Early Year Milk Price and Child Stunting

:Evidence from Zambia

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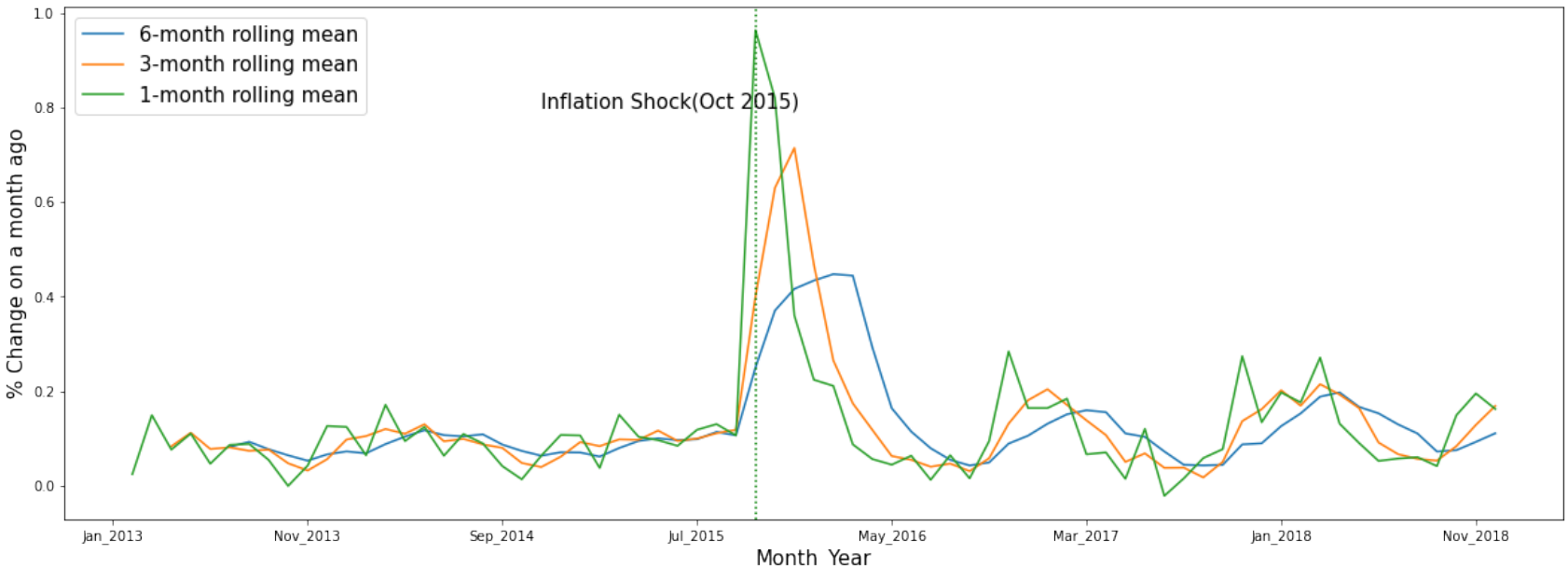
Introduction

Price Shock in Zambia

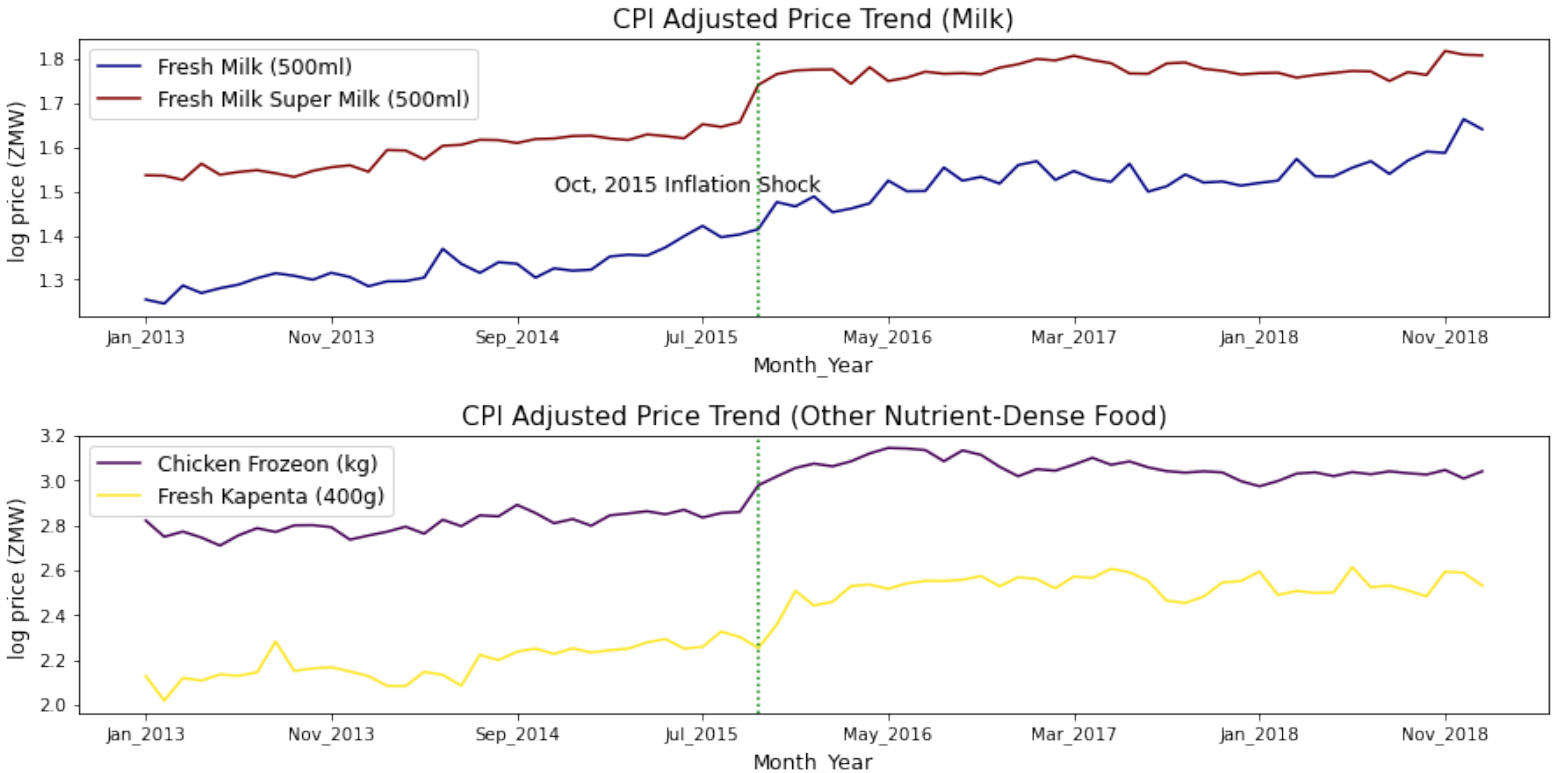
Zambia Currency (Kwacha) lost nearly 40% of its value against USD in late 2015 (Bertelsmann Stiftung, 2018)



Source : IMF CPI - Food data

Introduction

This inflation largely affected the price of nutrient-dense food



Note : Author's calculation using Zambia Price Data (2013-2018)

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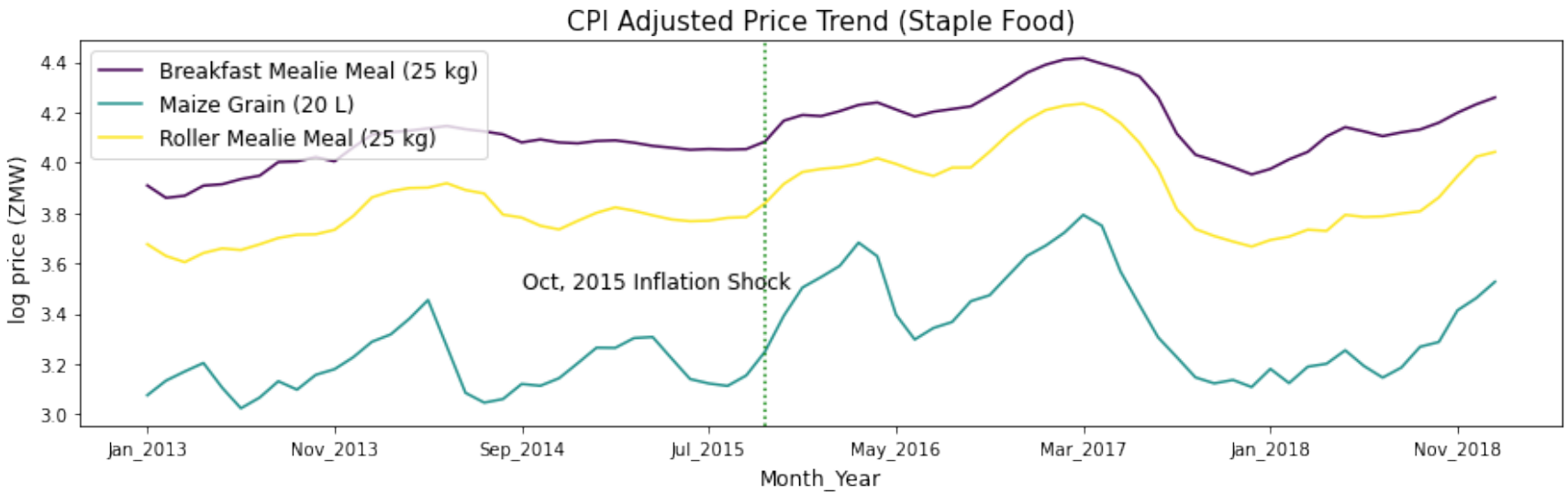

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Motivation

Food price hikes reduce consumption -> increase a risk of malnutrition

- Sharp increases in food prices have a negative impact on consumption, especially for nutrient-dense food.(Headey, Hirvonen, and Hoddinott, 2018).

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- Early-life chronic malnutrition carries long-lasting negative effects: diminished education, cognitive impairment, reduced earnings, and increased poverty risk. (Headey, Hirvonen, and Hoddinott, 2018).

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- Early-life chronic malnutrition carries long-lasting negative effects: diminished education, cognitive impairment, reduced earnings, and increased poverty risk. (Headey, Hirvonen, and Hoddinott, 2018).
- Few studies accounts for the biological period of exposure to economic shock (Woldemichael, Kidane, and Shimeles, 2022)

Research Question

- How does relative changes in price (nutrient-dense & staple food) affect Under-5 Child Stunting, a hardly reversible malnutrition measure.

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- Does timing of exposure to price shock matter?
- Which socio-economic group are vulnerable to the price increase?

Data

Child Nutrition & Demographics

- Zambia Demographic Health Surveys (2018)
  - Outcome Variable : **Stunting (=1 if Height for Age Z-Score $<$ 2 SD)**
  - Covariates : Maternal Education, Health Environment, and other demographics (Child level & HH level)

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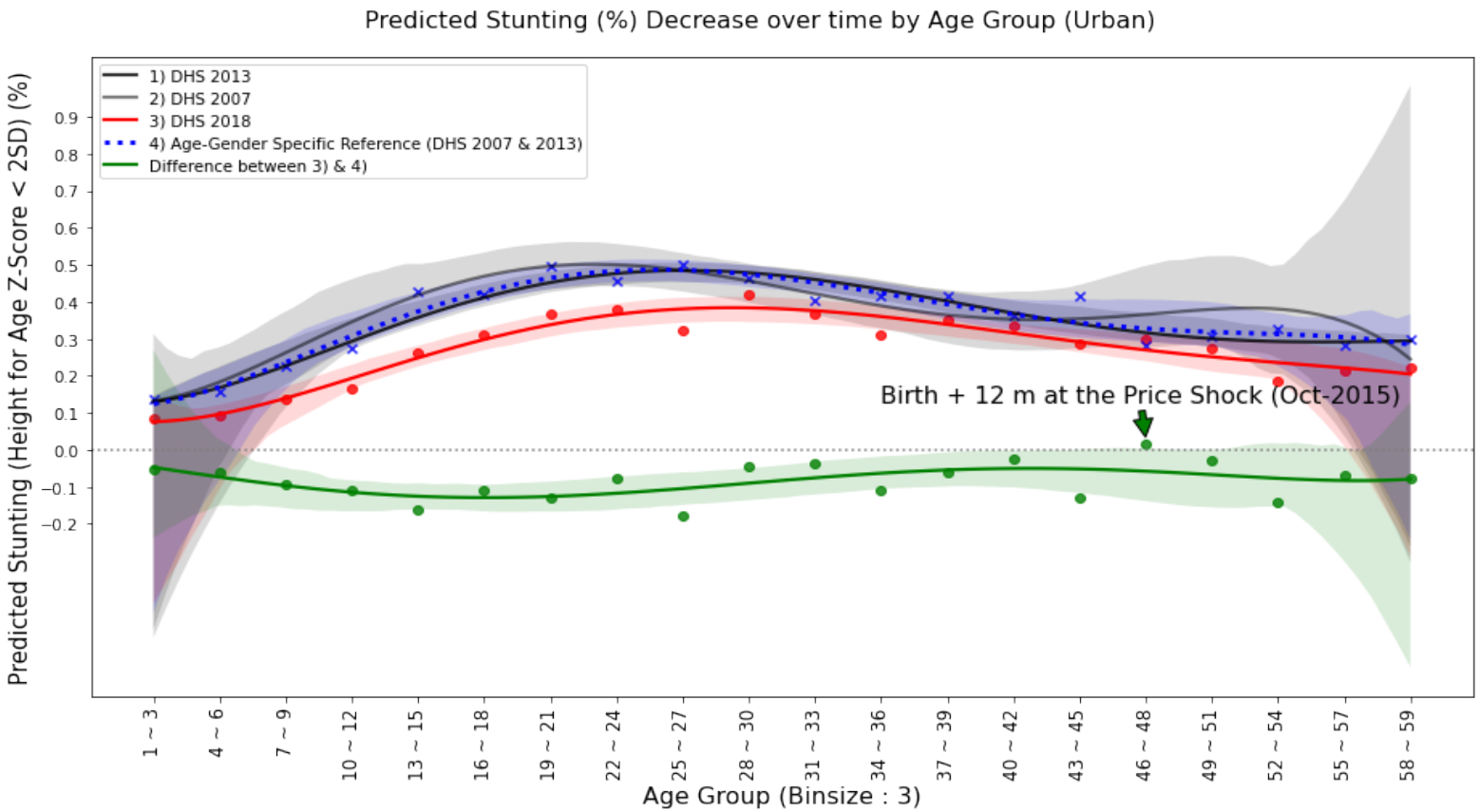
Context

Prevalence of Stunting over Time by Age Group (**Urban** VS Rural)



Note : Author's calculation using Zambia DHS 2007, 2013, 2018

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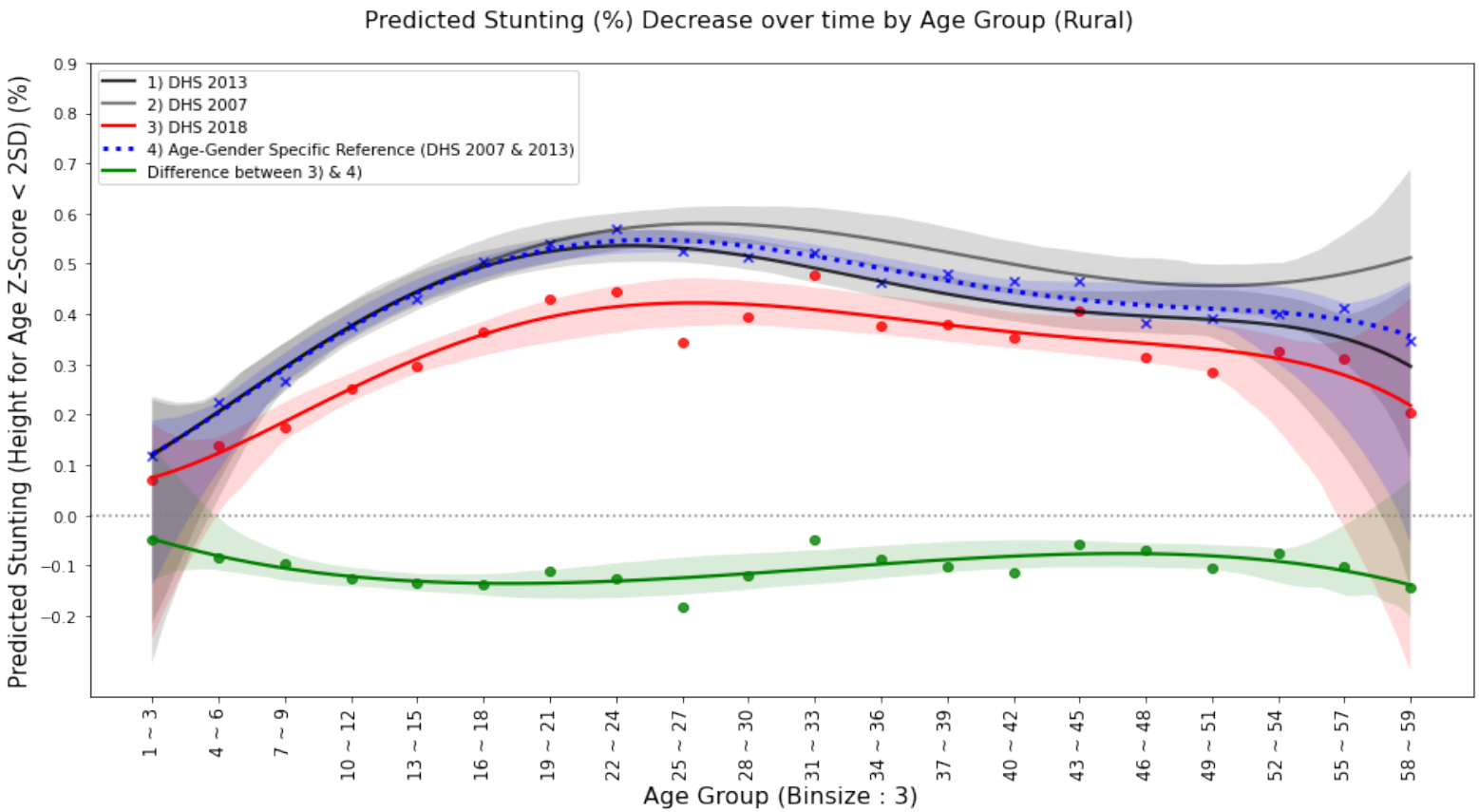

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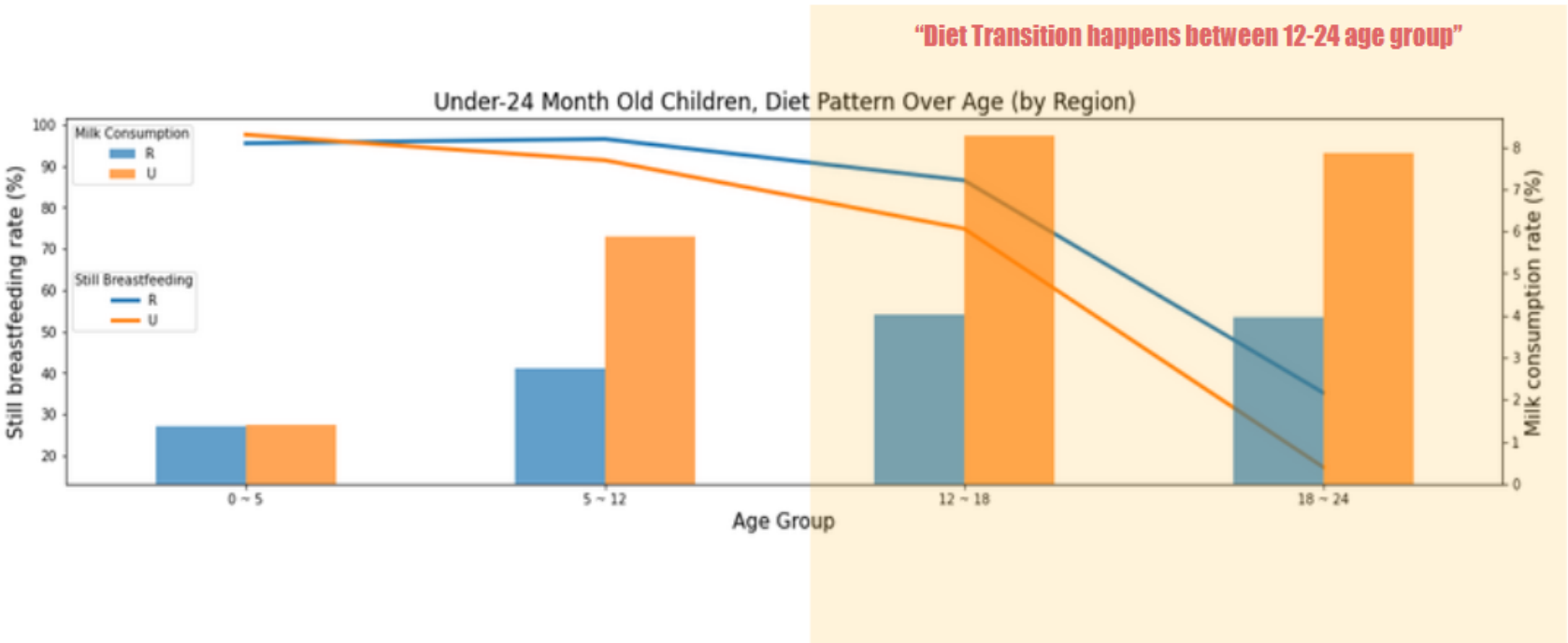
Context

Diet Transition - from Breastfeeding to Milk Complement (Urban VS Rural)

- Urban children consume more milk, quit breastfeeding and are fed milk earlier than rural children.
- This transition largely occurs in the 2^{nd} year (12m-24m).



Note : Author's calculation using Zambia DHS (2018) 24 hours Diet Module

Model Specification & Estimation Strategy

Price Measures in the Key Developmental Period (12 - 24m) (Woldemichael, Kidane, and Shimeles, 2022)

$$Early\ Year\ Average\ Price^{C}_{b,d(t)} = (N-n)^{-1} \cdot \sum_{t=n}^{N} \cdot Price^{C}_{b,d(t)}$$

d : district, b : year-month of birth for each child
n and N : month indicators that define both start and end of key developmental period, and superscript
C : commodity(e.g. fresh milk or mealie meal.)

Model Specification & Estimation Strategy

Model Specification

Reduced Form Nutrition Production Function (Behrman and Deolalikar, 1988)

$$y_i = \alpha + \delta_1 * (N-n)^{-1} \cdot \sum_{t=n}^{N} log\ price_{b,d(t)}^{Fresh\ Milk}$$

$$+ \delta_2 * (N-n)^{-1} \sum_{t=n}^{N} log\ price_{b,d(t)}^{Mealie\ Meal}$$

$$+ \gamma * \mathrm{HH_h} + \zeta * \mathrm{Mother_m} + \eta * \mathrm{Child_i} + \theta_{\mathrm{FE}} + \epsilon_i$$

$y_i = Stunting_{\mathbf{2018}} (= 1 if HAZ \leq 2SD)$, d : district, b: birth cohort
HH = wealth group dummy, number of under 5 children, head of sex, *Mother* = mother's education level, birth at first birth, *Child* = age by month, sex, birth order, $FE \in \{\emptyset, cluster, household\}$

Model Specification & Estimation Strategy

Estimation Strategy

- Linear Probability Model (LPM)

  LPM with fixed effects simplifies the interpretation of the coefficients, but it only provides the linear approximation to average partial effects.

- Correlated Random Effects (CRE) Probit Model

  We model the unobserved cluster/household effect as a function of the data (Wooldridge, 2013) (Wooldridge, 2013). We add means of time-varying covariates(e.g. price measures) to the model and estimate them with random effects probit.

Descriptive Statistics

We focus on children aged 24 - 60 months, who completed the first two years of life. No systematic differences in nutritional status at birth between groups.

Table 1 : Balance At Birth (Cluster Level) - Age > 24m

	Age <12 month at Price Shock			Age >= 12 month at Price Shock			
	N	Mean	SD	N	Mean	SD	Diff
Birth Weight (kg)	1284	3.313	0.631	2615	3.227	0.602	-0.038
Birth Size							
Average	1719	0.618	0.485	3385	0.616	0.486	-0.001
Larger than Average	1719	0.192	0.394	3385	0.199	0.399	0.006
Smaller than Average	1719	0.079	0.269	3385	0.084	0.277	0.005
Very Large	1719	0.052	0.222	3385	0.052	0.222	0
Very Small	1719	0.023	0.152	3385	0.02	0.141	-0.003
First 3 days, Given anything other than breast milk	670	0.055	0.229	2324	0.059	0.237	0.005

Estimation Result by Region (Urban vs Rural)

Milk price increase is statistically associated with a rise in stunting risk in only in urban areas.

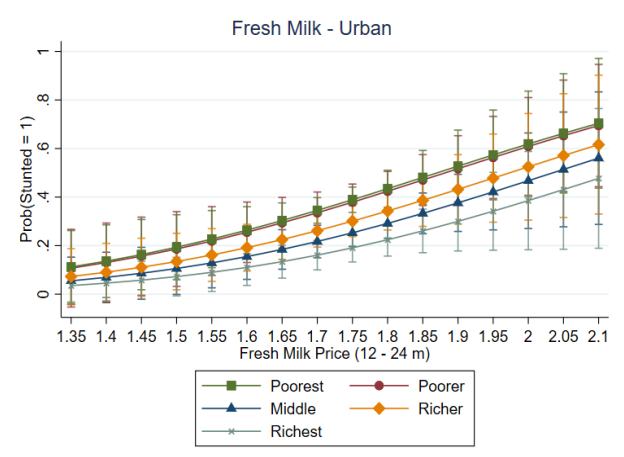
Table 1. LPM-FE vs CRE Probit Model and Average Marginal Effects

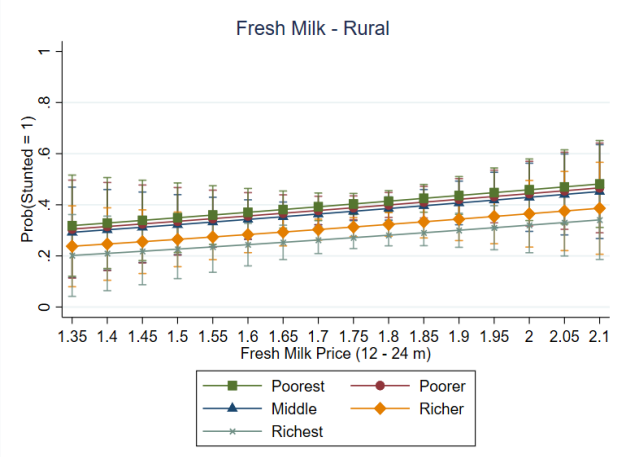
	Urban					Rural				
	(1) Base	(2) Cluster FE	(3) CRE Probit (Cluster)	(4) HH FE	(5) CRE Probit (HH)	(6) Base	(7) Cluster FE	(8) CRE Probit (Cluster)	(9) HH FE	(10) CRE Probit (HH)
log Fresh Milk Price	0.340**	0.961**	0.906**	2.121**	1.711***	-0.014	0.176	0.242	-0.378	-0.362
	(0.154)	(0.431)	(0.365)	(0.978)	(0.691)	(0.084)	(0.242)	(0.244)	(0.515)	(0.378)
log Mealie Meal Price	-0.089	-0.203	-0.163	-0.195	0.012	0.090	0.062	0.047	0.205	0.207**
	(0.116)	(0.172)	(0.168)	(0.470)	(0.171)	(0.075)	(0.097)	(0.098)	(0.230)077	(0.328)
Observations (Number of Groups)	1431	1431 (198)	1431 (198)	1431 (1328)	1431 (1328)	3453	3453 (347)	3453 (347)	3453 (3020)	3453 (3020)
Controls										
Household Wealth (1-5)	Yes	Yes	Yes	No	No	Yes	Yes	Yes	No	No
Child Characteristics	No	Yes	Yes	Yes	Yes	No	Yes	Yes	Yes	Yes
Household Characteristics	No	Yes	Yes	No	No	No	Yes	Yes	No	No
Mother's Characteristics	No	Yes	Yes	Yes	Yes	No	Yes	Yes	Yes	Yes
Cluster Fixed Effects	No	Yes	No	No	No	No	Yes	No	No	No
Household Fixed Effects	No	No	Yes	Yes	Yes	No	No	Yes	Yes	Yes
Cluster / HH Mean Values Included	No	No	Yes	No	Yes	No	No	Yes	No	Yes

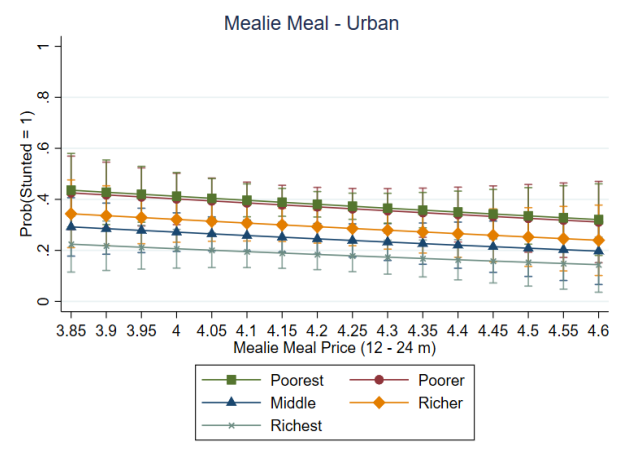
*Notes : Coefficients and standard errors are from separate models. Cluster/HH mean values are included for time varying price measures. CRE probit standard errors are clustered bootstrap estimates, while LPM standard errors are corrected for eachclustering level. Each model includes different set of covariates (see bottom of each column), but results are not shown. Asterisks ***, **, and * indicate significance at the 1%, 5%, and 10% levels, respectively.*

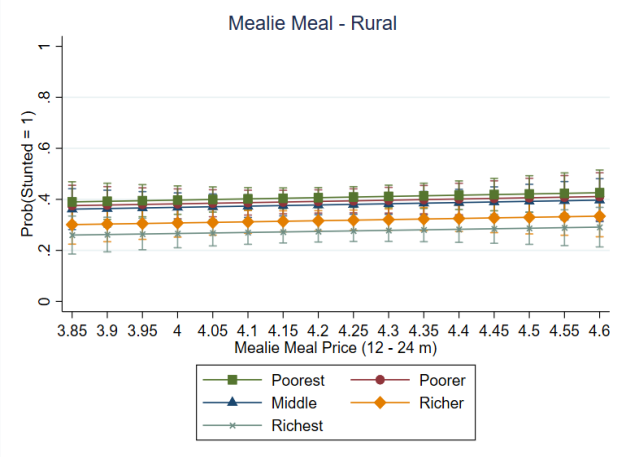
Estimation Result : Heterogeneity by Wealth Group

Children from poorer households in urban aresa are more vulnerable to milk price hikes.









Note : Figures are from model (3) and (8) from Table 1

Robustness Test 1

Adding Weather Extreme Events (e.g. Drought and Extreme Hot)

Models are robust to weather extreme events.

Table 2. Robustness Test

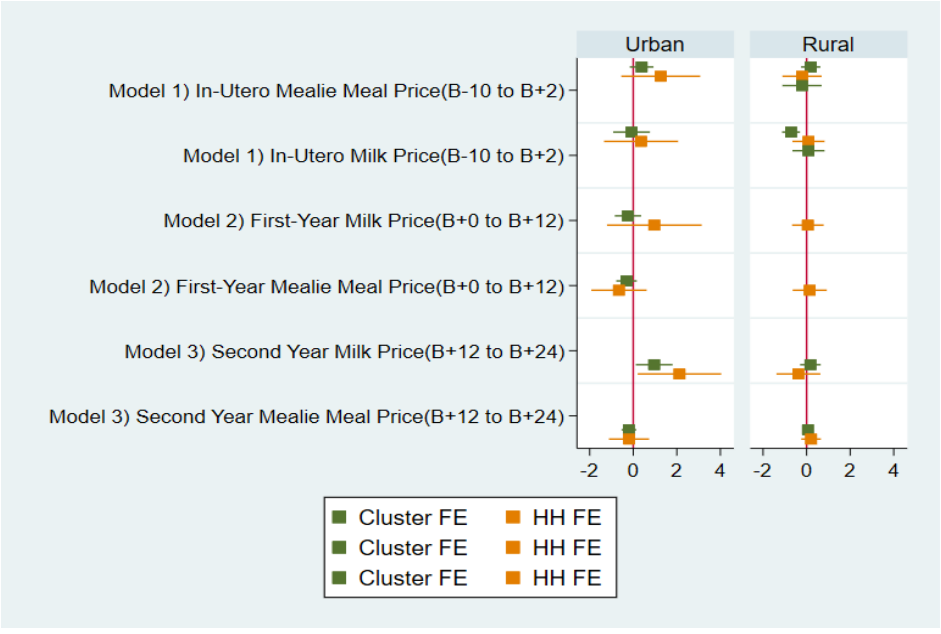
	CRE Probit							
	Urban				Rural			
	Price Only (Table 1)		Price & Weather Events		Price Only (Table 2)		Price & Weather Events	
	Cluster	HH	Cluster	HH	Cluster	HH	Cluster	HH
log Fresh Milk Price	0.906**	1.711**	0.685*	1.613***	0.242	-0.362	0.232	-0.471
	(0.261)	(0.691)	(0.381)	(0.500)	(0.244)	(0.378)	(0.176)	(0.372)
log Mealie Meal Price	-0.163	0.012	-0.082	-0.762	0.047	0.207**	0.014	0.188***
	(0.168)	(0.171)	(0.173)	(0.136)	(0.098)	(0.682)	(0.097)	(0.072)
Observations (Number of Groups)	1431 (198)	1431 (1328)	1423 (198)	1423 (1303)	3453 (347)	3453 (3020)	3147 (347)	3147 (2768)

*Note: Coefficients and standard errors are from separate models. CRE Probit standard errors are clustered bootstrap estimates. Each model includes controls, cluster indicators, both year and month of birth indicators but not shown. Asterisks ***, **, and * indicate significance at the 1%, 5%, and 10% levels, respectively.*

Robustness Test 2

Models using Price Measures with Different Time Boundaries

Milk prices are only positive and significant when exposure occurs between 12 - 24m in urban area both at cluster & household level.



Note : Marginal effects from models with different time boundaries

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Thank you for your attention

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