# Do remote rural people pay higher prices for more nutritious foods? Evidence from 130,975 price observations at rural markets in Malawi, 2007-2017

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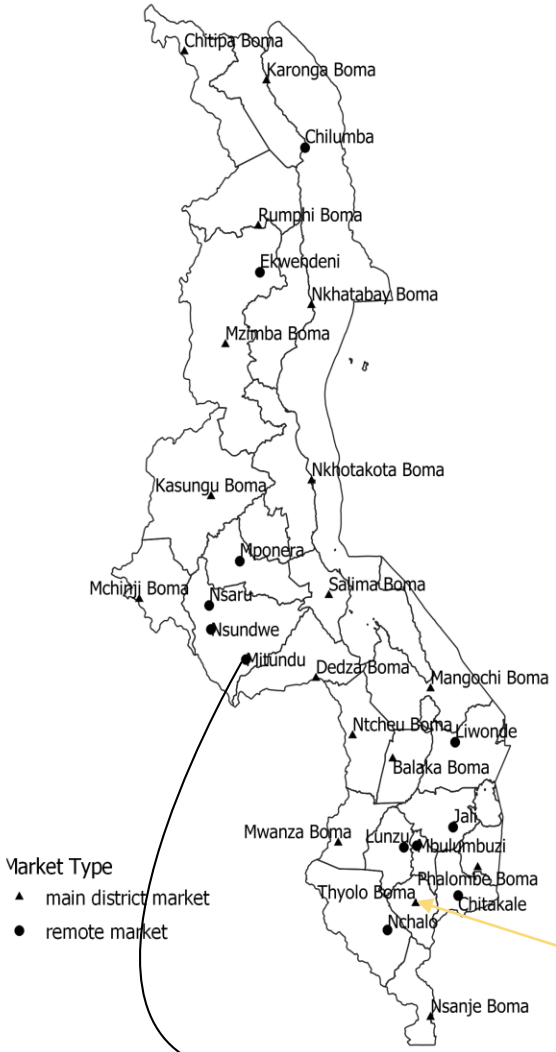
# Motivation for the study

- Linear optimization approach has been widely used to estimate the cost of least diet required to meet a set of micronutrients e.g. Stigler, 1945; Smith, 1959
- Estimate the cost of nutritious diets among food groups using consumer food price monitoring data for computation of CPIs e.g. Masters *et al.*, 2018; Bai *et al.*, 2018.
  - CPI measures the cost of living using weights derived from observed expenditure shares, without data on the health consequences associated with each type of food item consumed.
    - Expenditures in the CPI are a poor indicator for the cost of nutritious diets.

# Motivation for the study

- Study contributions to literature on "cost of nutritious diets":
  - 1. describes how retail prices for different kinds of food are collected, and test for systematic differences in relative costs between boma 'rural town' versus more remote rural markets in Malawi.
  - 2. provide a novel test of price differences over the entire mix of foods needed for nutrient adequacy, relative to the cost of subsistence from its cheapest source, comparing boma versus more remote rural markets.

# Do prices vary by type of market, as well as location?




## Are prices lower in more central markets, in district capitals with more infrastructure?

### Boma daily market

Thyolo
(Thyolo district capital)

### Smaller open air market

Mitundu market
(44 km from district capital )

Map and photos: S. Kaiyatsa, April 2019

# Research hypothesis

- More nutritious foods are usually more perishable, so they require either refrigeration or a high volume of sale to be sold at a low price, relative to the prices of basic staples.
- This leads us to believe that the price ratio of more nutritious foods to less nutritious foods would be greater in markets that serve poorer people.
  - Thus, poorer people pay a higher premium for more nutritious foods relative to basic staples.

# Methods

- We test for systematic differences in prices in boma vs remote markets using OLS regression:

1) $$P_{ijt} = \beta_0 + \beta_1 Z_{it} + \beta_2 F_i + \beta_4 (Z_{it} * F_i) + \beta_5 X_{it} + \beta_6 M_{it} + \beta_7 Y_{it} + \varepsilon_{it}$$

- We compare healthy foods to starchy staples using a food-group approach as a robustness check, comparing the average, least-cost, second-lowest and median priced item from each food group at each market every month.
  - We use the six food groups classification from the Malawi MoHP: starchy staples, legumes and nuts, animal-sourced foods, vegetables, fruits, and fats and oils.
- We also estimate equation 1 with, food group price index, $P_{gjt}$.

# Methods

- We then estimate the cost of diets that achieve overall nutrient adequacy (CoNA) using a linear optimization for each market in each month:

2) $$\min. C_{jt} = \Sigma_i p_i q_i \; subject\ to\ \Sigma_i n_{ij} q_i \geq EAR_i \; and \; \Sigma_i n_{ie} q_i = E$$

- We compare CoNA to the cost of caloric adequacy (CoCA), which constrains the linear optimization by an energy requirement only:

3) $$\min. C_{jt} = \Sigma_i p_i q_i, \; subject\ to\ \Sigma_i n_{ie} q_i = E$$

- Finally, use OLS regression to test whether CoNA or CoCA is different between boma and more remote markets:

4) $$C_{it} = \beta_0 + \beta_1 Z_{it} + \beta_2 X_{it} + \beta_3 M_{it} + \beta_4 Y_{it} + \varepsilon_{it}$$

# Data

- We use Malawi's consumer price monitoring data from January 2007 through July 2017, in 29 rural markets.
  - Not all items are available in each market every month, so our final dataset consists of 130,975 individual food prices in 3,701 market-months.
  - Food basket constitutes about 55 food items

# Descriptive results

**Contrary to our expectations,**
**costs per day are *lower* in more remote towns than in district capitals**

| Cost per day (US$ at PPP prices) | More remote marketplaces | | District capitals | | |
|---|---|---|---|---|---|
| | Mean | Std. Dev | Mean | Std. Dev | t-statistic |
| **Cost of Nutrient Adequacy (CoNA)** | **1.48** | 0.81 | **1.61** | 0.82 | -4.429*** |
| **Cost of Caloric Adequacy (CoCA)** | **0.75** | 1.29 | **1.01** | 2.41 | -4.054*** |

**Prices in more remote markets are lower for vegetables, fruits and starchy staples**

| Cost per item (Malawi kwacha / kg) | More remote marketplaces | | District capitals | | t-statistic |
|---|---|---|---|---|---|
| | Mean | Std. Dev | Mean | Std. Dev | |
| **Vegetables** | **186** | 156 | **196** | 157 | -5.0277*** |
| **Fruits** | **157** | 122 | **162** | 121 | -1.6857** |
| **Staples (incl. plantains)** | **167** | 150 | **170** | 157 | -1.5342* |
| Animal foods | 714 | 1139 | 719 | 1139 | -0.3406 |
| Fats and oils | 377 | 278 | 372 | 252 | 0.7466 |
| Legumes and nuts | 356 | 194 | 347 | 190 | 2.3259** |

Source: CANDASA results, from Kaiyatsa et al. (2019)

# Empirical results

**Are there systematic differences in food prices between boma versus more remote rural?**

| **Dependent variable: Price of food per kg in MK** | **OLS Estimator** | |
|---|---|---|
| | **Coefficients** | **Std. Errors** |
| *Covariates:* | | |
| Type of market type # Food item | | |
| *=1 if boma market#=1 if whole grain maize flour* | 48.86* | (28.96) |
| *=1 if boma market#=1 if fresh chambo fish* | -152.7*** | (42.74) |
| *=1 if boma market#=1 if dried chambo fish* | 235.8*** | (28.22) |
| *=1 if boma market#=1 if dried utaka fish* | 143.7*** | (22.52) |
| *=1 if boma market#=1 if beef mixed cut* | 38.04* | (21.62) |
| *=1 if boma market#=1 if powdered milk* | 72.55*** | (24.90) |
| *=1 if boma market#=1 if chicken eggs* | 96.02*** | (21.74) |

Note: N= 130975; ***, **, * indicates that the corresponding coefficient estimates are statistically significant at the 1%, 5%, and 10% level respectively.

# Empirical results

## Do poorer people pay a higher premium for more nutritious foods relative to basic staples?

| Dependent variable: average price of each item in each food group per kg in MK | OLS Estimator | |
|---|---|---|
| | **Coefficients** | **Std. Errors** |
| *Covariates*: | | |
| Type of Market | | |
| *=1 if boma market* | -40.62*** | (15.50) |
| Malawi's food group | | |
| *=1 if Vegetables* | -0.416 | (8.305) |
| *=1 if Fruits* | -45.75*** | (12.64) |
| *=1 if Animal foods* | 547.8*** | (8.016) |
| *=1 if Legumes and nuts* | 166.2*** | (10.27) |
| *=1 if Fats and oils* | 233.4*** | (12.67) |
| Market type # Food group | | |
| *=1 if boma market# =1 if Vegetables* | 3.303 | (10.81) |
| *=1 if boma market# =1 if Fruits* | -8.634 | (16.33) |
| *=1 if boma market# =1 if Animal foods* | -1.873 | (10.54) |
| *=1 if boma market# =1 if Legumes & nuts* | -3.867 | (13.36) |
| *=1 if boma market# =1 if Fats & oils* | -12.88 | (16.64) |

Note: N= 102515; ***, **, * indicates that the corresponding coefficient estimates are statistically significant at the 1%, 5%, and 10% level respectively.

# Empirical results

## Do poorer people pay a higher premium for least-expensive item in each food group relative to the least-expensive starchy staples

| Dependent variable: least-expensive item in each food group per kg in MK | OLS Estimator | |
|---|---|---|
| | Coefficients | Std. Errors |
| *Covariates:* | | |
| Type of Market | | |
| *=1 if boma market* | -6.545 | (9.676) |
| Malawi's food group | | |
| *=1 if Vegetables* | -10.19 | (7.526) |
| *=1 if Fruits* | 2.354 | (8.162) |
| *=1 if Animal foods* | 5.141 | (7.873) |
| *=1 if Legumes and nuts* | 61.00*** | (8.896) |
| *=1 if Fats and oils* | 99.20*** | (9.730) |
| Market type # Food group | | |
| *=1 if boma market# =1 if Vegetables* | 3.420 | (9.855) |
| *=1 if boma market# =1 if Fruits* | 1.648 | (10.23) |
| *=1 if boma market# =1 if Animal foods* | 24.36** | (10.92) |
| *=1 if boma market# =1 if Legumes & nuts* | 13.31 | (10.75) |
| *=1 if boma market# =1 if Fats & oils* | -30.16*** | (11.48) |

Note: N=637; ***, **, * indicates that the corresponding coefficient estimates are statistically significant at the 1%, 5%, and 10% level respectively.

# Relationship between CoNA index and type of the market

| **Dependent variable: Cost of Nutrient Adequacy index or Cost of Calorie Adequacy index** | **OLS Estimator (CoNA)** | | **OLS Estimator (CoCA)** | | **OLS Estimator (CoNA/CoCA ratio)** | |
|---|---|---|---|---|---|---|
| | **Coefficient** | **Std. Error** | **Coefficient** | **Std. Error** | **Coefficient** | **Std. Error** |
| *Covariates:* | | | | | | |
| Type of market | | | | | | |
| *=1 if boma market* | 0.277*** | (0.101) | -0.269 | (0.266) | -0.167 | (0.806) |

Note: N=3297; ***, **, * indicates that the corresponding coefficient estimates are statistically significant at the 1%, 5%, and 10% level respectively.

# Conclusions

- Given that consumers served by most remote markets are among the poorest while those served by the boma markets (rural towns) tend to be middle income:
  - Our finding suggests that middle-income consumers are worse off than poor consumers in accessing nutrient-dense foods that meet their long-term health needs.
- Therefore, our results demonstrate that lower diet quality in more remote rural areas, if any, would be due to lower incomes and purchasing power rather than higher relative prices as had been hypothesized for this study.

# Thank you!!!