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Supplementary Article

Comparing Costs of Living across World Cities

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Abstract

This paper compares costs of living across world cities. The International Comparison Program (ICP) reports price levels across world economies in its calculation of purchasing power parity through an extensive scale of price data collection and rigorous methodology. While the price levels are reported only at the national level, some modification makes it possible to compare the cost of living across a group of world cities. In addition, various agencies report costs of living rankings for world cities on a regular basis, and some of them, such as the Economist Intelligence Unit (EIU)'s World Cost of Living Survey, systematically collect a wide variety of items from a host of cities, even covering low-income countries. This article's application of the ICP method to the EIU price data yields an overall reasonable result: richer cities have higher price levels, and the rankings of cities based on their price levels are similar when using the ICP and EIU data. Nevertheless, the results based on the EIU data differ from the ICP data relatively widely in some nonfood items and among cities with low price levels. This result highlights important issues regarding the data and methodology required to measure costs of living for development purposes.

JEL classification: E31, O47, R32

Keywords: purchasing power parity, price level, urbanization, International Comparison Program, Sub-Saharan Africa

1. Introduction

The cost of living (COL) in a city and comparison with other cities comprise important information for development policy in several aspects. First, welfare and poverty measurements require a COL adjustment. Comparing household consumption aggregates across space, such as urban and rural areas, without taking account of spatial differentials in the COL could result in underestimation of poverty in areas with higher price levels (Ravallion 2008). Some empirical studies find the significant impacts of spatial price adjustment on welfare and poverty measurements (e.g., Jolliffe, Datt, and Sharma 2004; Gibson, Le, and Kim 2017). Second, the COL is a key determinant for the productivity and population size of cities. High costs inhibit firms' production of tradable goods by raising the level of nominal wages and making firms less competitive (Venables 2017). This may be particularly constraining for African cities, which mostly produce nontradable goods and services (Lall, Henderson, and Venables 2017). Together with the shape

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of a wage curve, in theory, the COL also influences the population size of a city (Duranton 2008). Thus, appropriately measuring the COL across cities is an essential task.

However, measuring spatial differences in the COL requires a non-trivial effort due to a number of methodological challenges. Unlike the consumer price index (CPI), which measures temporal changes in prices, COL indexes measure differences in prices across space, and have several unique challenges.[1] Goods and services typically consumed by households may vary widely across countries. The margins of error surrounding the COL depend on the reliability of the underlying price and expenditure weights, but also the extent to which the goods and services priced reflect the consumption patterns and the price levels of each country, and the inherent variability in price and economic structures between countries. Thus, the COL across countries that have similar price and economic structures are more precise than those between countries that are dissimilar.

The International Comparison Program (ICP) measures costs of living across countries in order to measure the size of economies (i.e., purchasing power parity, PPP), though it does not report price levels at the subnational level. The ICP produces PPPs, which are used to adjust nominal gross domestic product (GDP) in local current units by taking into account the cross-country differences in price levels (World Bank 2015a and 2015b).[2] Price levels, or the price level index (PLI) that is derived by dividing PPPs by nominal exchange rates, are officially reported only at the country level. Using the ICP data, the authors' previous study (Nakamura et al. 2019) calculates PLI at the city level for countries where price data were collected predominantly in major cities or where the price adjustment ratio can be used to recover city-level PLI. However, this kind of adjustment was possible for only a limited number of countries.[3]

Although they are widely used, worldwide COL city rankings reported by various private agencies are not always useful for development purposes. Several agencies report the rankings of world cities based on the COL on a regular basis. For example, the Economist Intelligence Unit (EIU) reports such ranking biannually as the World Cost of Living Survey. Its 2016 COL index highlights Singapore, Hong Kong, Zurich, Tokyo, and Osaka as the top five most expensive cities, while listing Mumbai, Karachi, Bangalore, Lagos, and Almaty as the least expensive (The Economist 2017). While these rankings provide useful information for employers who need to calculate the amount of compensation for internationally hired staff, they are not always convenient to use for development purposes.

By taking advantage of the wide item and geographic coverage of the EIU price data, this paper experiments with calculating the COL across world cities relevant for development. The study selects a basket of items in the EIU price data relevant for the non-expat population and applies the same method used by the ICP to calculate PLIs for cities. To assess the results, those PLIs were then compared with the PLIs that are calculated based on the ICP data adjusted for the city level, following Nakamura et al. (2019). In so doing, this study aims to highlight the kinds of price data and methodology that are required for development purposes.

This study's application of the ICP method to the EIU price data yields an overall reasonable result: richer cities have higher price levels, and PLI-based city rankings are similar between the ICP and EIU data. Nevertheless, the results based on the EIU data differ from the ICP data relatively widely in some nonfood items and among cities with low PLIs. This is probably because the basket of goods and services in the EIU survey does not include what locals in low-income cities typically consume, while the ICP basket covers the good and services typically consumed by the average consumer. Moreover, while the

1 Of course, constructing the CPI itself has many challenges (e.g., Hamilton 2001; Gaddis 2016), and its impacts on poverty can be significant (Dabalen, Gaddis, and Nguyen 2019).

2 The PPP is also used in the measurement of international poverty by the World Bank (Ferreira et al. 2016).

3 Although the fact that price data were collected predominantly in urban areas in many countries made it possible to obtain PLIs at the city level, this urban bias in price data collection is by no means ideal for poverty measurement in general (Ravallion and Chen 2010).

Figure 1. Cities in EIU Data

ICP uses national expenditure weights, the EIU uses an identical set of weights that is internationally based and not geared toward the spending pattern of any specific country.

The rest of this paper is structured as follows. Section 2 explains the methodology by presenting the EIU and ICP data and showing how PLIs are calculated based on them. Section 3 reports the results of calculated PLIs across cities and comparison of the EIU- and ICP-based PLIs. Section 4 concludes.

2. Methodology

Data

The EIU's World Cost of Living survey collects data for the survey in 140 cities in nearly 90 countries every year (see fig. 1 and table A1.1 in appendix A1 for the list of cities used for this study's analysis).[4] Survey prices of more than 160 items are gathered from supermarkets, medium-priced retailers, and more expensive specialty shops (see appendix A2 for the list of food items in the EIU data). The EIU's data contain price information for a number of cities in low-income countries. For example, nine cities in eight Sub-Saharan Africa countries are included in the data: Abidjan, Dakar, Douala, Harare, Johannesburg, Pretoria, Lagos, Lusaka, and Nairobi. For the purpose of comparison with the 2011 ICP data, the study uses only EIU price data collected in 2011.

The ICP is a global statistical program designed to collect comparable price data and report estimates of PPPs of the world's economies. The ICP collects price data for comparable goods and services and compiles national accounts expenditure data that are used as weights. The national statistical office of each country collects the underlying data for each economy. The ICP requires that price collection be conducted based on a nationally representative survey frame that would result in national annual average prices. However, due to the limited coverage of country's CPI survey frames and/or shortage in resources, some countries opted to collect in urban areas (or capital cities) only.

The indicator primarily used in this study is the PLI for the household consumption component of GDP, which indicates the price level of goods and services faced by the average household in each country for a given year, relative to a reference country or group of countries.[5] PLIs are calculated by dividing the

4 Cities included in the EIU survey have changed over time.

5 The study does not include the PLIs of housing rents in household consumption, because they are calculated based on data collected by different methods across regions and classified as a "comparison-resistant component" by the ICP.

PPPs by the nominal exchange rate for each country. Interpreting the PLI for a country is straightforward; for instance, when using the United States as a reference country with its PLI of 100, Country A's PLI of 50 for food items indicates that food is overall 50 percent cheaper in Country A relative to the United States.

This study selects 56 countries from the ICP data, for which it can calculate PLIs for the capital or largest cities that are covered by the EIU data (table A1.1 in appendix A1). PLIs for the capital cities can be directly calculated in countries where price data were collected in those cities. For African and Asian countries that did not collect price data predominantly in urban areas, their price relatives are adjusted to the price relatives of capital cities based on the known price level ratio between them (African Development Bank 2012; Asian Development Bank 2013).

Calculation of PLI Based on the EIU Price Data

Because the EIU data record prices in local currency units, they are not directly comparable across cities in different countries. This study calculated a price level index for each category of goods and services as of 2011 as follows. At the first stage, elementary PPPs were calculated based on the local currency unit prices from the EIU price data, using the Country Product Dummy (CPD) method.[6] The CPD regression can be written as:

$$\ln p_{cp} = y_{cp} = x_{cp}\beta + \varepsilon_{cp}$$

where P_{cp} is the price of product p in city c; Dc_j and Dp_i are city and product dummies, respectively; Np and Nc are number of products and cities, respectively; and

$$x_{cp} = [Dc_2 \ldots Dc_{Nc} Dp_1 Dp_2 \ldots Dp_{Np}]$$
$$\beta = [\alpha_2 \ldots \alpha_{Nc} \gamma_1 \gamma_2 \ldots \gamma_{Np}]^T$$

At the second stage, elementary PPPs were aggregated using the Gini-Éltetö-Köves-Szulc (GEKS) method. This method is nonadditive and consists of two stages. First, the basic heading PPPs were aggregated using the national accounts expenditure structures to obtain the bilateral Fisher PPPs (F-PPPs) for all pairs of cities.[7] For any two cities j and k, the binary F-PPP was computed as:

$$P_{F\,j,k} = \left(\left(\frac{\sum_i p^i_j q^i_k}{\sum_i p^i_k q^i_k} \right) \left(\frac{\sum_i p^i_j q^i_j}{\sum_i p^i_k q^i_j} \right) \right)^{1/2}$$

Second, all direct and indirect F-PPPs were averaged geometrically to obtain the transitive GEKS-PPPs. The GEKS-PPPs were computed as:

$$P_{GEKS\,j,k} = \left(\prod_l P_{F\,j,l} / P_{F\,k,l} \right)^{1/K}$$

where K is the total number of cities. Finally, the PLIs were calculated as the ratio of the PPP to the exchange rate and expressed as a percentage.

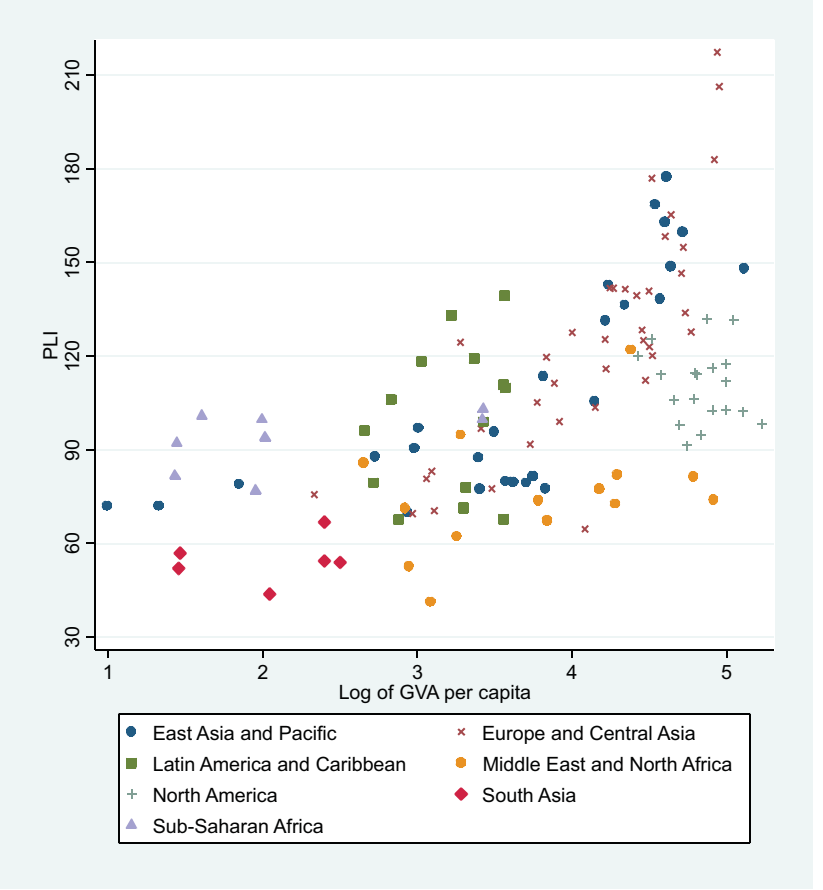
3. Results

Figure 2 summarizes the results of the PLI calculations for world cities by applying the ICP method to the EIU price data. Overall, price levels are higher in richer cities, which are measured by the per capita gross

6 Each city was treated separately.

7 National expenditure structures were used as a proxy for city-level expenditure structures.

Figure 2. Costs of Living Rankings of World Cities Based on Modified EIU Data



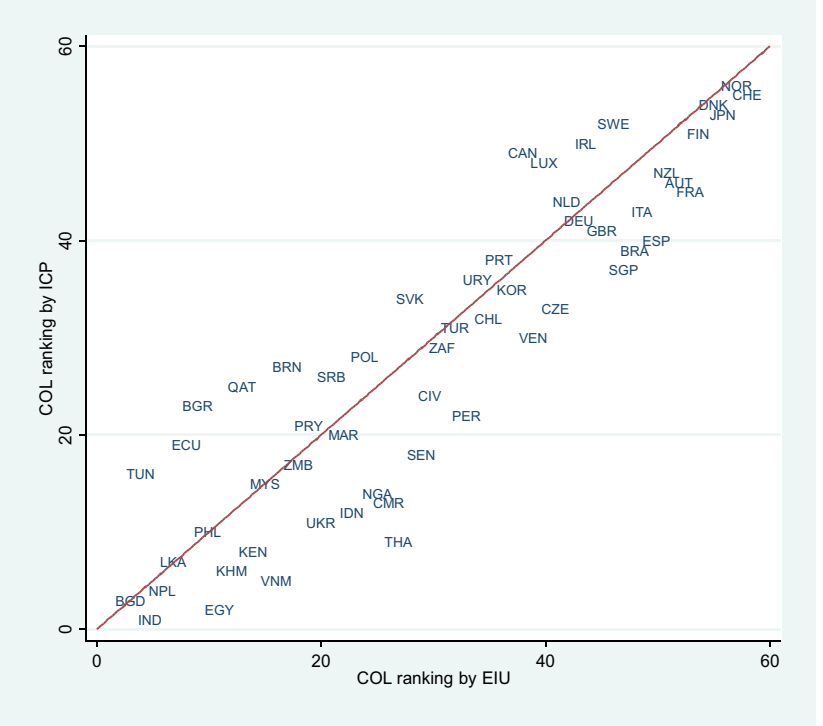
Source: Authors' calculations based on the EIU price data.
Note: Price level index (PLI) is normalized so that the average score equals to 100.

value added (GVA) (Oxford Economics 2015). The arc shape below is similar to what the ICP reports for world economies (World Bank 2015a). This observation is aligned with the Balassa-Samuelson model (Balassa 1964; Samuelson 1964), which explains higher price levels in more developed countries by their higher relative productivity in traded goods.[8] Because exchange rates equate the price of tradable goods across countries, relative productivity in tradable goods leads to higher wages in the tradable sector in richer countries. This results in a rise in prices of nontradable goods and services and the overall price levels of the countries. In addition, as observed by Nakamura et al. (2019), African cities have higher PLIs relative to their income level.

The study then compares the rankings of cities based on the EIU data and the ICP data, finding a similarity in their rankings. Among the 140 cities in the EIU data, 56 cities are matched with the ICP data. In ranking those cities, they are ordered from the lowest PLI (1 = Delhi [India]) to the highest PLI (56 = Oslo [Norway]). The rankings are highly correlated as many cities are clustering around the 45-degree line in fig. 3 and the correlation coefficient is very high (0.902). The difference between the two rankings tends to be larger in cities with lower PLIs.

8 Some other explanations highlight difference in factor endowment (Bhagwati 1984) and nonhomothetic preferences (Bergstrand 1991).

Figure 3. Comparison of Costs of Living Rankings between the EIU and ICP Data



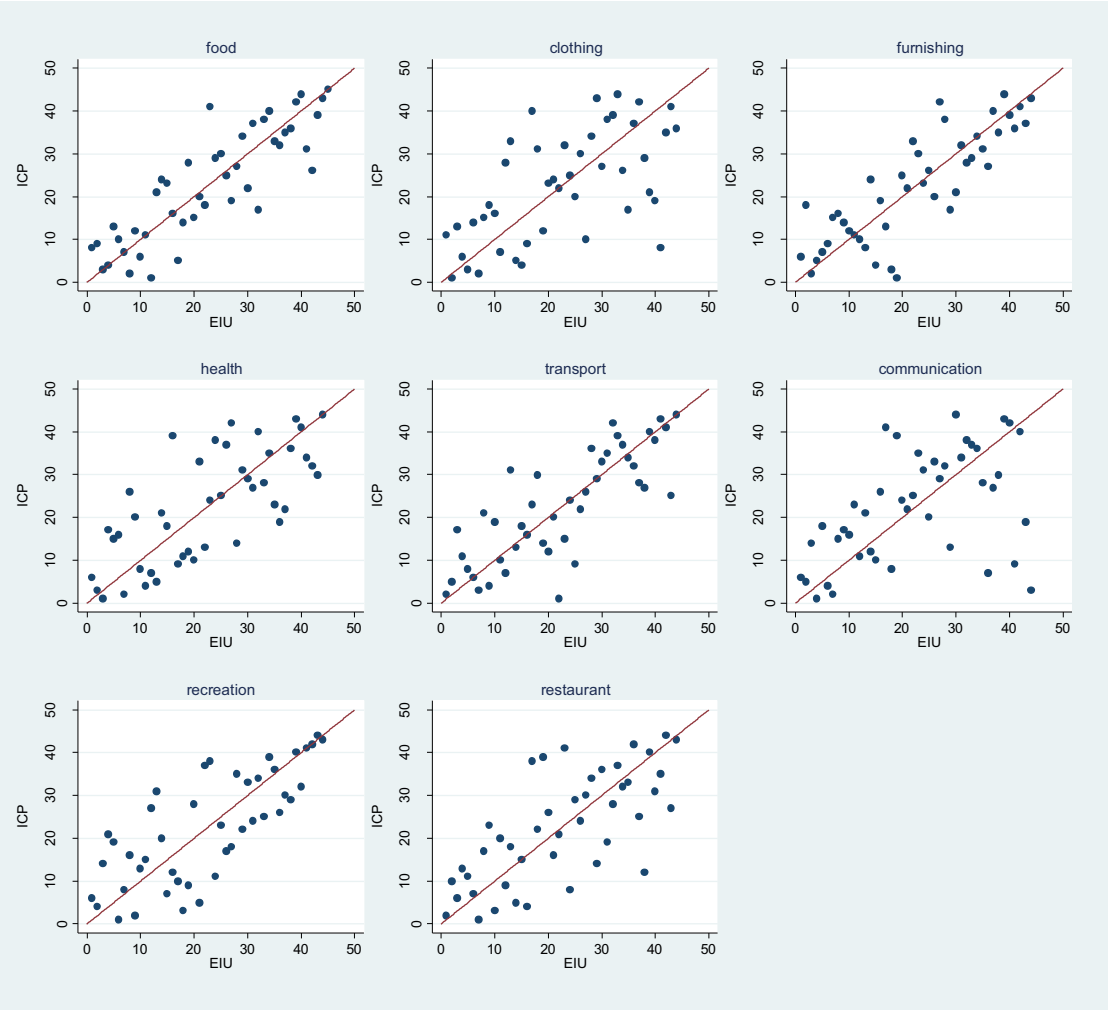
Source: Authors' calculations based on the ICP and EIU data.
Note: Countries are ordered from the lowest to highest PLI.

Another comparison of the EIU and ICP-based rankings for each category of items shows that the gaps are relatively wide in some nonfood categories. In addition to the PLIs for household consumption as a whole, this study calculates PLIs for the following categories of items: food and nonalcoholic beverages, clothing, furnishings, health, transport, communication, recreation, and restaurants. Unfortunately, it is not possible to compute such disaggregated PLIs for a group of Asian countries that required price adjustment from the national PLIs to capital-city PLIs, since such adjustment was possible only for household consumption as a whole. For the remaining 44 countries, their rankings were compared based on the EIU and ICP data (fig. 4). While PLIs for food are highly correlated (the correlation coefficient is 0.859), rankings differ widely in communications (0.499) and clothing (0.613). Unlike household consumption, the gaps in the rankings in communications and clothing are wider even among cities with higher PLIs.

4. Conclusion

The purpose of the exploratory analysis in this paper was to clarify what data and methodology are required to better measure costs of living across cities for development purposes. Various agencies report COL rankings for world cities on a regular basis, and some of them, such as the EIU's World Cost of Living Survey, systematically collect a wide variety of items from a host of cities, covering low-income countries. This study's application of the ICP method to the EIU price data yields an overall reasonable result: richer cities have higher price levels, and PLI-based city rankings are similar between the ICP and EIU data. Nevertheless, the results based on the EIU data differ from the ICP data relatively widely in some

Figure 4. Comparison of Item-Wise Costs of Living Rankings between the EIU and ICP Data



Source: Authors' calculations based on the ICP and EIU data.
Note: Countries are ordered from the lowest to highest PLI.

nonfood items and among cities with low PLIs. This is probably because the basket of goods and services in the EIU survey does not include what locals in low-income cities typically consume, while the ICP basket aims to cover the goods and services typically consumed by the average consumer. Moreover, while the ICP uses national expenditure weights, the EIU uses an identical set of weights that is internationally based and not geared towards the spending pattern of any specific country. Subnational COL indexes (or PPP) based on price data from country's CPI that are collected with a sampling frame explicitly covering subnational areas would be a useful product for development purposes.

Appendix A1. List of Cities in EIU Data Used for This Paper

Table A1.1. List of Selected Cities (EIU)

Region	City (countries/economies)
Sub-Saharan Africa	Abidjan* (Côte d'Ivoire), Dakar* (Senegal), Douala* (Cameroon), Harare* (Zimbabwe), Johannesburg* and Pretoria (South Africa), Lagos* (Nigeria), Nairobi* (Kenya)
Europe-OECD	Auckland* and Wellington (New Zealand); Adelaide, Brisbane, Melbourne, Perth, and Sydney (Australia); Amsterdam* (Netherlands); Athens (Greece); Atlanta, Boston, Chicago, Cleveland, Detroit, Honolulu, Houston, Los Angeles, Miami, Minneapolis, New York, Pittsburgh, San Francisco, Seattle, and Washington, DC (United States of America); Barcelona and Madrid* (Spain); Berlin*, Düsseldorf, Frankfurt, Hamburg, and Munich (Germany); Bratislava* (Slovakia); Brussels (Belgium); Budapest (Hungary); Calgary, Montreal, Toronto*, and Vancouver (Canada); Dublin* (Ireland); Geneva and Zurich* (Switzerland); Helsinki* (Finland); Copenhagen* (Denmark); London* and Manchester (United Kingdom); Lisbon* (Portugal); Luxembourg* (Luxembourg), Lyon and Paris* (France); Milan and Rome* (Italy); Osaka and Tokyo* (Japan); Oslo* (Norway); Prague* (Czech Republic); Seoul* (Republic of Korea); Singapore (Singapore); Stockholm* (Sweden); Taipei (Taiwan, China); Vienna* (Austria)
Middle East and North Africa	Abu Dhabi and Dubai (United Arab Emirates), Algiers (Algeria), Amman (Jordan), Cairo* (Egypt), Casablanca* (Morocco), Doha* (Qatar), Jeddah and Riyadh (Saudi Arabia), Kuwait City (Kuwait), Muscat (Oman), Tel Aviv (Israel), Tehran (Iran), Tunis* (Tunisia)
Eastern Europe and Central Asia	Almaty (Kazakhstan), Baku (Azerbaijan), Belgrade* (Serbia), Bucharest (Romania), Istanbul* (Turkey), Kiev* (Ukraine), Moscow (Russia), Sofia* (Bulgaria), St. Petersburg (Russia), Tashkent (Uzbekistan), Warsaw* (Poland)
Latin America	Asunción* (Paraguay), Buenos Aires (Argentina), Bogotá (Colombia), Caracas* (Venezuela), Guatemala City (Guatemala), Lima* (Peru), Montevideo* (Uruguay), Mexico City (Mexico), Panama City (Panama), Quito* (Ecuador), Rio de Janeiro, São Paulo* (Brazil), San Jose (Costa Rica), Santiago* (Chile)
East Asia and the Pacific	Bandar* (Brunei Darussalam); Bangkok* (Thailand); Beijing, Dalian, Guangzhou, Qingdao, Shanghai, Shenzhen, Suzhou, and Tianjin (China); Ho Chi Minh City* and Hanoi (Vietnam); Hong Kong (Hong Kong SAR, China); Jakarta* (Indonesia); Kuala Lumpur* (Malaysia); Manila* (Philippines); Phnom Pen* (Cambodia)
South Asia	Colombo* (Sri Lanka), Dhaka* (Bangladesh), Kathmandu* (Nepal), Karachi (Pakistan), Mumbai and New Delhi* (India)

Note: * Indicates cities that can be matched with the ICP data.

Appendix A2. List of Nonalcohol Food Items in the EIU Data

Apples (1 kg) (supermarket)
Apples (1 kg) (mid-priced store)
Bacon (1 kg) (supermarket)
Bacon (1 kg) (mid-priced store)
Bananas (1 kg) (supermarket)
Bananas (1 kg) (mid-priced store)
Beef: filet mignon (1 kg) (mid-priced store)
Beef: filet mignon (1 kg) (supermarket)
Beef: ground or minced (1 kg) (supermarket)
Beef: ground or minced (1 kg) (mid-priced store)
Beef: roast (1 kg) (supermarket)
Beef: roast (1 kg) (mid-priced store)
Beef: steak, entrecote (1 kg) (supermarket)
Beef: steak, entrecote (1 kg) (mid-priced store)
Beef: stewing, shoulder (1 kg) (supermarket)
Beef: stewing, shoulder (1 kg) (mid-priced store)
Butter, 500 g (mid-priced store)
Butter, 500 g (supermarket)
Carrots (1 kg) (supermarket)
Carrots (1 kg) (mid-priced store)
Chicken: fresh (1 kg) (supermarket)
Chicken: fresh (1 kg) (mid-priced store)
Chicken: frozen (1 kg) (supermarket)
Chicken: frozen (1 kg) (mid-priced store)
Coca-Cola (1 l) (supermarket)
Coca-Cola (1 l) (mid-priced store)
Cocoa (250 g) (supermarket)
Cocoa (250 g) (mid-priced store)
Cornflakes (375 g) (supermarket)
Cornflakes (375 g) (mid-priced store)
Drinking chocolate (500 g) (supermarket)
Drinking chocolate (500 g) (mid-priced store)
Eggs (12) (supermarket)
Eggs (12) (mid-priced store)
Flour, white (1 kg) (supermarket)
Flour, white (1 kg) (mid-priced store)
Fresh fish (1 kg) (supermarket)
Fresh fish (1 kg) (mid-priced store)
Frozen fish fingers (1 kg) (supermarket)
Frozen fish fingers (1 kg) (mid-priced store)
Ground coffee (500 g) (supermarket)
Ground coffee (500 g) (mid-priced store)
Ham: whole (1 kg) (supermarket)
Ham: whole (1 kg) (mid-priced store)
Instant coffee (125 g) (supermarket)
Instant coffee (125 g) (mid-priced store)
Lamb: chops (1 kg) (supermarket)
Lamb: chops (1 kg) (mid-priced store)
Lamb: leg (1 kg) (supermarket)
Lamb: leg (1 kg) (mid-priced store)
Lamb: Stewing (1 kg) (mid-priced store)
Lamb: Stewing (1 kg) (supermarket)
Lemons (1 kg) (supermarket)
Lemons (1 kg) (mid-priced store)
Lettuce (one) (supermarket)
Lettuce (one) (mid-priced store)
Margarine, 500 g (mid-priced store)
Margarine, 500 g (supermarket)
Milk, pasteurized (1 l) (supermarket)
Milk, pasteurized (1 l) (mid-priced store)
Mineral water (1 l) (supermarket)
Mineral water (1 l) (mid-priced store)
Mushrooms (1 kg) (supermarket)
Mushrooms (1 kg) (mid-priced store)
Olive oil (1 l) (supermarket)
Olive oil (1 l) (mid-priced store)
Onions (1 kg) (supermarket)
Onions (1 kg) (mid-priced store)
Orange juice (1 l) (mid-priced store)
Orange juice (1 l) (supermarket)
Oranges (1 kg) (supermarket)
Oranges (1 kg) (mid-priced store)
Peaches, canned (500 g) (supermarket)
Peaches, canned (500 g) (mid-priced store)
Peanut or corn oil (1 l) (supermarket)
Peanut or corn oil (1 l) (mid-priced store)
Peas, canned (250 g) (supermarket)
Peas, canned (250 g) (mid-priced store)
Pork: chops (1 kg) (supermarket)
Pork: chops (1 kg) (mid-priced store)
Pork: loin (1 kg) (supermarket)
Pork: loin (1 kg) (mid-priced store)
Potatoes (2 kg) (mid-priced store)
Potatoes (2 kg) (supermarket)
Sliced pineapples, canned (500 g) (supermarket)
Sliced pineapples, canned (500 g) (mid-priced store)
Spaghetti (1 kg) (supermarket)
Spaghetti (1 kg) (mid-priced store)
Sugar, white (1 kg) (supermarket)
Sugar, white (1 kg) (mid-priced store)
Tea bags (25 bags) (supermarket)
Tea bags (25 bags) (mid-priced store)
Tomatoes (1 kg) (supermarket)
Tomatoes (1 kg) (mid-priced store)
Tomatoes, canned (250 g) (supermarket)
Tomatoes, canned (250 g) (mid-priced store)
Tonic water (200 ml) (supermarket)
Tonic water (200 ml) (mid-priced store)
Veal: chops (1 kg) (supermarket)
Veal: chops (1 kg) (mid-priced store)
Veal: fillet (1 kg) (supermarket)
Veal: fillet (1 kg) (mid-priced store)
Veal: roast (1 kg) (supermarket)
Veal: roast (1 kg) (mid-priced store)
White bread, 1 kg (mid-priced store)
White bread, 1 kg (supermarket)
White rice, 1 kg (mid-priced store)
White rice, 1 kg (supermarket)
Yoghurt, natural (150 g) (supermarket)
Yoghurt, natural (150 g) (mid-priced store)

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