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# Agricultural commercialization and nutrition; effects on smallholder coffee farmers in Guatemala

Joanna van Asselt

## Introduction

- Agricultural commercialization is the transition from growing crops for home consumption to growing some or all crops for sale.
- We examine the relationship between agriculture commercialization and undernutrition and overnutrition in rural Guatemala.
- To examine the link between commercialization and undernutrition we explore the impact of commercialization on household calorie consumption and household dietary diversity of coffee farming households.
- To estimate the impact of commercialization on overnutrition we use individual measures of overweight and obesity for the male and female household heads.

## Model

- To examine the impact of commercialization on nutrition we estimate the following type of regression model:
$$O_i = \beta_0 + \beta_1 C_i + \beta_2 X_i + \epsilon_i \tag{1}$$
where  $O_i$  is the nutrition outcome for individual or household i,  $C_i$  is the level of commercialization,  $X_i$  is a vector of controls, and  $\epsilon_i$  is the random error term.
- We define the level of commercialization (CCI) as the gross value of crop sales relative to the gross value of all crop production (see also Carletto et al., 2017 and Ogotu et al., 2020).
- Our control variables include age, education, household characteristics and farm characteristics.

### Undernutrition

- We regress CCI on calorie, protein, fat, and carbohydrate consumption at the household level by adult equivalents (AE). In these models, a positive  $\beta_1$  suggests that commercialization leads to improved nutrition.

### Overnutrition

- To examine the impact of commercialization on overnutrition we estimate separate regressions of CCI on male and female body mass indexes (BMI). In these models, a positive  $\beta_1$  suggests that commercialization leads to overnutrition.

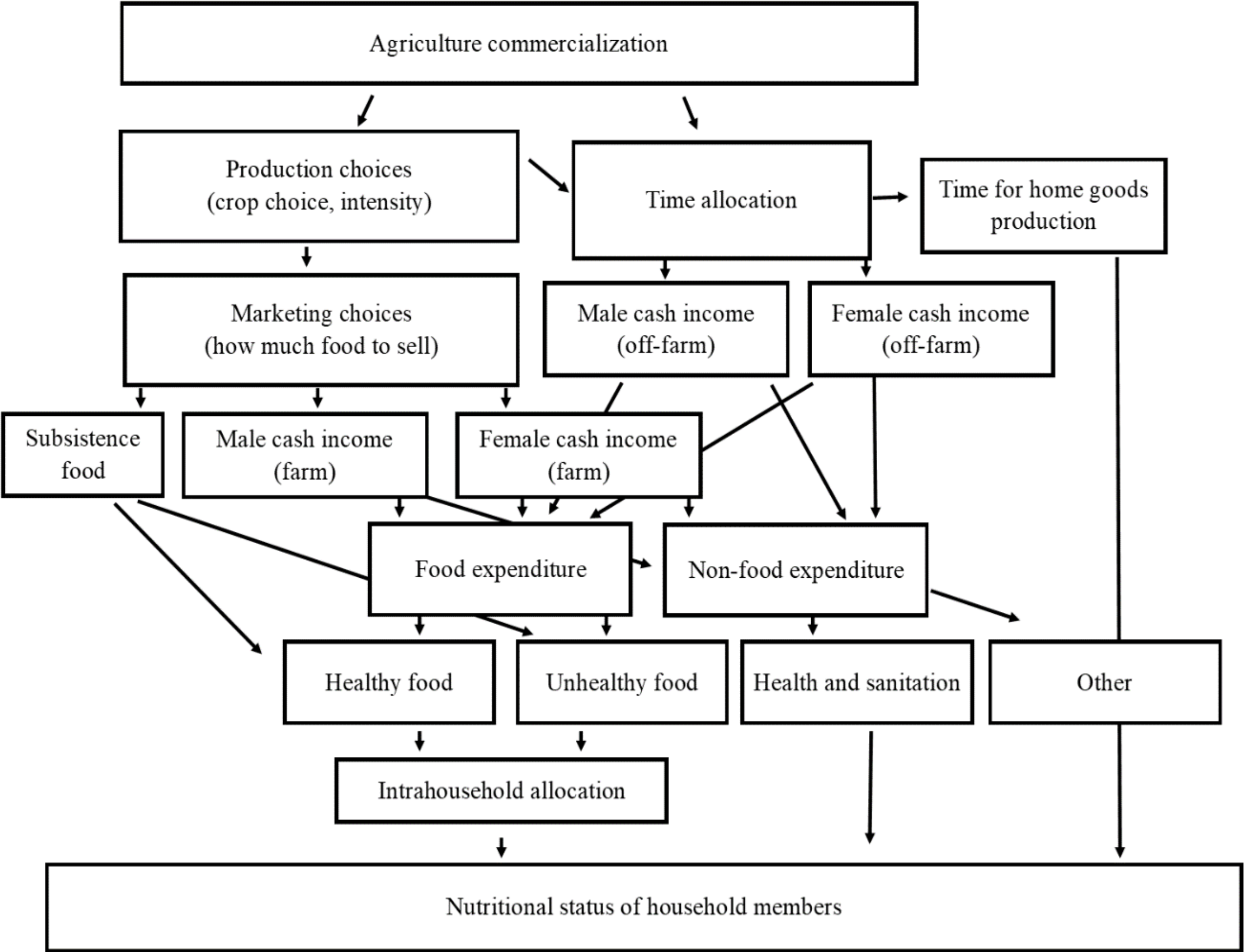
### Identification strategy

- We use an instrumental variable approach to account for potential endogeneity issues. We identified three valid instruments for commercialization: the average community distance (in time) to the nearest health center, the average number of mechanized agriculture tools in the community, and a binary variable for whether members of the household preform the labor for planting their crops.

## Data

- The data I use for my analysis comes from a survey carried out between November and December of 2017 by the Center for Tropical Agriculture (CIAT) along with the University of Florida in two coffee growing regions of Guatemala.
- In the East, the survey was conducted in La Unión and Olopa, and in the West, La Reforma and Nuevo Progreso.
- The sample has 250 households, 125 in each region. The sample is not representative of those regions.
- Only smallholder coffee farmers were surveyed.

## Conceptual framework



## Table 1: Household and member production and commercialization

	Household	Men	Women
Manages a plot (%)	92.0	85.2	24.8
CCI	87.6	90.4	87.2
CCI coffee	79.6	82.0	74.7
Number of cultivated crop groups	2.6	2.2	2.0
Number of cultivated crops	2.8	2.4	2.1
Manages livestock (%)	93.6	22.8	61.6
Number of livestock groups	1.6	2.0	1.8
Farming area (acres)	2.3	1.5	0.4
Farm planted to coffee (%)	56.7	61.5	60.5
Farm planted to fruit (%)	22.0	23.0	21.1
Farm planted to vegetables (%)	1.7	1.8	1.6

Note: Manages a plot refers to whether the male or female head in the household manages a plot. The households who do not have a male or female plot manager have other family members managing their plots. The CCI measure includes these households and therefore the average of men and women in the West is not the same as the CCI in the West. Number of cultivated groups includes cereals; starchy roots and tubers and plantains; vegetables; fruit crops; legumes and nut trees; coffee and other (non-food) cash and fiber crops (including cocoa, sugarcane and wood). Number of livestock groups includes large mammals; medium mammals, small mammals, poultry, and fish.

## Discussion

### Undernutrition

- CCI is the share of income from crops marketed relative to the share of income from all crops. A ten percentage-point increase in CCI increases household calorie consumption as well as protein, fat, and carbohydrate consumption (Table 3). This weakly supports the hypothesis that **commercialization decreases undernutrition** (given our small sample, the 10 percent significance level is still meaningful).
- Coffee commercialization is defined as the percent of farm income that comes from coffee relative to all farm income. In contrast to general CCI, **coffee commercialization has no impact** on nutrition. The coefficients are positive but not significant.
- Complete commercialization is when a household sells all of its agriculture products on the market. The **caloric gains from completely commercializing are very large**. Households that are fully commercialized consume more calories, protein, fat, and carbohydrates.

### Overnutrition

- We find a **positive and significant relationship between commercialization and male BMI** but no relationship between commercialization and female BMI (Table 4).
- We also see a **positive and significant impact of coffee commercialization on male BMI**, but similarly not on female BMI.
- We see no impact of complete commercialization on male or female BMI.

### Concluding remarks

- Over the previous decade there has been a change in diet structure and a decrease in physical activity that has resulted in an increase of overweight and obese individuals in low- and middle-income countries (LMICs) (Popkin et al., 2012).*
- Our results demonstrate the importance of considering overnutrition in addition to undernutrition. We find that while commercialization increases household calorie consumption (kcal/day/AE), it also increases overweight and obesity in men in those households.*

## References

Carletto, C., Corral, P., Guelfi, A., 2017. Agricultural commercialization and nutrition revisited: Empirical evidence from three African countries. Food Policy 67, 106–118. <https://doi.org/10.1016/j.foodpol.2016.09.020>

Ogotu, S.O., Gödecke, T., Qaim, M., 2020. Agricultural Commercialisation and Nutrition in Smallholder Farm Households. Journal of Agricultural Economics 71, 534–555. <https://doi.org/10.1111/1477-9552.12359>

Popkin, B.M., Adair, L.S., Ng, S.W., 2012. Global nutrition transition and the pandemic of obesity in developing countries. Nutrition Reviews 70, 3–21. <https://doi.org/10.1111/j.1753-4887.2011.00456>.

## Table 2: Nutrition status for male and female household heads

	Count		Percent	
	Male	Female	Male	Female
Underweight	4	7	1.7	2.9
Normal	143	91	59.1	37.8
Overweight	81	94	33.5	39.0
Obese	14	49	5.8	20.3
Total	242	241	100.0	100.0

Note: Underweight is defined as individuals with a body mass index (BMI) of less than 18.5, normal, 18.5 to 24.9, overweight, 25.0 to 29.0, obese, greater than 30.0.

## Table 3: Commercialization impacts on calorie, protein, fat, and carbohydrate consumption

	Calories (kcal/day/AE)	Protein (gr/day/AE)	Fat (gr/day/AE)	Carbohydrates (gr/day/AE)
CCI	296.94* [174.45] (0.089)	15.66* [ 9.24] (0.090)	15.40* [ 9.36] (0.100)	24.02* [13.96] (0.085)
CCI coffee	112.69 [131.76] (0.392)	4.60 [ 6.90] (0.505)	4.49 [ 6.99] (0.521)	13.51 [10.82] (0.212)
Commercial	14,966.72** [7534.61] (0.047)	771.85* [397.42] (0.052)	762.64* [401.97] (0.058)	1,286.45** [610.83] (0.035)

Note: SE are shown in brackets and P-values in parenthesis. Other covariates were included and can be seen with the full model results in Tables A6-A9 in the appendix of our paper. The sample size is 246. AE, male adult equivalent. CCI is the commercialization index which ranges from 0 to 100. CCI coffee is the coffee crop commercialization index which ranges from 0 to 100. Commercial is a binary variable that takes the value of 1.0 if the household has a CCI of 99 or 100. \*, \*\*, \*\*\* significant at 10%, significant at 5% and 1% level, respectively.

## Table 4: Impact of nutrition on male and female BMI

	(Men, BMI)	(Women, BMI)
CCI	0.06* [ 0.03] (0.073)	-0.03 [ 0.05] (0.549)
CCI coffee	0.05** [ 0.03] (0.049)	-0.01 [ 0.04] (0.764)
CCI >=99	1.11 [ 1.47] (0.449)	-0.96 [ 2.02] (0.633)

Note: SE are shown in brackets and P-values in parenthesis. Other covariates were included and can be seen with the full model results in Tables A9-A11 in the Appendix of our paper. The sample size is 246. BMI, body mass index. CCI is the commercialization index which ranges from 0 to 100. CCI coffee is the coffee crop commercialization index which ranges from 0 to 100. Commercial is a binary variable that takes the value of 1.0 if the household has a CCI of 99 or 100. \*, \*\*, \*\*\* significant at 10%, significant at 5% and 1% level, respectively.