Health and development

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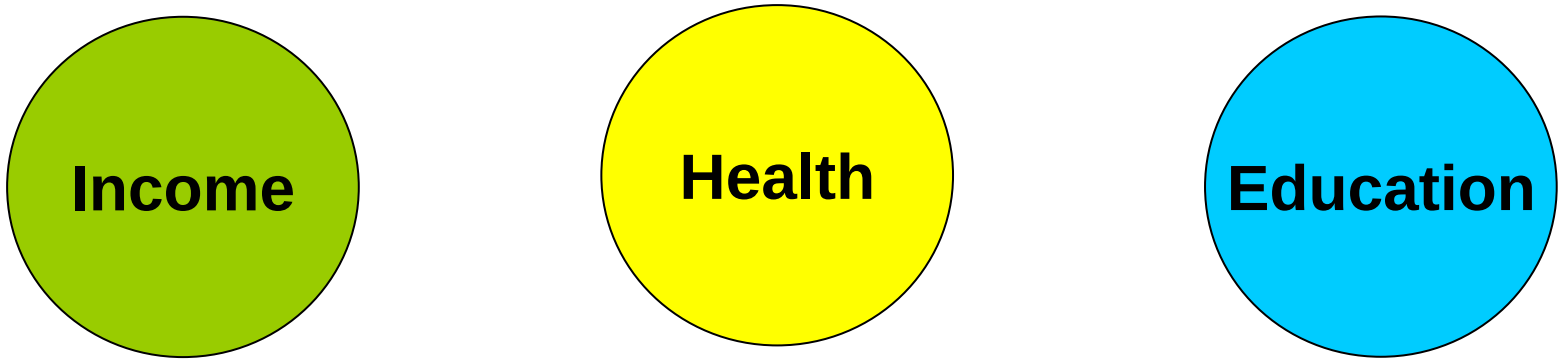
Outline of lecture

1. Why health is an important topic within development economics

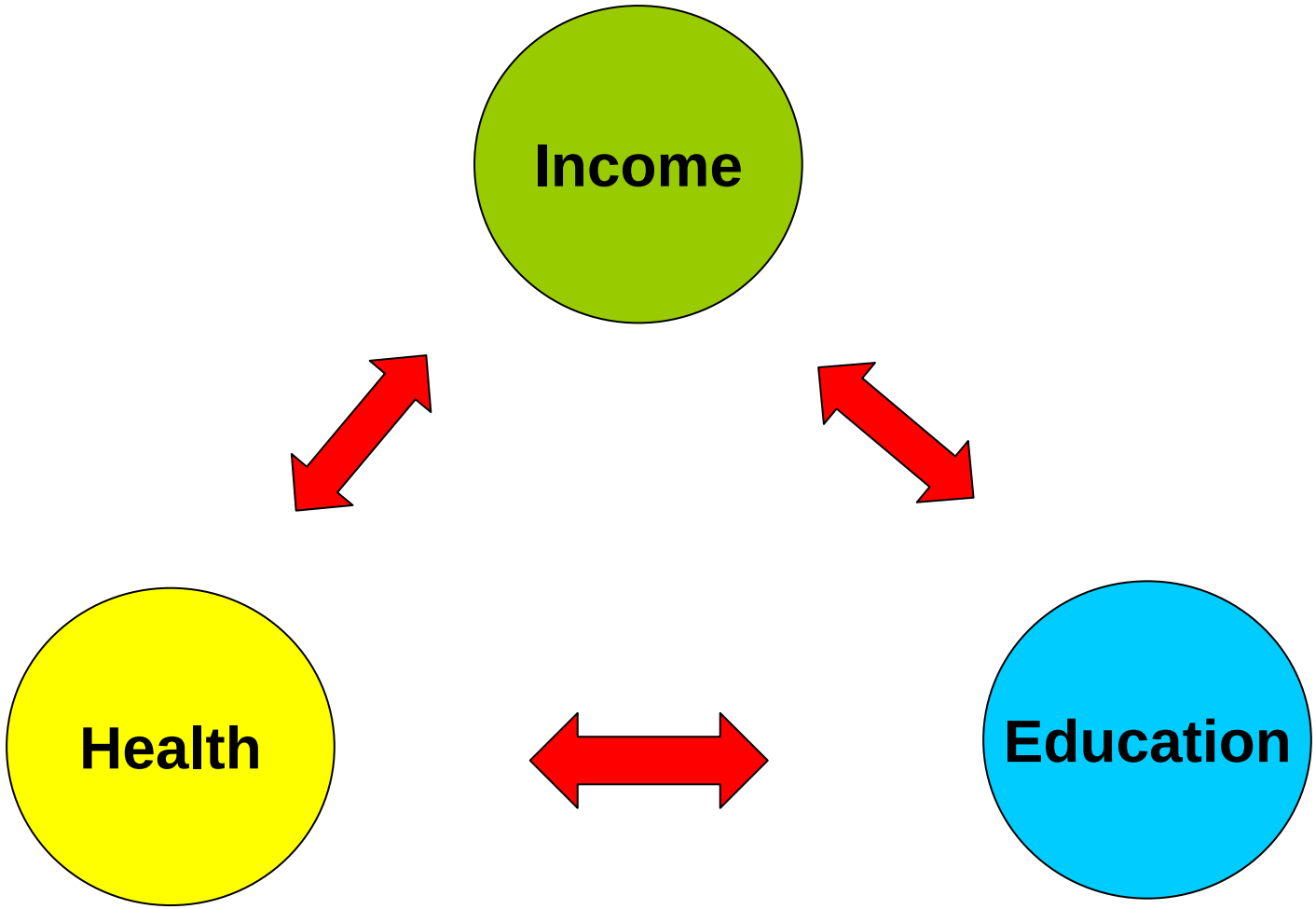
2. Impacts of health
   - Overview
   - Effect of longevity on educational investments (Jayachandran and Lleras-Muney 2009)

3. Determinants of health
   - Overview
   - Improving labor productivity through iron supplementation (Thomas et al. 2006)

Health and education as ends in themselves



Health and education as means to higher income



Mortality versus GDP

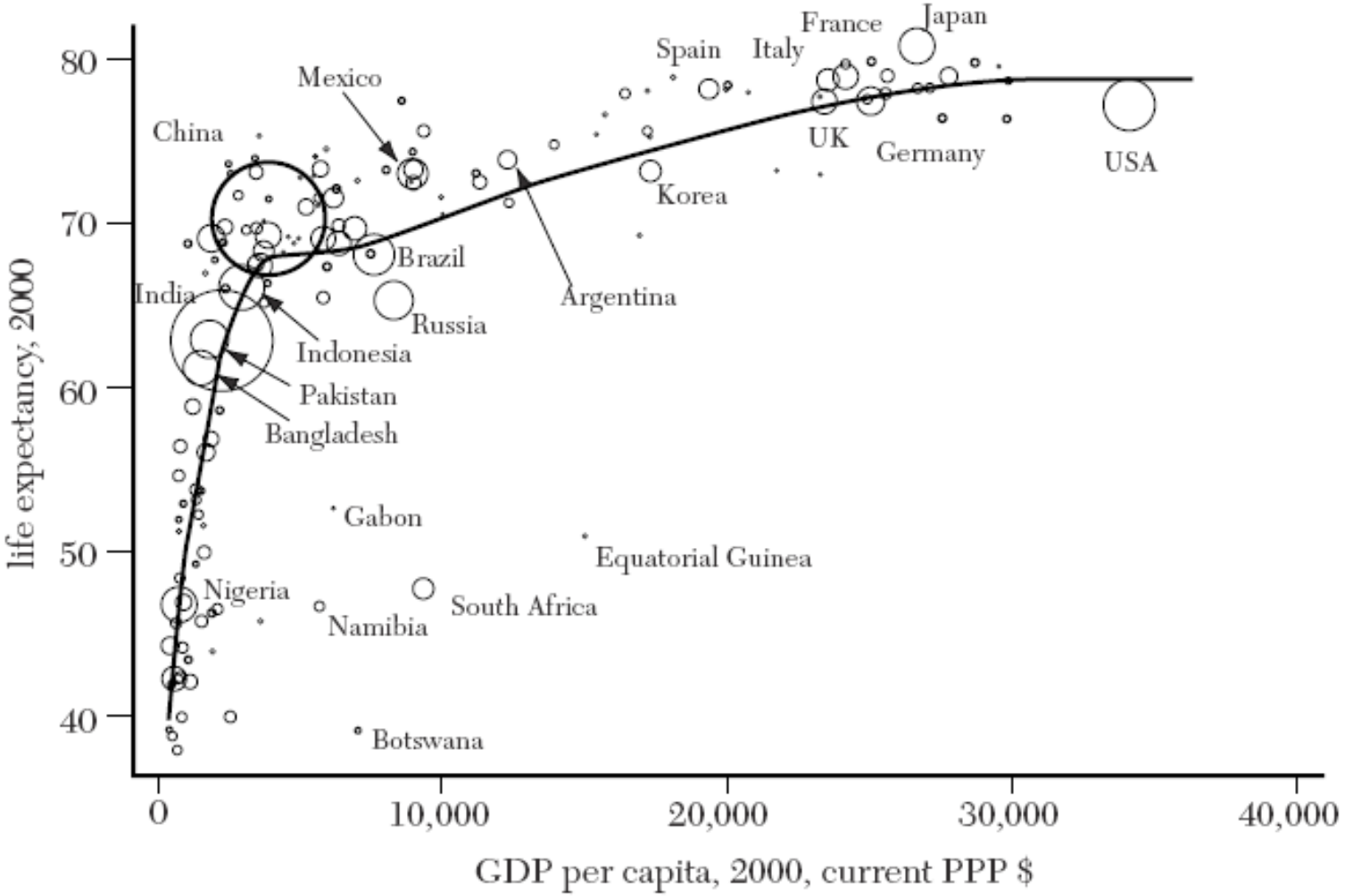


Figure 1. The Preston Curve: Life Expectancy versus GDP Per Capita

Circles are proportional to population. Reproduced from Deaton (2003, Figure 1).

Large role of government

- Govt plays a large role in health sector
- Therefore, a great deal of policy-making in these arenas, which research in development economics informs

Why is government so involved?

- Basic rights that society wants to guarantee to its citizens
- Externalities
  - Technological progress (e.g., healthy, productive people generate ideas)
  - Infectious diseases
- Market imperfections (moral hazard and health insurance)
- Break intergenerational transmission of poverty
  - Want to lift people out of poverty permanently
  - Difficult to raise earning capacity of an adult after health status is largely determined
  - Role for paternalism if parents not investing optimally for their children

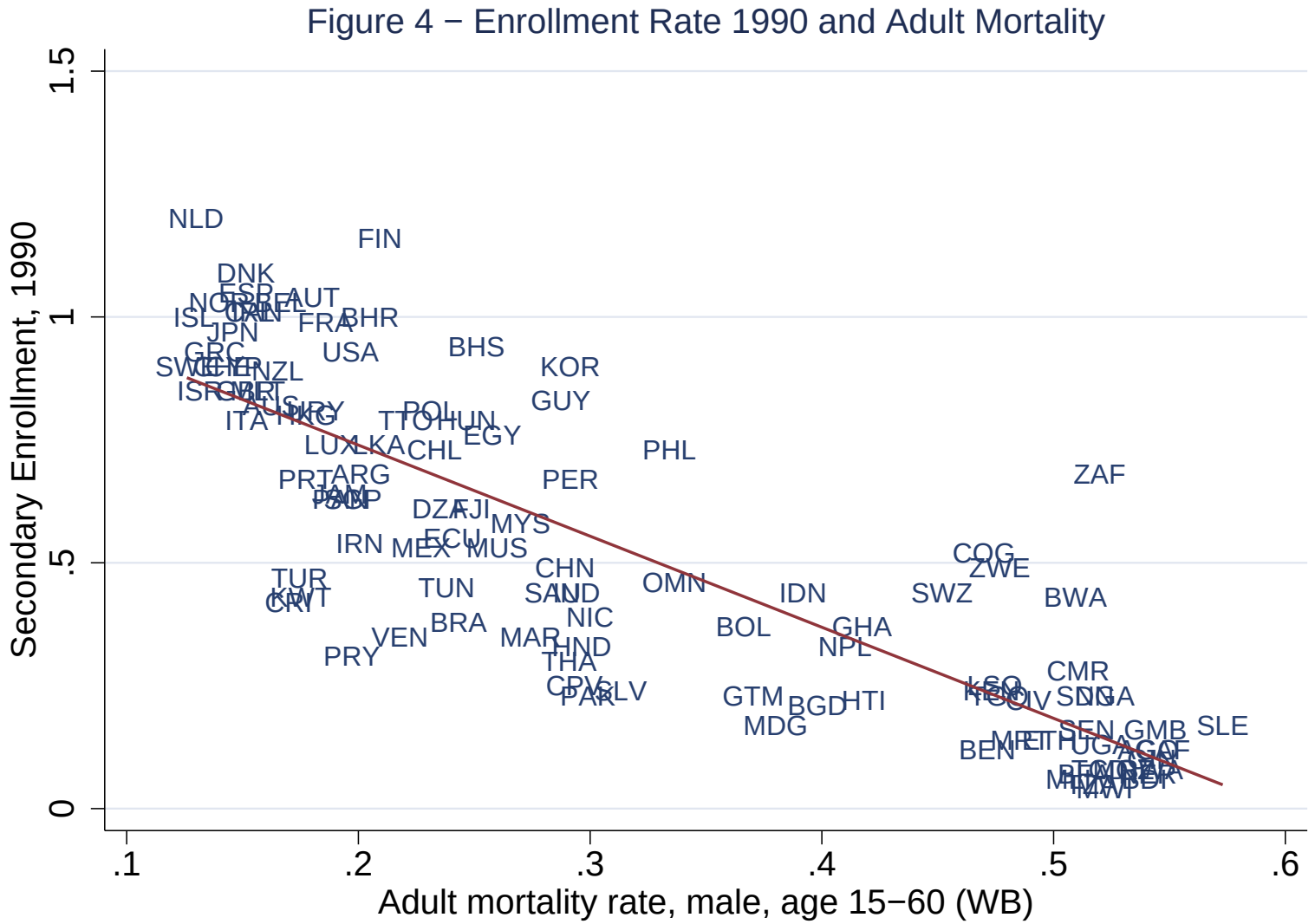
Types of research questions

- We would like to know how much to spend on health (effects of human capital)
- We would like to know how to spend money effectively to improve health (determinants of human capital)
- Example 1: Effects of health
  - How improved life expectancy leads to increased education (Diff-in-diff)
- Example 2: Determinants of health
  - How iron supplementation increases labor productivity (RCT)

Effects of longevity on education

- Longer time horizon increases the value of investments that pay out over time
- Improvements in life expectancy increase the incentive to invest in education
- Also applies to other types of investments, e.g., in a business
- Idea originates with Ben-Porath (1967)

High mortality associated with low schooling



Improving on this cross-country evidence

- Many other factors could explain why certain countries have both low school enrollment and high mortality

- Where mortality is high, there is also a lot of sickness among school-age children
  - Health also enables children to attend school
  - This is a different way health affects education

- Gains in life expectancy have mainly been from decreases in child mortality — risk that is realized before human capital investments are made

Jayachandran and Lleras-Muney (2009)

- Question:

  What is the effect of life expectancy on educational investment?

- Obtain estimates that isolate life expectancy channel
  - Use declines in maternal mortality
  - Study Sri Lanka between 1946 and 1953

What the paper's success will hinge on

1. Convince reader of contribution: Identification strategy isolates life expectancy channel better than previous papers

2. Show that results are internally valid

   - Show they are robust to specification changes
   - Rule out readers' omitted variable concerns

3. Present results in a way that they have external validity

Why maternal mortality?

- Adult mortality
  - *Future* mortality risk at time of human capital investment
  - Early in adulthood so averted death $\rightarrow$ large life expectancy gain
- Does not affect school-age morbidity
- Salient (easily observed) cause of death
- Males serve as comparison group

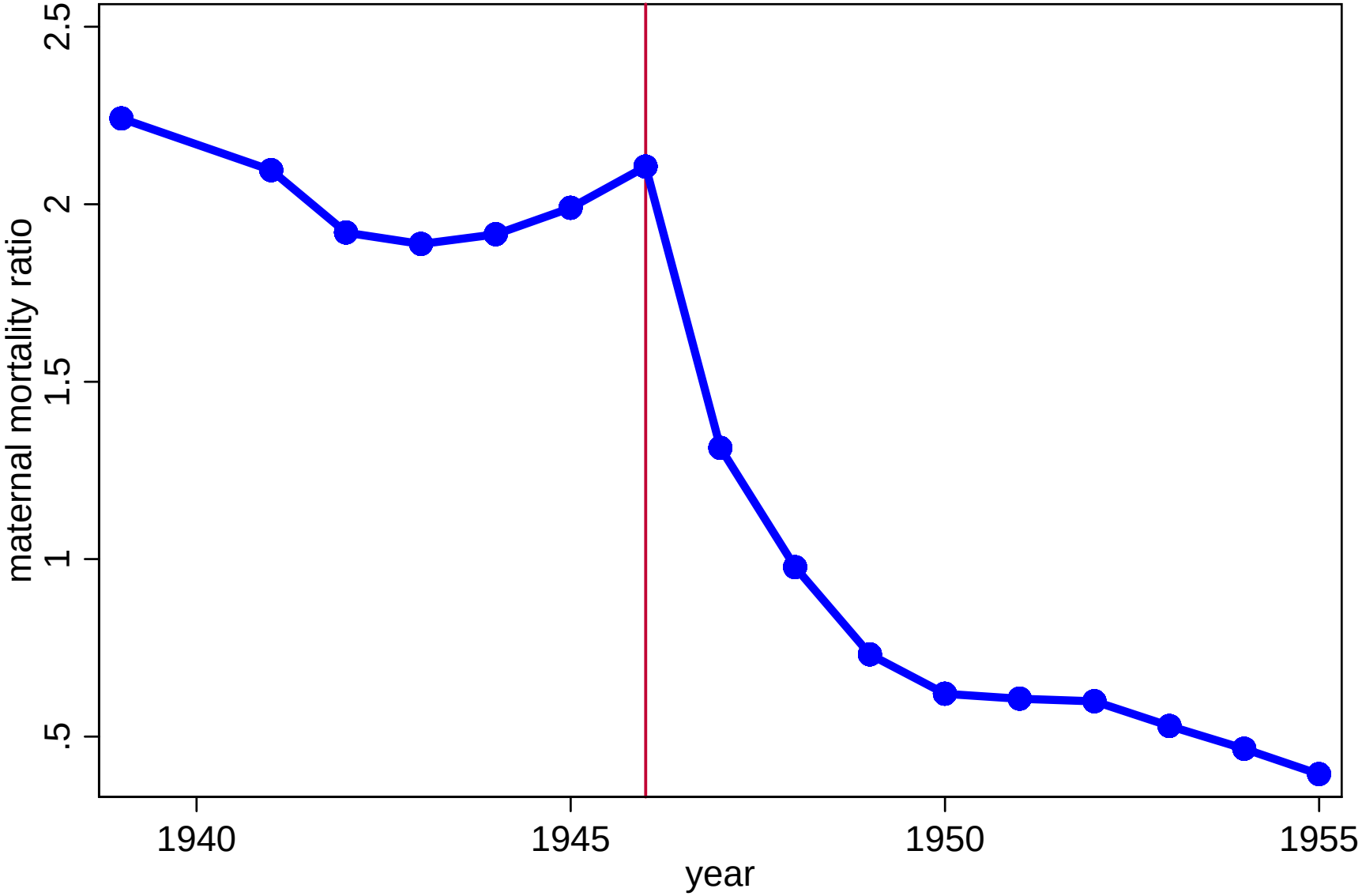
Why Sri Lanka?

- Rapid decline in maternal mortality ratio (maternal deaths per 100 live births), or MMR
  - MMR in 1946 was 1.8%
  - MMR by 1953 had fallen to 0.5%
- Represents a large mortality improvement
  - Total fertility rate (lifetime births) was $\sim$5, so lifetime mortality risk of $\sim$9%
  - Translates into 1.5 year increase in female life expectancy
- Geographic variation within Sri Lanka in the declines
- Good data

Predicted effects of maternal mortality risk

- Reduces the benefit of girls' schooling since shorter time horizon over which to earn returns
  - MMR declines $\rightarrow$ Increase in girls' education for young cohorts
- Raises cost of childbearing (chance of mother dying) and lowers benefit (daughter will have shorter life)
  - MMR declines $\rightarrow$ Increase in fertility

Figure 3b: Maternal mortality for Sri Lanka, 1939-1955



Background on MMR declines

- Expansion of health care services, with focus on maternal and child health
  - Ambulances
  - Hospitals and health centers
  - Birth attendants
- New technologies (sulfa drugs, penicillin)
- Malaria eradication

Data

- Vital statistics
  - Mortality by gender, 5-year age group, district, year
  - Maternal mortality ratio (not by age)
- Census of 1946 and 1953
  - Population
  - % Literate by age
  - School enrollment

Empirical strategy: DDD

- Time, gender, district

$$Y_{dgt} = \beta_1 \cdot MMR_{dt} \times female + \mu_{dg} + \gamma_{dt} + \nu_{gt} + \varepsilon_{dgt}$$

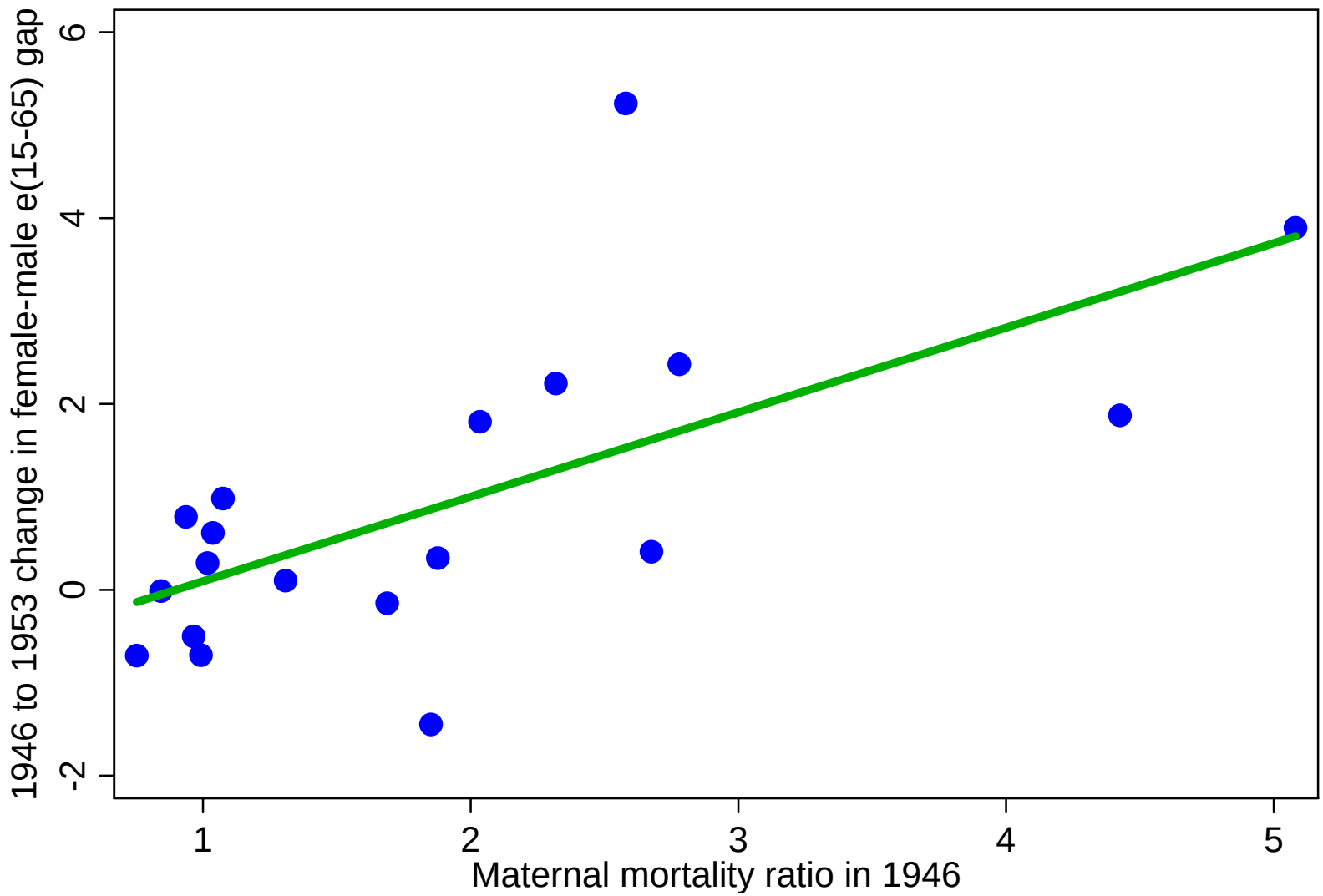
  N = 76 (19 districts $\times$ 2 genders $\times$ 2 years)

- When outcome is education, prediction is $\beta_1 < 0$: High MMR reduces girls' education

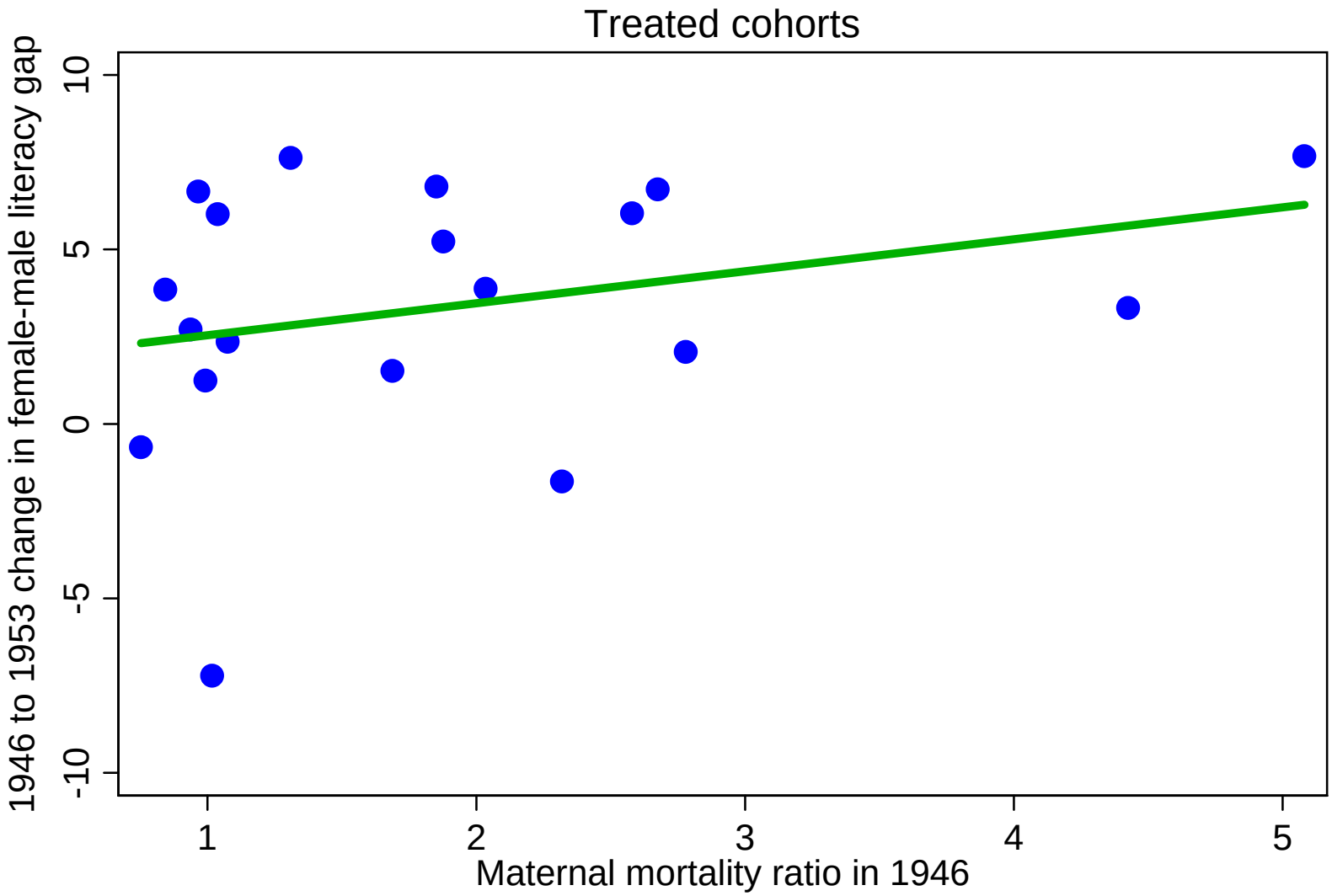
Useful to express results in terms of life expectancy

- Use mortality tables to calculate life expectancy
- Estimate similar models to see how change in MMR affects life expectancy
- Then can combine results to say how much education changes when life expectancy changes

Changes in female-male life expectancy versus MMR



Changes in female-male literacy versus MMR



Effect of MMR on literacy

	Basic	Add nutritional diseases & malaria death rates	1946 level as IV for 1946-53 drop
Ages 5-19 (treated group)			
	-0.879*	-1.652**	-1.008**
lagged MMR*female	[0.453]	[0.656]	[0.470]
Placebo test: Ages 25-44			
	-0.151	0.273	-0.149
lagged MMR*female	[0.469]	[0.450]	[0.476]

Magnitudes

- MMR declined by 1.3 points during 1946-53
- Increased female literacy by 1.1 percentage point, or 2.5%
- Elasticity of literacy with respect to life expectancy $= 0.6$
- MMR declines account for 1/3 of (relative) increase in female literacy for this period

Also examine school attendance and completed schooling

- 0.15 extra of schooling per year of life expectancy
- Elasticity of years of education with respect to life expectancy $= 1.0$

Robustness checks

TABLE VI
EFFECT OF MATERNAL MORTALITY ON LITERACY: ROBUSTNESS CHECKS

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
	Basic	Drop two outliers	Population weights	Ages 5–14 as treated group	Ages 5–14 as treated group, controlling for other diseases	MMR lagged 1 year	MMR lagged 2 years	MMR lagged 3 years	MMR lagged 4 years
Lagged MMR × female	−0.879*	−0.922	−1.378**	−0.637	−1.621**	−0.210	−0.683*	−0.731	−1.160**
	[0.453]	[1.087]	[0.754]	[0.447]	[0.743]	[0.551]	[0.398]	[0.455]	[0.473]
Observations	228	204	228	152	152	228	228	228	228
R^2	0.36	0.33	0.13	0.54	0.55	0.36	0.36	0.36	0.36

Threats to internal validity

- Labor demand effect, e.g., demand for midwives
  - Estimated effect is that 16,500 extra girls became literate
  - Increase from 400 to about 900 midwives

- Less developed districts just catching up on all fronts
  - Placebo test on older cohorts: there were no pre-trends
  - 1946 MMR not correlated with 1946 gender gap in literacy

Threats to validity (continued)

- Effect of MMR on girls' literacy due to to fewer orphan girls
  - Take extreme case: every orphaned girl is illiterate, and no effect of maternal death on boys
  - Much smaller effect size than estimated effect
- Girls freed up from home production when family members are healthier

Conclusions

- Human capital is responsive to longevity
  - Elasticity of literacy with respect to life expectancy is 0.6
  - 1 extra year of life $\Rightarrow$ 0.12 to 0.15 more years of schooling
- For cost-benefit analysis of policies to improve health, incentive effects on investment are an important component

Other studies examining effects of longevity

- Did increases in longevity cause GDP growth over the 20th century? (Acemoglu and Johnson)
- Does finding out you have a debilitating disease affect educational attainment and preventative health behaviors? (Oster)

Impacts of health – other examples

- Impact of intestinal worms on school attendance (Miguel and Kremer)
  - Role for public policy because of externalities
  - Not only an extra benefit of improving health but also one of the least expensive ways to increase school attendance
- Impact of nutrient intake (e.g., iron) on labor productivity (Thomas et al.)
- Impact of parent having AIDS on child nutrition and schooling (Thirumurthy et al.)
- Long-term impacts of health as an infant or in utero (Almond)

Determinants of health

- Households make investments in their human capital
- Social return may differ from private return (externalities)
- Imperfections may mean that the privately optimal investment is not occurring
- Demand-side problems
  - Credit constraints
  - Lack of information (e.g., about returns to health)
- Supply side problems
  - Quality of health services may be low because of weak incentives

Effect of health on productivity: dietary iron

- Thomas et al (2006) studies iron deficiency in Indonesia
- RCT that provides iron supplementation
- Hypothesis tested:

  Iron deficiency $\rightarrow$ Lower aerobic capacity, less endurance, more fatigue $\rightarrow$ Lower labor productivity $\rightarrow$ Lower earnings

- Why might there be a rationale for intervention?

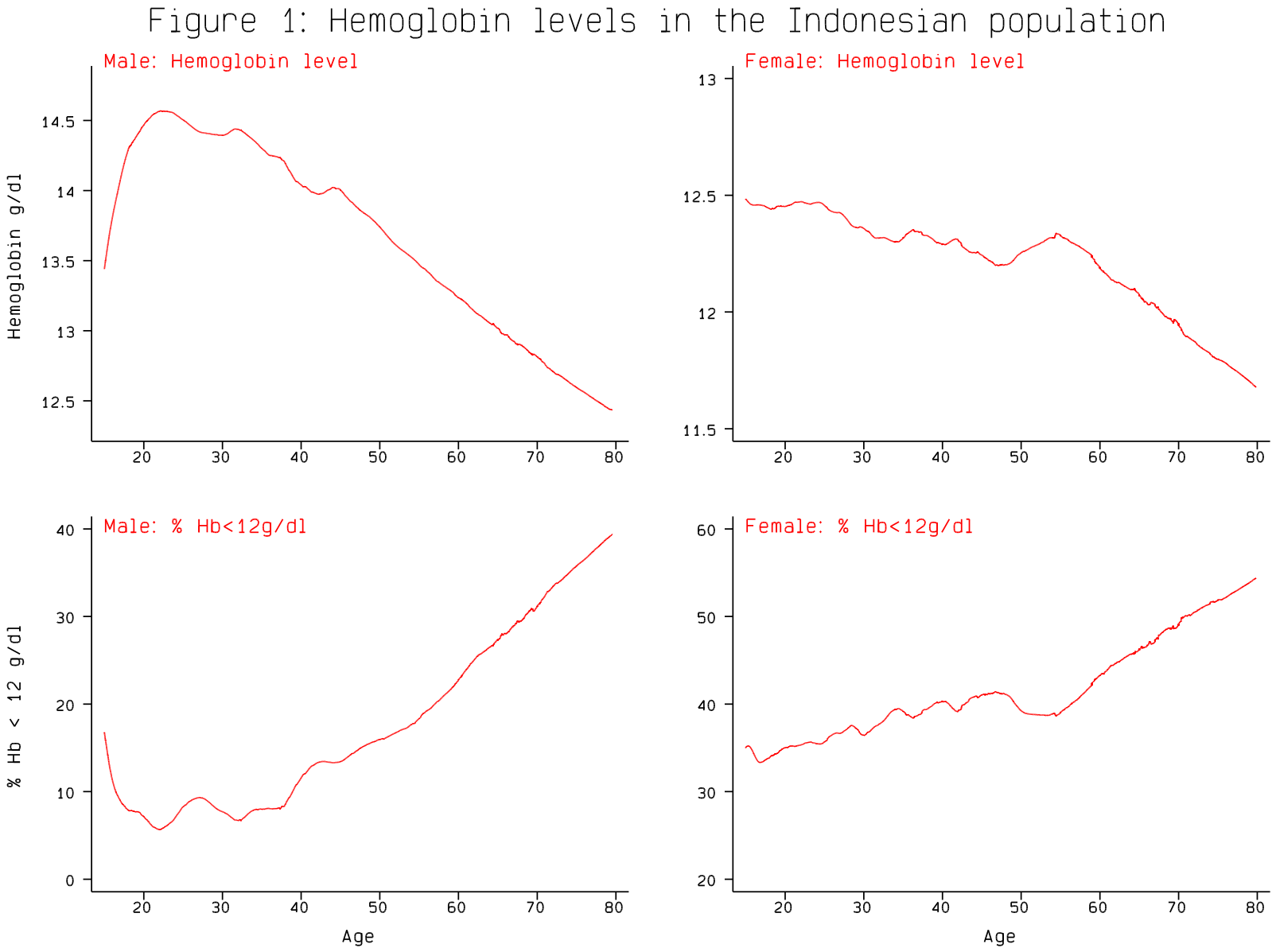


Figure 1: Hemoglobin levels in the Indonesian population
Male: Hemoglobin level
Female: Hemoglobin level
Male: % Hb<12g/dl
Female: % Hb<12g/dl
Hemoglobin g/dl
% Hb < 12 g/dl
Age
Age

x-axis is age

Design of study

- Random sample of 4300 HHs (17,500 people) in 1 district near Yogyakarta, Java
- This paper focuses on adults age 30-70: $\sim$8000 people
- Randomized intervention
  - Distributed dietary iron supplements to the treatment group
  - Randomized at household rather than individual level
- Compared treated to controls
  - Hemoglobin (Hb) levels (indicator of iron in blood)
  - Other health measures (self-reported, VO_2^{max})
  - Labor market outcomes
  - Time allocation

Why a randomized intervention

- Strong correlation between hemoglobin levels and labor market outcomes
  - Reverse causality?
  - Omitted variables?

Sample attrition

- Keeping attrition low is important
- Statistical power
- With non-random attrition, biased estimates of average treatment effect (ATE)

$$Earnings_i = \alpha + \beta Treat_i + \gamma X_i + \epsilon_i$$

  - Suppose attrition is correlated with $\epsilon_i * Treat_i$
    Example: Most ambitious of the treated migrate (to migrate need to be healthy + ambitious)

Sample attrition (cont'd)

- If treated people with especially good outcomes (high earnings) are disproportionately missing from sample, will underestimate the average treatment

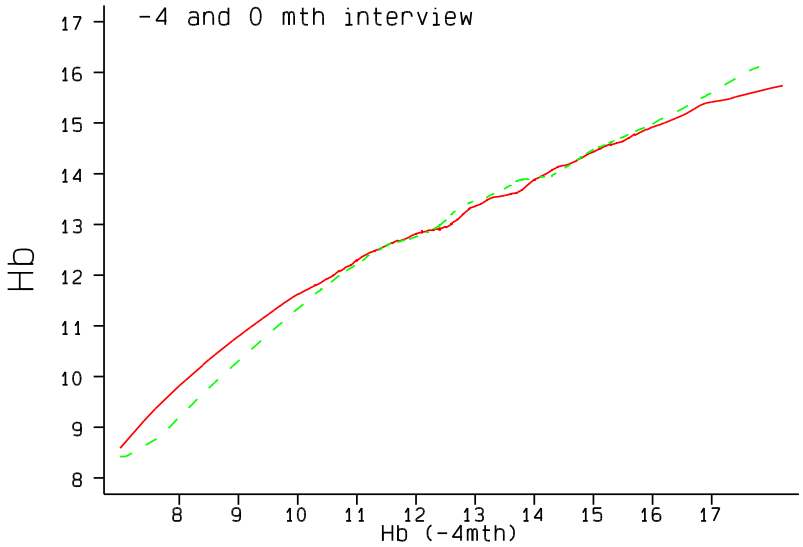
- Cannot test directly whether attrition is non-random on unobservables such as ϵ_i or β_i

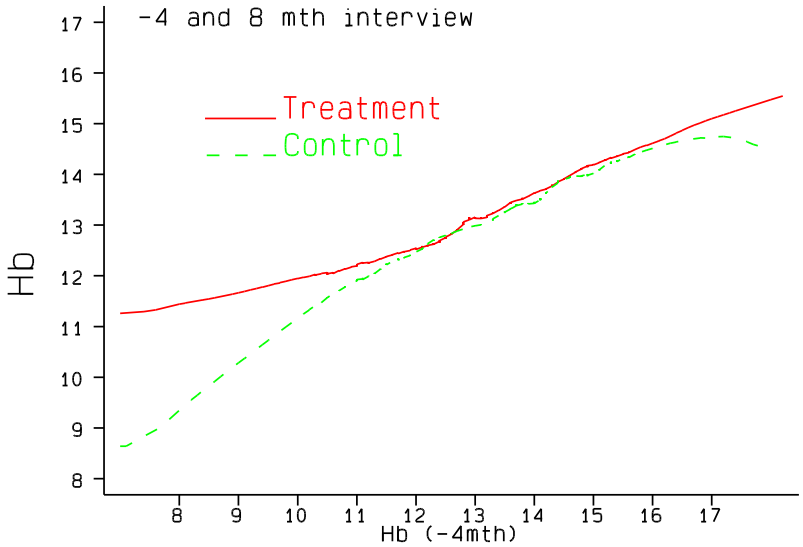
- Can check how attrition varies with observables
  - Is attrition rate different for treatment and control?
  - Is attrition differently correlated with observables (X_i) for treatment versus control?

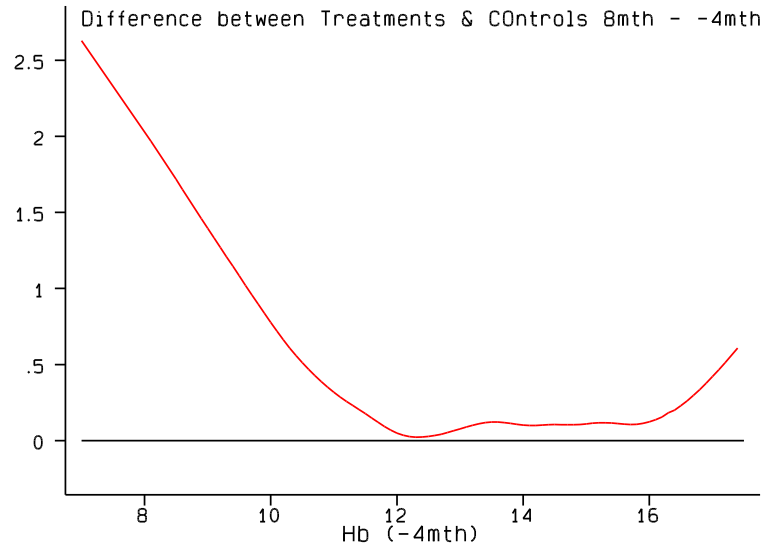
- This study, in fact, has very low attrition ($< 3\%$)

Hb results: males

Figure 2: Hemoglobin level of males age 30-70

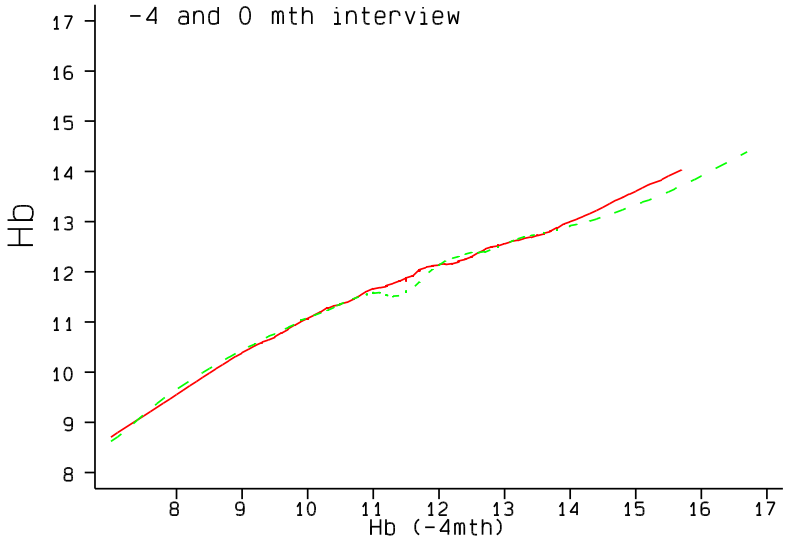


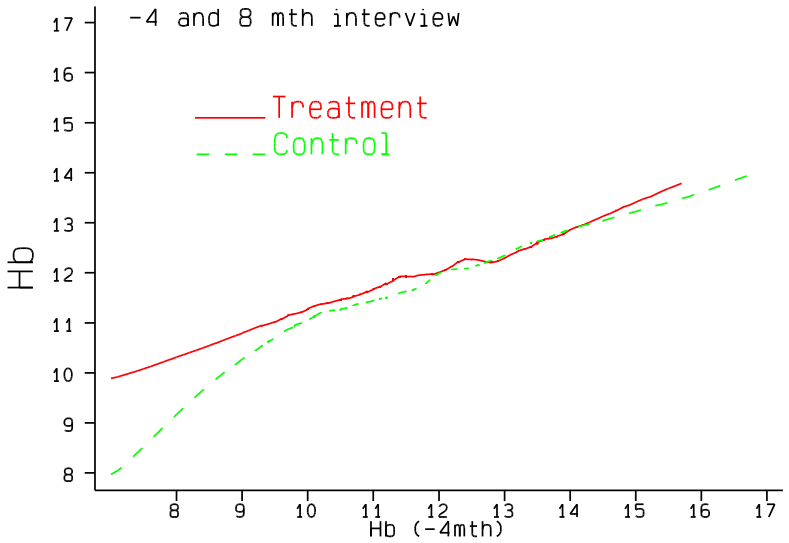


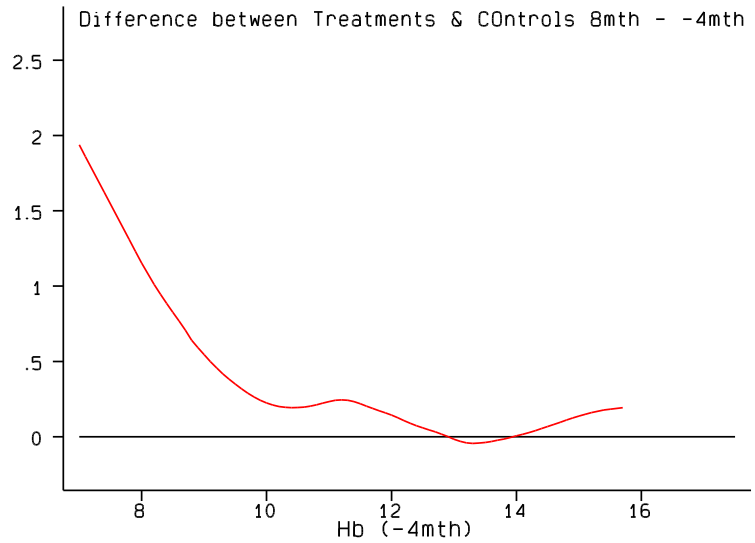


Hb results: females

Figure 3: Hemoglobin level of females age 30-70







Hb results as regressions

Table 3
Hemoglobin status: Intent to treat effects

Indicator	Sample	Status at 8 mths: Treat-ment (1)	Status at 8 mths: Control (2)	Status at 8 mths: Diff T-C (3)	-4 mths: Diff T-C (4)	8 - (-4)mths: Diff-in Diff (5)	8 - (-4)mths: Adj Diff -in-diff (6)	Low Hb @baseline DinD (7)	High Hb @baseline DinD (8)
Hemoglobin	Male	13.250	13.127	0.123	-0.059	0.183	0.181	0.399	0.101
		[0.040]	[0.040]	[0.057]	[0.059]	[0.057]	[0.057]	[0.109]	[0.064]
	Female	11.974	11.819	0.156	0.040	0.116	0.117	0.203	-0.022
		[0.033]	[0.033]	[0.046]	[0.048]	[0.048]	[0.048]	[0.057]	[0.081]
Hemoglobin <11g/dl	Male	0.069	0.078	-0.009	0.009	-0.017	-0.017	-0.066	0.000
		[0.006]	[0.006]	[0.009]	[0.010]	[0.011]	[0.011]	[0.021]	[0.012]
	Female	0.195	0.249	-0.054	-0.012	-0.041	-0.041	-0.072	0.017
		[0.009]	[0.009]	[0.013]	[0.014]	[0.016]	[0.016]	[0.019]	[0.027]
Hemoglobin <12g/dl	Male	0.179	0.206	-0.027	-0.004	-0.023	-0.023	-0.046	-0.013
		[0.009]	[0.009]	[0.013]	[0.014]	[0.015]	[0.015]	[0.030]	[0.017]
	Female	0.461	0.499	-0.038	-0.024	-0.014	-0.014	-0.036	0.020
		[0.011]	[0.011]	[0.016]	[0.016]	[0.019]	[0.019]	[0.022]	[0.032]
Sample size	Male	1,804	1,759	3,563	3,563	3,563	3,563	899	2,664
	Female	2,021	2,042	4,063	4,063	4,063	4,063	2,710	1,353

Self-reported health (Tab 7)

Indicator	Sample	Change in Treatments - Change in Controls: If low Hb @baseline DinD (1)	If high Hb @baseline DinD (2)	Low-High Hb @baseline DinDinD (3)
1. Pr(Unable carry heavy load) self reported	Male	-0.032	0.002	-0.034
		[0.015]	[0.008]	[0.017]
	Female	-0.008	-0.018	0.009
		[0.014]	[0.019]	[0.023]
2. Pr(Has more energy) self reported	Male	0.026	0.001	0.025
		[0.021]	[0.013]	[0.025]
	Female	0.011	-0.008	0.019
		[0.012]	[0.017]	[0.020]
3. Pr(Has less energy) self reported	Male	-0.032	0.010	-0.041
		[0.012]	[0.007]	[0.014]
	Female	0.009	-0.009	0.017
		[0.008]	[0.011]	[0.014]
4. Pr(Felt fatigued) (in last month)	Male	-0.040	-0.050	0.010
		[0.043]	[0.025]	[0.049]
	Female	-0.007	-0.013	0.006
		[0.025]	[0.036]	[0.044]
5. Pr(Felt dizzy) (in last month)	Male	-0.043	-0.023	-0.020
		[0.037]	[0.022]	[0.043]
	Female	-0.056	0.016	-0.072
		[0.024]	[0.033]	[0.041]

Labor productivity effects (Tab 5)

Indicator	Sample	Change in Treatments - Change in Controls: If low Hb @baseline DinD (1)	If high Hb @baseline DinD (2)	Low-High Hb @baseline DinDinD (3)
1. Pr(not working in month of survey interview)	Male	-0.036	-0.003	-0.033
		[0.012]	[0.007]	[0.014]
	Female	-0.020	0.029	-0.049
		[0.014]	[0.020]	[0.024]
2. $\sqrt[4]{}$Earnings (Rp 000) (last 4 months)	Male	0.576	-0.012	0.582
		[0.299]	[0.173]	[0.346]
	Female	0.163	0.033	0.130
		[0.091]	[0.127]	[0.156]
3. Hours spent working (last 4 months)	Male	-12.968	-44.185	31.217
		[36.368]	[21.027]	[42.013]
	Female	9.644	30.137	-20.493
		[15.264]	[21.425]	[26.309]
4. $\sqrt[4]{}$Hrly earnings (Rp 000) (last 4 months)	Male	0.126	0.007	0.119
		[0.066]	[0.038]	[0.076]
	Female	0.034	-0.009	0.043
		[0.025]	[0.035]	[0.043]
5. $\sqrt[4]{}$Hrly earnings (Rp 000) conditional on being non zero (last 4 months)	Male	0.113	-0.006	0.119
		[0.069]	[0.040]	[0.080]
	Female	0.056	-0.021	0.077
		[0.026]	[0.037]	[0.046]

Effects for self-employed

- Improvements mainly for self-employed
- 40% increase in hourly earnings (huge!)
- Is the prediction that treatment should lead to more more or less labor supply? No real change seen
- This is the short run

Summary of effects

- Main findings
  - Significant increase in Hb levels, especially for those with low Hb
  - Improvements in self-reported health
  - Higher hourly earnings, mainly for self-employed
- Longer run effects?
  - Higher wages or salaries
  - Job mobility
  - Migration

Policy implications

- Why don't people invest in iron supplements?
  - Knowledge?
  - Availability of supplements?
- Is the intervention used in this study a viable policy?
  - Probably not cost effective as is
  - Fortifying food?
    - Cost of fortified fish sauce: \$6 per year
    - Benefit is about \$40 per year
    - Individual's rate of return of buying fortified food is high
    - But only 20% of the population is iron deficient
- Targeted intervention?

Many open research questions

- Much work to be done on the determinants and consequences of health
- Big open issues include quality of service and demand for preventative health

Other research areas related to health

- Environmental degradation and health (example: air pollution leads to lower labor productivity)
- Competition and other industrial organization questions, government versus private provision
- Gender discrimination in health investments made by parents

Topics lend themselves to micro-empirical work

- Data are available
  - Many household surveys collect data on infant mortality and health status, for example
- Potential for strong identification strategies
  - Policy-makers affect health
  - Natural experiments and randomized experiments