

# Structural Transformation and the Demographic Transition: Evidence from Bangladesh

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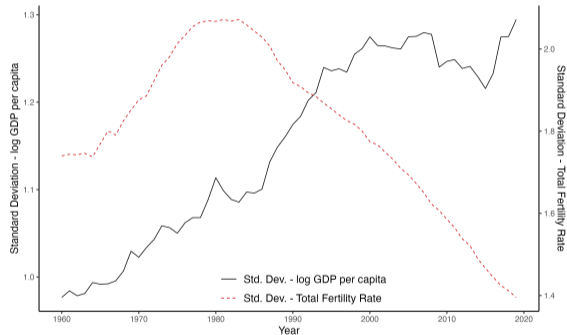
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# Motivation

- Fertility rates are converging, in part due to family planning programs
- Income per capita convergence less clear, despite predictions of neoclassical growth models (Solow 1956)
- Importance of surplus labor in macroeconomic models (Lewis, 1954; Gollin et al., 2002, 2007; Leukhina and Turnovsky, 2016)
- Question: Does faster demographic transition impact the pace of industrialization?



# What we do

How does the demographic transition affect structural transformation?

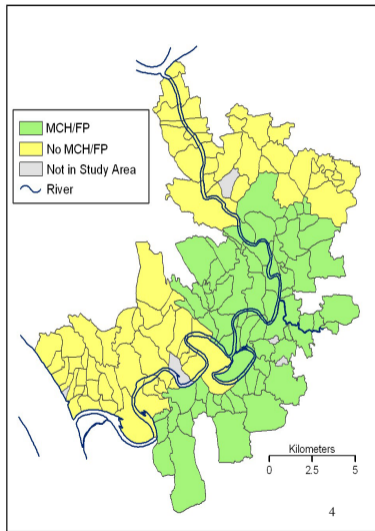
- Key challenges:
  - ▶ Need exogenous variation in fertility and early-life mortality
  - ▶ Impact of lower fertility on labor market not felt until children grow up, so many years of data needed for evaluation

# What we do

How does the demographic transition affect structural transformation?

- Key challenges:
  - ▶ Need exogenous variation in fertility and early-life mortality
  - ▶ Impact of lower fertility on labor market not felt until children grow up, so many years of data needed for evaluation
- Leverage quasi-experimental variation in access to contraception & early-childhood vaccines 45 years ago in rural Matlab, Bangladesh
- Use rich data on individuals/households across several decades
- Examine long-run effects on sectoral employment and farming practices

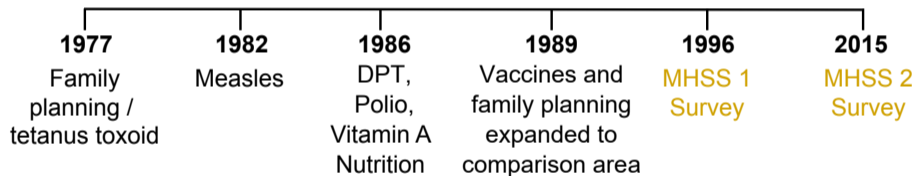
# Matlab Maternal and Child Health / Family Planning Program



- Introduced by International Centre for Diarrheal Disease Research, Bangladesh 1977-1988
- Highly successful, large rise in contraceptive prevalence, immunization
- Comparison villages socially and economically similar pre-intervention (Phillips et al. 1982; Koenig et al. 1990) Balance
- Clustering reduced information spillovers (Huber and Khan 1979) and facilitated estimation of community effects

# Matlab Mother and Child Health and Family Planning Program

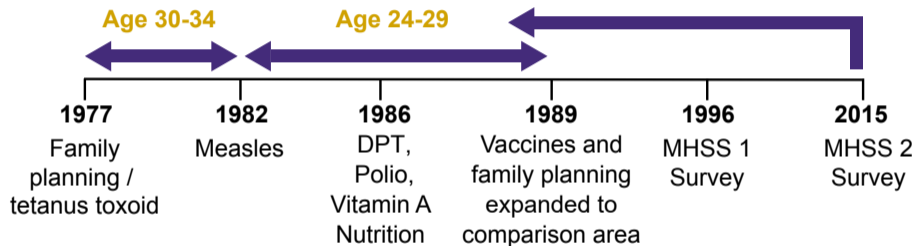
MCH-FP



- Monthly in-home visits by community health workers

# Matlab Mother and Child Health and Family Planning Program

MCH-FP



- Monthly in-home visits by community health workers
- Matlab Health and Socio-Economic Survey (MHSS) 1996 & 2015

# Data—Matlab Health and Socioeconomic Surveys (MHSS)

- MHSS had two waves: 1996 and 2012-2015
  - ▶ MHSS a representative random sample taken in 1996 of households in Matlab
  - ▶ Our baseline sample: 2,580 MHSS1 households
- Large number of demographic and socioeconomic characteristics
  - ▶ Detailed labor market data
  - ▶ Agricultural variables on inputs/outputs



# Data—Matlab Health and Socioeconomic Surveys (MHSS)

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  - ▶ Our baseline sample: 2,580 MHSS1 households
- Large number of demographic and socioeconomic characteristics
  - ▶ Detailed labor market data
  - ▶ Agricultural variables on inputs/outputs
- Very low attrition
  - ▶ Intense effort to follow internal and international migrants who left Matlab subdistrict
  - ▶ Followed 90% of men born during the experimental period
- Demographic Surveillance System facilitates linkages across time and to ancestors
- Pre-intervention variables derived from 1974 and 1982 censuses

# Baseline Estimation Strategy

Compare conditional means between treatment and control households

Estimate at the 1996 household level [Detail](#):

$$Y_h = \omega_0 + \omega_1 T_h + \zeta X_h + \varepsilon_h$$

for household  $h$

- Outcome  $Y_h$
- Treatment eligibility  $T_h$  based on 1974 village of 1996 household head (intent-to-treat approach) [Detail](#)
- $X_h$  is a vector of 1974 baseline controls tied to the 1996 household head
- cluster SEs at 1974 village level

## Effect of MCH/FP on HH Sectoral Composition - 2015

As a fraction of total hours worked, treated households spent **3.1pp less** time in manufacturing and **5.2pp more** in agriculture

Dependent variable: % of household work time spent per sector			
	(1)	(2)	(3)
	Agriculture	Manufacturing	Services
Treated	0.0520*** (0.0158)	-0.0314** (0.0150)	-0.0105 (0.0166)
% chg. rel. to mean	23.2	-17.2	-2.5
Mean	0.22	0.18	0.42
Baseline controls	Y	Y	Y
Embankment controls	Y	Y	Y
Observations	2580	2580	2580

Notes: The table presents estimates for outcomes measured in 2015 aggregated at the MHSS1 household-level. Variable means refer to the comparison group. Standard errors are clustered by the MHSS1 household head's pre-program village. \*, \*\*, and \*\*\* denote statistical significance at the 10%, 5%, and 1% levels, respectively.

## Key Mechanisms

- Program reduced number of births among prime age women by  $\sim 1$  (Joshi and Schultz 2007), so fewer marginal members went into non-agricultural jobs
- Effects mediated by rural-to-urban migration & intrahousehold allocation based on individual human capital (Barham 2012; Barham et al. 2022)
- Treated farmers adjust to fewer household members by being **15pp more** likely to use high-yield seeds for labor intensive crops

# Key Mechanism: Household Size

First-stage

	(1) Number of Men Age 24-34	(2) Number of Women Age 24-34
Treated	-0.13*** (0.04)	-0.06* (0.04)
Observations	2580	2580
Adjusted $R^2$	0.007	-0.001
Mean	0.8	0.7
% chg. rel. to mean	-16.05	-8.99
Baseline controls	Y	Y
Controlling for embankment	Y	Y

Notes: The table presents estimates of the effect of the MCH-FP on 2014 outcomes at the MHSS1 household-level. Variable means refer to the comparison group. Standard errors are clustered by pre-program village. \*, \*\*, and \*\*\* denote statistical significance at the 10%, 5%, and 1% levels, respectively.

# Key Mechanism: Household Size

## Second stage

Dependent variable: % of household work time spent per sector			
	(1)	(2)	(3)
	Agriculture	Manufacturing	Services
Num. males age 24-34	-0.389** (0.155)	0.235* (0.140)	0.0787 (0.118)
Mean	0.22	0.18	0.42
First-stage F-stat.	10.4	10.4	10.4
Baseline controls	Y	Y	Y
Embankment controls	Y	Y	Y
Observations	2580	2580	2580

Notes: The table presents 2SLS estimates for outcomes measured in 2014 aggregated at the MHSS1 household-level. Variable means refer to the comparison group. Standard errors are clustered by the 1996 household head's pre-program village. \*, \*\*, and \*\*\* denote statistical significance at the 10%, 5%, and 1% levels, respectively.

# Conclusion

- Shown some of the first well identified causal evidence of effect of the demographic transition on structural transformation
- Find that the demographic transition slows down structural transformation
  - ▶ driven by smaller household sizes
  - ▶ intrahousehold sectoral allocation based on human capital
  - ▶ costs of migration to urban centers high (Imbert and Papp 2020), without significant wage gains (Barham, Kuhn, and Turner 2022)
- Farmers adjust to smaller household size by more intensively using technology and purchased inputs

# Appendix



# Effect of MCH-FP on Sectoral Employment

## Individual-level (Men only)

	Share hours by sector			
	(1)	(2)	(3)	(4)
	Agriculture	Manufacturing	Services	Hours worked
Treatment × Born 1982-88	-0.00484 (0.0219)	-0.0787** (0.0313)	0.0688* (0.0409)	-7.676 (106.7)
Treatment × Born 1977-81	0.0581* (0.0299)	-0.0445 (0.0340)	-0.0395 (0.0463)	10.10 (122.2)
Treatment × Not born 1977-88	0.0522* (0.0273)	0.0158 (0.0149)	-0.0349 (0.0304)	-222.5** (103.5)
% Chg., Treat×(Born 1982–88)	-5.7	-35.3	13.2	-0.2
% Chg., Treat×(Born 1977–81)	59.37	-24.32	-6.97	0.31
% Chg., Treat×(Born Pre-1977 or Post-1988)	18.68	16.90	-10.05	-9.78
Mean if born 1982-88	0.09	0.22	0.52	3073.36
Mean if born 1977-81	0.10	0.18	0.57	3290.94
Mean if born pre-1977 or post-1988	0.28	0.09	0.35	2276.51
Observations	2819	2819	2819	2819

Notes: The table presents estimates of the effect of the MCH-FP on 2014 outcomes for men at the individual-level. Means by age group refer to the non-treated. Standard errors are clustered by pre-program village. Regressions are weighted to adjust for attrition between birth and the MHSS2 survey. \*, \*\*, and \*\*\* denote statistical significance at the 10%, 5%, and 1% levels, respectively.

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# Effect of MCH-FP on Sectoral Employment

## Individual-level (Women only)

	Share hours by sector			
	(1)	(2)	(3)	(4)
	Agriculture	Manufacturing	Services	Hours worked
Treatment × Born 1982-88	0.0596*** (0.0220)	0.00754 (0.0260)	-0.0214 (0.0193)	76.12 (78.60)
Treatment × Born 1977-81	-0.0193 (0.0367)	-0.00957 (0.0288)	0.0255 (0.0271)	-52.51 (89.69)
Treatment × Not born 1977-88	0.0124 (0.0282)	-0.00839 (0.0120)	-0.00907 (0.0110)	-42.77 (44.29)
% Chg., Treat×(Born 1982–88)	41.1	6.1	-28.9	16.8
% Chg., Treat×(Born 1977–81)	-10.61	-8.68	41.44	-11.22
% Chg., Treat×(Born Pre-1977 or Post-1988)	5.02	-22.00	-18.98	-12.53
Mean if born 1982-88	0.14	0.12	0.07	454.43
Mean if born 1977-81	0.18	0.11	0.06	468.01
Mean if born pre-1977 or post-1988	0.25	0.04	0.05	341.43
Observations	3322	3322	3322	3322

Notes: The table presents estimates of the effect of the MCH-FP on 2014 outcomes for women at the individual-level. Means by age group refer to the non-treated. Standard errors are clustered by pre-program village. Regressions are weighted to adjust for attrition between birth and the MHSS2 survey. \*, \*\*, and \*\*\* denote statistical significance at the 10%, 5%, and 1% levels, respectively.

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% Chg., Treat×(Born 1982–88)	41.1	6.1	-28.9	16.8
% Chg., Treat×(Born 1977–81)	-10.61	-8.68	41.44	-11.22
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# Urbanization or Rural Industrialization?

To discern whether baseline effects are driven by rural-to-urban migration, estimate baseline specification but separate urban jobs from rural jobs

- Important question for household welfare
- Migration is costly, so workers might prefer rural industrialization

## Effect on Rural Households

Dependent variable: % of household work time spent per sector			
	(1)	(2)	(3)
	Agriculture	Manufacturing	Services
Treated	0.0424*** (0.0154)	0.00144 (0.00732)	-0.0245 (0.0153)
% chg. rel. to mean	19.3	3.1	-11.5
Mean	0.22	0.05	0.21
Baseline controls	Y	Y	Y
Embankment controls	Y	Y	Y
Observations	2580	2580	2580

Notes: The table presents regression estimates for outcomes measured in 2014 aggregated at the 1996 household-level. Variable means refer to the comparison group. Standard errors are clustered by the 1996 household head's pre-program village. \*, \*\*, and \*\*\* denote statistical significance at the 10%, 5%, and 1% levels, respectively.

## Effect on Urban Households

Dependent variable: % of household work time spent per sector			
	(1)	(2)	(3)
	Agriculture	Manufacturing	Services
Treated	0.00958 (0.00642)	-0.0329*** (0.0118)	0.0140 (0.0180)
% chg. rel. to mean	191.6	-24.1	6.9
Mean	0.00	0.14	0.20
Baseline controls	Y	Y	Y
Embankment controls	Y	Y	Y
Observations	2580	2580	2580

Notes: The table presents regression estimates for outcomes measured in 2014 aggregated at the 1996 household-level. Variable means refer to the comparison group. Standard errors are clustered by the 1996 household head's pre-program village. \*, \*\*, and \*\*\* denote statistical significance at the 10%, 5%, and 1% levels, respectively.



# Agricultural Adjustment

- Treated households more likely to continue farming.
    - ▶ despite having less HH labor to draw upon
  - Adjustment margins:
    - ▶ Adopt labor-saving technology/capital.
    - ▶ Hire labor from outside the household.
- Can observe these outcomes at the crop-level.
- ▶ We categorize crops as either labor intensive or non-labor intensive

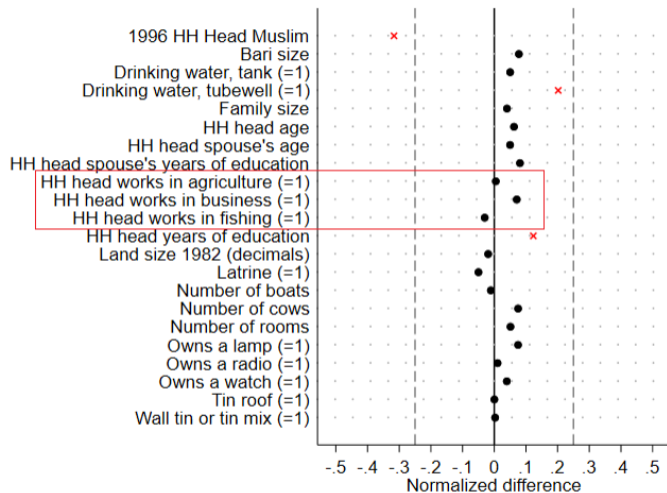
Effect on rev./acre

# How did Farmers Adjust to Fewer Household Members?

	Use of High-Yield Seeds		Use of Capital for Crop		Cost of market inputs	
	(1) labor intensive crops	(2) non-labor intensive crops	(3) labor intensive crops	(4) non-labor intensive crops	(5) labor intensive crops	(6) non-labor intensive crops
Treated	0.146*** (0.041)	0.004 (0.045)	0.026 (0.017)	0.010 (0.007)	29.689** (13.088)	-0.539 (35.280)
Observations	785	1346	785	1346	785	1346
Adjusted $R^2$	0.041	0.006	0.003	0.022	-0.003	0.035
% chg. rel. to mean	32.3	0.8	2.7	1.1	32.0	-0.2
Mean	0.45	0.46	0.96	0.99	92.87	267.61
Baseline controls	Y	Y	Y	Y	Y	Y
Embankment control	Y	Y	Y	Y	Y	Y

*Notes:* The table presents estimates of at the MHSS1 household-level for outcomes measured in 2014. Variable means refer to the comparison group. Standard errors are clustered by pre-program village. Regressions are conditional on the household growing either a labor-intensive crop (columns 1, 3, and 5) or a non-labor-intensive crop (columns 2, 4, and 6). Labor intensive crops are jute, vegetables, paddy aus, other crops, maize, and wheat, while non-labor intensive crops are dal, mustard, paddy boro, paddy aman, and potatoes. Labor intensity is computed as the ratio of acres cultivated for a given crop (including both owned and sharecropped land) to hours worked by family members on the family farm (number of weeks  $\times$  average weekly hours) for households that grew only 1 crop. Market inputs are crop inputs purchased by the household. They are seeds, fertilizer, pesticides, irrigation, tilling, and labor. \*, \*\*, and \*\*\* denote statistical significance at the 10%, 5%, and 1% levels, respectively.

# Baseline Balance (in 1974) between Treatment and Control Households



# Assigning Treatment Status

## Intent-to-treat approach

- Treatment during program (1977-1988) assigned based on village of residence
- But outcomes observed in 2012-2015
  - ▶ Household's location may be affected by MCH-FP (Barham and Kuhn 2014)
- Therefore, we link respondents back to their 1974 household
- 1974 household location determines treatment status

## Two issues:

- Affected individuals might not be alive in 1974
- Households may have mixed treatment status

→ Assign household treatment status based on household head (or ancestors) in 1996.

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# Estimation Strategy

## Aggregation

In MHSS wave 2 (2012-2014), we measure

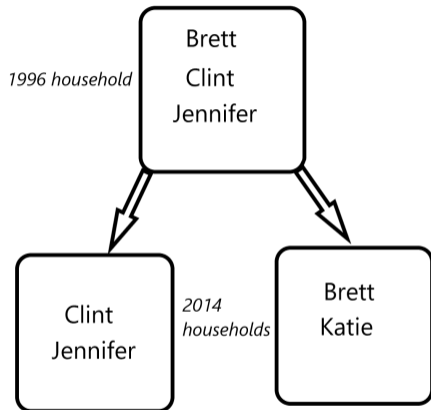
- employment at the individual level
- agriculture at the household level

We estimate our baseline regressions at the MHSS wave 1 (1996) household level

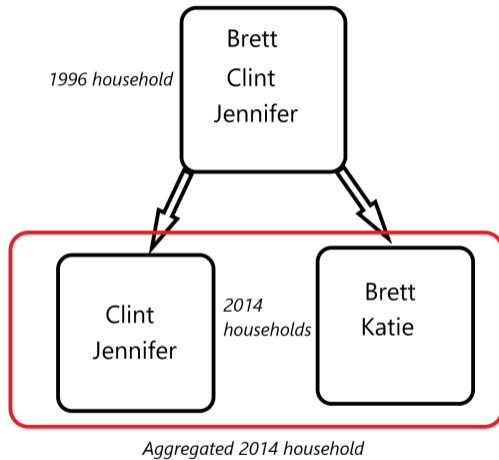
- Want to avoid household formations and splits that results from the program between waves 1 and 2
  - Typically, household makes migration/employment decision, not individual
  - Maintain consistent unit of observation across regressions
- Results robust to alternative aggregations (individual or village)

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# Household Aggregation



# Household Aggregation



## Effect of MCHP-FP on Consumption Shares

	(1)	(2)	(3)
	Agriculture	Manufacturing	Services
Treated	0.01 (0.01)	0.00 (0.00)	-0.01 (0.02)
Observations	2575	2575	2575
Adjusted $R^2$	-0.001	0.002	-0.001
% chg. rel. to mean	1.4	0.3	-2.3
Mean	0.49	0.19	0.35
Embankment dummies	Y	Y	Y
Baseline controls	Y	Y	Y

*Notes:* The table presents estimates of equation 6 for consumption shares measured in the MHSS2 aggregated at the MHSS1 household-level. Variable means refer to the comparison group. Standard errors are clustered by the 1996 household head's pre-program village. Baseline and embankment control variables assigned based on the MHSS1 household head's traceback household. Consumption goods classified into sectors based on United Nations (2018). \*, \*\*, and \*\*\* denote statistical significance at the 10%, 5%, and 1% levels, respectively



## Effect of MCHP-FP on Revenue and Profits per Acre

	(1) Revenue per acre (min. price)	(2) Revenue per acre (max. price)	(3) Profit per acre (min. price)	(4) Profits per acre (max. price)
Treated	-0.591 (39.52)	24.74 (143.0)	-10.63 (52.18)	-34.27 (144.3)
% chg. rel. to mean	-0.1	16.0	-1.6	-41.4
Mean	446.13	154.24	683.45	82.84
Embankment controls	Y	Y	Y	Y
Baseline controls	Y	Y	Y	Y
Observations	1411	1411	1411	1411

Notes: The table presents estimates of the effect of the MCH-FP on 2014 outcomes at the MHSS1 household-level. Standard errors are clustered by pre-program village. Prices derived from the national Bangladeshi statistical yearbooks 2012-2014. Minimum prices are the minimum price listed in the yearbook for a given year within a crop type (e.g., Paddy Aman) amongst all varieties of that crop type (e.g., coarse or fine). Profits net of imputed family farm labor costs. \*, \*\*, and \*\*\* denote statistical significance at the 10%, 5%, and 1% levels, respectively.

# Effects of MCH-FP on Long-term Employment by Fraction of Household Treated

PANEL A: Share of household members employed by sector			
	(1)	(2)	(3)
	Agriculture	Manufacturing	Services
% HH treated	0.051*** (0.014)	-0.021*** (0.008)	-0.007 (0.010)
% chg. rel. to mean	23.0	-19.5	-2.5
Mean	0.22	0.11	0.26
Baseline controls	Y	Y	Y
Embankment control			
Observations	2580	2580	2580
PANEL B: Fraction of household hours worked by sector			
	(1)	(2)	(3)
	Agriculture	Manufacturing	Services
% HH treated	0.053*** (0.016)	-0.033** (0.015)	-0.006 (0.016)
% chg. rel. to mean	23.81	-18.13	-1.56
Mean	0.22	0.18	0.41
Baseline controls	Y	Y	Y
Embankment control			
Observations	2580	2580	2580

*Notes:* The table presents estimates for outcomes measured in 2014 aggregated at the MHSS1 household-level. Variable means refer to the comparison group. Standard errors are clustered by the 1996 household head's pre-program village. The dependent variable in panel A is the share of household members working in each sector. The dependent variable in panel B is the fraction of total hours worked with the MHSS1 household allocated to each sector. See Appendix ?? for more details on how we classify workers into sectors. Industry employment shares do not sum to 1 for two reasons. First, we do not report results for two small sectors, construction and mining. Second, a small set of respondents not providing sufficient information to classify them into sectors. \*, \*\*, and \*\*\* denote statistical significance at the 10%, 5%, and 1% levels, respectively.

# Model Setup

- Consider a small open economy with  $L$  households Evidence on consumption shares
- Two sectors: manufacturing ( $m$ ) and agriculture ( $a$ )
- Three factors: labor ( $L$ ), imported intermediates ( $Z$ ), and land ( $T$ )
- Manufacturing production:

$$Q_m = A_m L_m$$

- Agriculture production:

$$Q_a = A_a \left[ \omega Z_a^{\frac{\epsilon-1}{\epsilon}} + (1-\omega) L_a^{\frac{\epsilon-1}{\epsilon}} \right]^{\frac{\theta\epsilon}{\epsilon-1}} T_a^{1-\theta}$$

# Solving the Model

In equilibrium:

- $T_a = T$
- $L = L_a + L_m$
- Fixed factor (land)  $\implies$  declining  $MPL_a$  while  $MPL_m$  remains constant.

# Solving the Model

In equilibrium:

- $T_a = T$
- $L = L_a + L_m$
- Fixed factor (land)  $\implies$  declining  $MPL_a$  while  $MPL_m$  remains constant.

EMPIRICAL PREDICTIONS:

(given *decrease* in  $L$ )

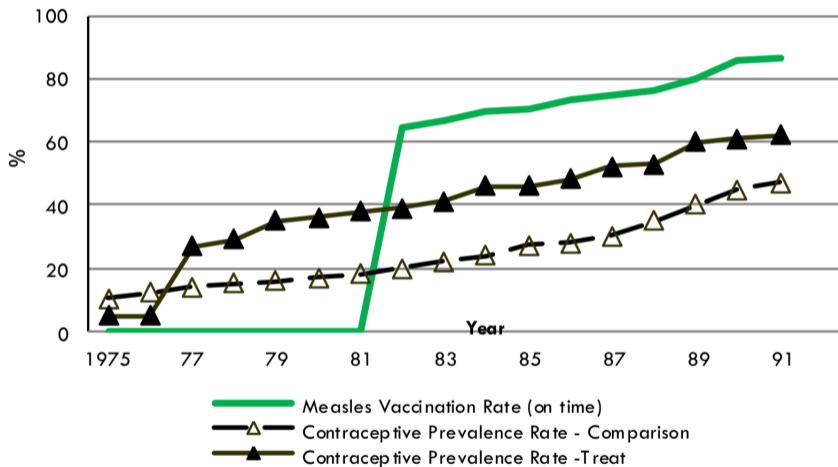
- 1 a *higher* share of workers employed in the agricultural sector,
- 2 a *lower* share of workers employed in manufacturing,
- 3 *more* intensive use of intermediate inputs in agriculture

# Bibliography

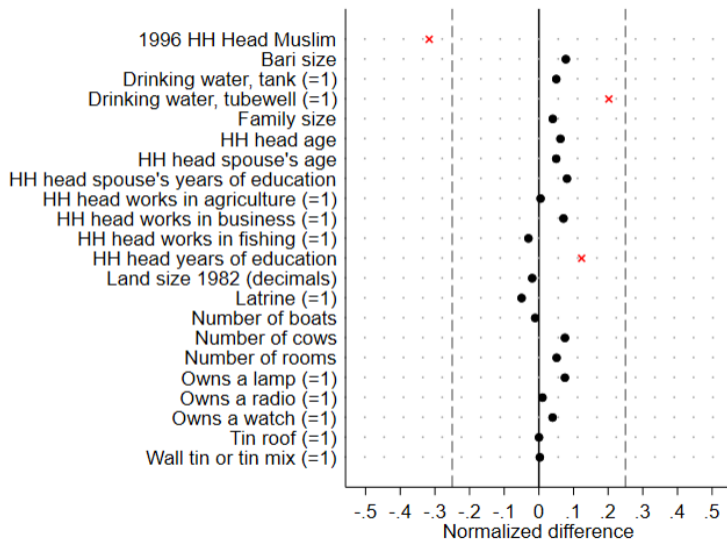
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# Program Rollout Succeeded

Phillips et al. 1984; Koenig et al. 1990, 1991; icddr,b 2007; Joshi and Schultz 2013

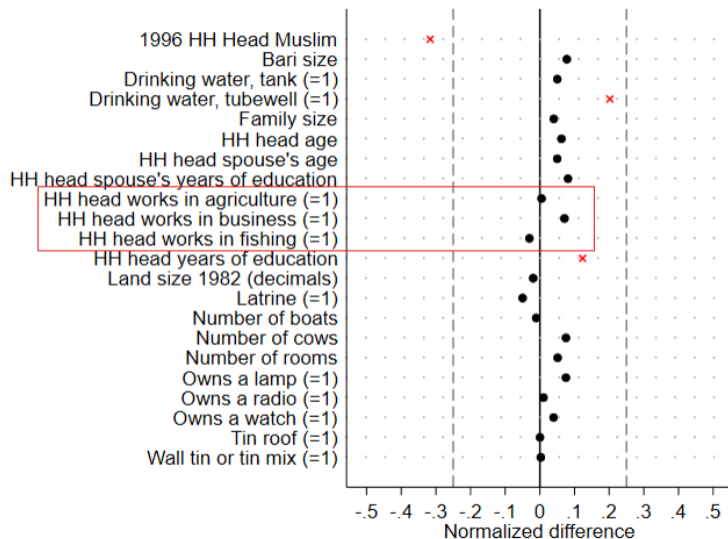


# Baseline Balance (in 1974) between Treatment and Control Households





# Baseline Balance (in 1974) between Treatment and Control Households



## Effect of MCH-FP on HH Sectoral Employment Composition - 1996

	(1)	(2)	(3)
	Dummy: Work in agr.	Dummy: Ever worked in agr.	Total earnings agr.
Treated	0.04 (0.03)	0.01 (0.03)	386.57 (403.71)
% chg. rel. to mean	6.7	1.3	16.0
Mean	0.54	0.63	2412
Baseline controls	Y	Y	Y
Embankment controls	Y	Y	Y
Observations	2580	2580	2580

*Notes:* The table presents estimates of the effect of the MCH-FP on 1996 outcomes at the MHSS1 household-level. Standard errors are clustered by pre-program village. Agricultural employment is defined based on occupation codes (=1 if agriculturist, agricultural laborer, or fisherman). \*, \*\*, and \*\*\* denote statistical significance at the 10%, 5%, and 1% levels, respectively.