International Comparison of Retail Food Prices to Guide Agriculture and Food Systems

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Food Prices for Nutrition

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Agenda

1. Introduction
2. Methods and Datasets
3. Results in Mexico, South Africa, China, Vietnam, and the Philippines
4. Confidence Interval Analysis in Mexico
5. Conclusions
1. Introduction
Food Prices for Nutrition project has estimated to date the cost of a healthy diet in the world using ICP 2017 data, but these global datasets have limitations.

**Research question:** What would the cost of a healthy diet be if we were to use national price datasets from the Consumer Price Index (CPI)?

In this presentation, we explore using comprehensive CPI datasets for the cost of a healthy diet estimation in Mexico, South Africa, China, Vietnam, and the Philippines.
2. Methods and Datasets
Methods

The Cost of a Healthy Diet

- The cost of the least expensive locally-available foods to meet requirements for energy and food-based dietary guidelines.

Following the Healthy Diet Basket method

- A diet pattern comprised of the median amounts of each food group across 10 national food-based dietary guidelines that sums to a total of 2330 kcal (Herforth et. al., 2022).

<table>
<thead>
<tr>
<th>Food Group</th>
<th>Number of food items selected</th>
<th>Energy content (kcal)</th>
<th>Typical weights of example foods (g)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Starchy Staples</td>
<td>2</td>
<td>1,160</td>
<td>322 g dry rice</td>
</tr>
<tr>
<td>Vegetables</td>
<td>3</td>
<td>110</td>
<td>270-400 g</td>
</tr>
<tr>
<td>Fruits</td>
<td>2</td>
<td>160</td>
<td>230-300 g</td>
</tr>
<tr>
<td>Animal-source Foods</td>
<td>2</td>
<td>300</td>
<td>210 g egg</td>
</tr>
<tr>
<td>Legumes, Nuts &amp; Seeds</td>
<td>1</td>
<td>300</td>
<td>85 g dry bean</td>
</tr>
<tr>
<td>Oils &amp; Fats</td>
<td>1</td>
<td>300</td>
<td>34 g oil</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>11</strong></td>
<td><strong>2,330</strong></td>
<td></td>
</tr>
</tbody>
</table>
Datasets – Mexico and South Africa, publicly available NSO data

**Mexico**: monthly average prices of 122 items from **46 cities** in 2017
- 75 items: 12SS+6LNS+23AF+10V+18F+6FT
- High-quality data with multiple observations for each food item in each city/month
- Possibility to calculate confidence intervals

**South Africa**: monthly average prices of 152 items from **9 provinces** in 2017
- 86 items: 18SS +3LNS+43AF+12V+6F+4FT
- Food item variation across provinces: from 61-83

**Legend**: Starchy Staples – SS; Legumes, Nuts & Seeds – LNS; Foods from Animals – AF; Vegetables – V; Fruits – F; Oils and Fats – FT
Datasets – Vietnam and Philippines, FPN through NSO

**Vietnam**: monthly average prices of 176 items from 25 provinces in 2017
- 107 items: 18SS +9LNS+43AF+18V+16F+3FT
- Food item variation across provinces: 107

**Philippines**: monthly average prices from 83 provinces (17 regions) in 2017
- Starting from over 1500 items! - data cleaning and preparation with (at least) 3 rounds of food identification and matching work
- 180 items = 35SS+8LNS+46AF+45V+34F+12FT
- Food item variation across provinces: from 33-87

**Legend**: Starchy Staples – SS; Legumes, Nuts & Seeds – LNS; Foods from Animals – AF; Vegetables – V; Fruits – F; Oils and Fats – FT
Datasets – China, FPN through quasi-official data source

China: monthly average prices of 62 items from **100 cities/counties (31 provinces)** in 2017

- 52 items = 6SS+1LNS+22AF+14V+5F+4FT
- Food item variation across provinces: from 45-51
- Quasi-official food price datasets, in the purpose of cross-checking inflation data published by the NSO
- Covering all major food groups and common food items in China

**Legend:** Starchy Staples – SS; Legumes, Nuts & Seeds – LNS; Foods from Animals – AF; Vegetables – V; Fruits – F; Oils and Fats – FT
3. Results in Mexico, South Africa, China, Vietnam and the Philippines
Mexico – Cost of a Healthy Diet in 2017, by month

11.0%
Note: The dot is the average diet cost over 12 months in each city. Error bar refers to the standard deviation.
Mexico – Food selection and cost allocation

A. Food selection

1. Starchy Staples
   - Rice
   - Corn tortilla
   - Wheat flours
   - 1. Starchy Staples
   - Chayote
   - Cucumber
   - Green tomato
   - Tomato
   - Carrot
   - Onion

2. Legumes, Nuts and Seeds
   - Beans
   - Processed beans
   - Edible vegetable oils and fats

3. Animal Foods
   - Milk powder
   - American cheese
   - Egg

4. Vegetables
   - Fresh pasteurized milk

5. Fruits
   - Orange
   - Bananas
   - Avocado
   - Guava

B. Cost allocation

1. Starchy Staples
   - Wheat flours
   - Corn tortilla
   - Corn dough and flours
   - Pasta for soup

2. Legumes, Nuts and Seeds
   - Beans

3. Animal Foods
   - American cheese
   - Fresh pasteurized milk
   - Fresh cheese
   - Chicken

4. Vegetables
   - Milk powder
   - Egg
   - Onion
   - Carrot

5. Fruits
   - Orange
   - Bananas
   - Avocado
   - Guava
Mexico – Location-specific food

- Chayote
- Green tomato
- Corn tortilla
South Africa – Cost of a Healthy Diet in 2017, by month

Note: Box shows 25th-75th percentile of diet cost in each month of all 9 provinces. Blue dashed line refers to average cost of all provinces and months. Red dashed line is the single estimate of the diet cost by ICP 2017.
South Africa – Cost of a Healthy Diet in 2017, by province

**Note:** The dot is the average diet cost over 12 months in each province. Error bar refers to the standard deviation.
South Africa – Food selection and cost allocation

A. Food selection
1. Starchy Staples
   - Special maize
   - Cake flour
   - Super maize
   - Beetroot
   - Cabbage
   - Pumpkin
   - Onions
   - Carrots

2. Legumes, Nuts and Seeds
   - Baked beans - tinned
   - Peanuts

3. Animal Foods
   - Sunflower oil (incl canola oil)
   - Full cream milk - fresh
   - IQF chicken portions

4. Vegetables
   - Bananas
   - Apples
   - Pears

5. Fruits
   - Pineapple

B. Cost allocation
1. Starchy Staples
   - Special maize
   - Cake flour
   - Super maize

2. Legumes, Nuts and Seeds
   - Baked beans - tinned
   - Peanuts

3. Animal Foods
   - Sunflower oil (incl canola oil)

4. Vegetables
   - Bananas
   - Apples

5. Fruits
   - Pears
   - Pineapple
   - Carrots
   - Onions
   - Pumpkins
South Africa – Location-specific food

Beetroot  Pumpkin  Chicken giblets
China – Cost of a Healthy Diet in 2017, by month

Note: Box shows 25th-75th percentile of diet cost in each month of all 31 provinces. Blue dashed line refers to average cost of all cities and months. Red dashed line is the single estimate of the diet cost by ICP 2017.
Note: The dot is the average diet cost over 12 months in each province. Error bar refers to the standard deviation.
China – Food selection and cost allocation

A. Food selection

1. Starchy Staples
   - Wheat flour (standard)
   - Cornstarch
   - Wheat flour (special grade)
   - Rice (round-grained)
   - Tofu

2. Legumes, Nuts and Seeds
   - 2. Legumes, Nuts and Seeds

3. Animal Foods
   - Pork Meat, belly
   - Silver carp
   - Egg

4. Vegetables
   - Carrot
   - Garlic sprout
   - Chinese chives
   - Cabbage
   - Napa Cabbage

5. Fruits
   - Pear
   - Bananas
   - Tofu

6. Oils and Fats
   - Soybean oil

B. Cost allocation

1. Starchy Staples
   - Wheat flour (standard)
   - Cornstarch
   - Wheat flour (special grade)
   - Rice (round-grained)
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2. Legumes, Nuts and Seeds
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   - Egg
   - Silver carp
   - Pork Meat, belly

4. Vegetables
   - Carrot
   - Garlic sprout
   - Chinese chives
   - Cabbage
   - Napa Cabbage

5. Fruits
   - Pear
   - Bananas
   - Tofu

6. Oils and Fats
   - Soybean oil
China – Location-specific food

- Tofu
- Garlic sprout
- Napa Cabbage
Philippines – Cost of a Healthy Diet in 2017, by month

Note: Box shows 25th-75th percentile of diet cost in each month of all 83 provinces. Blue dashed line refers to average cost of all provinces and months. Red dashed line is the single estimate of the diet cost by ICP 2017.
Philippines – Cost of a Healthy Diet in 2017, by region

Note: The dot is the average diet cost over 12 months in each region. Error bar refers to the standard deviation.
Philippines – Food selection and cost allocation

A. Food selection

1. Starchy Staples
   - Corn Grits
   - Rice
   - Wheat Flour
   - Cassava
   - Mixed Vegetables

2. Legumes, Nuts and Seeds
   - Munggo
   - Raw Peanut
   - Lard
   - Cooking Oil

3. Animal Foods
   - Canned Fish
   - Dried Fish
   - Fresh, Pork

4. Vegetables
   - Squash
   - Kangkong
   - Onions
   - Sayote
   - Chayote

5. Fruits
   - Canned Fish
   - Dried Fish
   - Fresh, Pork

B. Cost allocation

6. Oils and Fats
   - Coconut Oil
   - Palm Oil
   - Vegetable Oil
   - Corn Oil

7. Legumes and Nuts
   - Dried Fish
   - Munggo
   - Fresh, Pork
   - Fresh Shells
   - Maize
Philippines – Location-specific food

Okra

Camote tops

Fresh avocado
Vietnam – Cost of a Healthy Diet in 2017, by month

Note: Box shows 25th-75th percentile of diet cost in each month of all 25 provinces. Blue dashed line refers to average cost of all cities and months. Red dashed line is the single estimate of the diet cost by ICP 2017.
Vietnam – Cost of a Healthy Diet in 2017, by province

Note: The dot is the average diet cost over 12 months in each province. Error bar refers to the standard deviation.
Vietnam – Food Selection and Cost Allocation

A. Food selection

1. Starchy Staples
   - Rice vermicelli
   - Ordinary rice, regular (Xí dạo or similar)

2. Legumes, Nuts, and Seeds
   - Navy bean (normal)
   - Oil (Neptune)
   - Mustard green

3. Animal Foods
   - Beef
   - Pork belly

4. Vegetables
   - Carrot
   - Cabbage
   - Mung bean sprouts

5. Fruits
   - Banana, dwarf
   - Vietnamese apple
   - Papaya

B. Cost allocation

1. Starchy Staples
   - Rice vermicelli
   - Ordinary rice, regular (Khang dan or similar)

2. Legumes, Nuts, and Seeds
   - Navy bean (normal)
   - Yellow dried soybean (type 1)
   - Mango (other countries)
   - Dried jackfruit (Vina Mit)
   - Vietnamese apple
   - Pineapple

3. Animal Foods
   - Beef
   - Pork belly

4. Vegetables
   - Carrot
   - Cabbage
   - Mung bean sprouts

5. Fruits
   - Banana, dwarf
   - Vietnamese apple
   - Papaya
   - Fresh clam
   - Whole duck without internal organs
Vietnam – Location Food

- rice vermicelli
- mung bean sprouts
- mustard green
4. Confidence Interval Analysis in Mexico
Data and method

- For each food item in each city/month, Mexico NSO published multiple observations
- Using Mexico City as an example, the observation numbers are from 18 (Nopales) - 170 (Beef)
- Monte Carlo simulation, assuming the sample mean $\sim N(\mu, \frac{\sigma}{\sqrt{n}})$ – randomly generate 1,000 estimated sample mean for each city-item-month
Results based on synthetic data

- Similar trends with higher precision/confidence

<table>
<thead>
<tr>
<th>Month</th>
<th>CoHD based on monthly average (2017 PPP USD)</th>
<th>CoHD based on synthetic data (2017 PPP USD with 95% CI)</th>
<th>Month</th>
<th>CoHD based on monthly average (2017 PPP USD)</th>
<th>CoHD based on synthetic data (2017 PPP USD with 95% CI)</th>
</tr>
</thead>
<tbody>
<tr>
<td>January</td>
<td>2.64</td>
<td>2.62 (2.53, 2.71)</td>
<td>July</td>
<td>2.84</td>
<td>2.82 (2.72, 2.90)</td>
</tr>
<tr>
<td>February</td>
<td>2.64</td>
<td>2.62 (2.52, 2.70)</td>
<td>August</td>
<td>2.83</td>
<td>2.82 (2.72, 2.91)</td>
</tr>
<tr>
<td>March</td>
<td>2.63</td>
<td>2.61 (2.53, 2.70)</td>
<td>September</td>
<td>2.87</td>
<td>2.86 (2.76, 2.95)</td>
</tr>
<tr>
<td>April</td>
<td>2.67</td>
<td>2.65 (2.56, 2.74)</td>
<td>October</td>
<td>2.84</td>
<td>2.82 (2.72, 2.91)</td>
</tr>
<tr>
<td>May</td>
<td>2.73</td>
<td>2.72 (2.62, 2.80)</td>
<td>November</td>
<td>2.93</td>
<td>2.91 (2.82, 3.00)</td>
</tr>
<tr>
<td>June</td>
<td>2.74</td>
<td>2.72 (2.63, 2.80)</td>
<td>December</td>
<td>2.93</td>
<td>2.91 (2.82, 3.00)</td>
</tr>
</tbody>
</table>
5. Conclusions
Conclusions

- Cost of a healthy diet using monthly subnational CPI data is lower than using the global ICP dataset, and reveals within-country variation
  - Although different CPI data structures are given in the five countries covered in this study, lower estimates ranging from 10%-30% consistently found
  - Subnational variations display across countries
  - Temporal variations (seasonality patterns) display in certain countries (Mexico and South Africa)
  - Cost portions by food group vary across countries, but not much within countries
  - More granular data in Mexico may help to generate 95% confidence intervals for the CoHD estimations – consistent with results from monthly average price
Conclusions

- **Key factors leading to the differences are:**
  - **Item selection:** Locally available nutritious foods, not surveyed by the ICP, may help reduce diet costs substantially.
  - **Item quality:** ICP prices standardized items across countries.
  - **Survey frame:** Differences can be due to survey framework and outlet section differences.
  - **Averaging method:** ICP national annual average is weighted, while here we are using simple average of monthly subnational CPI data.
  - **Quality assurance:** Differences are more pronounced in certain countries than others – ICP has robust quality assurance and validation protocols that some countries may not have the capacity for.
Conclusions

- The national CPI retail food price data could improve the precision of measuring and tracking the cost of a healthy diet
  - Provide more locally available nutritious food items.
  - The bottom line, annual subnational data, although monthly may help to assess seasonality.
  - However, quality assurance, data standardization, and data validation are extremely important for global monitoring programs.
  - CPI data access may pose challenges in certain countries.
DISCUSSIONS AND QUESTIONS