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Poverty Price Levels: An Application to Brazilian Metropolitan Areas

by

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Abstract

One of the many complex issues related to international comparisons of poverty is how to adjust the purchasing power of currencies (PPPs) to reflect the relative price levels of the goods and services faced by poor consumers. This paper reviews the problem and adjustment methods for poverty PPPs and describes estimates for different income groups in eleven cities in Brazil. The data are based on detailed household expenditure surveys for approximately 40 headings in each of the eleven cities. The headings consist of food items that make up part of the 'poverty basket' in Brazil, a set of household goods that are used periodically by various government and private institutions to track price changes over time and across regions. The income groups range from households that earn less than one minimum salary to those averaging more than thirty minimum salaries per month. We attempt to show that the variation in prices and expenditures across cities and across income groups is significant, suggesting that the use of national average prices and expenditures in a study of poverty levels may be misleading. Our results show that poor consumers often face different prices than the average consumer, and that price levels for food in some of the poorer cities are higher than those in higher income cities. Our conclusion is that the variation in prices and expenditures across cities and across income groups is significant, suggesting that the use of national average prices and expenditures in a study of poverty levels may be misleading.

Introduction

Purchasing power parities (PPPs) convert currencies to a common measure and are obtained by averaging the relative prices of goods and services weighted by their corresponding expenditures. Thus, the PPP for a country reflects the amount of currency required to obtain a basket of goods and services in the framework of a system of national accounts. The methodology for obtaining PPPs is essentially bottom-up, beginning from a price collection effort and a household expenditure survey to a set of average national prices and average expenditure weights for a country as a whole. These national price and expenditure data are then combined with data from other countries to form the basis of the ICP (International Comparison Programme) estimates of GDP (Gross Domestic Product) at 'real' prices, that is, at currencies converted to a common measure by the PPP for each country.

The GDPs at PPPs of a country are the most commonly used monetary measure of its income for international comparisons. Less clear is the best measure for comparing

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poverty levels across countries. Whether poverty is defined relative to the median or average GDP of a country, or defined as an absolute value such as the dollar per person per day standard, the question remains as to whether the PPP calculated at the level of GPD is the appropriate conversion factor, or whether a 'poverty-specific PPP' is more appropriate.

This paper reviews the current literature on the feasibility and appropriateness of adjustments to PPPs for poverty estimates, and then uses Brazilian data to illustrate some of these adjustments.

Background

1. Adjusting Expenditure Weights

PPP estimates at the level of GDP are built up from consumption, investment and government expenditure headings using national average expenditure distributions for a common set of headings that originate in detailed item specifications. A poverty PPP could be estimated from modifications of this framework. The next sections provide a review of the types of modifications possible, and they fall under the following categories:

a) use only a subset of consumption items,
b) use a mixture of private and public consumption items,
c) use a poverty-specific expenditure distribution, and
d) use a national average distribution obtained from democratic rather than plutocratic weights.

a) Level of Aggregation (Use a subset of consumption items)

One approach to adjusting PPPs is to estimate them at a level of aggregation below that of GDP, namely at the level of consumption. Heston (1986) found that for 118 market economies, the proportion of the population at the lowest quartile was higher in 1980 when calculated using Consumption PPPs than the proportion estimated at GDP PPPs. Biru and Ahmad (1994) analyzed the sensitivity of poverty levels in 56 countries to PPPs at different aggregations of consumption. They found that the poverty level was even higher when estimated using PPPs at the level of food and clothing than when estimated using consumption PPPs. This was especially true in low income countries, so if those items make up the bulk of consumption for poor people, they are likely to face higher real consumption costs than suggested by PPPs estimated at a more aggregate level. At the sub-national level, Aten (1999) found that for a limited number of food items, poorer cities in northeast Brazil had higher price levels than the wealthier cities in the southeast.

b) Public versus Private Consumption

A related problem in adjusting PPP expenditure weights is the identification of items most relevant to poverty analysis, such as publicly provided health and education. In the studies cited above, the main adjustment to the aggregate GDP PPP was to use a subset of consumption items, one that includes only private goods and services. Smeeding, Rainwater and Burtless (2001) have converted poverty levels based on pretax income to one based on after-tax income, including cash and non-cash aid for the 20 more advanced economies of the world. They found that low-income Americans fare worse than other nations partly because of the lower level of social spending in the U.S., approximately 4% compared to between 7% and 10% of GDP for other advanced countries.

To illustrate the difference between private and public expenditures, Alwitt and Donley (1996) show the poverty rates using various income definitions. In the United States, the official poverty rate was 14.5% for all persons and 11.7% for families in 1992. If cash transfers to the poor are excluded, the poverty rates increase to 22.6% and 20.1% respectively, but when Medicare, Medicaid and other noncash transfers such as housing vouchers and food stamps are included, the rates decrease to 11.7% and 9.2% (Table 4.8 p. 61). Adding the return from owned homes further decreases the rates by about 1%. (Alwitt and Donley, 1996).

c) Poverty-Specific Expenditure Distribution

A second adjustment to PPPs at either the aggregate level or at a poverty-specific consumption level is to use weights that better reflect the expenditure distribution of low-income population groups rather than an average national expenditure distribution. Heston (1986) estimated such PPPs using expenditure weights of poorer groups (the lowest quintile for Brazil, the 3rd decile for India, and rural estate worker in Malawi, for example) to produce PPPs for 127 economies. He found that these poverty PPPs were higher than the overall PPPs in South America and Asia but lower in Africa. Although cautious about the results due to the paucity of these income-specific distributions, his study suggests that the count of those in poverty will be understated if the national averages are used. Another study by Biru (1998), in Zambia, shows poverty incidence based on regional price levels from McKay (1992), Glewwe (1987) and Grootaert and Kanbur (1994) as well as estimates of PPPs by income group. Although limited by data constraints, Biru's study finds that the bottom deciles do tend to face higher price relatives for basic necessities than the population in the higher deciles.

In the United States, the percent expenditures for low-income households (under $10,000) on food and housing was greater than for the average household (Ambry 1993, quoted in Alwitt and Donley (1996). Using data from the 1991 Consumer Expenditure Survey, Alwitt and Donley showed that poor consumers are much less likely to eat out, spending 19% more than average households on food consumed at home. They also found that poor households spend their money wisely on food. That is, they purchase fewer convenience foods (frozen prepared food, flour mixes) and gratification foods (cookies, chips, candy) than the average household, and more filling foods (rice, pasta, bread) and ingredient foods (flour, eggs, sugar). This was contrary to what a sample of the public *perceives* poor people eat. Although the sample was small, consisting of a

survey of 300 non-poor people from the U.S. Midwest, 25 of those sampled were experts or professionals in the field, such as social workers, who also had erroneous perceptions of the consumption patterns of the low-income household. Another expenditure heading that was analyzed in the study was the so-called 'sin' products, such as alcohol and cigarettes and gambling. In total, poor and non-poor households spent the same proportion of their incomes on these products (2%), and the only alcohol that was consumed disproportionately more by low-income consumers was malt liquor. Also, fewer poor people gambled in total, but low-income groups spent a higher percentage of their incomes on lottery tickets (Selinger 1993 quoted in Alwitt and Donley). However, people with incomes below $20,000 in 1990 were 17% more likely to smoke than the wealthier households (Simmons Market Bureau Research, Inc., 1991 quoted in Alwitt and Donley).

In the U.S., according to Alwitt and Donley, the average expenditures of poor households on housing was 44% and on food products was 16% of their total expenditures. The most common form of housing is private rentals, public housing and single room occupancy (SRO) hotels. In addition, low-income households (less than $10,000) pay 35% more to maintain their homes and 51% more for utilities than all households, due to lower quality housing in general. The next largest expenditure for this group was on transport (13%), with low-income consumers spending 52% more on public transportation than the average household. They were 44% less likely to drive, and nearly a third of those who owned a car spent 6 hours or more per month fixing or working on their cars.

In 1992 Congress requested a study to evaluate alternative definitions of poverty in the U.S. and this report, published by the National Research Council (1995) suggests that consumer expenditure data be used to calculate the expenditures on food, clothing and shelter for families at the 30^{th} percentile of expenditures. The poverty threshold should then be set at 1.15 to 1.25 times this amount, with further adjustments due to housing costs for the nine census regions and metropolitan areas. Currently, the poverty threshold assumes that the cost of food is 30% of total expenditures (as a result of Orshansky's original work on 1961 Bureau of Labor Statistics data), and updates the per capita cost of food using the Consumer Price Index, with no adjustments for housing cost differences or more recent expenditure distribution data. If the recommendations of the Council are adopted, the definition of poverty changes to a more relative one (based on expenditure weights of the 30^{th} income percentile of the population) and would take into account cost of living differences across the United States. This raises the question of how weights should vary across countries in estimating a poverty PPP.

d) Democratic versus Plutocratic Weights

PPP estimates are based on one set of average expenditure distributions per country. These expenditure weights are used in calculating the multilateral price relatives at various levels of aggregation and depending on the method used, the weights will vary in importance. For example, the Geary system used in producing the Penn World Table weights countries with a high per capita GDP more when differences in per capita GDP

are greater than differences in population size. Similarly, the U.S. Consumer Price Index (CPI) is plutocratic in that the larger quantities consumed (by the wealthier households) carry more weight than smaller quantities. A poverty CPI and a poverty PPP could use a different weighting system, one more closely related to population size.

Some countries, such as India, produce a Rural CPI and an Urban CPI, with expenditure weights reflecting the two different groups. Brazil estimates a 'Poverty CPI', but uses direct quantity weights derived from consumer survey, discussed in more detail below.

2. Adjusting Prices

In the expenditure adjustments described above, the poverty-specific PPP was generally higher than the overall PPP at a more aggregate level, suggesting an undercount of those in poverty using the GDP or the Consumption PPPs. There are some studies supporting the notion that the poor face higher prices for durable and nondurable goods due to household and marketplace characteristics. Alwitt and Donley (1996) cite work by Andreasen (1975) on price differences between neighborhoods in the inner city, by Consumers Union (1993) in Los Angeles, by the New York City Department of Consumer Affairs (1991) and by Hoch et al. (1995) in Chicago. In Hoch's study, supermarkets assigned 'price zones' on the basis of levels of local competition. Kunreuther (1973) found that in New Haven, CT, the poor purchased smaller sized packages in smaller stores due to transport and location constraints. Rao's (2000) study of villages in South India also shows a higher unit price paid by those who buy in very small quantities, generally the very poor families.

The poor will also pay relatively more for financial services, as bank fees are structured to encourage large balances and will often charge for cashing checks, for example, if a minimum balance is not maintained. There are usually fewer bank branches in poor neighborhoods, and low-income consumers spend disproportionately more in cash-checking outlets or currency exchanges. Poor consumers will also use pawnshops as a source of loans, and 'secured credit cards' such as those offered by Western Union. These have higher annual fees and interest rates than regular credit cards. Alwitt and Donley conclude that "to the extent that the poor are geographically segregated and predominantly poor areas have fewer retail establishments, businesses face less competitive pressure, allowing them to charge higher prices to a captive market" (1996 p.224).

Although these PPP and expenditure adjustments suggest higher price levels faced by specific low income groups, in general, aggregate price levels tend to rise with incomes, especially when all consumption items are included, such as public and private goods and services. This is true in the United States, where interarea price differences are large, and price levels are higher in the higher income regions and cities (Aten (1986), Kokosky, Cardiff and Moulton (1994)). In India, Deaton and Tarozzi (2000) compare price indexes derived from unit values from the national sample survey for two time periods, and between rural and urban areas in 17 states, plus Delhi. They find price levels approximately 15% higher in urban areas, and generally higher in wealthier states. Their

adjusted poverty line shows a smaller gap between urban and rural areas than the official poverty line, and shows too that these differences are uneven across states. Another study in northeast Brazil by Musgrove and Galindo (1988), report little or no difference among small and large retailers, or between items sold in bulk or in small quantities.

A limitation of the current ICP methodology is its emphasis on national price averages, rather than local or regional prices, and the use of average expenditure data, rather than a poverty specific expenditure distribution. In the remainder of this paper, we use Brazilian data to illustrate a) differences in prices and expenditures across income groups, b) differences between regional price levels and the national average, b) the variation in price levels across income groups and regions.

An Application to Brazil

1. Prices in the Poverty Basket

In Brazil, there is a well-used term to denote the minimum consumption bundle for the poor: the 'cesta basica'. Literally translated as the basic basket, it can consist of a physical bundle, sold in most supermarkets, or it can denote the official set of items used by many private and public institutions to track inflation. They are not always the same, and may vary geographically in terms of quantities and item selection. In addition, there are different types of basket, for individuals, for families with children, even for different locations within a neighborhood.

In spite of its varied description, it is still of great interest within Brazil because of its relation to the national minimum wage. The minimum wage is set, by law, and must not be less than, in theory, the expenses incurred by an adult worker for shelter, clothing, hygiene and transport, in addition to a minimum bundle of food products[3]. The food quantities were established in 1938 and were to provide the adult worker with a balanced amount of proteins, calories, calcium and phosphorus (DIEESE 1993). However, the law does not estimate the proportional expenditures on the other non-food items, so that the percentage of the minimum wage that is needed to cover the basic food basket has risen to almost 60%. (DIEESE 2001). Table 1 below shows the contents of the basket and Table 2 the price variation by city for June 2001.

Table 1. Minimum quantities for Basic Basket (one month supply)

Product	Quantity
1. Meat	6.0 kg
2. Milk	7.5 l
3. Beans	4.5 kg
4. Rice	3.0 kg
5. Flour	1.5 kg
6. Potato	6.0 kg
7. Vegetables (tomatoes)	9.0 kg

[3] According to the Decreto Lei (Law) number 399, article 2, dated 30th April 1938

Product	Quantity
8. Bread	6.0 kg
9. Coffee	600 gm
10. Fruit (bananas)	90 units
11. Sugar	3.0 kg
12. Lard/Oil	750 gm
13. Butter	750 gm

Potatoes are not priced in the north and northeastern states, and there are other regional variations. For example, the quantities of flour, rice and vegetables are higher, but coffee, milk and meat quantities are lower in the north, while meat, oil and milk are higher in the southern cattle producing regions.

Table 2. National Basic Basket Survey in 16 Cities, June 2001

Capital city	Cost (R$)
Porto Alegre	127.6
São Paulo	127.6
Rio de Janeiro	120.5
Curitiba	119.7
Brasilia	116.1
Florianopolis	115.9
Belo Horizonte	115.9
Vitoria	110.9
Aracaju	107.4
Belem	104.1
Fortaleza	101.5
Goiania	101.1
João Pessoa	100.9
Natal	98.9
Recife	97.5
Salvador	94.6

Source: DIESSE (Interunion Department of Statistics and Socio-Economic Studies), June 2001.

The gross national minimum wage is R$ 180, but drops to R$ 166 net of Social Security taxes. From Table 2, the adult worker would have to work 156 hours a month in Porto Alegre or São Paulo in order to buy a basket, but only 115½ hours in Salvador. Also, the wealthier southeastern cities have higher prices than the poorer north and northeastern cities. These may illustrate price level differences, but a) the quantity weights are fixed across cities, and b) the surveys are for salaried workers and may not reflect the 'average poor' consumer. However, prices are collected across outlets and weighted by frequency of purchase in those outlets, for about 1000 consumers in each city, and it would be interesting to merge this information with, for example, average income data at those outlets.

Another source of price survey data is the IBGE (Instituto Brasileiro de Geografia e Estatistica). These are not specific to prices paid by salaried workers as in the DIESSE data described above, but their coverage is more comprehensive, even though they are averaged across each city. Since the IBGE also publishes the corresponding weights for each heading in each city, their price levels can be compared to the fixed quantity weights price levels above. In the next section we describe the data used in this paper, followed by a comparison of our results and the two basket levels obtained from the DIESSE and IBGE price surveys. Then in Section 3, we begin a more detailed analysis of our data with respect to expenditure weights and prices by income groups and by metropolitan areas.

2. Description of Data

Our expenditure and price data are based on a national survey known as POF (*Pesquisa de Orçamento Familiar*) for 1995-96, and its sampling frame represents 12.5 million families (46.4 million people) in the eleven largest metropolitan areas of Brazil: Porto Alegre, Curitiba, São Paulo, Rio de Janeiro, Belo Horizonte, Salvador, Recife, Fortaleza, Belem, Brasilia and Goiania. Brazil's total population was estimated at 161.5 million in 1996.

This data set has fewer cities than the DIESSE set described in the previous section because it is a more comprehensive sample, with quantity weights and more detailed expenditure headings. The data contain 236,053 observations on expenditures for 41 food products that constitute the food 'basket' proposed by ECLAC (1989). These observations reflect actual purchases made by just over 16,000 households. There are an additional five hundred thousand observations on other expenditures, but for this paper, we begin with only the food categories, as they may be more easily comparable across countries in ECLAC. The food basket accounts for approximately one quarter of all consumption expenditures, and corresponds to between 66% and 31% of total food and drink expenditures of families earning less than 2 minimum salaries and more than 30 minimum salaries, respectively.

Nearly eighty percent of the observations (181,000) had both quantity and expenditure information, and for reasons discussed below, the prices used in this exercise are based on the unit values calculated for each heading[4]. This made it possible to aggregate the data by income groups and by metropolitan area. In the future, it is hoped that final product data will be collected instead of the implicit prices used here. Efforts to undertake this are planned for São Paulo and 15 other cities in a joint effort by the University of São Paulo and the Institute for Economic Research (FIPE). This would enable us to match outlet prices and location with consumers, since the POF contains the point-of-purchase data for each product. As mentioned earlier, there are price surveys published by the Brazilian Institute of Geography and Statistics (IBGE), and include the basket bundle described in the previous section, but they are aggregated for the entire city, and cannot be obtained by income group.

[4] Menezes, Gaiger and (2002) use the unit values in an analysis of demand functions, based on the same data set.

Our final expenditure and implicit price matrix consists of observations on 39 food headings for 11 cities and 30 income group levels. The income groups range from families earning one minimum salary per month to over thirty minimum salaries per month. We also have a number of variables related to each income group level within each city, such as the total per capita expenditures, average household size, number of equivalent adults, years of schooling, number of rooms per dwelling, and type and number of household appliances.

Figure 1 below shows the average nominal monthly per capita income for each city. The four cities with the lowest average incomes, Recife, Fortaleza, Salvador and Belem, are in the northeast and north, and the cities in the south and southeast tend to have higher incomes. Brasilia is the capital in the central part of the country, and records the highest nominal per capita income.

Figure 1 Nominal Monthly per capita Income

The population of each city is given in Figure 2. São Paulo alone accounts for 34% of the population and 41% of the income in this sample. At the other extreme, Belem is the smallest city with 2% of the population and only 1.3% of the total income. Recife, the poorest, has 6.3% of the population and 3.4% of the total income.

Unit Values

> Since it is currently not possible to obtain price surveys by income groups, we return briefly to the issue of unit values versus specification prices at outlets based on point-of-purchase surveys. There are at least two major concerns with the use of unit values, namely (i) keeping quality constant, and (ii) keeping quantities constant. In (i), a comparison of differences between unit values and prices for all consumers may indicate the 'problem' headings. With respect to (ii) if the poor do purchase food products in smaller quantities, thus incurring a packaging premium of some kind, this should be reflected in the aggregate price level. But the combination of the two becomes intractable. The most we can do here is analyze the raw data and flag the larger discrepancies between the two.

A table of the unit values that we use (labeled POF), and the prices (labeled IBGE), for each of the 39 headings, is given below. These are the unweighted averages across 11 cities. The third column is the ratio of the unit values to the prices, and the last column is the expenditure weight (in percentages) averaged across all cities, from the POF data. The table is sorted by the unit value to price ratio.

Table 3 Prices in 1996 R$	Unit Values (POF) (1)	Prices (IBGE) (2)	Ratio (1)/(2)	Expenditure Weight

Table 3 Prices in 1996 R$	Unit Values (POF) (1)	Prices (IBGE) (2)	Ratio (1)/(2)	Expenditure Weight
1 MILK	0.80	3.48	0.23	9.2%
2 LIMES	0.81	2.33	0.35	0.2%
3 SAUSAGE	2.04	4.57	0.45	0.7%
4 HAM	5.34	9.12	0.59	0.7%
5 PORTUGUESE SAUSAGE	3.33	5.43	0.61	1.2%
6 FISH	3.65	5.68	0.64	11.4%
7 BUTTER	4.83	6.93	0.70	0.6%
8 BANANA	0.89	1.21	0.73	2.0%
9 ITALIAN SAUSAGE	2.48	3.27	0.76	0.7%
10 POWDERED MILK	6.20	8.14	0.76	3.3%
11 CHEESE	5.83	7.60	0.77	2.0%
12 LIVER	2.18	2.73	0.80	3.2%
13 PORK	2.66	3.28	0.81	1.3%
14 ONIONS	0.59	0.73	0.81	0.7%
15 MAYONNAISE	4.20	4.81	0.87	0.4%
16 MANIOC FLOUR	0.59	0.65	0.90	0.5%
17 GROUND COFFEE	5.68	6.27	0.91	3.7%
18 MEAT (1ST GRADE)	3.69	4.07	0.91	11.0%
19 ORANGES	0.43	0.46	0.94	1.6%
20 CHICKEN	1.72	1.83	0.94	8.7%
21 MANIO	0.60	0.63	0.96	0.3%
22 MEAT (2ND GRADE)	2.38	2.49	0.96	6.6%
23 SUGAR	0.53	0.54	0.97	3.2%
24 FRENCH BREAD	2.26	2.16	1.04	3.0%
25 MARGARINE	3.10	2.96	1.05	1.5%
26 CABBAGE	0.58	0.54	1.06	0.2%
27 RICE	0.74	0.67	1.10	5.8%
28 PASTA	1.70	1.49	1.14	1.9%
29 GARLIC	5.43	4.74	1.15	0.4%
30 SALT	0.36	0.32	1.15	0.3%
31 POTATO	0.74	0.63	1.18	1.8%
32 WHEAT FLOUR	0.79	0.66	1.21	1.2%
33 CRACKERS	3.34	2.74	1.22	1.7%
34 TOMATO PASTE	4.13	3.39	1.22	0.4%
35 COOKIES	3.84	3.09	1.24	2.3%
36 TOMATO	0.86	0.68	1.26	1.4%
37 BEANS	1.07	0.82	1.30	0.8%
38 SOYBEAN OIL	1.58	1.04	1.52	2.6%
39 YOGHURT	7.71	4.18	1.85	1.5%
Average Ratio (weighted by expenditures)			0.88	

There are some large differences. For example, Yoghurt has unit values 1.85 times the IBGE prices, and Milk is at the other end of the range, with unit values less than a quarter of the specification price[5].

[5] Menezes has been in contact with the IBGE about the existing differences in prices at the city level. They are partially due to the treatment of missing values and aggregation methods.

The weighted average of the ratios is 0.88, and the weighted average across the headings for each city is shown in Table x. The cities are in ascending income order. Both high income (São Paulo, Brasilia) and low income (Recife) show smaller ratios.

Table 4	Average Ratio (unit value/price) Weighted by expenditure values
Recife	0.85
Fortaleza	0.91
Salvador	0.92
Belem	0.91
Belo Horizonte	0.94
Goiania	0.95
Rio de Janeiro	0.88
Curitiba	0.83
Porto Alegre	1.00
São Paulo	0.83
Brasilia	0.81

Figure 3 shows the distribution of the ratios by their expenditure share weight. Fish, milk, meats and rice have the largest weights, but the meats, chicken and rice ratios are close to 1.00. More worrying is the milk and fish headings, with low unit value to price ratios and large weights in the expenditure distribution.

Figure 2. Distribution of Unit Value to Price Ratios

In the next sections, we proceed with the estimation of the (unit value) price levels, followed by an analysis of the differences across cities and between the various income groupings.

3. Methodology

We use the aggregation method known as the country-product-dummy (CPD) approach, originally developed by Summers (1973) and Kravis et al. (1975) and used more recently in weighted form by, among others, Rao (1995), Aten (1999) and Kokosky, Cardiff and Zieschang (1999). Rao suggests weighting each observation by its expenditure value, so that we in fact minimize the weighted residual sum of squares, rather than just the residual sum of squares. He calls this weighting a generalized CPD, and he shows that the resulting estimates are equivalent to a multiplicative version of the Geary method. Although the additive consistency in the regular Geary system is lost, the CPD method allows us to compare variances of estimates (Rao 1995). This is what we use here. That is, the weights are the normalized expenditures on each city, or share values[6]. We refer to

[6] Weights based on expenditure quantities, rather than share values, resulted in only marginally different estimates. The highest difference was for Soybean Oil, a 7.3% differential in expected price. The changes in price levels for cities were less than 1%.

our unit values as *prices* in the sections that follow, but will return later to some of the implications of the use of unit values on the results.

1) Heading and City Price Levels

In the first set of comparisons, the log of the price vector is regressed on a set of dummy variables representing the headings and the cities. To avoid perfect multicollinearity, not all dummies are included in the regression.

The section below illustrates the interpretation of the estimated dummy coefficients (adapted from Kennedy (1992, 216-227)). For example, we exclude one of the cities, and we omit the intercept in a regression of the eleven cities and their 39 headings in Equation 1:

Equation 1.

$$\ln P = a_1 H_1 + a_2 H_2 + ... + a_{39} H_{39} + g_1 R_1 + g_2 R_2 + ... + g_{10} R_{10} + e$$

H_1 is a dummy variable taking the value one whenever the price observation is for sugar, and zero otherwise; H_2 through to H_{39} are similarly defined for all the other food headings. The Rs are the dummy variables for the cities, with the last city, R_{11}, excluded, to avoid perfect multicollinearity.

The log price in the excluded city is given by the coefficient of the related dummy variable, plus an error term. The estimate of α_1 is the expected sugar price in city 11 (Brasilia), α_2 the expected meat price in Brasilia, and so forth. The interpretation of each γ is the extent to which belonging to a particular city changes the log price, regardless of heading.

2) Heading and Income Price Levels

If we substitute income class dummies for the city dummies, the relationship is shown in Equation 2:

Equation 2

$$\ln P = a_1^* H_1 + a_2^* H_2 + ... + a_{39}^* H_{39} + b_1 INC_1 + b_2 INC_2 + ... + b_{29} INC_{29} + e$$

The βs are simply the extent to which a particular income class changes the log price, regardless of heading. We exclude the highest income class (INC_{30}). INC_1 corresponds to households earning 1-2 minimum salaries, INC_2 corresponds to 2-3 minimum salaries, up to INC_{30}, with households earning 30 minimum salaries or more. The α^*s reflect the expected log prices in the highest income class, averaged across all cities.

We also test the model with a condensed income group aggregation: low, middle and high. The low income group consists of households in INC_1 through INC_{10}, middle is INC_{11} through INC_{20} and high is INC_{21} through INC_{30}. In this case, the high income group dummy is excluded during model estimation and becomes the base group.

3a) Heading, Income and City Price Levels

If we combine the two equations above, and use both city and income class dummies, the CPD equation is given in 3a below:

Equation 3a.

$$\ln P = a_1^{**} H_1 + ... + a_{39}^{**} H_{39} + b_1^{*} INC_1 + ... + b_{29}^{*} INC_{29} + g_{11}^{*} R_1 + ... + g_{10}^{*} R_{10} + e$$

No dummy for income class 30 or for city 11 is included, otherwise we would again have perfect multicollinearity, since $H_1 + H_2 + \ldots + H_{39} = INC_1 + INC_2 + \ldots + INC_{30}$, or $H_1 + H_2 + \ldots + H_{39} = R_1 + R_2 + .. + R_{11}$.

The α^{**}s are the expected log prices for the omitted income (class 30) in the omitted city (R=11). The interpretation of the β^{*}s is the extent to which belonging to a particular income class changes the log price, regardless of heading and city. In other words, the difference in log price between income classes is the same for all headings and cities. Similarly, the interpretation of each γ^{*} is the extent to which belonging to a particular city changes the log price, regardless of heading and income class. As in the previous section, we test the model with just a condensed income group aggregation of low, middle and high class.

3b) Heading, Income and City Price Levels with Interaction

The final set of CPD estimates allows the city and income dummies to interact. We use only the three condensed income groups. This specification is shown in Equation 3b:

Equation 3b

$$\begin{aligned}\ln P = {} & a_1^{***} H_1 + ... + a_{39}^{***} H_{39} + d_{Low\,1}(INC_{Low} * R_1) + ... + d_{Low\,11}(INC_{Low} * R_{11}) + ... \\ & ... + d_{Mid\,1}(INC_{Mid} * R_1) + ... + d_{Mid\,11}(INC_{Mid} * R_{11}) + ... \\ & ... + d_{High\,1}(INC_{High} * R_1) + ... + d_{High\,10}(INC_{High} * R_{10}) + e\end{aligned}$$

The highest income group for city 11 is omitted ($\delta_{High\,11}$), so that the α^{***}s are the expected log prices of each heading in the highest income group in Brasilia. The interpretation of the dummies is straightforward: $\delta_{Low\,1}$, for example, is the extent to which being in the low income group in city 1 differs from that of the high income group

in Brasilia, $\delta_{Low\ 11}$ is the extent to which being in the low income group in Brasilia differs from that of the high income group in Brasilia, and so forth.

The important difference between Equations 3a and 3b is that in 3a, the differences between income groups is the same for all cities, whereas 3b allows these differences to vary across cities. That is, in 3a, the expected price is "the sum of two parts, one attributable to being in a low-income group and the other attributable to being in a particular city; there is no role for any special effect that the combination of interaction of city and income group might have" (Kennedy 1992, p.219).

4. Results

Section 1.City Price Levels is a comparison of estimated price levels using only heading and city dummy variables (Equation 1).

First, in **Section 1 a) Unit Values versus IBGE Prices**, we show the price levels obtained from the IBGE data and the price levels obtained from our unit values POF data. Since the IBGE data is not broken down into income groups, we estimate Equation 1 across all income levels.

In **Section 1b) Income Class 1 Expenditure Weights**, we apply the poorest class (INC_1) expenditure weights to a middle income class (INC_{16}) set of prices, and examine whether it makes a difference in the resulting city price levels.

In **Section 1c) Income Class 1 versus Income Class 16 versus Income Class 30** we run three separate CPDs, one for each class using Equation 1, and obtain the heading and city price levels for each. Since each class will have a set of heading coefficients reflecting the expected prices in Brasilia for that income class, the differences in city price levels are not comparable in absolute magnitude. They reflect the variation relative to different sets of average prices. The international analogy would be obtaining PPPs relative to different currency units, or obtaining price levels for a group of countries at different latitudes. Even if there is country overlap, the price levels will reflect variation relative to different average international prices.

Section 2. Income Price Levels, substitutes the city dummies with income class dummies (Equation 2). The base is the highest class (INC_{30}), and the resulting price levels reflect the extent to which a lower class changes the expected prices, regardless of heading. The city variation is assumed to be equal to zero. Two sets of equations are estimated, the first using all 30 income classes and the second using a condensed grouping of low, middle and high income.

In **Section 3a. Income and City Price Levels**, we use dummy variables for both Income class and for City (Equation 3a). Again, we estimate coefficients for all the 30 income classes and then for a condensed low, middle and high income grouping. The omitted dummy is the highest class or the highest income group in Brasilia.

Finally, in **Section 3b. Income and City Price Levels with Interaction,,**. we look at the effect that the combination or interaction of income group and city may have on the expected prices (Equation 3b).

1. City Price Levels

a) Unit Values versus Prices.

Table 5 shows the relative prices from the three different data sets highlighted in this paper. The first column is the DIESSE poverty basket price relatives, the second column shows the price levels that Azzoni, Do Carmo and Menezes (2000) estimated for ten of these cities, based on the 1996 IBGE price survey. Their basket includes housing, transport and other goods, with only 32 food items out of 59 products. The range of their price levels is greater: from 1.13 (São Paulo) to 0.88 (Fortaleza, Belem, and Belo Horizonte), relative to Brasilia (1.00). Our estimated price levels using unit values are shown in column 3. The cities are in ascending order of nominal incomes per capita.

Table 5. City Price Levels – Unit Values versus Prices

Table 5 Cities ordered by increasing income	DIESSE (2001 poverty basket)	Azzoni et al (1996 IBGE data - includes services)	Unit Values (1996 POFdata –only food headings)
Recife	0.84	0.94	1.01
Fortaleza	0.87	0.88	0.94
Salvador	0.81	0.93	1.00
Belem	0.90	0.88	1.06
Belo Horizonte	1.00	0.88	0.94
Goiania	0.87	-	0.92
Rio de Janeiro	1.04	1.05	1.06
Curitiba	1.03	0.91	0.99
Porto Alegre	1.10	0.93	1.08
São Paulo	1.10	1.13	1.07
Brasilia	1.00	1.00	1.00
Range	**0.29**	**0.25**	**0.16**

Sources: Diesse (2001) and Azzoni, Carmo, e Menezes (2000).

Broadly speaking, city price levels for Diesse are higher in the higher income cities (Rio de Janeiro, Curitiba, Porto Alegre, São Paulo) while the two other columns – IBGE and POF data, do not appear to have the same pattern. Diesse represents the poverty basket described previously, and their weights are the same in all cities. The relatives across the cities for IBGE and POF levels follow the same pattern, except for Porto Alegre, with a below-Brasilia price level in the IBGE data (0.93) but a 1.08 price level in our data. The

patter is similar in that the lower price levels are for Fortaleza and Belo Horizonte and the higher levels are for Rio de Janeiro and São Paulo.

One obvious difference is the overall higher levels for the POF data, and the larger range of levels for the IBGE data. Part of the explanation may be that our POF sample is for food headings only, while the results from Azzoni et al contain other headings, in addition to services. This would suggest that components of the basic food basket are relatively expensive in the poorer cities.

b) Income Class 1 Expenditure Weights

In this section we apply the lowest income class (INC_1) expenditure weights to a middle class (INC_{16}) set of prices and compare them to the levels using only median income group data. This was one of the modifications discussed earlier in the Background section: using poverty-specific expenditure distributions instead of national average expenditure distributions. Table 6, column 1, shows the price levels in the cities for Income Class 16 (between 15-16 minimum salaries) and the corresponding price levels when the expenditure weights of Income Class 1 (between 1-2 minimum salaries) are used instead of the Class 16 weights.

Table 6. City Price Levels for Median Class

Table 6 City Price Levels	INCOME CLASS 16 (1)	SAME WITH CLASS 1 EXPENDITURE WEIGHTS (2)	Difference (1)-(2)
RECIFE	0.978	0.972	0.006
FORTALEZA	0.933	0.903	0.030
SALVADOR	0.929	0.934	-0.005
BELEM	1.008	0.999	0.009
BELO HORIZONTE	Min 0.895	Min 0.858	0.037
GOIANIA	0.912	0.887	0.025
RIO DE JANEIRO	1.014	0.961	0.053
CURITIBA	0.929	0.943	-0.014
PORTO ALEGRE	0.983	0.954	0.029
SÃO PAULO	Max 1.075	Max 1.041	0.034
BRASILIA	1	1	0
Range	**18%**	**18.3%**	

The range does not change significantly (18.3% versus 18%), and 8 of the 10 cities have lower price levels relative to Brasilia with the lower income weight distribution. Rio has the largest decrease, from 1.014 to 0.961, while the largest increase is for Curitiba.

c) Class Level 1 versus Class Level 16 versus Class Level 30

The final comparison in this section is where we take the lowest, the middle, and the highest class levels (INC_1, INC_{16} and INC_{30} respectively) and run separate regressions in the form of Equation 1. It is important to stress here that the resulting city price levels cannot be compared directly, since each group faces different average prices, given by (the antilog) of the heading coefficients. In Table 7 we show the estimates for both headings and city levels for each of these class levels.

Table 7. Heading and City Price Levels for Three Class Levels

	Table 7 City and Heading Price Levels	(Lowest class) INC_1	(Median class) INC_{16}	(Highest class) INC_{30}
	HEADING	(R$)	(R$)	(R$)
1	Sugar	0.442	0.559	0.626
2	Meat (2nd grade)	1.914	2.601	2.763
3	Onions	0.494	*0.604*	0.587
4	Chicken	1.246	1.642	2.312
5	Mayonnaise	3.328	4.227	4.731
6	Margarine	2.526	3.152	3.657
7	Italian sausage	2.174	2.640	3.010
8	Oils	0.946	1.310	2.965
9	Tomatoes	0.756	0.817	1.049
10	Oranges	0.331	0.409	0.465
11	Butter	5.149	5.868	6.214
12	Rice	0.574	0.781	0.793
13	Fish	1.737	2.902	6.692
14	Salt	0.262	0.354	0.353
15	Garlic	4.127	5.718	6.890
16	Salty crackers	2.689	3.572	3.634
17	Manioc flour	0.446	0.689	0.735
18	Powdered milk	5.760	7.174	8.044
19	Meat (1st grade)	2.785	3.660	4.525
20	Banana	0.633	0.998	1.091
21	Yogurt	6.366	8.193	9.212
22	Limes	0.754	0.959	0.999
23	Potatoes	0.658	0.750	0.936
24	Manioc	0.534	0.678	0.753
25	Cheeses	4.536	5.726	7.422
26	Tomato paste	*4.597*	4.482	5.027
27	Liver	1.589	2.769	2.752
28	Ham	3.944	6.969	7.422
29	Wheat flour	0.709	0.791	0.857
30	Sausage	1.954	2.526	2.942
31	Portuguese sausage	3.150	3.744	4.262
32	Cabbage	0.507	0.649	0.703
33	Pork	1.866	2.453	3.797
34	Beans	0.861	1.117	1.227
35	Milk	0.632	0.848	0.970
36	Macaroni	1.260	1.635	2.152
37	French bread	1.889	2.297	2.597

	Table 7 City and Heading Price Levels	(Lowest class) INC_1	(Median class) INC_{16}	(Highest class) INC_{30}
38	Cookies	2.913	3.767	4.537
39	Coffee	4.873	5.942	6.035
	CITY)	**INC_1**	**INC_{16}**	**INC_{30}**
1	RECIFE	1.204	0.978	0.943
2	FORTALEZA	1.225	0.933	Min 0.817
3	SALVADOR	1.149	0.929	0.874
4	BELEM	1.262	1.008	0.896
5	BELO HORIZONTE	1.111	Min 0.895	0.958
6	GOIANIA	1.066	0.912	0.818
7	RIO DE JANEIRO	Max 1.325	1.014	Max 1.031
8	CURITIBA	1.277	0.929	0.900
9	PORTO ALEGRE	1.261	0.983	0.951
10	SÃO PAULO	1.127	Max 1.075	1.000
11	BRASILIA	Min 1.000	1.000	1.000
	Range	**32.5%**	**18%**	**21.4%**

Expected prices for nearly all headings increase as we increase the class level, although some of the increases likely reflect the large quality differential that was pointed out earlier. For example, the Fish heading (13) has an average price (in Brasilia) of R$1.737 in the low-income level group, but R$ 6.692 in the highest class. Only three headings appear to decrease in average price: onions, tomato paste, and liver, and these by relatively small amounts.

In terms of city price levels, the differences are more dramatic, although care must be taken in their interpretation. For example, the poor (class level 1) in Recife, pay 1.204 times what the poor in Brasilia pay, regardless of heading, but the middle (class level 16) in Recife, pay only 0.978 times what their middle class counterparts in Brasilia pay.

This does not necessarily mean that the poor pay more than the middle or the wealthy class groups because the levels are relative to the average price in that income class group. For example, if we take the first heading, for Sugar, the expected average price of sugar in Brasilia for the poor is R$0.442. For the middle class it is R$ 0.559 and for the wealthier group it is R$ 0.626. The poor in Recife may expect to pay on average, 1.204 times R$ 0.442, or R$ 0.53, while the middle group in Recife will expect to pay 0.978 times R$ 0.559, or R$ 0.55 for Sugar. It may be the case that for some of the headings, the differentials will result in a higher average price paid by the low class, but the effect of both class and city levels are examined in more detail in Section 3.

What is less obvious from the table are comparisons within a column, for example, within the INC_{30} column. The highest class in Fortaleza face lower prices on average than their high class counterparts in São Paulo (Fortaleza is 0.817 to São Paulo's 1.00), but the low class in Fortaleza faces higher prices than its low income counterpart in São Paulo (1.225 versus 1.127, respectively). In other words, the poorest person is better off buying food

in São Paulo than in Fortaleza, but the richer person is better off buying food in Fortaleza[7].

2. Income Price Levels

In this section, we estimate Equation 2, which substitutes the city dummies of Equation 1 with income group dummies. Two sets of equations are estimates, one with all classes and one condensing the 30 income classes into three groups: low, middle and high income groups. These groups correspond to aggregations of the classes used in the survey, namely households earning between 0 and 10, 11 and 20, and 21 to 30 or more minimum salaries. Note that in the previous section we took one income class from each minimum salary band – the first (INC_1), the median (INC_{16}) and the highest (INC_{30}) class.

Using only income dummies we constrain the city variation in price levels to be zero, and simply look at the extent to which belonging to a particular income group changes the expected prices. In Table 8, the expected prices for each heading and the income price levels relative to the omitted income dummy (the highest class – INC_{30} in the first column, and the highest income group in the second column).

Table 8. Heading and Income Price Levels

	Table 8 Heading and Income Price Levels	30 income classes	3 income groups
	HEADING	R$	R$
1	Sugar	0.589	0.553
2	Meat (2nd grade)	2.656	2.502
3	Onions	0.652	0.613
4	Chicken	1.893	1.784
5	Mayonnaise	4.822	4.547
6	Margarine	3.405	3.215
7	Italian sausage	3.091	2.919
8	Oils	1.498	1.411
9	Tomatoes	0.934	0.880
10	Oranges	0.477	0.448
11	Butter	6.105	5.757
12	Rice	0.837	0.787
13	Fish	3.411	3.204
14	Salt	0.398	0.375
15	Garlic	6.233	5.857
16	Salty crackers	3.692	3.475
17	Manioc flour	0.770	0.727
18	Powdered milk	7.759	7.326
19	Meat (1st grade)	4.055	3.823
20	Banana	1.013	0.952

[7] That is, if we assume that quality differences stemming from unit values are smaller across cities at different income levels than across income groups within a city.

	Table 8 Heading and Income Price Levels	30 income classes	3 income groups
21	Yogurt	8.685	8.208
22	Limes	1.008	0.951
23	Potatoes	0.832	0.783
24	Manioc	0.770	0.728
25	Cheeses	6.527	6.160
26	Tomato paste	4.906	4.640
27	Liver	2.761	2.598
28	Ham	7.189	6.760
29	Wheat flour	0.870	0.820
30	Sausage	2.606	2.455
31	Portuguese sausage	4.034	3.820
32	Cabbage	0.685	0.644
33	Pork	3.335	3.168
34	Beans	1.173	1.110
35	Milk	0.873	0.823
36	Macaroni	1.861	1.748
37	French bread	2.551	2.404
38	Cookies	4.199	3.954
39	Coffee	6.365	5.997

INCOME CLASS		INCOME GROUP	
Lowest	1	0.840	Low	0.917
	2	0.849	Middle	0.940
	3	0.859	High	1.000
	4	0.842		
	5	0.881		
	6	0.871		
	7	0.856		
	8	0.890		
	9	0.882		
	10	0.858		
	11	0.882		
	12	0.865		
	13	0.869		
	14	0.891		
	15	0.872		
Middle	16	0.884		
	17	0.890		
	18	0.897		
	19	0.902		
	20	0.903		
	21	0.883		
	22	0.922		
	23	0.941		
	24	0.920		
	25	0.927		
	26	0.944		
	27	0.942		

Table 8 Heading and Income Price Levels	30 income classes	3 income groups
28	0.968	
29	0.984	
Highest 30	1.000	

The average heading prices are those expected by the highest class (column 1) and highest income group (column 3), across all cities. The income coefficients show the extent to which belonging in a particular income class, or group, changes this expected average price. Here we see more clearly that the lowest income classes will pay less than the higher income classes, except for a drop in class 21 and some peaks in classes 8 and 14. Overall, the lowest class will pay only 0.84, or 84% of the price paid by the highest class, regardless of heading. Similarly, the lowest income group pays on average, 91.7% of the prices paid by the highest income group.

As shown in the previous section, there is variation across cities, so it is possible that for some headings, the expected prices for a lower income group in one city may exceed those for a higher income group in another city, but the average effect appears to be that expected average prices increase with income. In the next section we examine both the effects of city and income group variation on the price levels.

3a. Income and City Price Levels

The results in this section are the estimates of Equation 2. That is, we run one regression for all the observations, with dummy variables for headings, for income and for cities. There are no interaction effects, and the expected (log) price is composed of three parts – one attributable to the heading, one to the income class or group and one to the city. The income group refers to the same condensed grouping of the 30 classes into Low, Medium and High incomes used in the previous section.

The antilog of each heading estimate (e^{α}) is the expected price of the heading for the highest income group in the base city, Brasilia (in 1996 R$). These and the income and city price levels are shown in Table 9.[8].

	Table 9 Heading, Income and City Price Levels	30 Income Classes	3 Income Groups
	HEADING	R$	R$
1	Sugar	0.586	0.551
2	Meat (2nd grade)	2.644	2.493

[8] They are sorted in alphanumerical order, hence p2 follows p19, p3 follows p29, and p9 is the last one on the list.

	Table 9 Heading, Income and City Price Levels	30 Income Classes		3 Income Groups
3	Onions	0.652		0.614
4	Chicken	1.881		1.774
5	Mayonnaise	4.787		4.518
6	Margarine	3.386		3.199
7	Italian sausage	3.064		2.896
8	Oils	1.491		1.405
9	Tomatoes	0.927		0.875
10	Oranges	0.469		0.441
11	Butter	6.061		5.720
12	Rice	0.829		0.780
13	Fish	3.313		3.115
14	Salt	0.394		0.371
15	Garlic	6.204		5.836
16	Salty crackers	3.657		3.446
17	Manioc flour	0.771		0.728
18	Powdered milk	7.722		7.298
19	Meat (1st grade)	4.020		3.793
20	Banana	1.001		0.942
21	Yogurt	8.542		8.080
22	Limes	1.006		0.949
23	Potatoes	0.824		0.776
24	Manioc	0.768		0.726
25	Cheeses	6.436		6.080
26	Tomato paste	4.872		4.612
27	Liver	2.749		2.589
28	Ham	7.041		6.627
29	Wheat flour	0.866		0.817
30	Sausage	2.588		2.441
31	Portuguese sausage	3.989		3.780
32	Cabbage	0.678		0.639
33	Pork	3.324		3.161
34	Beans	1.163		1.102
35	Milk	0.868		0.819
36	Macaroni	1.859		1.748
37	French bread	2.476		2.335
38	Cookies	4.238		3.995
39	Coffee	6.318		5.958
	INCOME CLASS		INCOME GROUP	
	Lowest 1	0.842	Low	0.918
	2	0.854	Middle	0.941
	3	0.862	High	1.000
	4	0.843		
	5	0.883		
	6	0.874		
	7	0.858		

Table 9 Heading, Income and City Price Levels	30 Income Classes	3 Income Groups
8	0.892	
9	0.884	
10	0.860	
11	0.883	
12	0.868	
13	0.869	
14	0.893	
15	0.873	
Middle 16	0.885	
17	0.890	
18	0.899	
19	0.905	
20	0.904	
21	0.884	
22	0.922	
23	0.942	
24	0.920	
25	0.927	
26	0.945	
27	0.943	
28	0.969	
29	0.984	
Highest 30	1.000	
CITY		
RECIFE	1.016	1.016
FORTALEZA	0.942	0.942
SALVADOR	1.000	0.999
BELEM	1.066	1.066
BELO HORIZONTE	0.940	0.940
GOIANIA	0.925	0.925
RIO DE JANEIRO	1.059	1.059
CURITIBA	0.989	0.989
PORTO ALEGRE	1.084	1.084
SÃO PAULO	1.070	1.070
BRASILIA	1.000	1.000

The estimates for the income classes and groups follow the same pattern as in Table 8, that is, they increase with increasing income. The range is also similar, from 0.842 in the lowest income class and 0.918 in the lowest group. The class levels are shown graphically in Figure 4.

Figure 3. Income Class Price Levels

The city prices levels are nearly identical whether we use all classes or a condensed grouping, and are consistent with results from the previous sections. Rio de Janeiro, São Paulo, and Porto Alegre have higher price levels than Brasilia, as might be expected, given their size and their per capita nominal income levels. However, Recife, the poorest city, as well as Belem, also have higher price levels than Brasilia, while Curitiba, one of the richer cities, has a lower level than Brasilia. These results are consistent with results by Aten (1999) based on 1985 IBGE data with observed food prices, instead of unit values.

3b. Income and City Price Levels with Interaction

In the above estimates of Equation 3, the differences in price levels are forced to be equal across headings. That is, the shift in the regression line due to income group or city is the same for all headings, and there are no interaction effects. One way to examine whether interaction effects are significant is to remove the old dummy variables and create new ones, such that the new dummies are combinations of the old ones. For example, remove the income and city dummies and create a set of 32 (3x11, minus one as base), dummies corresponding to each combination of income (low, middle, high) and city. This was shown in Equation 3b.

Table 10 shows the results of this estimation.

The highest income group for city 11 is omitted so that the heading estimates are the expected prices in the highest income group of Brasilia. The interpretation of the dummies is straightforward: Low Recife, for example, is the extent to which being in the Low income group in Recife differs from that of the High income group in Brasilia, Low Brasilia is the extent to which being in the Low income group in Brasilia differs from that of the High income group in Brasilia, and so forth. The important difference between these results and Table 9 are that the differences between income group levels are allowed to vary across cities.

Table 10
City and Income Interaction

HEADING		
1	Sugar	0.550
2	Meat (2nd grade)	2.487
3	Onions	0.613
4	Chicken	1.767
5	Mayonnaise	4.509
6	Margarine	3.192
7	Italian sausage	2.884
8	Oils	1.402
9	Tomatoes	0.873
10	Oranges	0.440

Table 10 City and Income Interaction				
11	Butter	5.707		
12	Rice	0.778		
13	Fish	3.109		
14	Salt	0.369		
15	Garlic	5.824		
16	Salty crackers	3.435		
17	Manioc flour	0.726		
18	Powdered milk	7.285		
19	Meat (1st grade)	3.788		
20	Banana	0.939		
21	Yogurt	8.048		
22	Limes	0.945		
23	Potatoes	0.774		
24	Manioc	0.725		
25	Cheeses	6.049		
26	Tomato paste	4.594		
27	Liver	2.581		
28	Ham	6.605		
29	Wheat flour	0.815		
30	Sausage	2.436		
31	Portuguese sausage	3.771		
32	Cabbage	0.637		
33	Pork	3.145		
34	Beans	1.098		
35	Milk	0.817		
36	Macaroni	1.742		
37	French bread	2.337		
38	Cookies	3.977		
39	Coffee	5.943		

CITY * INCOME	Low	Mid	High
RECIFE	0.926	0.959	1.030
FORTALEZA	0.900	0.897	0.901
SALVADOR	0.907	0.941	1.018
BELEM	0.967	1.027	1.062
BELO HORIZONTE	0.839	0.871	0.986
GOIANIA	0.856	0.875	0.919
RIO DE JANEIRO	1.001	1.001	1.035
CURITIBA	0.918	0.921	0.998
PORTO ALEGRE	1.046	1.005	1.058
SÃO PAULO	0.944	1.004	1.114
BRASILIA	0.904	0.961	**1.000**

The range in levels is 27.4%, with the lowest level in the Low income group in Belo Horizonte (0.839) and the highest is in the High income group in São Paulo (1.114). That is, the low income group in Belo Horizonte pays 83.9% of what the high income group

expects to pay in Brasilia, while the high income group in São Paulo pays 111.4% of what the high income group in Brasilia expects to pay.

Figure 5 shows the interaction dummies in a graph. Unlike the results of Section 1, the difference in magnitude across price levels is directly comparable, as the expected average price (for the base, equal to the high income group in Brasilia), is the same for all estimates. Fortaleza and Porto Alegre both have higher price levels in the low income group relative to their middle and high income groups. Fortaleza in the low income group has a price level of 0.900 which is slightly higher than in the middle group (0.897). The low income group level in Porto Alegre is 1.046 compared to 1.005 in the middle income group. However, in general, the price levels increase with income within cities.

Figure 4. Income and City Price Levels

On the other hand, we see again that some of the poorer cities have high price levels (Recife and Belem in particular), while Curitiba has a lower price level than might be expected for a relatively rich city. Similarly, the poor in Belem pay higher relative prices than the poor in São Paulo (0.967 versus 0.944). The contrast is greater between the two poorest cities: the high income group in Fortaleza has an average price level that is lower than the lowest income group in Recife (0.901 versus 0.926)

There appear to be two patterns –within cities (or within a country as a whole) and the other across cities. When we look at differences in price levels by income within cities, or for the country as a whole, price levels increase with increasing income. However, when we look at across-city variations, there are low income cities with high price levels and vice versa, and this pattern persists for any given income group.

The last graph, Figure 6, shows the price levels normalized on the national average (Brazil = 1.00). It highlights the fact that an estimate of poverty price levels should take into account sub-national data. Rio de Janeiro's poor would be undercounted if we took an absolute measure of poverty based on national levels, since all income groups in Rio pay above average prices for food headings. However, the reverse is true in São Paulo, as in many of the other cities.

Figure 5. Price Levels relative to National Average

Conclusion

The background section in this paper describes the current literature on the modifications to a PPP that is estimated at the level of GDP that would make it more suitable for poverty level comparisons. These include changes to the expenditure weights and adjustments to the prices, so that PPPs might better reflect consumption patterns of low-income groups. The second section is an empirical analysis of the use of price level adjustments in Brazil. We begin with a description of the 'poverty basket' concept, and use data from eleven metropolitan regions to illustrate some of the differences between price levels at various income groupings within and across the cities.

The method used throughout is the weighted Country Product Dummy (CPD) approach that enables us to obtain the expected average prices for each heading, and to separate the income from the city effect in the estimated prices. It also measures the variance and robustness of the different estimators, although this comparison is not given here[9].

Our price data are based on unit values, so there are numerous caveats with respect to our results, most critical being whether quality is held constant when unit values are used across income groups. Given this uncertainty, we attempt to compare more closely the headings that have larger discrepancies and also show the estimates of city price levels based on specification prices in relation to our estimates. Overall, average unit values (averaged across all income group and cities) are lower than the average prices. The fish and milk headings, with large expenditure shares, show the largest discrepancies between unit values and prices. Having said this, our results are consistent with other work that uses specification prices for food headings only.

In the analysis we compare the estimated CPD coefficients for various equations. We find that price levels increase with increasing incomes within cities, but that is not true for price levels across cities. That is, poorer cities may have relatively high price levels, and the reverse is also true.

In either case, it is safe to say that estimating an income-specific price level, or a set of regional price levels, would alter the way one counted those in poverty. An example from our data are the cities of Rio de Janeiro and Porto Alegre, where the price levels for the low income groups are higher than the national average price level.

This paper shows that price levels across income levels and regions may be large. The type of analysis that we carried out, using weighted least squares and dummy variables, is relatively easy to compute, and makes it simple to compare and interpret the resulting price levels, including the associated errors of the estimates. The critical challenge lies in obtaining prices that hold constant the unit of purchase and the quality of the purchased good, in addition to information that links the specified price with the income level and location of the buyer.

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[9] Some details of each model are provided as an Annex, although we have not yet included a discussion.

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Figure 1. Nominal per capita Incomes and Population for 11 cities in Brazil

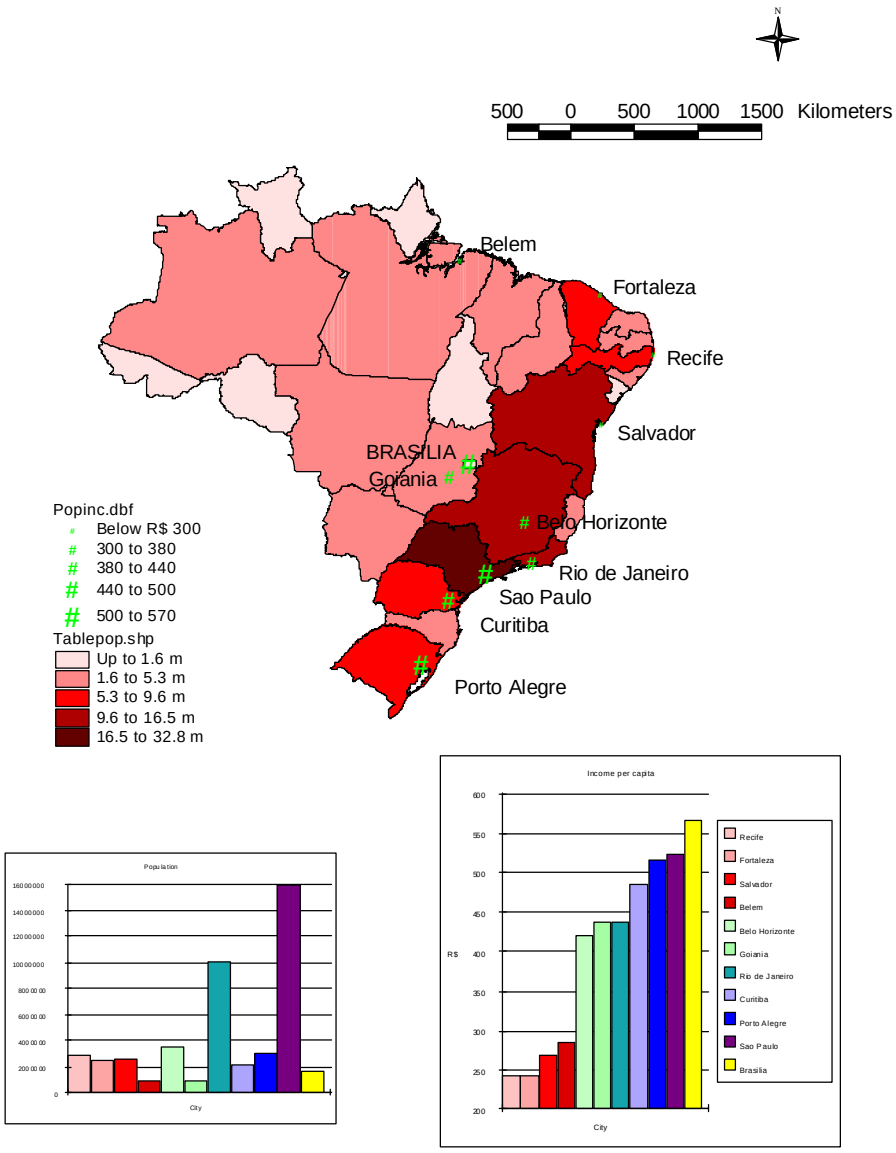

Figure 2. Distribution of Unit Value to Price Ratios

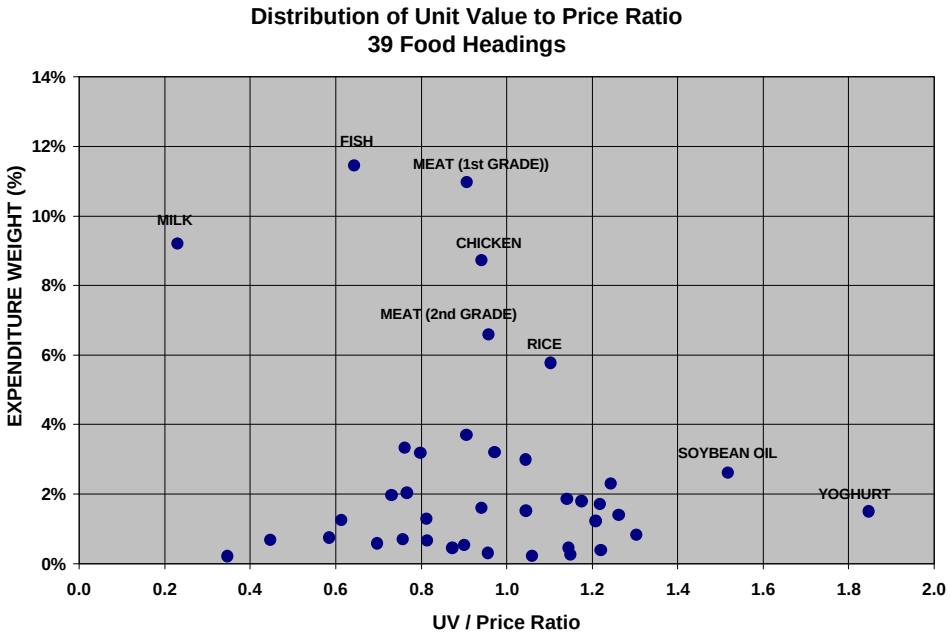

Figure 3. Income Class Price Levels

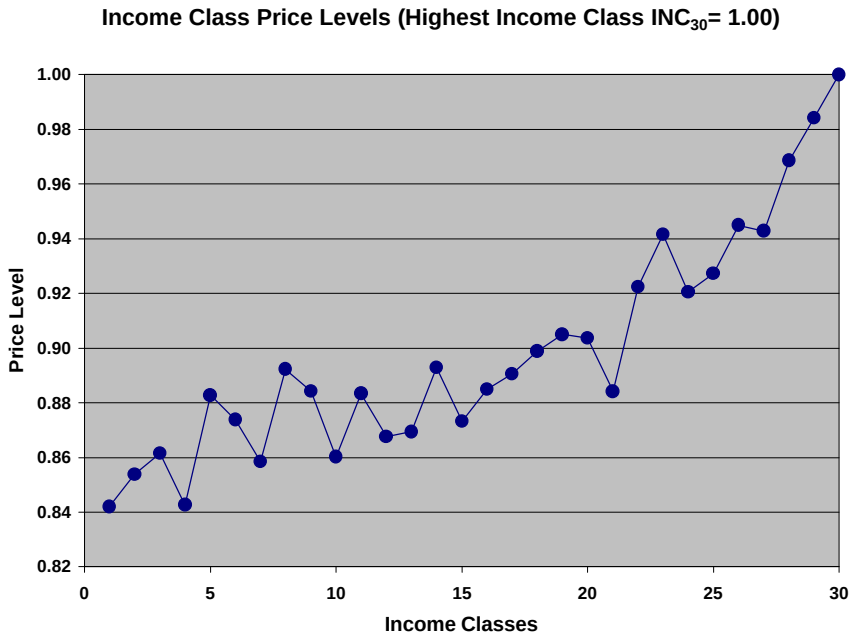

Figure 4 Income and City Price Levels

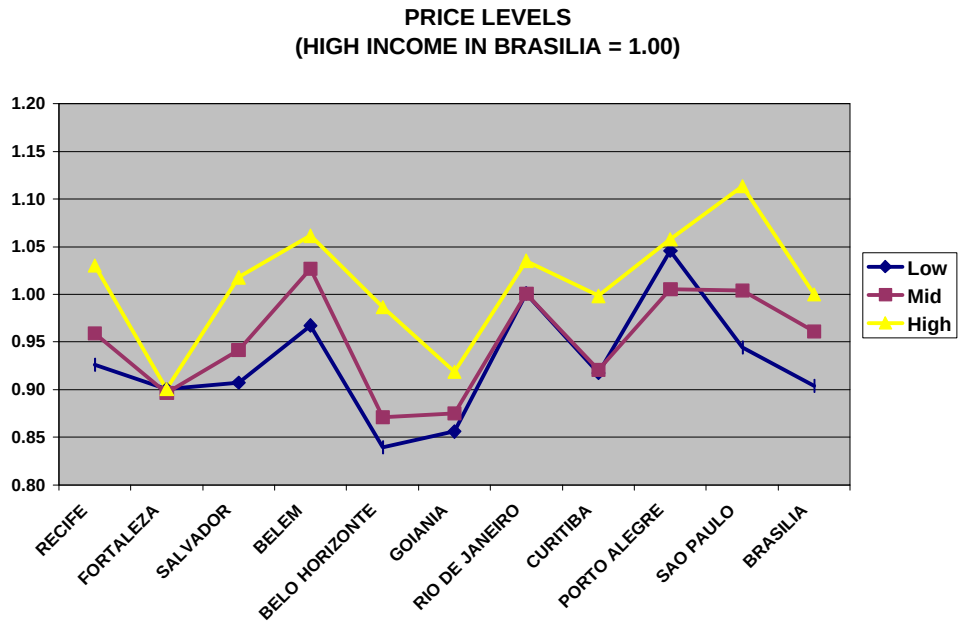

Figure 5. Price Levels relative to National Average