 we use three “central” values, 1, 2 and 3. The implied elasticities can then be compared to directly estimated ones (derived from Clements and Chen, 2010, with the same data), which are given in column 6. Although the agreement is not exact, the implied elasticities of column 4, corresponding to $\Delta = 2$, seem to be closest, especially for the important case of food: For this good, here the implied income elasticity is 0.62, which is close to the estimated value of 0.66. The excess supply elasticity of $\Delta = 2$ is consistent with the supply and demand elasticities being 1 and -1, respectively. As these computations are based on the simplifying assumption that the excess supply elasticities are the same for all goods, the results should not be taken to be hard and fast. Nonetheless, the not unreasonable agreement between the implied and estimated elasticities can be interpreted as providing some reassurance that the pricing model (12) makes economic sense.

6. Price Dispersion and Income

The parameter β_i in model (12) represents the sensitivity of the relative price of good i to changes in income. This dependence of prices means that income has a systematic impact on price dispersion. Using the pricing equations to analyse dispersion has the effect of eliminating much of the noise in the variance of prices and gives rise to several interesting concepts including the value of income that leads to a minimum variance (MV), as well as variance-equivalent incomes. This and the next section peruse these issues.

Dispersion Quadratic in Income

We divide both sides of equation (12) by w_{ic} and then substitute the expression for the relative price of good i , $\log p_{ic} - \log P_c$, into the definition of the variance (2). Taking the expectation and writing $y_c = E(\Pi_c)$ and $x_c = \log(Q_c/\bar{Q})$, we obtain an expression for the dispersion of relative prices that is quadratic in income:

$$(13) \quad y_c = \lambda_0 + \lambda_1 x_c + \lambda_2 x_c^2, \quad \text{with } \lambda_0 = \sum_{i=1}^{12} \frac{\tilde{\alpha}_i^2 + \sigma_i^2}{w_{ic}}, \quad \lambda_1 = \sum_{i=1}^{12} \frac{2\tilde{\alpha}_i \beta_i}{w_{ic}} \quad \text{and} \quad \lambda_2 = \sum_{i=1}^{12} \frac{\beta_i^2}{w_{ic}},$$

where $\tilde{\alpha}_i = \alpha_i + \gamma_i D_c$ is the intercept of the pricing equation (12) for good i in country c and $\sigma_i^2 = E(\varepsilon_{ic})^2$ is the variance of the disturbance term of that equation. To implement equation (13), we use the estimates of Table 2 and the shares of countries that are representative of the poor and rich groups of countries. Table 4 and Figure 3 present the results, to be discussed in detail below.

Meanland and MV Income

As income is measured relative to the mean, the intercept in equation (13), λ_0 , represents the variance of prices corresponding to mean income. This is dispersion in “Meanland”, the hypothetical country at the centre of the world with mean income. As $dy/dx = \lambda_1 + 2\lambda_2 x_c$, and $\lambda_2 > 0$, $x^* = -\lambda_1/2\lambda_2$ is the variance-minimising value of income. In terms of the basic parameters of equation (13), this MV income takes the form

$$(14) \quad \log \frac{Q^*}{\bar{Q}} = -\sum_{i=1}^{12} \kappa_i \frac{\tilde{\alpha}_i}{\beta_i}, \quad \text{with } \kappa_i = \frac{\beta_i^2/w_{ic}}{\sum_{i=1}^{12} \beta_i^2/w_{ic}} > 0, \quad \sum_{i=1}^{12} \kappa_i = 1.$$

Thus, MV income is a weighted average of ratios of the intercept to the slope in equation (12), with the signs changed, $-\tilde{\alpha}_1/\beta_1, \dots, -\tilde{\alpha}_{12}/\beta_{12}$. The weight for good i in (14), κ_i , is proportional to $\beta_i^2/w_{ic} = w_{ic} (\beta_i/w_{ic})^2$, which is the square of the income elasticity of the relative price of i , weighted by its share w_{ic} . In view of the discussion above result (11), κ_i is proportional to the contribution of the good in question to the variance of the income elasticities of the relative prices.

From (11), κ_i is also proportional to the contribution of good i to the variance of the income elasticities of demand, under the condition that the excess supply elasticity is the same for each good.

Another interesting way to express the quadratic (13) is in terms of the deviation of income from its MV value. It follows from $x^* = -\lambda_1/2\lambda_2$ that $\lambda_2(x - x^*)^2 = \lambda_2 x^2 + \lambda_1 x + \lambda_1^2/4\lambda_2$, so that equation (13) can be written as

$$y_c = \lambda'_0 + \lambda_2(x_c - x^*)^2, \text{ with } \lambda'_0 = \lambda_0 - \lambda_1^2/4\lambda_2.$$

This shows that when $x_c = x^*$, the variance of prices is minimised and takes the value $\lambda_0 - \lambda_1^2/4\lambda_2$. As $\lambda_2 > 0$, the variance is higher for all other values of income, and increases with the square of the deviation of income from MV income. In view of the logarithmic formulation, this deviation is the difference of country c 's income from the MV value, $\log(Q_c/Q^*)$. The excess of the variance over its minimum is $y_c - \lambda'_0$; the income elasticity of this excess is 2.

A Picture of Dispersion

Figure 3 is a sketch of expected price dispersion against income for the rich and poor countries. As can be seen, for most values of income, dispersion for the poor is above that for the rich. But as the two curves are not parallel, they intersect at the point A and for incomes below this critical value, dispersion in the rich countries exceeds that of the poor. Relative income at this point is

$$(15) \quad \frac{-(\lambda_1^P - \lambda_1^R) \pm \sqrt{(\lambda_1^P - \lambda_1^R)^2 - 4(\lambda_2^P - \lambda_2^R)(\lambda_0^P - \lambda_0^R)}}{2(\lambda_2^P - \lambda_2^R)},$$

where λ_i^g is the quadratic coefficient of order i in equation (13) for country group g ($g = R, P$, for rich, poor). In the figure, we use the positive root in (15) as that is closest to mean income.

The point of intersection of the curve with the vertical axis is dispersion in Meanland. This is B_P for the poor and B_R for the rich, with $B_P > B_R$, reflecting again that on average dispersion is higher in poorer countries. The minimum-variance points are C_P and C_R , which show that for rich countries as compared to the poor (i) this variance is lower; and (ii) the corresponding income is higher (C_R lies to the right of C_P). In terms of the quadratic coefficients, the points of intersection with the vertical axis are $B_P = \lambda_0^P$ and $B_R = \lambda_0^R$, so these coefficients determine the overall “height” of each curve. The sensitivity of dispersion to variations in income is given by the slope of the quadratic. This slope is expressed in terms of the change in the variance for a one-percent increase in income; the income elasticity of the variance (the slope divided by the variance) is proportional to

this slope. For country group g ($g = R, P$), the slope is $\lambda_1^g + 2\lambda_2^g \log(Q^c/\bar{Q})$. Thus, for income less than MV in the poor countries (given by the point C_P in the figure), the difference in the slopes between the two groups, $(\lambda_1^R - \lambda_1^P) + 2(\lambda_2^R - \lambda_2^P) \log(Q^c/\bar{Q})$, is always negative. This establishes that in this range, a proportionate increase in income decreases dispersion by more in the rich countries than in the poor.

Finally, the change in the income sensitivity of dispersion is $2\lambda_2$, which is a measure of the curvature of the quadratic. It follows from equations (10), (11) and (13) that the ratio of this coefficient for the rich to that for the poor is the ratio of the variances of the income elasticities of demand:

$$(16) \quad \frac{\lambda_2^R}{\lambda_2^P} = \frac{d(\text{income sensitivity of dispersion in rich})}{d(\text{income sensitivity of dispersion in poor})} = \frac{\text{variance of income elasticities in rich}}{\text{variance of income elasticities in poor}}.$$

This result holds under the condition that the excess supply elasticities are the same. From column 2 of Table 4, the estimate of λ_2^R is almost 40 percent larger than that for the poor, implying that there is substantially more diversity among the income elasticities of demand for the rich as compared to the poor. Identifying the differences in goods in the basket by the dispersion of the income elasticities of demand, result (16) agrees with the idea that for the rich, consumption patterns are more diversified and relatively less intensive in food in particular (Engel's law).

More on Meanland and MV Income

The estimates of the zero-order coefficient in the quadratic (13), λ_0 , contained in column 4 of Table 4, are 0.33 and 0.26 for the poor and rich countries, respectively. Thus, dispersion at mean income is $\sqrt{0.33} = 0.57$ and $\sqrt{0.26} = 0.51$, or about 57 and 51 percent for the poor and rich. The last two entries in this column of the table establish that these values are significantly different.

Column 5 of Table 4 reveals that in the poor (rich) countries, variance is a minimum when income is about 132 (166) percent above the mean. The last two entries in this column show that the difference between these two income values is significant. From column 6, the minimum variance is 29 (17) percent for the poor (rich), and again this difference is significant. The next several columns indicate that Greece has income closest to the minimum-variance for the poor, while Iceland plays this role for the rich.

Equation (14) defines MV income as a weighted average of ratios of the intercept to slope coefficients (with the signs changed) in the pricing model (12). This income can thus be decomposed

commodity-wise, as in Table 5. This shows that for both groups of countries, food and housing are the dominant contributors to MV income.⁶

7. Dispersion-Equivalent Income

As price dispersion depends on income, it is natural to ask, what change in income has the effect of equalising dispersion? We call this change “dispersion-equivalent income” (DEI). This section investigates the nature of DEI and applies the idea to the two groups of countries.

As discussed above, dispersion in the poor countries is higher than in the rich and, usually, dispersion falls as income rises. These two characteristics are only satisfied in the shaded region of Figure 4. The left-hand boundary of the region is defined by the intersection of the two curves, where income is x_1 ; for incomes below this value, dispersion of the rich exceeds that of the poor. The right-hand boundary of the region corresponds to the minimum point for the poor, associated with income x_2 ; when income exceeds x_2 , dispersion in the rich group continues to fall (which is satisfactory), but that for the poor rises (not satisfactory). Within the shaded region, we can ask, by how much does income of the rich need to be lowered to eliminate the difference in dispersion? Consider, for example, the case when income for each group is x_3 . Here, dispersion in the two groups is equalised when income of the rich is lowered by $\Delta x > 0$ to $x_3 - \Delta x$. This Δx is DEI corresponding to x_3 .

In the above, we commenced with the poor and then determined the adjustment of the income of the rich required to increase their dispersion so that it was equal to the poor’s; in this sense, the poor are the base group. We could just as well reverse things and start with the rich. Thus, when the rich’s income is $x_3 - \Delta x$, by how much does the poor’s income need to be increased? Answer: the same Δx , which establishes that the analysis is symmetric with respect to the base group. However, there is an additional consideration when we start with the rich: A positive DEI exists only within the smaller, cross-hatched sub region of Figure 4, where income falls in the range $x_1 \leq x \leq x_4$. The new boundary value x_4 is income when dispersion of the rich equals the minimum value for the poor. For

⁶ It should be noted that we explored two extensions to and checks on the results. First, some of the relative prices for Lebanon, Iran and Georgia seem to be outlying observations. As a robustness check, we redid the results of Table 4 with the data for these three countries omitted; this had only a very marginal impact on the results. Second, in Table 2 poor countries were distinguished from the rich by an intercept dummy. This treatment was re-examined graphically by plotting each relative price against income and then fitting separate regression lines for the rich and poor groups of countries. For most commodities, the scatterplots show something approximating an intercept shift. Clothing and furnishings are exceptions to this general rule, but as these goods each absorb about 5 percent of the budget for an average country, they are unlikely to substantially affect the overall results which entail weighting by budget shares. However, when pricing model (12) was estimated separately for the two groups of countries and the quadratic (13) reevaluated, the results do change. There may be a case to keep the two groups separate, but due to the relatively small sample size for the rich, it is not possible to be hard and fast on this issue. For details, see Appendix A1.

income exceeding x_4 , no addition to income of the poor will equalise dispersion. To summarise, it is legitimate to use either the rich or the poor as the base group for the analysis of DEI, but given the way the two curves are drawn in Figure 4, the feasible range of income is smaller when the rich are used for this purpose.

As is clear from Figure 4, the nonlinearities mean that DEI varies with income; as will be shown below, DEI is quadratic in income. This is further illustrated by Figure 5, which plots DEI against income.⁷ The curve to the right, which refers to the case in which the base is the poor, is derived from the left curve (base = rich) by adding the DEI for the rich, the height of their curve, to income of the rich to obtain the income of the poor. For example, when income of the rich is $x_3 - \Delta x$, $\text{DEI} = \Delta x$. As the point A on the curve for the rich lies above the 45° line, $\Delta x > |x_3 - \Delta x|$. The associated point on the poor's curve is B, where DEI is the same Δx as before, while income is the previous value, $x_3 - \Delta x$, plus DEI , Δx , or x_3 . Figure 5 reveals three patterns in the nature of DEI. First, DEI increases with income, reflecting that the rising difference in dispersion for the rich and the poor. Second, in the range $x_1 \leq x \leq x_4$, the DEI curve for the rich lies everywhere above that for the poor. This means that when the income of the poor is increased to equalise dispersion, DEI is larger than when the rich's income is reduced. Finally, for a given income within the range $x_1 \leq x \leq x_4$, the marginal DEI, $d(\text{DEI})/dx$, for the rich exceeds that for the poor.

To formulate DEI algebraically, we apply equation (13) to the rich and poor groups of countries explicitly by defining the quadratic coefficients as λ_k^g , for $k = 0, 1, 2$ (for the order) and $g = R, P$ (for the rich and poor). Thus, we now have

$$y_c = \lambda_0^R + \lambda_1^R x_c + \lambda_2^R x_c^2, \text{ with } \lambda_0^R = \sum_{i=1}^{12} \frac{\alpha_i^2 + \sigma_i^2}{w_{ic}}, \lambda_1^R = \sum_{i=1}^{12} \frac{2\alpha_i \beta_i}{w_{ic}} \text{ and } \lambda_2^R = \sum_{i=1}^{12} \frac{\beta_i^2}{w_{ic}}, \text{ if } c \in \text{Rich},$$

$$y_c = \lambda_0^P + \lambda_1^P x_c + \lambda_2^P x_c^2, \text{ with } \lambda_0^P = \sum_{i=1}^{12} \frac{\tilde{\alpha}_i^2 + \sigma_i^2}{w_{ic}}, \lambda_1^P = \sum_{i=1}^{12} \frac{2\tilde{\alpha}_i \beta_i}{w_{ic}} \text{ and } \lambda_2^P = \sum_{i=1}^{12} \frac{\beta_i^2}{w_{ic}}, \text{ if } c \in \text{Poor}.$$

These equations for the two groups differ for two reasons. First, the zero-order coefficients contain the respective intercepts of equation (12), $\tilde{\alpha}_i = \alpha_i + \gamma_i$ for the poor and α_i for the rich. Second, the budget shares in the coefficients are different across countries.

Write the variance for country c that belongs to group g as a function of income as $y_c = f_g(x_c)$. Then, DEI, Δx , solves $f_R(x_c) = f_P(x_c + \Delta x)$. Using the above, this becomes

$$\lambda_0^R + \lambda_1^R x_c + \lambda_2^R x_c^2 = \lambda_0^P + \lambda_1^P (x_c + \Delta x) + \lambda_2^P (x_c + \Delta x)^2, \text{ or } \phi_0 + \phi_1 \Delta x + \phi_2 (\Delta x)^2 = 0,$$

⁷ For clarity, this figure is not drawn on the same scale as Figure 4.

with $\phi_0 = \lambda_0^P - \lambda_0^R + (\lambda_1^P - \lambda_1^R)x_c + (\lambda_2^P - \lambda_2^R)x_c^2$, $\phi_1 = \lambda_1^P + 2\lambda_2^P x_c$ and $\phi_2 = \lambda_2^P$. The roots of this equation are

$$\Delta x = \frac{-\phi_1 \pm \sqrt{\phi_1^2 - 4\phi_2\phi_0}}{2\phi_2}.$$

We evaluate this equation with the quadratic coefficients of Table 4 and use the smaller root. When the rich is used as the base for the comparison, the admissible range of income is $-1.11 \leq x \leq -0.26$, which is equivalent to the poor's income falling within the range 33-77 percent of the mean. Table 6 gives the values of DEI and as can be seen, it is sensitive to income: DEI is 3 percent of income when the poor's income is 33 percent of the mean, while DEI is 61 percent when income rises to 56 percent of the mean.

8. The Cost of Dispersion

Consider two countries with the same income and suppose that because of flawed institutions and/or policies, price dispersion is higher in one than the other. This will distort economic decisions and impose a welfare cost on the high-dispersion economy. In this section, we analyse the welfare implications of the higher dispersion in the poor group of countries. This analysis takes place under several simplified conditions: The excess dispersion is taken to be distortionary, and the implications are confined to consumption in the context of a simple demand. For these reasons, the results that follow should be viewed as illustrating the issues involved, rather than representing precise quantification.

Suppose distortions change the vector of n prices by $\Delta \mathbf{p}$, which leads to changes in consumption of $\mathbf{S}\Delta \mathbf{p}$, where $\mathbf{S}$ is the substitution matrix. The associated welfare cost can be expressed as $W = -\frac{1}{2}\Delta \mathbf{p}'\mathbf{S}\Delta \mathbf{p}$ (Harberger, 1964). It can be shown that the welfare cost as a fraction of income (M) is

$$(18) \quad \frac{W}{M} = -\frac{\kappa}{2}\Pi,$$

where $\kappa < 0$ is the negative of the elasticity of substitution and Π is price dispersion (2).⁸ In words, the welfare cost is proportional to the price variance, where the proportionality factor is one-half of the elasticity of substitution. The cost of the higher dispersion in the poor, as compared to the rich, is then $\Delta(W/M) = -(\kappa/2)\Delta\Pi$, where $\Delta\Pi > 0$ is the increase in dispersion.

In view of the broad nature of the commodity groups, there is not likely to be much substitutability between them, so a low value of the elasticity of substitution would be appropriate. Thus, if this elasticity is one-half, then the welfare cost is one-quarter of the increase in the variance.

⁸ For the derivation of result (18), based on Selvanathan's (1985) model, see Appendix A2.

One way to measure $\Delta\Pi$ is by the increase in the variance at mean income, which from the last entry of column 4 of Table 4 is $7.95 \left(\times 100^{-1}\right)$. Thus, the welfare cost for the poor, expressed as a proportion of their income, is $7.95/4 \approx 2$ percentage points higher than that for the rich. Although apparently quite modest, for some countries this figure could be near one year's economic growth. As the cost repeats itself each year, the implication is that in some cases the elimination of the underlying distortions could lead to a non-trivial acceleration of growth. But as our estimate of the cost depends on the demand structure used, the value of the elasticity of substitution and exactly how the increase in dispersion is measured, it should be clear that it provides only a back-of-the-envelope indication of the order of magnitude involved.

9. Concluding Comments

This paper has dealt with the theory and measurement of differences in income and prices across countries. Using the data on the 130+ countries recently published by the International Comparison Program, the distribution of prices within poor countries was found to be substantially more dispersed than that in the rich group. As the prices of some commodities are strongly related to income, we developed a simple analytical model to understand this phenomenon. This model provides a novel link between prices and the income-sensitivity of consumption patterns. This approach implies that price dispersion is quadratic in income and gives rise to several interesting concepts including the value of income that minimises dispersion, as well as dispersion-equivalent income. Finally, we carried out some illustrative calculations regarding the welfare cost of dispersion. In summary, this framework permits an understanding of price dispersion, the identification of its determinants and provides useful new concepts.

Rather than reiterating the findings in detail, we conclude with some broader issues raised by the analysis. If higher dispersion entails a welfare cost, we could ask what is the source of the distortion? If it were the result of bad policy (taxes, import tariffs, misaligned exchange rate, etc.), or mispricing of factor inputs (under-priced natural resources, too high labour costs due to unions, etc.), then a genuine distortion exists that imposes human-made damage on the economy, as measured by the welfare cost. But if the distribution of prices is more dispersed because of natural factors such as climate, geography or factor endowments, then there is no distortion. The associated cost is not a welfare cost as usually understood, but a cost that simply has to be lived with.

What if the higher dispersion results from poor infrastructure such as low-quality ports, roads and telecommunications? Here, the higher costs could result in higher prices at home for imported commodities and lower prices of those goods that are exported, thus increasing overall dispersion. Without further information, it is not clear if this is a distortion that carries a welfare cost; for example, a country's infrastructure may be inferior by international standards, it may still be

appropriate if there is a limited pool of investable funds. Another difficulty occurs when the lack of access to modern technology causes the costs of certain goods to be higher than would otherwise be the case, while others are lower. The interpretation of the higher price dispersion is unclear here also. A final broader issue relates to how the economy responds to shocks of all kind. When the economy is better able to adjust to shocks, supply and demand schedules are more price elastic and relative prices are more stable. Accordingly, for a given disturbance, such as an oil-price shock, price dispersion will be lower due to the greater flexibility of the economy, other things remaining unchanged.

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TABLE 1
INCOMES AND DISPERSION OF PRICES, 132 COUNTRIES IN 2005

Country	Income p.c.	SD of prices	Country	Income p.c.	SD of prices	Country	Income p.c.	SD of prices
1. United States	100.0	0.0	46. Mexico	28.7	35.3	91. Kyrgyz	8.0	88.3
2. Luxembourg	92.2	16.8	47. Belarus	27.3	73.1	92. Sri Lanka	7.9	55.8
3. Iceland	80.7	29.1	48. Kazakhstan	26.5	72.9	93. Iraq	7.8	64.6
4. Norway	77.7	31.3	49. Mauritius	26.3	55.3	94. Mongolia	7.7	81.9
5. United Kingdom	76.9	26.7	50. Russia	26.3	63.1	95. Philippines	7.5	55.9
6. Austria	76.4	24.9	51. Bulgaria	26.1	62.8	96. Indonesia	7.4	50.9
7. Switzerland	74.6	18.9	52. Iran	25.2	69.1	97. Pakistan	7.3	68.1
8. Canada	74.4	21.8	53. Romania	24.4	53.5	98. Morocco	7.2	42.8
9. Netherlands	72.4	25.1	54. Oman	24.2	37.7	99. Lesotho	7.1	76.8
10. Sweden	72.0	25.3	55. Argentina	24.0	42.9	100. China	7.0	66.6
11. France	71.5	23.0	56. Serbia	23.7	58.3	101. Vietnam	6.8	91.3
12. Australia	70.6	23.3	57. Saudi Arabia	23.6	36.6	102. India	5.5	70.8
13. Denmark	69.8	25.2	58. Chile	23.3	36.0	103. Cambodia	5.3	79.8
14. Belgium	68.4	22.5	59. Uruguay	22.1	36.3	104. Yemen	5.2	57.7
15. Germany	67.5	21.3	60. Bosnia Herz.	21.9	55.9	105. Sudan	4.5	46.2
16. Hong Kong	66.3	38.4	61. Macedonia	20.5	60.6	106. Lao	4.4	82.1
17. Ireland	66.2	24.6	62. Ukraine	19.8	78.8	107. Djibouti	4.4	70.0
18. Japan	66.0	35.6	63. South Africa	19.3	41.7	108. Kenya	4.3	69.4
19. Taiwan	64.5	56.0	64. Malaysia	19.3	51.6	109. Sao Tome	4.3	62.6
20. Cyprus	63.4	33.7	65. Turkey	18.9	51.3	110. Congo, R.	4.1	81.9
21. Finland	63.0	24.6	66. Montenegro	18.7	55.8	111. Cameroon	4.0	52.8
22. Spain	61.9	28.5	67. Brazil	18.7	39.8	112. Nigeria	4.0	76.1
23. Italy	61.6	20.3	68. Venezuela	17.1	46.9	113. Senegal	3.9	57.7
24. Greece	59.4	30.1	69. Thailand	16.1	60.4	114. Chad	3.5	75.3
25. NZ	57.7	23.3	70. Albania	14.6	58.5	115. Nepal	3.4	64.7
26. Israel	54.7	34.4	71. Colombia	14.5	48.4	116. Bangladesh	3.3	54.8
27. Malta	54.3	42.5	72. Ecuador	13.7	43.0	117. Benin	3.3	66.3
28. Singapore	53.6	47.8	73. Jordan	13.7	52.4	118. Ghana	3.3	77.6
29. Qatar	50.5	61.5	74. Tunisia	13.7	49.9	119. Cote d'Ivoire	3.1	53.4
30. Slovenia	50.0	31.9	75. Peru	13.6	40.0	120. S. Leone	3.1	89.5
31. Portugal	49.0	25.6	76. Egypt	13.5	66.3	121. M'gascar	3.0	80.2
32. Brunei	48.7	55.6	77. Moldova	13.0	83.6	122. Togo	2.7	68.0
33. Kuwait	47.0	35.8	78. Maldives	12.9	101.4	123. Burkina Faso	2.5	60.7
34. Czech Rep	46.3	45.5	79. Gabon	12.7	78.4	124. Guinea	2.4	80.5
35. Hungary	42.6	48.1	80. Fiji	12.6	57.6	125. Mali	2.3	62.4
36. Bahrain	41.6	45.6	81. Georgia	12.1	94.2	126. Angola	2.3	64.9
37. Korea	40.4	41.7	82. Botswana	11.9	62.7	127. Rwanda	2.1	62.1
38. Estonia	39.4	47.2	83. Namibia	10.9	54.8	128. C. Africa	1.9	63.2
39. Slovakia	38.8	49.5	84. Swaziland	10.8	65.4	129. M'bique	1.7	61.6
40. Lithuania	38.3	54.2	85. Syria	10.5	57.8	130. Niger	1.3	58.5
41. Poland	36.7	48.8	86. Bolivia	10.2	63.6	131. G-Bissau	1.2	61.3
42. Croatia	36.1	50.0	87. Equat. Guinea	10.1	71.9	132. Congo, D. R.	0.4	61.3
43. Macao	36.1	44.4	88. Paraguay	9.9	50.4	Mean--All	27.4	52.9
44. Latvia	33.4	54.9	89. Cape Verde	8.8	47.6	--Rich	67.9	30.3
45. Lebanon	32.0	56.0	90. Bhutan	8.0	66.3	--Poor	15.5	60.7

Notes: 1. Standard deviations (SD) are to be divided by 100.

2. "Poor" countries are those with those numbered 29 and 32-132, excluding 34, 37 and 39, while the remainder are "rich".
Poor countries coincide with "Emerging and Developing Economies" of the IMF's 2010 *World Economic Outlook*; see
<http://www.imf.org/external/pubs/ft/weo/2010/01/weodata/groups.htm#oem>.

TABLE 2

RELATIVE PRICES AND INCOMES, 132 COUNTRIES IN 2005

$$w_{ic} \log(p_{ic}/P_c) = \alpha_i + \gamma_i D_c + \beta_i \log(Q_c/\bar{Q}) + \varepsilon_{ic}$$

Commodity	Intercept $\alpha_i (\times 100)$	Poor country dummy $\gamma_i (\times 100)$	Income $\beta_i (\times 100)$	Income elasticity β_i/w_i	R ²	SEE ($\times 100$)
Food	9.71 (0.99)	0.22 (1.21)	-5.31 (0.44)	-0.19	0.68	4.34
Alcoholic beverages	0.08 (0.21)	-0.11 (0.26)	0.11 (0.10)	0.03	0.03	0.94
Clothing	-0.55 (0.44)	2.71 (0.54)	0.88 (0.20)	0.17	0.18	1.93
Housing	-5.34 (1.40)	2.38 (1.71)	2.70 (0.62)	0.18	0.15	6.15
Furnishings	-0.09 (0.26)	0.91 (0.32)	0.49 (0.12)	0.10	0.12	1.15
Health	-4.53 (0.67)	-2.41 (0.82)	-0.24 (0.30)	-0.03	0.08	2.94
Transport	3.84 (0.63)	0.12 (0.77)	0.19 (0.28)	0.02	0.00	2.76
Communication	-0.14 (0.24)	0.84 (0.29)	-0.03 (0.11)	-0.01	0.12	1.05
Recreation	0.39 (0.17)	0.50 (0.20)	0.17 (0.07)	0.03	0.05	0.74
Education	-4.39 (0.87)	-5.23 (1.06)	0.28 (0.39)	0.03	0.30	3.83
Restaurants	1.48 (0.27)	0.09 (0.32)	0.47 (0.12)	0.11	0.17	1.17
Miscellaneous	-0.47 (0.21)	-0.02 (0.26)	0.29 (0.09)	0.04	0.13	0.93

Notes: 1. Standard errors in parentheses.
2. Regressions exclude US, the base country.
3. Elasticities in the third last column are evaluated at means.

TABLE 3
INCOME ELASTICITIES OF
PRICES AND DEMAND

Commodity (1)	Income elasticity of price β_i/w_i (2)	Income elasticity of demand			
		Value of excess supply elasticity Δ			Directly estimated (6)
		1 (3)	2 (4)	3 (5)	
Food	-0.19	0.81	0.62	0.43	0.66
Alcohol	0.03	1.00	0.06	1.09	0.93
Clothing	0.17	0.17	1.34	1.51	0.96
Housing	0.18	1.18	1.36	1.54	1.04
Furnishings	0.10	1.10	1.20	1.30	1.07
Health	-0.03	0.97	0.94	0.91	1.16
Transport	0.02	1.02	1.04	1.06	1.18
Communication	-0.01	0.99	0.98	0.97	1.22
Recreation	0.03	1.03	1.06	1.09	1.36
Education	0.03	1.03	1.06	1.09	0.99
Restaurants	0.11	1.11	1.22	1.33	1.28
Miscellaneous	0.04	1.04	1.08	1.12	1.30

Sources: Column 2 is from Table 2; column 6 is derived from Clements and Chen (2010).

TABLE 4
IMPLIED PRICE DISPERSION AND INCOME

$$y_c = \lambda_0 + \lambda_1 x_c + \lambda_2 x_c^2$$

Country group	Order of quadratic coefficients			Minimum variance		Country nearest MV income		
	Second λ_2	First λ_1	Zero λ_0	Income $x^* = -\lambda_1/2\lambda_2$	Variance y_{x^*}	Country	Income	Variance
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
Poor	2.47 (0.43)	-6.55 (2.60)	33.36 (1.24)	132.71 (54.23)	29.01 (1.68)	24.Greece	133.19	9.08
Rich	3.38 (0.49)	-11.23 (1.85)	26.41 (2.36)	166.28 (14.70)	17.07 (0.98)	3.Iceland	163.85	8.44
Difference	-0.91 (0.16)	4.68 (0.98)	6.95 (2.13)	-33.57 (14.25)	11.94 (1.41)			

- Notes:
1. Asymptotic standard errors in parenthesis.
 2. "Country nearest minimum variance" is restricted to those of the corresponding category (rich/poor).
 3. Budget shares of Chile and France are used to represent the rich and poor country groups, respectively. These are listed in column 2 of Table 5.
 4. All entries are to be divided by 100.

TABLE 5
COMMODITY DECOMPOSITION OF
MINIMUM VARIANCE INCOME

Commodity	Budget share w_i ($\times 100$)	Weight in eq (15) $\kappa_i = \frac{\beta_i^2 / w_i}{\sum_{i=1}^n \beta_i^2 / w_i}$ ($\times 100$)	Ratio of intercept to slope $-\frac{\tilde{\alpha}_i}{\beta_i}$	Contribution to MV income $-\kappa_i \cdot \frac{\tilde{\alpha}_i}{\beta_i} (\times 100)$
(1)	(2)	(3)	(4)	(5)
A. <u>Poor</u>				
1. Food	16.22	70.44 (12.13)	1.87 (0.21)	131.73 (21.03)
2. Alcohol	2.65	0.19 (0.32)	0.27 (1.28)	0.05 (0.19)
3. Clothing	7.09	4.43 (1.95)	-2.45 (0.49)	-10.86 (3.22)
4. Housing	15.37	19.22 (6.38)	1.10 (0.43)	21.07 (4.86)
5. Furnishings	7.32	1.33 (0.65)	-1.67 (0.37)	-2.22 (0.81)
6. Health	10.57	0.22 (0.54)	-28.92 (34.81)	-6.39 (7.93)
7. Transport	13.59	0.11 (0.31)	-20.84 (30.06)	-2.24 (3.39)
8. Communication	2.91	0.01 (0.08)	23.33 (99.84)	0.29 (1.22)
9. Recreation	4.03	0.29 (0.26)	-5.24 (2.18)	-1.52 (0.79)
10. Education	9.00	0.35 (0.97)	34.36 (48.64)	12.13 (16.67)
11. Restaurants	2.98	3.00 (1.55)	-3.34 (0.77)	-10.03 (3.28)
12. Miscellaneous	8.26	0.41 (0.27)	1.69 (0.76)	0.70 (0.24)
13. Total	100.00	100.00		132.71 (54.23)
B. <u>Rich</u>				
14. Food	10.58	78.93 (5.77)	1.83 (0.15)	144.33 (14.88)
15. Alcohol	2.37	0.15 (0.27)	-0.73 (2.32)	-0.11 (0.25)
16. Clothing	3.71	6.18 (2.74)	0.63 (0.42)	3.86 (3.65)
17. Housing	19.72	10.95 (4.64)	1.98 (0.42)	21.65 (8.99)
18. Furnishings	4.58	1.55 (0.75)	0.18 (0.51)	0.29 (0.87)
19. Health	12.04	0.14 (0.35)	-18.88 (24.92)	-2.67 (3.05)
20. Transport	11.35	0.09 (0.27)	-20.21 (31.92)	-1.90 (2.63)
21. Communication	2.15	0.01 (0.07)	-4.67 (25.43)	-0.06 (0.20)
22. Recreation	8.83	0.10 (0.09)	-2.29 (1.81)	-0.22 (0.10)
23. Education	7.11	0.33 (0.91)	15.68 (20.10)	5.12 (7.83)
24. Restaurants	4.77	1.37 (0.72)	-3.15 (1.23)	-4.32 (1.05)
25. Miscellaneous	12.80	0.19 (0.13)	1.62 (0.56)	0.32 (0.22)
26. Total	100.00	100.00		166.28 (14.70)

Note: Asymptotic standard errors in parenthesis.

TABLE 6
DISPERSION-EQUIVALENT INCOME,
ILLUSTRATIVE CALCULATIONS

Income (Relative to mean)		Dispersion equivalent income (Additional income relative to the base income of the poor)	
Logarithmic ($\times 100$) (1)	Percentage (2)	Logarithmic ($\times 100$) (3)	Percentage (4)
-111	33	3	3
-76	47	28	33
-57	56	47	61
-26	77	113	208

FIGURE 1

RELATIVE PRICES
IN RICH AND POOR COUNTRIES

A. Rich

B. Poor

FIGURE 2
RELATIVE PRICES AND INCOMES,
132 COUNTRIES IN 2005

(Continued on next page)

FIGURE 2 (continued)

RELATIVE PRICES AND INCOMES,
132 COUNTRIES IN 2005

Notes: 1. In panel i ($i = 1, \dots, 12$), the i^{th} relative price, $(\log p_{ic} - \log P_c) \times 100$, is plotted against relative income per-capita, $\log(Q_c/\bar{Q}) \times 100$, $c = 1, \dots, 132$, where $\bar{Q}$ is geometric mean income. The solid line is the LS regression line.

2. As it is an outlier, country number 114, Chad, is excluded from "Education" plot, but is included in the regression line.

3. US, the base country, is excluded from all scatterplots.

FIGURE 3
PRICE DISPERSION AND INCOME

FIGURE 4
PRICE DISPERSION AND INCOME

FIGURE 5
DEI AND INCOME

Appendix A1

THE DATA AND FURTHER RESULTS

The Data

The data used are budget shares, relative prices and real income per capita. Tables A1 and A2 contain the budget and shares prices, while Table 1 contains income. These data come from the World Bank's International Comparisons Program (2008).

Possible Outliers

The ICP prices data contain some outliers for Lebanon (country number 45), Iran (52) and Georgia (81). Lebanon has a high relative price for restaurants, while this price is low in Georgia; these two observations stand out in panel 11 of Figure 2. Additionally, in Georgia prices are low for alcoholic beverages, housing and transport, and high for clothing, furnishings and miscellaneous. Finally, in Iran prices seem to be (marginally) high for food and substantially low for communication. In view of the sample size, these outliers are unlikely to have any material impact on the results. Nevertheless, as a robustness check we redo the results of Table 4 with the data for the three countries omitted. As can be seen from panel B of Table A3, this has only a very marginal impact on the results.

More on Rich vs Poor

In Table 2 poor countries were distinguished from the rich by means of a shift in the intercept for each commodity, while the slope was taken to be the same. We examine this treatment in Figure A1, which extends Figure 2 by allowing both the slope and intercept to vary across country groups. For most commodities, the scatterplot shows something approximating an intercept shift. There are some exceptions to this general rule: for clothing and furnishings, the slopes of the regression lines appear different for the two country groups. Although they do not change signs, the slopes for health, communication and education also seem to differ across country groups. Clothing and furnishing, the two commodities that appear to depart most from the common slope assumption, each absorb a little over 5 percent of the budget for an average country. As they are only modest-sized components of the overall budget, even these cases may not substantially affect the results.

Next, we redo the results of Table 2 by allowing both the intercepts and slopes to vary, which amounts to estimating separate equations for the rich and poor. Panel A of Table A4 reproduces the previous results where both groups of countries are combined. As can be seen from panel B of the table, the intercepts on the poor generally approximate the sum of the intercept and poor country dummy shown in panel A, as is to be expected. Similarly, the slopes are not substantially different between panels A and B, with all signs being the same. Panel C of the table gives the results for the

rich countries and there are some differences here. Table A5 reveals that there are significant differences of the slopes in the two groups for clothing, furnishings, health and education, and a joint test of the hypothesis that the 12 slopes are pairwise equal is rejected. However, the differences are not too large for the important commodity food.

We return to Table A4 to consider further the differences between the poor and rich country groups. It follows from equation (10) that the income elasticity of the relative price of good i is

$$\frac{\beta_i}{w_i} = \frac{1}{\Delta}(\theta_i - 1),$$

where $\Delta > 0$ is the excess supply elasticity (for simplicity, this is taken to be the same for all goods), and θ_i is the conventional income elasticity of demand. This shows that β_i/w_i is proportional to the difference between θ_i and the weighted mean over all goods of these elasticities, viz., unity. Accordingly, for necessities ($\theta_i < 1$), the price elasticity β_i/w_i is negative. From panel B of Table A4, the income elasticity of the relative price of food in the poor is estimated to be -0.16, while it is -0.53 in the rich (panel C). Food is a necessity in both groups, as is to be expected, but it is more of a necessity, or less of a luxury, for the rich. One can readily appreciate that this is reasonable by considering the implausibility of the alternative whereby food is more of a luxury as income rises. The qualification to the discussion is that the estimated income coefficient for food for the rich has a relatively high standard error (it is more than three times larger than that for the poor). More will be said about this issue in the next paragraph. Another pattern in the results is that in 11 out of 12 cases, the income coefficients for the rich are larger in absolute value than those for the poor. This is reflected in the greater dispersion of the income elasticities β_i/w_i for the rich, which implies a larger dispersion of the income elasticities of demand. As discussed in Section 6, this agrees with the idea that relative to the poor, the consumption basket of the rich is more diversified and less specialised in food in particular.

As stated above, the results for the poor (contained in panel B of Table A4) are quite similar to those for all countries combined (panel A); but the rich (panel C) differ substantially from all countries. One reason for this asymmetry is that 99 countries belong to the poor group, while the rich comprises only 32, so the weight for the poor in the “world” is about three times that of the rich. As the world is a weighted average of the two groups, the results of panel A are skewed towards the poor. This is also the reason why the standard errors of the estimated coefficients for the rich are all substantially larger than those for the poor. Thus, while a case could be made that the two groups should be kept separate, the problem is that the relatively small sample size for the rich group leads to imprecise estimates for this group. In short, there is a tradeoff between more detailed modelling of individual responses and the precision of estimates.

Panel A of Table A6 gives the implied quadratic coefficients when all countries are combined; this is reproduced from Table 4. Again, the quadratic coefficients for the poor (panel B) are not substantially different from the combined case (panel A). For the rich, the coefficients change, but not their signs. The zero-order coefficient λ_0 for the rich is now larger than that for the poor, while the relative sizes of λ_1 and λ_2 for the two groups remain unchanged. Figure A2 contains the corresponding plots and as can be seen, when the two groups are separated the curve for the rich has substantially more curvature and there are now two intersection points within the relevant range. While the curve for the rich seems to change appreciably when the two groups are separated, it needs to be kept in mind that there is now substantially more sampling variability underlying that curve due to the smaller number of observations for the rich, as discussed above.

A Weighted Scatter

Figure A3 repeats the scatterplots of Figure 2 but with each relative price weighted by its budget share to reflect its relative importance. These scatters, which correspond to the regressions of Table 2, are not appreciably different to their unweighted counterparts.

Appendix A2

THE WELFARE COST OF PRICE DISPERSION

This appendix derives the expression for the welfare cost, equation (18), that is implied by Selvanathan's (1985) model. To place that model in context, we start with general differential demand equations.

Demand Equations

Let p_i, q_i be the price and quantity consumed of good i ($i = 1, \dots, n$), so that $M = \sum_{i=1}^n p_i q_i$ is total expenditure ("income" for short) and $w_i = p_i q_i / M$ is the budget share of i . A Marshallian demand equation for good i is $q_i = q_i(M, p_1, \dots, p_n)$, which can be written in differential form as $dq_i = (\partial q_i / \partial M) dM + \sum_{j=1}^n (\partial q_i / \partial p_j) dp_j$. Defining s_{ij} as the compensated price slope of the demand equation and using the Slutsky decomposition $\partial q_i / \partial p_j = s_{ij} - q_j (\partial q_i / \partial M)$, we have

$$dq_i = \frac{\partial q_i}{\partial M} \left(dM - \sum_{j=1}^n q_j dp_j \right) + \sum_{j=1}^n s_{ij} dp_j.$$

Multiplying both sides of the above equation by p_i/M and using the identity $dx/x = d(\log x)$, we obtain

$$w_i d(\log q_i) = \theta_i d(\log Q) + \sum_{j=1}^n \pi_{ij} d(\log p_j),$$

where $\theta_i = \partial(p_i q_i) / \partial M$ is the i^{th} marginal share, $d(\log Q) = d(\log M) - d(\log P)$ is the change in real income, with $d(\log P) = \sum_{j=1}^n w_j d(\log p_j)$ the Divisia price index, and $\pi_{ij} = (p_i p_j / M) s_{ij}$ is the $(i, j)^{\text{th}}$ Slutsky coefficient. In this formulation, the income effects of price changes transform money income into real income.

Selvanathan's Model

The i^{th} equation of the infinitesimal-change version of Selvanathan's (1985) model is

$$(A2.1) \quad w_i [d(\log q_i) - d(\log Q)] = \beta_i d(\log Q) + \kappa w_i [d(\log p_i) - d(\log P)],$$

where $\beta_i = \theta_i - w_i$ is an income coefficient and $\kappa < 0$ is the negative of the elasticity of substitution. The whole model comprises n demand equations of the above form and an attractive feature is its simplicity: While the model satisfies the usual requirements of homogeneity, symmetry and adding up, only the own-relative price appears in each equation. Moreover, the model is linear in the parameters and as it contains only n free parameters, it is parsimonious.

The substitution term in model (A2.1) is expressed in terms of relative prices. This can also be expressed in absolute prices by writing the substitution term as

$$\begin{aligned} \kappa w_i [d(\log p_i) - d(\log P)] &= \kappa w_i \left[d(\log p_i) - \sum_{j=1}^n w_j d(\log p_j) \right] \\ &= \kappa w_i \sum_{j=1}^n [\delta_{ij} - w_j] d(\log p_j) = \sum_{j=1}^n \pi_{ij} d(\log p_j), \end{aligned}$$

where δ_{ij} is the Kronecker delta and

$$(A2.2) \quad \pi_{ij} = \kappa w_i (\delta_{ij} - w_j)$$

is the $(i, j)^{\text{th}}$ Slutsky coefficient implied by this model. For $i, j = 1, \dots, n$, these coefficients satisfy $\sum_{j=1}^n \pi_{ij} = 0$ (homogeneity), $\pi_{ij} = \pi_{ji}$ (symmetry) and $\sum_{i=1}^n \pi_{ij} = 0$ (adding up).

The Welfare Cost

If on account of some distortion, the n prices change by $dp_1, \dots, dp_n$, then Harberger's (1964) measure of the welfare cost is $W = -(1/2) \sum_{i=1}^n \sum_{j=1}^n (dp_i) s_{ij} (dp_j)$. Using $\pi_{ij} = (p_i p_j / M) s_{ij}$, this can be expressed equivalently as

$$(A2.3) \quad \frac{W}{M} = -\frac{1}{2} \sum_{i=1}^n \sum_{j=1}^n d(\log p_i) \pi_{ij} d(\log p_j).$$

This states that the welfare cost (measured as a fraction of income) is proportional to a quadratic form in the n price log-changes, with proportionality factor $-1/2$. The matrix in this quadratic form is the $n \times n$ Slutsky matrix $[\pi_{ij}]$. As this matrix is negative semidefinite with rank $n-1$ (it is singular because of homogeneity), the welfare cost is nonnegative; it is zero when all prices change proportionately.

When the Slutsky coefficients take the form (A2.2), the cost (A2.3) becomes

$$\frac{W}{M} = -\frac{\kappa}{2} \sum_{i=1}^n \sum_{j=1}^n d(\log p_i) w_i (\delta_{ij} - w_j) d(\log p_j) = -\frac{\kappa}{2} \sum_{i=1}^n w_i d(\log p_i) [d(\log p_i) - d(\log P)].$$

The term on the far right of the above can be written as

$$-\frac{\kappa}{2} \left\{ \sum_{i=1}^n w_i [d(\log p_i) - d(\log P)]^2 + \sum_{i=1}^n w_i d(\log P) [d(\log p_i) - d(\log P)] \right\}.$$

As $\sum_i w_i d(\log P) [d(\log p_i) - d(\log P)] = 0$, we have

$$(A2.4) \quad \frac{W}{M} = -\frac{\kappa}{2} \sum_{i=1}^n w_i [d(\log p_i) - d(\log P)]^2 = -\frac{\kappa}{2} \Pi,$$

where Π is the variance of prices. This verifies equation (18).

An Alternative Approach

Another way of establishing result (A2.4) is as follows. The Slutsky matrix implied by Selvanathan's model is $\kappa \mathbf{W}(\mathbf{I} - \mathbf{u}'\mathbf{W})$, where $\mathbf{W}$ is an $n \times n$ diagonal matrix with the budget shares on the main diagonal, $\mathbf{I}$ is an identity matrix and $\mathbf{u}$ is a vector of unit elements. Let $\mathbf{p} = [d(\log p_i)]$ be a vector of the n price log-changes, so that $\mathbf{p}'\mathbf{W}\mathbf{p} = \sum_{i=1}^n w_i [d(\log p_i)]^2$ and $\mathbf{p}'\mathbf{W}\mathbf{u}'\mathbf{W}\mathbf{p} = [d(\log P)]^2$. Then,

$$\frac{W}{M} = -\frac{\kappa}{2} \mathbf{p}'\mathbf{W}(\mathbf{I} - \mathbf{u}'\mathbf{W})\mathbf{p} = -\frac{\kappa}{2} \left\{ \sum_{i=1}^n w_i [d(\log p_i)]^2 - [d(\log P)]^2 \right\},$$

which equals $-(\kappa/2)\Pi$.

TABLE A1
BUDGET SHARES IN 132 COUNTRIES IN 2005 (×100)

Country	Food	Alcoholic Beverages	Clothing	Housing	Furnishing	Health	Transport	Communication	Recreation	Education	Restaurant	Miscellaneous
1. United States	6.24	1.96	4.19	16.01	4.40	18.26	10.62	1.55	8.61	8.50	5.64	14.02
2. Luxembourg	6.88	7.66	2.81	15.50	5.38	10.63	13.67	0.97	7.60	9.97	5.38	13.54
3. Iceland	8.94	3.04	3.45	15.40	4.94	12.65	13.51	1.91	10.95	9.76	5.93	9.51
4. Norway	9.73	3.10	4.07	14.94	4.47	13.48	10.71	2.37	10.95	7.72	4.17	14.29
5. UK	7.13	2.96	4.64	15.50	4.60	10.02	11.92	1.77	10.83	5.99	9.38	15.25
6. Austria	8.74	2.39	5.22	16.69	6.06	9.85	10.75	2.16	10.25	7.81	9.77	10.32
7. Switzerland	9.27	3.05	3.52	20.48	3.94	13.26	6.94	2.37	8.50	7.91	7.01	13.74
8. Canada	7.69	3.18	3.77	19.21	5.01	11.78	11.56	1.90	9.11	7.91	5.69	13.20
9. Netherlands	8.19	2.19	4.01	17.64	4.83	10.67	8.90	3.49	8.83	7.46	3.93	19.87
10. Sweden	8.27	2.43	3.65	19.21	3.57	11.74	9.15	2.20	9.69	10.20	3.53	16.36
11. France	10.58	2.37	3.71	19.72	4.58	12.04	11.35	2.15	8.83	7.11	4.77	12.80
12. Australia	8.55	3.53	3.22	18.32	5.62	11.83	10.15	2.44	10.21	9.40	6.77	9.97
13. Denmark	8.08	2.79	3.50	19.33	4.20	11.02	9.96	1.55	9.23	9.10	3.62	17.63
14. Belgium	10.29	2.75	4.16	17.73	4.26	13.01	11.36	1.74	7.85	8.95	3.98	13.92
15. Germany	9.14	2.88	4.30	19.77	5.63	12.65	11.24	2.25	8.29	5.84	4.38	13.63
16. Hong Kong	8.90	0.72	9.87	17.79	5.06	8.50	6.35	2.95	11.47	7.60	9.19	11.60
17. Ireland	4.60	4.08	4.07	16.60	5.40	10.11	9.77	2.71	6.85	10.11	12.30	13.41
18. Japan	12.26	2.51	2.81	20.43	4.73	11.50	8.98	2.69	7.77	6.15	6.47	13.70
19. Taiwan	14.82	2.22	3.63	15.12	5.67	8.37	10.14	3.17	8.31	10.82	7.60	10.12
20. Cyprus	13.71	5.42	5.57	12.83	4.91	5.99	12.74	1.76	7.74	7.29	11.09	10.95
21. Finland	9.31	3.76	3.61	18.87	4.08	11.71	9.62	2.11	9.81	8.06	4.87	14.18
22. Spain	11.77	2.42	4.67	13.71	4.45	10.43	9.88	2.20	8.67	6.48	15.60	9.72
23. Italy	12.31	2.19	6.60	17.09	6.35	11.83	11.08	2.32	6.29	6.50	8.14	9.32
24. Greece	13.84	4.24	9.27	14.18	5.70	8.30	7.85	2.20	5.66	5.90	17.00	5.86
25. New Zealand	11.47	4.13	3.69	18.17	5.36	10.09	11.38	2.40	11.53	7.31	6.25	8.22
26. Israel	12.88	2.04	2.79	19.34	5.74	9.70	9.60	3.16	7.80	11.77	4.07	11.10
27. Malta	13.91	2.62	5.21	9.35	7.56	7.89	11.85	4.02	9.78	6.74	11.30	9.76
28. Singapore	8.22	2.29	3.54	14.18	5.99	8.44	16.58	2.35	12.20	7.99	7.53	10.70
29. Qatar	13.63	0.25	6.16	17.19	6.44	8.82	15.31	4.62	3.27	17.98	1.55	4.77
30. Slovenia	11.93	4.09	4.72	15.59	4.91	10.81	12.97	2.90	9.01	8.42	5.36	9.29
31. Portugal	13.15	2.94	5.97	11.45	5.58	12.19	11.60	2.41	7.30	8.55	8.57	10.29
32. Brunei	18.36	0.53	4.41	12.13	4.38	5.29	15.10	5.48	7.67	15.95	5.08	5.64
33. Kuwait	14.77	0.20	8.07	18.37	13.40	5.60	12.33	2.55	4.09	12.80	2.38	5.43
34. Czech Rep.	13.09	6.45	3.95	18.08	4.26	10.57	9.37	2.82	10.61	7.48	5.33	7.98
35. Hungary	13.32	6.59	2.85	14.68	5.28	10.81	12.55	3.59	7.89	7.73	3.96	10.75
36. Bahrain	18.96	0.52	6.83	18.19	9.33	11.11	9.97	2.25	3.38	11.59	2.19	5.69
37. Korea	13.66	2.13	3.74	15.12	3.59	8.28	9.66	4.90	6.66	10.54	6.69	15.03
38. Estonia	15.36	6.81	6.12	16.10	4.67	7.61	10.65	2.57	8.78	7.39	5.79	8.16
39. Slovakia	15.66	4.48	3.67	22.30	4.67	9.17	7.50	3.12	8.61	5.79	5.82	9.23
40. Lithuania	22.92	5.70	7.05	12.16	4.84	9.06	12.86	2.27	6.38	6.92	2.68	7.17
41. Poland	17.81	5.60	4.03	20.19	3.82	8.68	7.42	2.85	7.06	7.94	2.42	12.17
42. Croatia	19.28	3.87	4.62	14.75	7.41	9.39	9.06	2.89	7.70	6.89	7.50	6.63
43. Macao	13.25	0.89	4.91	13.93	2.22	8.10	8.71	5.63	15.33	8.35	12.26	6.42
44. Latvia	19.22	6.09	6.11	18.22	3.15	7.66	9.72	3.62	8.32	8.19	4.69	5.00
45. Lebanon	27.77	2.07	6.01	10.02	6.27	8.01	7.23	1.36	2.92	17.15	5.17	6.03

(Continued on next page)

TABLE A1 (continued)
BUDGET SHARES IN 132 COUNTRIES IN 2005 (×100)

Country	Food	Alcoholic Beverages	Clothing	Housing	Furnishing	Health	Transport	Communication	Recreation	Education	Restaurant	Miscellaneous
46. Mexico	21.98	2.34	2.57	15.40	6.84	7.03	15.90	1.79	3.00	8.80	6.45	7.89
47. Belarus	34.67	4.59	5.86	11.39	3.35	9.06	6.26	3.62	4.33	10.36	2.08	4.42
48. Kazakhstan	18.61	2.90	8.76	25.72	2.78	9.64	8.44	2.03	4.79	9.22	2.73	4.37
49. Mauritius	23.44	6.75	4.73	19.90	6.27	5.21	10.91	2.47	5.26	7.72	2.79	4.56
50. Russia	25.53	6.13	9.36	9.64	4.05	7.74	10.92	4.27	6.26	5.67	2.83	7.61
51. Bulgaria	19.51	3.29	2.87	18.10	3.54	7.82	16.07	5.46	5.22	5.75	8.00	4.37
52. Iran	23.39	0.67	6.24	24.52	5.58	8.42	9.24	2.45	3.59	7.64	1.55	6.70
53. Romania	24.95	4.37	3.08	19.78	4.29	8.21	14.78	1.76	4.35	6.02	4.40	4.00
54. Oman	22.11	0.49	6.32	17.26	5.11	5.39	12.20	3.82	2.18	11.70	2.26	11.17
55. Argentina	22.49	3.64	4.27	14.38	4.86	10.68	9.14	3.68	6.42	6.00	6.98	7.46
56. Serbia	25.64	4.62	3.84	21.49	4.47	8.18	8.27	3.35	4.48	5.34	2.37	7.95
57. Saudi Arabia	18.46	0.36	6.38	14.78	8.75	9.03	9.70	2.33	3.48	19.12	3.97	3.63
58. Chile	16.22	2.65	7.09	15.37	7.32	10.57	13.59	2.91	4.03	9.00	2.98	8.26
59. Uruguay	19.02	3.54	4.86	19.52	6.05	11.39	11.70	3.04	4.44	5.51	4.45	6.48
60. Bosnia	28.51	5.68	5.17	13.32	6.44	8.34	7.65	2.45	4.18	5.27	6.56	6.42
61. Macedonia	30.91	3.09	5.50	17.88	3.86	6.79	8.96	6.55	2.31	5.54	3.39	5.21
62. Ukraine	32.05	5.08	4.32	8.84	3.25	8.69	10.90	3.69	5.30	9.56	2.70	5.62
63. South Africa	17.61	5.03	5.02	11.17	6.67	10.88	15.09	2.09	4.06	10.16	2.28	9.95
64. Malaysia	17.28	1.48	2.21	17.46	4.66	4.85	12.67	5.23	4.13	9.02	7.62	13.40
65. Turkey	23.06	3.84	5.75	24.02	6.28	3.80	11.68	4.00	2.36	5.80	4.06	5.34
66. Montenegro	32.15	3.62	5.15	23.02	3.62	7.06	6.58	4.32	2.76	4.53	1.25	5.95
67. Brazil	15.50	2.25	4.10	16.27	5.67	12.00	11.87	4.03	4.32	8.39	3.68	11.90
68. Venezuela	26.07	2.92	3.98	11.07	5.18	8.83	9.08	4.61	4.17	10.44	8.15	5.49
69. Thailand	15.87	4.41	6.96	7.17	6.06	8.32	14.59	1.32	5.91	8.92	14.86	5.62
70. Albania	24.63	4.78	4.51	19.13	5.43	5.59	11.82	4.01	5.50	3.41	5.35	5.83
71. Colombia	24.32	3.98	4.40	14.17	5.19	10.66	10.74	2.81	3.52	8.53	5.79	5.87
72. Ecuador	25.92	2.08	6.23	11.43	6.83	7.08	14.13	4.47	6.01	8.89	2.97	3.97
73. Jordan	28.87	3.06	5.40	17.10	3.95	7.73	8.93	3.66	1.69	11.67	2.85	5.10
74. Tunisia	24.78	3.60	8.62	12.96	7.17	5.94	9.00	0.96	2.34	6.06	12.77	5.80
75. Peru	29.24	1.91	5.96	8.50	5.15	7.03	8.39	2.47	4.62	9.64	8.01	9.08
76. Egypt	41.65	2.74	7.71	12.88	3.63	4.89	3.96	2.61	2.53	7.51	3.09	6.80
77. Moldova	24.20	7.76	4.49	15.33	6.98	4.87	9.92	4.65	6.19	7.58	1.65	6.38
78. Maldives	22.95	2.02	3.54	29.70	3.49	9.44	3.41	3.12	3.52	14.04	1.10	3.68
79. Gabon	36.34	2.01	5.21	14.75	3.12	6.71	6.37	4.07	2.54	10.74	2.88	5.26
80. Fiji	26.25	2.97	2.35	25.80	9.49	5.51	7.61	0.39	4.96	7.36	2.84	4.49
81. Georgia	36.70	0.90	8.54	4.16	3.79	7.63	2.48	1.88	6.01	23.43	0.45	4.03
82. Botswana	21.94	8.81	6.18	9.04	7.40	6.49	13.02	2.92	2.42	16.57	0.19	5.03
83. Namibia	25.96	2.65	5.14	12.15	5.08	8.41	9.67	0.71	2.67	14.32	4.29	8.95
84. Swaziland	41.90	0.88	6.17	13.56	7.08	7.30	6.85	1.32	3.24	8.27	0.64	2.78
85. Syria	41.72	0.26	8.69	23.91	3.17	8.15	3.29	0.31	1.36	6.80	1.83	0.50
86. Bolivia	27.75	1.54	3.08	12.07	5.31	7.56	17.89	2.16	1.36	11.18	7.38	2.72
87. Eq. Guinea	39.49	2.37	5.39	14.28	3.96	7.40	8.35	3.91	1.64	3.91	3.56	5.73
88. Paraguay	32.30	2.50	7.88	11.68	5.17	5.24	11.37	2.41	6.19	5.41	4.19	5.67
89. Cape Verde	28.84	1.69	3.39	26.96	4.87	3.52	6.11	3.00	3.06	11.73	2.75	4.08
90. Bhutan	34.53	2.60	6.40	16.59	5.57	12.95	1.90	0.40	3.39	5.97	0.07	9.63

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TABLE A1 (continued)
BUDGET SHARES IN 132 COUNTRIES IN 2005 (×100)

Country	Food	Alcoholic Beverages	Clothing	Housing	Furnishing	Health	Transport	Communication	Recreation	Education	Restaurant	Miscellaneous
91. Kyrgyzstan	40.82	8.32	7.92	7.04	3.00	4.19	9.16	2.65	2.43	5.98	2.71	5.78
92. Sri Lanka	36.42	4.08	9.17	7.52	6.26	3.36	16.76	0.96	3.72	2.92	1.69	7.15
93. Iraq	32.12	0.79	5.20	15.73	7.66	15.19	9.25	1.16	1.00	9.17	0.72	2.01
94. Mongolia	35.88	2.30	10.81	16.80	3.65	5.26	6.31	1.88	3.28	10.41	0.55	2.87
95. Philippines	43.90	1.96	2.16	13.94	1.86	3.41	5.49	3.98	1.09	9.05	3.14	10.02
96. Indonesia	41.60	1.87	3.55	20.20	2.64	3.02	6.52	1.83	1.72	5.56	6.17	5.33
97. Pakistan	48.77	0.93	7.49	13.67	2.40	7.24	5.18	1.94	2.69	4.53	0.69	4.47
98. Morocco	31.09	2.85	5.03	13.00	4.29	5.36	8.83	5.06	3.17	10.44	5.69	5.20
99. Lesotho	35.48	3.51	12.55	7.35	6.57	7.28	5.75	1.79	1.60	13.31	0.20	4.63
100. China	24.12	2.05	6.30	14.66	3.92	6.21	4.03	4.17	4.65	9.79	5.23	14.86
101. Vietnam	31.34	2.28	3.54	15.15	4.81	8.13	9.58	0.86	4.80	9.22	6.74	3.54
102. India	33.69	2.13	5.21	12.13	2.76	7.32	15.32	1.52	1.91	5.71	1.86	10.44
103. Cambodia	47.20	3.78	1.82	12.55	1.77	7.64	7.22	0.25	2.42	6.00	4.76	4.59
104. Yemen	41.06	2.03	8.73	16.49	4.04	3.78	5.16	0.68	1.26	6.43	2.42	7.92
105. Sudan	55.60	1.50	4.69	14.30	5.82	2.02	8.17	0.10	2.95	1.68	0.10	3.06
106. Laos	47.35	5.57	1.75	12.37	2.86	3.09	10.54	0.44	2.97	6.84	2.97	3.25
107. Djibouti	33.64	12.98	2.51	16.32	6.94	4.25	7.91	0.45	0.35	7.91	4.04	2.69
108. Kenya	33.27	3.11	2.96	7.35	4.48	7.73	11.67	2.77	5.86	11.80	4.53	4.47
109. Sao Tome.	53.71	4.44	3.86	9.00	3.32	5.40	9.63	1.25	1.44	4.69	1.25	2.00
110. Congo, Rep.	37.52	3.87	2.45	13.03	3.38	5.95	7.90	4.91	2.12	8.09	7.72	3.06
111. Cameroon	43.37	2.53	9.97	8.79	10.43	2.34	7.04	1.28	1.62	4.12	6.13	2.37
112. Nigeria	56.67	1.02	5.85	11.35	7.03	3.04	4.71	0.33	1.31	4.30	0.71	3.69
113. Senegal	48.93	3.05	5.24	9.96	6.20	5.24	3.89	5.39	2.29	5.12	0.97	3.72
114. Chad	55.05	1.49	1.62	2.31	7.16	1.37	19.42	0.85	4.71	1.81	0.52	3.69
115. Nepal	48.72	3.24	6.20	13.84	2.30	8.81	3.94	0.30	1.02	4.56	2.40	4.69
116. Bangladesh	49.92	2.37	5.78	17.37	3.67	3.65	4.09	0.47	0.77	5.65	2.23	4.04
117. Benin	43.59	2.39	9.19	10.34	3.16	2.91	7.34	1.74	2.17	4.57	7.89	4.72
118. Ghana	49.15	2.12	9.14	6.64	6.44	5.70	5.89	0.30	2.97	8.14	0.03	3.47
119. Cote d'Ivoire	43.28	3.21	3.54	9.71	8.42	4.22	11.14	2.93	3.53	3.99	1.46	4.58
120. Sierra Leone	42.42	2.79	7.22	6.58	2.56	14.35	2.68	2.56	3.12	9.87	1.11	4.75
121. Madagascar	57.03	3.08	4.06	14.21	4.60	4.41	3.13	0.45	0.70	5.87	1.32	1.14
122. Togo	48.59	4.19	5.22	6.56	2.70	3.77	16.02	2.04	1.95	3.94	2.32	2.70
123. Burkina Faso	41.98	9.19	3.28	9.35	8.51	2.86	7.81	1.09	1.82	4.42	5.64	4.06
124. Guinea	44.04	2.01	6.86	7.49	5.55	12.08	7.84	0.23	1.16	6.73	2.02	3.98
125. Mali	46.70	1.64	4.81	11.18	6.38	4.41	9.91	0.89	3.07	6.19	1.83	3.00
126. Angola	40.70	4.41	4.92	8.89	5.67	5.60	5.13	0.82	2.12	5.51	2.99	13.24
127. Rwanda	42.65	13.18	3.41	14.18	5.09	3.46	5.12	0.55	1.20	6.79	1.71	2.67
128. CAR	56.84	8.98	7.74	5.01	5.09	1.73	3.55	0.85	1.75	3.43	1.91	3.13
129. Mozambique	60.09	3.23	5.90	6.85	2.67	4.73	4.03	0.16	2.13	7.52	0.45	2.26
130. Niger	46.41	2.28	7.12	8.47	4.79	4.59	7.95	0.78	5.23	3.48	5.15	3.75
131. Guinea-Biss.	52.27	1.72	8.33	13.54	7.26	2.74	6.50	0.53	3.91	2.25	0.48	0.45
132. Congo, D.R.	62.22	2.02	5.00	11.95	2.80	3.99	3.41	0.82	0.91	2.99	1.39	2.50
Mean--All	27.57	3.34	5.27	14.67	5.11	7.70	9.40	2.42	4.94	7.99	4.46	7.13
--Rich	10.53	3.22	4.42	16.86	5.03	10.58	10.57	2.48	8.98	8.08	7.23	12.02
--Poor	33.08	3.38	5.55	13.97	5.14	6.77	9.02	2.40	3.63	7.96	3.56	5.54

Note: Means exclude US.

TABLE A2
RELATIVE PRICES IN 132 COUNTRIES IN 2005

Country	Food	Alcoholic Beverages	Clothing	Housing	Furnishing	Health	Transport	Communication	Recreation	Education	Restaurant	Miscellaneous
1. United States	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
2. Luxembourg	9.61	-28.28	11.01	-0.37	1.23	-32.30	20.54	-34.09	10.48	3.29	19.45	-0.20
3. Iceland	19.83	30.93	21.76	-14.45	3.12	-34.24	26.65	-31.14	16.49	-53.79	51.10	3.63
4. Norway	20.15	42.92	14.99	-33.22	-4.78	-34.36	51.29	-28.87	12.30	-43.80	39.28	10.46
5. UK	6.58	39.28	1.12	-22.86	1.95	-43.13	42.56	-26.94	2.60	-31.70	34.09	-0.56
6. Austria	13.31	-14.57	9.93	-19.53	2.37	-40.48	44.08	-10.54	8.22	-32.70	25.53	4.61
7. Switzerland	15.73	-35.15	-3.20	14.00	-6.05	-31.54	20.77	-11.70	1.31	-25.58	22.06	3.51
8. Canada	19.86	39.84	20.59	-20.01	17.87	-17.71	23.23	-0.27	3.77	-40.05	32.11	-1.66
9. Netherlands	-7.15	-5.83	8.18	7.64	-1.14	-42.95	53.09	-7.08	7.51	-40.72	29.93	1.99
10. Sweden	12.35	9.37	14.05	-9.69	8.19	-32.76	46.06	-44.23	14.50	-38.34	37.93	9.66
11. France	7.03	1.37	-2.99	0.99	6.67	-38.49	33.52	-0.27	10.25	-45.27	35.88	2.12
12. Australia	15.50	35.77	0.13	-6.32	18.79	-27.98	26.42	16.70	9.25	-50.20	22.86	-0.45
13. Denmark	10.07	-15.66	-1.20	-3.01	-4.72	-31.84	50.18	-55.12	8.02	-38.44	40.87	6.17
14. Belgium	11.40	-10.74	14.83	0.86	6.19	-35.54	36.01	1.89	6.83	-36.87	32.76	0.35
15. Germany	8.06	-9.98	10.52	-2.30	-1.27	-43.50	37.33	-2.74	11.08	-15.27	20.96	0.33
16. Hong Kong	31.95	46.24	-4.63	35.11	17.29	-78.15	38.37	6.55	-19.90	-67.54	33.83	-13.10
17. Ireland	8.46	35.16	-10.15	0.10	-4.18	-37.02	29.01	-11.19	0.85	-42.77	33.68	0.99
18. Japan	58.71	-31.19	23.24	-3.34	23.25	-71.57	20.26	-4.16	-8.75	-37.39	29.87	0.62
19. Taiwan	58.81	16.25	10.28	24.07	47.36	-121.10	37.99	-17.67	-6.80	-93.78	27.27	-2.83
20. Cyprus	16.92	7.34	17.95	-45.05	8.56	-40.93	39.66	-77.02	9.72	-55.25	39.52	-6.49
21. Finland	8.50	9.79	13.28	-3.42	-0.58	-34.55	40.97	-45.26	10.88	-45.04	35.66	6.50
22. Spain	5.22	-29.14	13.47	-5.17	14.08	-50.65	37.06	3.98	11.66	-56.31	29.57	-9.30
23. Italy	15.69	-6.65	8.39	-14.53	6.38	-24.36	30.61	-8.32	7.88	-39.59	25.37	-6.08
24. Greece	14.08	-9.78	20.76	-21.19	11.13	-53.57	26.43	13.69	10.61	-71.24	30.40	-9.94
25. New Zealand	20.06	29.63	15.82	-3.79	16.95	-40.79	23.25	3.25	7.06	-51.67	5.89	-4.18
26. Israel	18.24	11.53	13.06	-12.21	13.65	-39.22	59.04	-13.28	21.53	-60.79	56.22	3.37
27. Malta	14.87	22.15	40.48	-68.56	33.14	-68.23	55.81	17.25	11.10	-71.26	18.85	-12.23
28. Singapore	29.16	118.74	18.70	20.88	26.26	-86.86	41.34	-36.86	-13.37	-96.11	23.69	-13.56
29. Qatar	-6.37	-40.37	6.30	125.73	-23.08	-68.78	-40.99	10.87	1.12	-38.15	41.56	-31.96
30. Slovenia	21.92	-10.89	41.50	-26.85	15.29	-46.89	45.30	-8.61	18.59	-48.24	18.43	1.62
31. Portugal	7.50	-12.26	14.89	-24.90	8.43	-40.68	46.93	11.13	13.72	-25.89	17.53	-1.77
32. Brunei	45.77	30.48	35.42	22.28	32.98	-89.11	14.98	30.75	19.55	-109.13	45.91	1.25
33. Kuwait	-13.30	-47.53	34.68	56.18	-15.73	-57.43	-30.09	9.08	18.66	-32.72	60.76	-5.13
34. Czech Rep.	27.76	13.38	70.97	-33.87	40.76	-67.14	67.11	61.92	10.50	-76.54	20.80	-4.35
35. Hungary	26.40	8.37	57.20	-45.05	22.79	-61.72	74.90	39.72	16.02	-84.69	35.40	-5.20
36. Bahrain	3.66	-26.34	2.17	80.20	-14.81	-54.44	-14.91	16.54	9.85	-60.41	55.77	-22.78
37. Korea	60.99	3.57	31.97	-4.92	-5.75	-83.25	29.25	-34.73	12.42	-53.77	46.45	-7.66
38. Estonia	26.69	0.41	60.21	-20.90	22.77	-71.77	54.43	26.69	11.36	-115.59	34.13	-11.90
39. Slovakia	33.04	10.71	58.75	-34.72	39.64	-68.86	76.74	65.35	16.58	-111.05	31.37	-2.39
40. Lithuania	23.23	3.97	72.89	-50.84	27.34	-72.57	62.44	11.29	9.99	-123.66	37.39	-8.68
41. Poland	26.22	10.38	80.68	-35.36	33.76	-72.27	75.96	55.06	26.26	-87.86	51.94	2.33
42. Croatia	31.70	17.25	53.33	-63.09	27.17	-64.05	61.77	8.87	16.71	-91.36	49.43	-7.41
43. Macao	34.48	2.64	4.69	13.46	33.81	-95.73	28.97	17.11	0.19	-93.47	40.06	-4.85
44. Latvia	30.58	-4.95	74.67	-32.44	29.12	-77.31	61.72	63.64	12.94	-120.40	43.64	-15.70
45. Lebanon	21.55	4.71	76.02	-3.35	23.77	-74.61	-0.40	54.49	31.56	-83.76	132.57	0.84

(Continued on next page)

TABLE A2 (continued)
RELATIVE PRICES IN 132 COUNTRIES IN 2005

Country	Food	Alcoholic Beverages	Clothing	Housing	Furnishing	Health	Transport	Communication	Recreation	Education	Restaurant	Miscellaneous
46. Mexico	12.59	-18.70	12.06	19.37	2.30	-41.47	23.34	44.14	15.06	-98.04	25.03	-10.17
47. Belarus	46.63	17.01	77.73	-91.74	64.06	-89.69	91.14	-34.79	43.10	-127.97	40.01	23.66
48. Kazakhstan	45.31	-10.70	93.06	-15.73	65.55	-105.94	62.76	83.54	33.87	-157.52	53.89	13.39
49. Mauritius	36.51	35.79	17.76	-47.18	5.38	-87.55	73.79	-18.21	48.26	-117.45	21.27	2.90
50. Russia	26.40	-16.50	74.63	-83.55	42.21	-100.06	50.92	39.12	17.59	-152.36	44.00	5.83
51. Bulgaria	33.24	0.03	55.32	-48.61	33.73	-92.66	68.78	74.60	13.84	-156.76	7.01	-14.25
52. Iran	77.39	-4.41	22.95	-7.86	46.10	-142.18	17.41	-154.81	30.25	-99.66	77.47	-9.75
53. Romania	34.73	-2.63	52.05	-28.95	17.82	-97.40	61.19	42.34	4.00	-122.10	20.42	-17.32
54. Oman	5.51	-16.64	1.91	62.82	-12.88	-61.60	-12.31	25.88	4.85	-53.51	56.45	-24.45
55. Argentina	25.05	-33.01	30.44	-25.73	30.72	-81.41	35.63	-24.52	42.10	-64.50	61.92	-4.58
56. Serbia	47.39	-12.99	75.97	-45.94	54.37	-84.39	80.76	-39.72	15.86	-118.46	50.53	-13.36
57. Saudi Arabia	16.20	-26.31	1.30	39.02	-15.96	-65.68	-3.07	68.18	41.41	-35.44	77.58	-12.50
58. Chile	20.94	-26.51	31.73	-27.35	30.85	-58.42	40.56	41.81	15.80	-54.57	35.45	-4.03
59. Uruguay	15.48	-19.61	29.44	-6.91	18.58	-69.91	46.71	-1.28	23.51	-68.12	45.77	-3.69
60. Bosnia	34.95	-13.48	72.87	-71.83	22.76	-69.14	74.28	-3.44	12.27	-126.05	37.33	-15.85
61. Macedonia	34.10	-19.66	57.59	-67.25	38.34	-101.49	75.71	52.19	28.57	-120.37	30.05	-16.82
62. Ukraine	39.00	-2.19	82.46	-117.16	66.48	-88.19	75.08	57.93	34.89	-159.99	66.07	22.33
63. South Africa	25.78	6.57	26.25	-39.10	32.00	-55.33	44.80	33.18	28.29	-76.71	50.71	0.94
64. Malaysia	33.87	70.30	12.67	21.98	18.55	-111.41	19.85	10.68	-3.52	-129.10	39.67	-5.77
65. Turkey	30.98	20.50	30.75	-55.43	9.29	-54.89	74.00	37.83	15.34	-109.71	41.55	-13.58
66. Montenegro	40.27	-26.85	80.99	-35.16	33.02	-98.26	72.04	-15.09	16.07	-132.97	47.22	-23.93
67. Brazil	16.33	-53.92	44.63	3.39	25.10	-69.91	55.74	9.55	36.89	-62.88	14.73	-5.01
68. Venezuela	41.00	-44.31	62.35	-54.43	38.00	-69.86	19.00	-4.73	39.39	-70.03	35.53	-7.02
69. Thailand	40.14	42.43	22.63	-40.32	36.92	-111.67	39.49	25.78	15.46	-134.97	33.23	3.66
70. Albania	34.23	-6.44	57.97	-38.39	25.82	-141.58	59.36	41.88	8.65	-168.21	26.32	-29.61
71. Colombia	42.17	-9.12	38.31	-44.36	20.57	-80.63	54.57	12.68	39.67	-73.10	10.52	4.25
72. Ecuador	28.05	-19.21	27.50	-18.48	8.44	-102.25	26.80	4.61	42.12	-78.93	35.81	-9.48
73. Jordan	19.87	-4.44	5.33	57.98	14.07	-90.38	-7.72	-1.22	21.64	-99.89	91.97	0.57
74. Tunisia	30.73	19.21	70.80	-70.47	-8.61	-82.57	51.88	13.12	46.33	-86.99	-1.09	-3.84
75. Peru	30.90	-1.97	17.36	-49.58	19.76	-69.24	28.27	13.76	24.18	-73.44	34.74	-16.54
76. Egypt	40.52	30.45	21.53	-25.98	-0.98	-148.38	-5.06	80.25	31.82	-167.08	75.21	-17.63
77. Moldova	48.88	-16.72	97.92	-89.53	72.62	-108.60	81.26	50.15	31.37	-195.15	59.09	7.68
78. Maldives	37.85	4.69	17.86	95.92	19.95	-147.47	53.57	-12.73	5.92	-188.82	52.18	-10.07
79. Gabon	63.32	-14.51	40.47	-52.31	27.31	-105.92	49.01	70.21	51.86	-163.29	48.01	-38.03
80. Fiji	14.08	12.00	-25.43	47.23	-0.36	-133.77	29.28	-49.89	-2.21	-143.47	51.25	-23.53
81. Georgia	40.60	-179.62	176.39	-216.17	64.62	-155.82	-120.73	-44.07	22.30	-41.66	-230.98	84.03
82. Botswana	57.49	8.76	30.23	-57.82	40.14	-50.80	55.89	25.58	57.92	-110.75	52.69	-17.50
83. Namibia	47.57	-19.23	31.39	-23.95	8.89	-84.95	46.79	50.62	45.06	-89.11	77.17	-5.35
84. Swaziland	36.83	17.36	56.14	-22.70	12.67	-172.73	46.03	54.73	45.64	-107.77	36.01	-33.59
85. Syria	23.36	-2.46	29.31	24.42	9.93	-113.94	18.80	28.75	1.78	-160.02	62.58	-29.38
86. Bolivia	41.83	11.04	57.19	-40.75	26.07	-95.81	39.06	38.25	52.28	-134.31	46.69	10.35
87. Eq. Guinea	48.69	-52.32	53.22	-64.23	6.42	-128.00	37.54	81.54	43.87	-209.60	20.27	-35.60
88. Paraguay	15.23	-22.33	48.34	-66.36	17.25	-88.40	54.76	-16.21	44.47	-122.28	35.66	-2.35
89. Cape Verde	33.17	-0.37	46.12	1.09	21.77	-107.06	32.44	20.43	33.02	-103.46	40.50	-31.47
90. Bhutan	48.02	34.42	33.22	-9.27	49.75	-127.62	70.22	47.23	36.67	-134.14	70.47	9.13

(Continued on next page)

TABLE A2 (continued)
RELATIVE PRICES IN 132 COUNTRIES IN 2005

Country	Food	Alcoholic Beverages	Clothing	Housing	Furnishing	Health	Transport	Communication	Recreation	Education	Restaurant	Miscellaneous
91. Kyrgyzstan	40.11	-3.58	86.33	-168.06	66.42	-151.98	54.43	56.91	17.92	-225.39	34.79	-18.97
92. Sri Lanka	26.31	57.26	-26.79	-78.80	15.12	-161.05	36.66	16.79	6.80	-189.32	37.30	-10.28
93. Iraq	46.94	34.22	24.26	47.88	-10.82	-107.95	14.28	63.33	54.69	-110.47	98.75	-5.11
94. Mongolia	42.40	25.09	31.45	19.06	38.56	-167.21	52.58	25.57	26.11	-198.46	82.05	19.05
95. Philippines	33.74	-39.36	15.83	-6.26	7.25	-96.79	36.58	36.69	11.07	-152.44	25.14	-9.33
96. Indonesia	27.48	41.65	-13.59	-6.41	1.42	-90.96	31.11	44.94	-7.26	-181.74	13.71	-22.39
97. Pakistan	45.27	37.98	8.93	-56.09	19.28	-142.78	48.29	-12.52	8.09	-185.51	62.12	-1.34
98. Morocco	27.12	55.93	29.97	-73.58	-19.19	-53.78	37.21	30.61	18.85	-53.74	42.54	-9.69
99. Lesotho	56.36	10.06	35.61	-80.09	20.32	-138.77	66.62	91.52	77.48	-128.76	48.30	3.64
100. China	42.89	47.00	64.69	-6.57	38.26	-165.74	50.90	-13.55	-3.57	-126.01	63.48	13.93
101. Vietnam	47.12	23.18	27.36	3.03	44.14	-154.84	100.10	21.55	13.62	-219.69	44.85	15.05
102. India	28.73	68.71	5.27	-25.18	36.01	-166.55	71.64	9.63	14.95	-169.83	52.94	1.35
103. Cambodia	39.88	-0.36	18.12	9.62	13.88	-170.50	47.34	49.81	1.00	-226.94	47.71	4.85
104. Yemen	30.41	-33.13	3.01	3.00	17.72	-140.07	11.72	81.10	33.18	-173.81	80.60	-4.27
105. Sudan	31.91	56.11	-29.87	-70.94	-36.69	-103.30	20.61	44.70	-10.09	-133.05	-10.66	-65.60
106. Laos	40.70	23.31	13.87	-74.06	18.79	-183.46	72.65	45.24	1.72	-228.98	40.01	1.53
107. Djibouti	57.77	-35.81	31.34	-57.39	43.68	-91.08	65.40	41.14	23.65	-154.29	75.67	-61.46
108. Kenya	46.18	18.71	1.76	-96.87	-10.52	-115.84	70.80	102.60	51.98	-103.84	3.42	-33.65
109. Sao Tome.	35.41	-13.02	35.32	-90.18	-11.99	-115.41	29.32	49.81	33.74	-183.00	23.03	-34.97
110. Congo, Rep.	56.89	0.37	39.33	-76.07	3.20	-106.57	57.74	81.30	42.27	-202.18	25.08	-39.36
111. Cameroon	31.10	-14.82	12.47	-88.34	-11.16	-107.80	25.69	79.72	37.53	-167.93	23.18	-35.41
112. Nigeria	55.14	-17.05	-15.06	-108.26	-45.55	-135.69	9.02	42.48	7.44	-206.72	20.78	-67.71
113. Senegal	43.38	-19.92	4.97	-88.35	-19.19	-106.70	40.46	8.39	9.48	-131.87	32.25	-29.54
114. Chad	27.12	-17.06	-28.78	-213.14	-12.97	-242.25	20.95	55.35	1.08	-416.35	8.33	-57.77
115. Nepal	27.64	51.18	8.42	-1.02	19.41	-152.23	90.28	26.00	5.84	-167.72	55.31	1.92
116. Bangladesh	25.33	-12.38	13.77	-13.65	6.45	-140.85	65.23	14.42	16.73	-172.63	49.46	-2.00
117. Benin	43.71	-12.46	2.09	-118.58	-10.62	-128.03	33.11	92.40	20.16	-165.54	28.10	-37.29
118. Ghana	58.24	-1.45	-3.21	-145.26	-9.38	-126.82	42.31	53.43	25.23	-145.80	44.52	-67.78
119. Cote d'Ivoire	32.18	-16.69	-4.11	-99.04	-19.84	-90.92	45.15	66.36	34.51	-122.78	10.65	-34.23
120. Sierra Leone	75.89	0.40	8.27	-126.84	12.98	-118.22	66.40	113.15	41.62	-140.87	54.78	-10.63
121. Madagascar	46.98	35.68	1.32	-75.45	-3.14	-103.93	63.30	44.41	26.86	-251.04	14.42	-28.20
122. Togo	34.51	-40.75	8.46	-153.34	-20.15	-77.10	34.72	81.12	14.30	-213.22	11.09	-50.15
123. Burkina Faso	34.28	-4.81	-25.47	-100.23	-1.98	-113.77	73.46	81.55	32.74	-167.39	26.17	-40.00
124. Guinea	67.36	-75.05	-1.82	-100.74	-46.15	-77.45	64.86	58.36	1.14	-188.05	11.03	-34.33
125. Mali	41.95	-45.95	-3.83	-79.18	-7.32	-108.53	43.23	60.31	29.95	-158.17	12.71	-24.40
126. Angola	53.81	-30.09	27.74	-109.76	-1.02	-87.95	44.69	57.30	41.54	-138.28	47.78	-35.12
127. Rwanda	31.69	4.63	46.51	-34.58	26.97	-126.89	68.02	72.18	54.74	-182.90	26.80	-13.80
128. CAR	35.80	-26.59	-7.86	-173.75	-28.14	-110.17	56.28	49.02	11.64	-189.50	0.59	-45.98
129. Mozambique	31.58	6.15	20.22	-128.90	-0.82	-99.59	67.09	71.94	33.59	-133.37	39.69	-21.99
130. Niger	36.77	-14.28	-25.65	-109.86	-12.33	-108.34	49.17	62.30	28.90	-151.68	20.92	-46.66
131. Guinea-Biss.	30.64	-27.05	24.54	-102.19	-2.83	-130.62	46.86	122.50	32.60	-216.19	18.79	-37.05
132. Congo, D.R.	36.46	-21.36	-24.58	-86.92	-26.34	-131.51	49.21	68.73	12.77	-186.20	16.18	-66.76
Mean--All	31.31	-0.22	26.65	-36.76	13.64	-90.87	42.20	23.82	19.74	-115.13	36.14	-11.43
--Rich	19.19	9.50	16.20	-10.33	11.25	-48.14	39.28	-9.64	7.40	-49.80	30.29	-1.28
--Poor	35.55	-3.36	30.30	-45.68	14.56	-105.60	43.57	34.87	23.92	-137.41	38.39	-14.83

Notes: 1. The elements in this table are the logarithmic relative price of good i in country c, $(\log p_i^c - \log P^c) \times 100$.

2. Means exclude US.

TABLE A3
IMPLIED PRICE DISPERSION AND INCOME,
WITH AND WITHOUT OUTLIERS

$$y_c = \lambda_0 + \lambda_1 x_c + \lambda_2 x_c^2$$

Country group	Order of quadratic coefficients			Minimum variance	
	Second λ_2	First λ_1	Zero λ_0	Income $x^* = -\lambda_1/2\lambda_2$	Variance y_{x^*}
(1)	(2)	(3)	(4)	(5)	(6)
A. <u>No countries omitted</u>					
Poor	2.47 (0.43)	-6.55 (2.60)	33.36 (1.24)	132.71 (54.23)	29.01 (1.68)
Rich	3.38 (0.49)	-11.23 (1.85)	26.41 (2.36)	166.28 (14.70)	17.07 (0.98)
Difference	-0.91 (0.16)	4.68 (0.98)	6.95 (2.13)	-33.57 (14.25)	11.94 (1.41)
B. <u>Three countries omitted</u>					
Poor	2.53 (0.43)	-6.75 (2.76)	32.49 (1.27)	133.47 (51.27)	27.99 (1.74)
Rich	3.47 (0.50)	-11.63 (1.88)	26.25 (2.37)	167.44 (14.31)	16.51 (0.96)
Difference	-0.95 (0.16)	4.89 (1.02)	6.25 (2.03)	-33.96 (15.61)	11.48 (1.42)

- Notes:
1. Asymptotic standard errors in parenthesis.
 2. All entries are to be divided by 100.
 3. Panel A is from Table 4.
 4. Georgia, Lebanon and Iran are omitted in Panel B.

TABLE A4

RELATIVE PRICES AND INCOMES,
RICH AND POOR COUNTRIES SEPERATED, 132 COUNTRIES IN 2005

$$w_{ci} \log(p_{ci}/P_c) = \alpha_i + \gamma_i D_c + \beta_i \log(Q_c/\bar{Q}) + \varepsilon_{ci}, \quad w_{ci} \log(p_{ci}/P_c) = \alpha_i + \beta_i \log(Q_c/\bar{Q}) + \varepsilon_{ci}$$

Commodity	Intercept $\alpha_i (\times 100)$	Poor country dummy $\gamma_i (\times 100)$	Income $\beta_i (\times 100)$	Income elasticity β_i/w_i	R ²	SEE ($\times 100$)
A. <u>All countries (C = 131)</u>						
Food	9.71 (0.99)	0.22 (1.21)	-5.31 (0.44)	-0.19	0.68	4.34
Alcoholic beverages	0.08 (0.21)	-0.11 (0.26)	0.11 (0.10)	0.03	0.03	0.94
Clothing	-0.55 (0.44)	2.71 (0.54)	0.88 (0.20)	0.17	0.18	1.93
Housing	-5.34 (1.40)	2.38 (1.71)	2.70 (0.62)	0.18	0.15	6.15
Furnishings	-0.09 (0.26)	0.91 (0.32)	0.49 (0.12)	0.10	0.12	1.15
Health	-4.53 (0.67)	-2.41 (0.82)	-0.24 (0.30)	-0.03	0.08	2.94
Transport	3.84 (0.63)	0.12 (0.77)	0.19 (0.28)	0.02	0.00	2.76
Communication	-0.14 (0.24)	0.84 (0.29)	-0.03 (0.11)	-0.01	0.12	1.05
Recreation	0.39 (0.17)	0.50 (0.20)	0.17 (0.07)	0.03	0.05	0.74
Education	-4.39 (0.87)	-5.23 (1.06)	0.28 (0.39)	0.03	0.30	3.83
Restaurants	1.48 (0.27)	0.09 (0.32)	0.47 (0.12)	0.11	0.17	1.17
Miscellaneous	-0.47 (0.21)	-0.02 (0.26)	0.29 (0.09)	0.04	0.13	0.93
B. <u>Poor Countries (C = 99)</u>						
Food	9.93 (0.54)		-5.31 (0.50)	-0.16	0.54	4.87
Alcoholic beverages	-0.02 (0.11)		0.12 (0.10)	0.04	0.02	0.95
Clothing	2.17 (0.24)		0.92 (0.22)	0.17	0.15	2.16
Housing	-2.97 (0.76)		2.67 (0.70)	0.19	0.13	6.87
Furnishings	0.84 (0.14)		0.52 (0.13)	0.10	0.15	1.24
Health	-6.96 (0.36)		-0.29 (0.33)	-0.04	0.01	3.23
Transport	3.99 (0.34)		0.23 (0.31)	0.03	0.01	3.06
Communication	0.71 (0.13)		-0.01 (0.12)	0.00	0.00	1.13
Recreation	0.89 (0.08)		0.17 (0.07)	0.05	0.06	0.68
Education	-9.65 (0.47)		0.22 (0.43)	0.03	0.00	4.25
Restaurants	1.58 (0.13)		0.48 (0.12)	0.13	0.14	1.17
Miscellaneous	-0.51 (0.11)		0.28 (0.10)	0.05	0.07	0.98
C. <u>Rich Countries (C = 32)</u>						
Food	10.12 (2.52)		-5.60 (1.77)	-0.53	0.25	1.94
Alcoholic beverages	1.40 (1.20)		-0.82 (0.84)	-0.25	0.03	0.92
Clothing	4.27 (0.76)		-2.54 (0.54)	-0.57	0.43	0.59
Housing	-8.55 (3.82)		4.98 (2.69)	0.30	0.10	2.94
Furnishings	3.05 (0.91)		-1.74 (0.64)	-0.34	0.20	0.70
Health	-9.95 (2.06)		3.60 (1.45)	0.34	0.17	1.59
Transport	8.07 (1.77)		-2.80 (1.25)	-0.27	0.14	1.37
Communication	1.61 (0.93)		-1.27 (0.65)	-0.51	0.11	0.71
Recreation	1.27 (1.16)		-0.46 (0.82)	-0.05	0.01	0.89
Education	-11.17 (2.33)		5.09 (1.64)	0.63	0.24	1.79
Restaurants	2.34 (1.52)		-0.14 (1.07)	-0.02	0.00	1.17
Miscellaneous	-2.46 (0.88)		1.70 (0.62)	0.14	0.20	0.68

- Notes: 1. Standard errors in parentheses.
2. All regressions exclude US, the base country.
3. Elasticities in the third last column are evaluated at means.
4. Panel A reproduces Table 2.

TABLE A5

WALD TESTS OF EQUALITY OF
COEFFICIENTS ACROSS COUNTRY GROUPS

Commodity	Intercepts	Slopes
<u>A. Individual commodities.</u>		
Food	0.01 (0.94)	0.03 (0.87)
Alcoholic beverages	1.39 (0.24)	1.25 (0.26)
Clothing	6.88 (0.01)	35.75 (0.00)
Housing	2.05 (0.15)	0.69 (0.41)
Furnishings	5.76 (0.02)	11.89 (0.00)
Health	2.05 (0.03)	6.89 (0.01)
Transport	5.12 (0.02)	5.56 (0.02)
Communication	0.93 (0.34)	3.61 (0.01)
Recreation	0.11 (0.74)	0.60 (0.44)
Education	0.41 (0.52)	8.27 (0.00)
Restaurants	0.25 (0.62)	0.33 (0.56)
Miscellaneous	4.85 (0.03)	5.17 (0.02)
<u>B. All commodities</u>		
	29.77 (0.00)	80.05 (0.00)

Note: The test statistics in panel A (B) follow a χ^2 distribution with one (twelve) degrees of freedom. P-values are in parenthesis.

TABLE A6
IMPLIED PRICE DISPERSION AND INCOME,
RICH AND POOR COUNTRIES SEPERATED

$$y_c = \lambda_0 + \lambda_1 x_c + \lambda_2 x_c^2$$

Country group (1)	Order of quadratic coefficients			Minimum variance		Intersection	
	Second	First	Zero	Income	Variance	Income	Variance
	λ_2 (2)	λ_1 (3)	λ_0 (4)	$x^* = -\lambda_1/2\lambda_2$ (5)	y_{x^*} (6)	(7)	(8)
<u>A. All Countries Combined</u>							
Poor	2.47 (0.43)	-6.55 (2.60)	33.36 (1.24)	132.71 (54.23)	29.01 (1.68)	-120.47 (45.68)	44.83 (3.10)
Rich	3.38 (0.49)	-11.23 (1.85)	26.41 (2.36)	166.28 (14.70)	17.07 (0.98)		
Difference	-0.91 (0.16)	4.68 (0.98)	6.95 (2.13)	-33.57 (14.25)	11.94 (1.41)		
<u>B. Rich & Poor Separated</u>							
Poor	2.48 (0.49)	-6.26 (3.17)	16.38 (0.64)	126.54 (65.25)	12.41 (0.71)	128.98 (47.12)	12.41 (0.62)
Rich	13.32 (3.75)	-52.91 (12.80)	58.50 (10.79)	198.62 (10.31)	5.96 (0.90)		
Difference	-10.84 (3.52)	46.64 (11.98)	-42.12 (10.57)	-72.08 (25.74)	6.45 (0.47)		

Notes: 1. Asymptotic standard errors in parenthesis.
2. All entries are to be divided by 100.
3. Panel A reproduces Table 4 and intersection values from Figure 3.

FIGURE A1
RELATIVE PRICES AND INCOMES
RICH vs POOR COUNTRIES

(Continued on next page)

FIGURE A1 (continued)
RELATIVE PRICES AND INCOMES
RICH vs POOR COUNTRIES

Notes: 1. In panel i ($i = 1, \dots, 12$), the i^{th} relative price, $(\log p_i^c - \log P^c) \times 100$, is plotted against relative income per-capita, $\log(Q^c/\bar{Q}) \times 100$, $c = 1, \dots, 132$, where $\bar{Q}$ is geometric mean income. The black solid line is the LS regression line for the poor countries, while the grey line refers to the rich..

2. As it is an outlier, country number 114, Chad, is excluded from “Education” plot, but is included in the regression line.

3. US, the base country, is excluded from all scatterplots.

FIGURE A3
TWO VERSIONS OF
DISPERSION AND INCOME RELATION

A. All Countries Combined

B. Rich and Poor Separated

Note: Panel A is Figure 3 on a different scale.

FIGURE A3
WEIGHTED RELATIVE PRICES AND INCOMES,
132 COUNTRIES IN 2005

(Continued on next page)

FIGURE A3 (continued)

WEIGHTED RELATIVE PRICES AND INCOMES,
132 COUNTRIES IN 2005

- Notes: 1. In panel i ($i = 1, \dots, 12$), the i^{th} relative price, weighted by the corresponding budget share, $w_i(\log p_i^c - \log P) \times 100$, is plotted against relative income per-capita, $\log(Q^c/\bar{Q}) \times 100$, $c = 1, \dots, 132$, where $\bar{Q}$ is geometric mean income. The solid line is the LS regression line.
2. US, the base country, is excluded from all scatterplots.
3. All estimates and standard errors are to be divided by 100.

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