Enhancing labour productivity by improving nutrition in Kenya: micro-econometric estimates for dynamic CGE model calibration

Estefanía Custodio (ISCIII), Sofía Jiménez (Universidad de Zaragoza), María Priscila Ramos (IIEP, UBA-CONICET), Martina Sartori (EC JRC-Seville), Emanuele Ferrari (EC JRC-Seville)

Outline

1. Introduction
2. Empirical strategy applied to Kenya
3. Results
4. Conclusion and further steps in this research

Introduction

Background and motivation

SUSTAINABLE DEVELOPMENT GOALS

2 ZERO HUNGER

Boulanger et al. (2020)
Ramos et al. (2020; 2021)
Nechifor et al. (2021)

Two pathways to improve labour productivity:

1) the reinforcement of **health conditions**
2) the allowance for better **learning capacities**

8 DECENT WORK AND ECONOMIC GROWTH

Objectives

AIMS

1. to provide econometric estimates about the linkages between FS&N indicators (i.e., food consumption and nutritional status of households' members) and labour productivity (L-productivity):

   Specific objective/tasks:

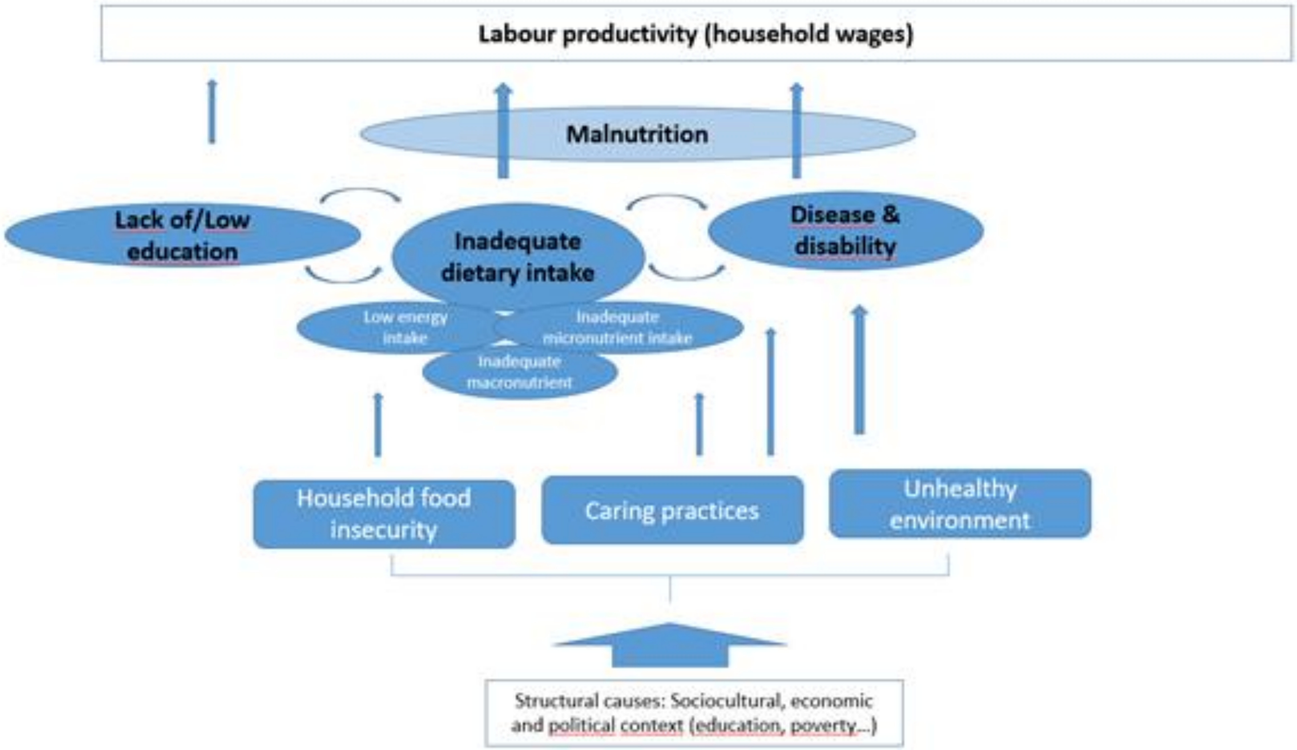
   - Development of micronutrients indicators computed at household level.
   - Non-parametric and *parametric* estimations related to FS&N and labour productivity.

1. to provide parametric insights for dynamic pathways (baseline's drivers to L-productivity and growth) in a CGE framework (DEMETRA CGE model for Kenya).

1. to contribute to the literature on how the UN SDG# 2 (no hunger) interact with the SDG#8 (decent work and economic growth).

Empirical strategy applied to Kenya

FS&N impact pathway for Labour productivity



Empirical strategy

Based on the previous scheme about pathways to L-productivity, we look to estimate:

L-prod = f(DEC, Nut, FIES, Educ, D&D)

- **L-prod**: wage or sector output -> W monthly wages per AME at the HH level
- **DEC**: daily energy (kilocalories) consumed per AME at the HH level.
- **Nut**: each macro (fat, protein, carbohydrate) and micronutrient (minerals and vitamins) intake per day per AME at HH level -> we keep only micronutrients due to high collinearity of macronutrients.
- **FIES**: indicator food insecurity experiences (at HH or individual levels) based on 8 (yes/no) questions about food consumption during the last 12-month period -> scale from mild to severe food insecurity.
- **Educ**: the maximum level of formal education reached (complete) by HH active members (primary, secondary, university) - ratio to active HH members.
- **D&D**: number of active members in a HH with chronic diseases or disability.

Based on nutrition-earning literature we estimate the semi-log wage equation at the HH level:

$$\ln W_{AME} = \alpha + \beta_1 \ln DEC_{AME} + \beta_{2,n} NUT_{AME,n} + \beta_3 FIES + \beta_{4,e} EDUC_e + \beta_5 D\&D + \mu$$

Data sets and data treatment

2015/2016 Kenya integrated household budgetary survey (KIHBS)

- Consumption quantities by food item in grams
- Total and food expenditure
- Labour income & worked hours -> W
- 8 questions of FIES
- Other variables: HH size, HH ame, education, diseases, disability

Treatments:

- Cleaning of outliers for consumed quantities.
- Monthly wages per AME (in ln)
- FIES at HH level (Dummy variable, value one if households have 7 or 8 affirmative answers)-
- Ratio of active HH member that achieved each formal level of education
- Number of active HH members with D&D

2018 Kenya Food Composition Tables (FCT KEN2018)

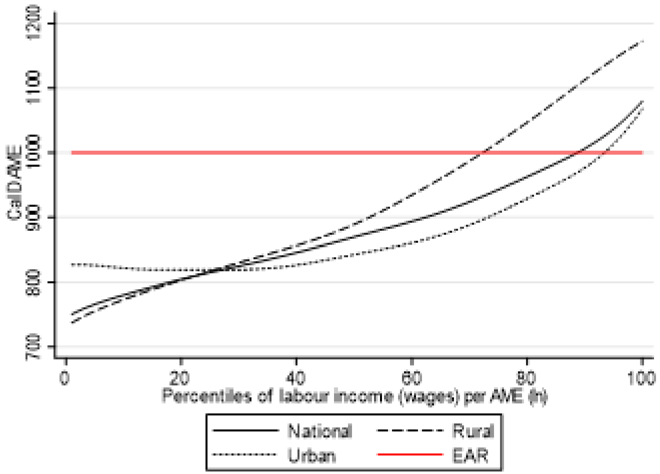
- Biochemical contents of food items per 100gr

- Matching with food items from the HH survey
- Computation of DEC, macro and micronutrients intake according to consumed quantities per AME at HH level.

Summary of descriptive statistics

Variable	Obs.	Mean	Std. Dev.	Min	Max
Household size (# persons)	15891	4.68	2.44	1	28
WageAME (shillings/month/AME)	15891	66,438	130,761	44	7,200,000
lnWageAME ln(shillings/month/AME))	15891	10.34	1.30	3.77	15.79
DECDAME (kcal/day/AME)	15891	2,566	1,233	0	14,644
lnDEC ln (kcal/day/AME)	15890	7.72	0.57	1.89	9.59
Calcium (mg/day/AME)	15891	823	567	0	5,850
Heme Iron (mg/day/AME)	15891	1.93	2.27	0	28.72
Zinc (mg/day/AME)	15891	17.20	16.44	0	275.29
Vitamin C (mcg/day/AME)	15891	130	126	0	1,692
Vitamin B2 (mg/day/AME)	15891	1.77	1.40	0	30.04
Vitamin A RAE (mg/day/AME)	15891	564	928	0	27,056
Vitamin B12 (mg/day/AME)	15891	4.69	7.42	0	119.04
FIES rawscore	15891	3.84	3.13	0	8
Severe Food insecurity FIES	15891	0.31	0.46	0	1
University (ratio)	15891	0.11	0.27	0	1
Secondary (ratio)	15891	0.29	0.35	0	1
Primary (ratio)	15891	0.47	0.41	0	1
Chronic Disease & Disability (#)	15891	2.16	1.39	0	14

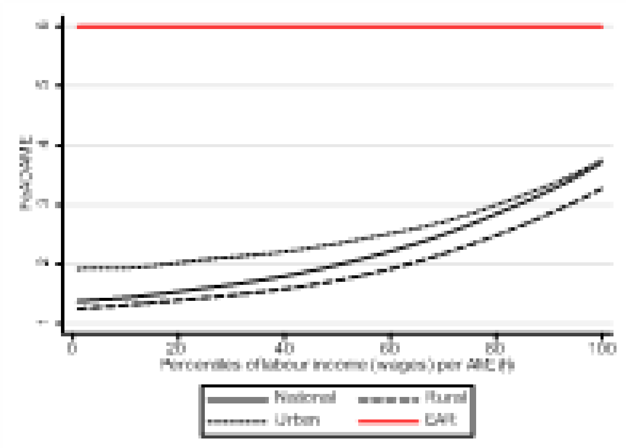
Micronutrients intake across percentiles of income



Calcium intake per AME increases with the level of HH per capita expenditure - greater in rural than in urban areas.

Poorer HH presents deficits of calcium (from 1 to 60 percentiles of per capita expenditure) according to the young male adult's requirement.

Micronutrients intake across percentiles of income

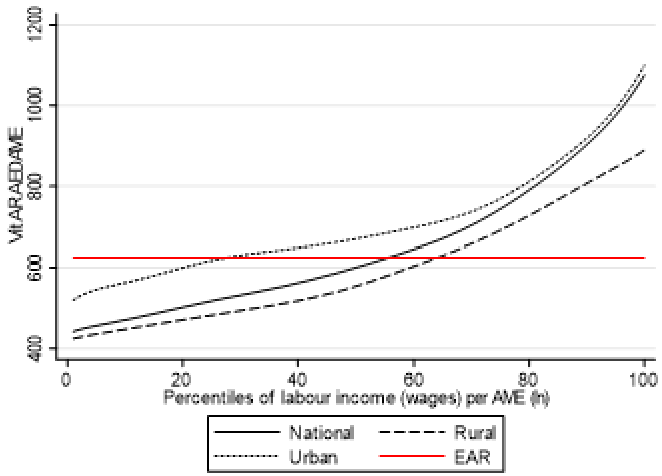


Iron from animal sources (Heme) intake per AME increases with the level of HH per capita expenditure.

BUT deficits in Heme iron intake per AME appears in every HH.

No deficits for Non-Heme iron intake per AME across percentile of per capita expenditure (not shown here).

Micronutrients intake across percentiles of income



Lipid-soluble vitamins (A) intake per AME increases with the level of HH per capita expenditure.

Poorer Half of percentiles of per capita expenditure presents deficits in Vitamin A intake per AME.

Results

Results of the semi-log wage equation estimation

Bivariate regressions: all micronutrient variables, as well as the daily caloric intake (ln DEC) showed a positive and significant association with ln Wame.

Multivariate regression: coefficient associated to ln DEC turned into negative when combined with micronutrients

- relevance of micronutrients in the diet to explain L-productivity measured by ln Wame
- “empty calories” that contribute in energy but not in micronutrients -> Hyp. tested: when introducing Carbohydrate (main source of empty calories), the coefficient associated to CAR picked the negative sign and that of the ln DEC turned again into positive.
- all micronutrients introduced in the wage equation as well as education and D&D indicators and FIES are significant at 1%.
- the sign of estimates of most micronutrients are positive as expected (most relevant is Heme-Iron), but vitamins B12 and C.
    - Vit C turned to negative when calcium/zinc/Vit B2 are introduced -> Hyp: Protein absorption limitation (ej. Vit C and calcium)
    - Vit B12 turned to negative when calcium/Heme-iron are introduced -> Hyp: all come from animal sources

Semi-log Wage equation estimates focusing on micronutrients intake

VARIABLES	National lnWageAME *Coef.* *(Std- Err)*	Unskilled lnWageAME *Coef.* *(Std- Err)*	Skilled lnWageAME *Coef.* *(Std- Err)*	Rural lnWageAME *Coef.* *(Std- Err)*	Urban lnWageAME *Coef.* *(Std- Err)*
lnDEC ln (kcal/day/AME)	-0.148***	-0.2153***	-0,133***	0.0365	-0.170***
	(0.0239)	(0.0364)	(0.0312)	(0.0378)	(0.0299)
Calcium (mg/day/AME)	0.000105***	0.000274***	-3.08e-06	0.000143***	0.000122*
	(3.84e-05)	(6.60e-05)	(4.81e-05)	(5.43e-05)	(6.21e-05)
Heme Iron (mg/day/AME)	0.0955***	0.076***	0.109***	0.0594***	0.0812***
	(0.00657)	(0.101)	(0.00834)	(0.00949)	(0.00810)
Zinc (mg/day/AME)	0.00405***	0.00458***	0.00375***	0.00364***	0.00251***
	(0.000674)	(0.00144)	(0.000749)	(0.00101)	(0.000846)
Vitamin B2 (mg/day/AME)	0.0458***	0.0362	0.0445***	0.0641***	0.0312***
	(0.00988)	(0.0228)	(0.0106)	(0.0204)	(0.0109)
Vitamin B12 (mg/day/AME)	-0.0172***	-0.0195***	-0.0163***	-0.0174***	-0.0172***
	(0.00259)	(0.0042)	(0.00328)	(0.00369)	(0.00369)
Vitamin A RAE (mg/day/AME)	5.17e-05***	7.81e-06	8.22e-05***	3.32e-05	8.38e-05***
	(1.63e-05)	(3.05e-05)	(1.73e-05)	(2.45e-05)	(2.02e-05)
Vitamin C (mcg/day/AME)	-0.000775***	-0.000870***	-0.000705***	-0.000730***	-0.000753***
	(0.000128)	(0.00020)	(0.000159)	(0.000161)	(0.000232)
Severity FIES (Q7Q8)	-0.477***	-0.464***	-0.484***	-0.423***	-0.475***
	(0.0225)	(0.0307)	(0.0326)	(0.0268)	(0.0370)
University (ratio)	1.223***		1.499***	0.906***	0.973***
	(0.0485)		(0.102)	(0.0702)	(0.0804)
Secondary (ratio)	0.561***		0.903***	0.218***	0.460***
	(0.0400)		(0.1003)	(0.0492)	(0.0748)
Primary (ratio)	0.176***	0,181***	0.151	-0.0105	0.186**
	(0.0370)	(0.0420)	(0.099)	(0.0417)	(0.0760)
Chronic Disease & Disability (#)	-0.102***	-0.141***	-0.0559***	-0.0455***	-0.125***
	(0.00696)	(0.0131)	(0.00908)	(0.00880)	(0.0107)
Constant	11.20***	11.28***	10.79***	9.589***	11.89***
	(0.178)	(0.131)	(0.249)	(0.278)	(0.230)
Observations	15890	6838	9052	9277	6613
R-squared	0.188	0.095	0.220	0.123	0.171

Final remarks

Conclusions at this stage and further work

All micronutrients included in the wage-nutrient equation have a positive impact (except Vitamins B12 and C) on labour productivity even when adjusted by the daily caloric intake.

Intake of diets rich in micronutrients is more important than the consumption of diets higher in caloric intake but poor in micronutrients.

Importance of a diverse diet.

Improving diets could develop synergies to achieve SDG 2 of “no hunger” and SGD 8 of decent work and growth, being labour productivity one of the key growth drivers.

Similar results by subsamples: rural/urban, skilled/unskilled

Next step in this research:

- to calibrate dynamic baseline with estimates related to nutrition and to evaluate the impact of food policies over L-productivity and economic growth.

Thank you