Worms at Work: Long-run Impacts of Child Health Gains

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- Joint work with Sarah, Joan, Ted.

The Impact of Public Health Investments

- Optimal public health subsidy depends on direct, externality impact
- Advocates argue child public health investments generate high returns through improved adult living standards
- But hard to estimate causal impact
  - Studies of impact of adult health on productivity in particular industries:
    - E.g., Studies of firms' provision of ARVs (Habyarimana, Mbakile and Pop-Eleches ,2010), plantation worker studies (Strauss, 1986)
    - But child health could affect education, occupational choice
  - Few panel datasets track children into adulthood
  - Isolating impact of child health investments is difficult
  - Externalities

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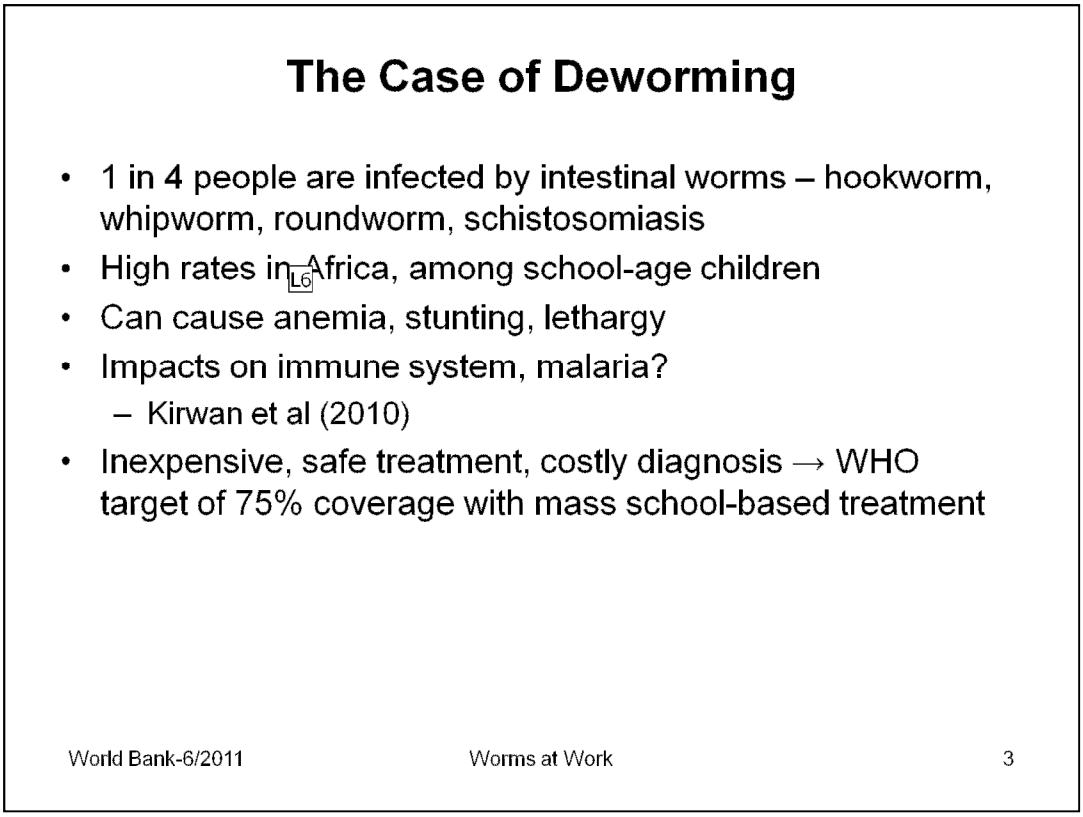
If high price sensitivity because little impact, other priorities, then arguably should not subsidize



1. Chronic parasitic infections have lingering health effects throughout life (Crimmins and Finch 2005).

2. A recent double-blind placebo randomized controlled trial among Nigerian preschool children finds that children who received deworming treatment for 14 months show reduced infection prevalence with *Plasmodium*, the malaria parasite (Kirwan et al. 2010), and other authors have hypothesized that deworming might even provide some protection against HIV infection.

3. But before jumping into those results let me just summarize / recap the earlier findings and policy impacts.

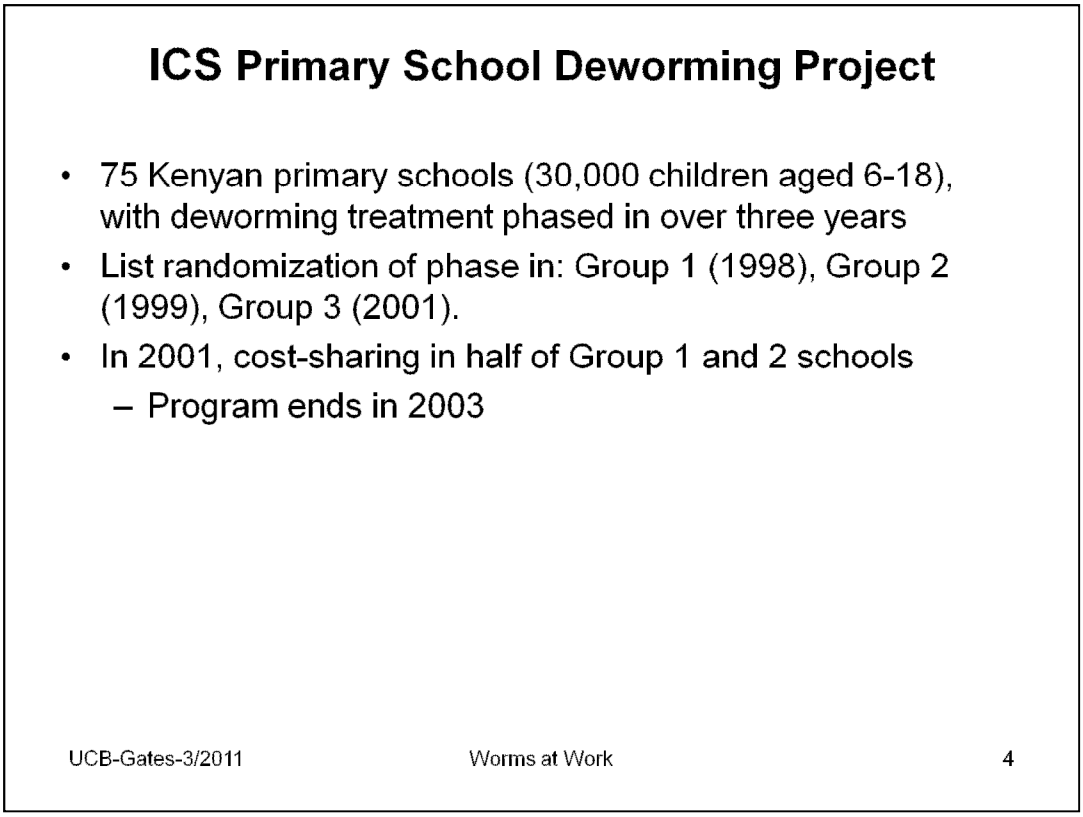
4. INSERT WORM PICTURE?

5. Kills worms, but then get re-infected, so retreat every year or 6 months

6. INSERT something about transmission mechanism, worm lifecycle

Slide 3

L6 remove to notes
Ludo, 16/05/2011



1. In rural western Kenya 90% have some infection, > 50% moderate to heavy High, but not off charts, and surprisingly little anemia

2. ICS phased deworming and health education into 75 primary schools (30,000 children aged 6-18)

3. List randomization into:

   Group 1 (in 1998-2003)

   Group 2 (1999-2003)

   Group 3 (2001-2003)

Short-Run Impacts

- At one year mark 25% of pupils had serious worm infections in treated schools, 52% in untreated
- Significant gains in height, self-reported health
- School absence falls one quarter (7 percentage points)
- Reduced re-infection, school absence among other community members, including:
  - Untreated children in treatment schools
  - Children in schools within 6 km
  - Younger siblings (Ozier 2010)
- Cost/year of increased school participation = $3.50.
- Take up 75% when treatment was free; 18% under cost-sharing.

World Bank-6/2011 Worms at Work 5

The height gains go away in the current sample.

4.1pp decrease in “sick in past week” (control mean 45%), 3.7 pp decrease in “sick often” (control mean 15%)

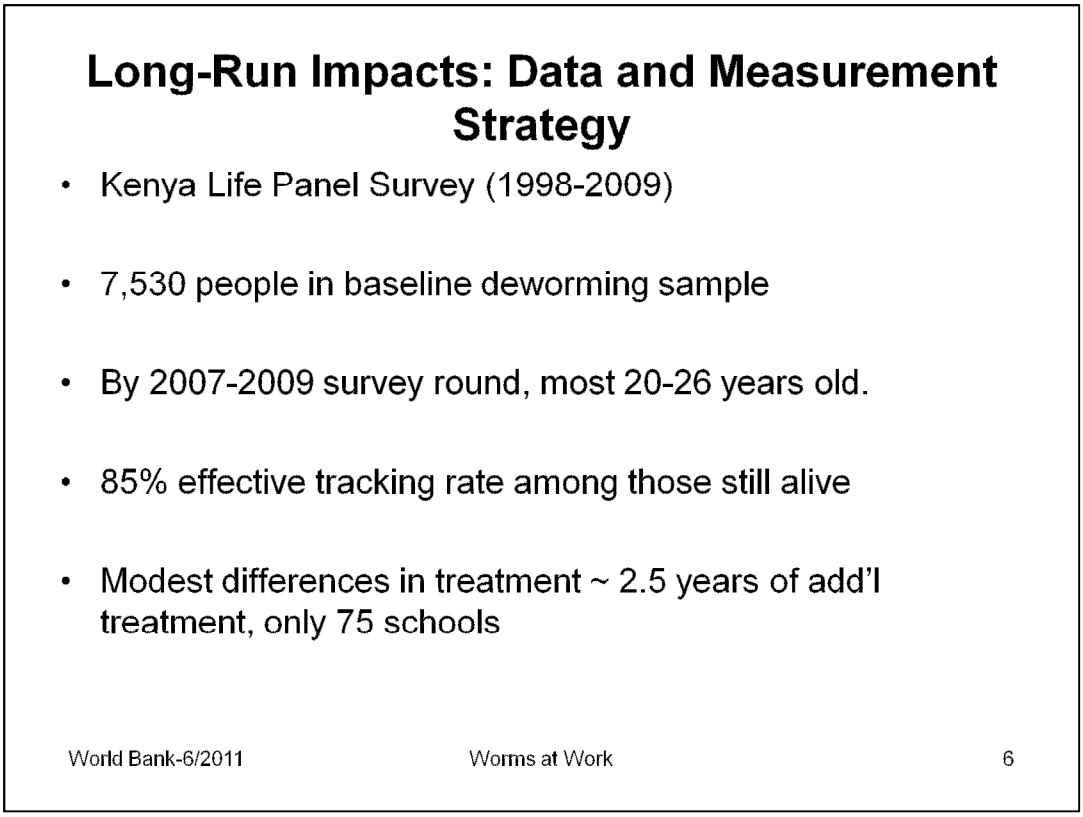
1. Less likely to fall sick often takes on a value of one if falls sick often, zero otherwise, decline in 3.7pp (mean in control 15.4%)

2. Self reported health status takes on a value of one if health very good, and zero otherwise, improvement of 4.1pp over a mean in the control of 67.3%

Effect on untreated children was 70% of the effect on the treated

Ozier (2010) - children 0-3 years old when the deworming program was launched who had older siblings in treatment schools had average test score gains of 0.4 standard deviation units

Most effective of various options tried in area for



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1. The team regularly updated contact information, often using cell phones.

2. A high effective tracking rate for a young adult population over a decade.

Long-Run Impact: Health and Education

- Self-reported health improved, no significant BMI, height changes
- Primary school participation, 1998-2001, increased by 0.129 years (p<.01)
- Years enrolled in school, 1998-2007, increased by 0.279 years (p<.1)
- More grade repetition, not grade completion
- Test score mean effect increase by 0.1 s.d. (p<.1)
  - includes 1999 test, passed primary school exam, and 2007-09 English test
  - No cognitive gain on Raven's matrix

World Bank-6/2011 Worms at Work 7

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1. Mention that we have a simple model in the paper that attempts to make sense of the channels of impact, but no time to discuss here.

1. This value of 0.3 years takes into account both additional years enrolled in school, as well as increased participation.

2. The test score impact is a mean effect of 1999 academic test, passed primary school exam, and the 2007-2009 English test. .1 standard deviation improvement across these few measures.

Average meals/day in control group is 2.16

1. We also see increased expenditures on health in the past month (91.1KSH, p<0.01)

Long-run Economic Impacts

- As adults, treatment group ate 0.1 more meals / day ($p<0.01$)
- Their neighbors also ate 0.08 more meals/day ($p<.01$)
- Work hours rose 12% (1.76 hours, $p<0.10$)
  - Effect concentrated among those with positive hours (2.4 hours/week, $p < .05$)

World Bank-6/2011 Worms at Work 8

Control group: average meals eaten 2.16, hours worked last week is 23.0, all sectors.

(1) A standard view is that the welfare gains from deworming are best captured in wage gains, ignoring increased hours worked. However, this breaks down if better health improves the capacity to work longer hours – which Grossman (1972) argued is the distinguishing characteristic of health capital

(2) Increase in hours is 5.2 (from base of 42.2) in the wage earner subsample.

(3) median hours worked rose by 8% (1.10 hours, $p<0.05$)

(1) For non-treatment within 6k, increase is 6.60, not significantly different than treatment, 95% sure different from 0.

(1) Days missed for control wage-earners is 1.46

(4) Proportions in the labor force are nearly identical across groups.

(5) Schapiro (1919, *JAMA*) finds 15-27% wage gains on Costa Rican plantations after deworming

1. Both the US South and Costa Rica deworming campaigns were funded by the Rockefeller Foundation. Neither had an experimental design. Bleakley relies on baseline differences in infection rates and argues that areas with low baseline exposure function as a control group of sorts. Schapiro relies on a before-after comparison..

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Disaggregating Economic Impact

- Look among wage earners, self-employed, farmers (no shifts between these groups)
- Strongest effects among wage earners
  - Total earnings in past month rose 29% ($p<.01$)
  - Work 5.2 more hours per week
  - 0.5 fewer workdays missed each month due to poor health ($p<.05$)
  - Earnings rose by .25 log points ($p<0.01$)
    - Consistent with Bleakley (2007, 2010) evidence on US South
  - Men triple employment in manufacturing (9 p.p., $p<0.01$).
  - Women do less casual labor, domestic services (17 p.p., $p=.11$).

World Bank-6/2011 Worms at Work 9

(1) The degree of selection into the wage earner subsample is a key issue in assessing the validity of these results. Although I do not have time to go through these here, we go though a host of exercises to check this all of which indicate that selection bias is unlikely to be driving our results. These include

(i) there is no differential selection into wage earning subsamples

(ii) the observable characteristics of wage earners in the treatment and control groups are indistinguishable

(iii) there are significant impacts on certain labor market outcomes in the full sample

(iv) results are robust to a standard Heckman selection correction model

and to restricting analysis to a subsample where labor market participation is substantially higher than average

(2) This pattern indicates that health investments not only boost productivity and work capacity in existing activities, but, by leading individuals to shift into more lucrative economic activities (like manufacturing employment), may also contribute to the structural transformation of the economy a whole.

(3) A decomposition along the lines of Oaxaca (1973) indicates that 90% of the increase in labor earnings for the treatment group, and 20% of the increase in hours worked, can be explained by the sectoral shifts documented. Note that average earnings in manufacturing are twice those in casual labor or domestic work.

Long-run Impacts: Income, Disaggregated

- Some effects among self-employed
  - Suggestive positive point estimates on self-reported and constructed profits, and total employees hired
  - Combining these variables, mean effect size 0.175 standard deviations ($p<0.05$)
- Little estimated impact in agriculture
- Hard to measure productivity in these sectors
  - Measurement error?
  - Individual versus family production?
  - Differential impact across sectors?

For agriculture, look at total value of crop sales, indicator for use “improved” practices, don’t get significant results

Externalities and cost sharing

- Positive, large and statistically significant local spillovers in terms of both meals eaten (0.080, $p<0.01$) and labor supply for those with positive hours (2.75 hours/week, $p<0.05$).
- Deworming creates an estimated 20% increase in labor earnings for wage earners within 6km (0.199, $p=.22$)
- Cost sharing leads to a 15.4% decrease in earnings (-.154, $p<.1$)

Cost sharing coefficient is not significantly different than deworming indicator

Returns

- Depends on assumptions, but estimated social financial rate of return is around 75% per year treating increased hours as gain in endowment
- Externality benefit alone sufficient to justify full subsidy

MR7

World Bank-6/2011 Worms at Work 12

Say something about national program in Kenya, AP, Bihar,

Amrita, Lesley

An upper bound of 74.1% is obtained by considering the increase in total earnings while disregarding the opportunity cost of time spent in school (wage earner sample only). If add opportunity costs of schooling, 21.3% rate of return. If consider whole sample, ranges from 41.9 to 103.4 (Panel C).

For reference, at the time of writing nominal commercial interest rates in Kenya are 10-12% per annum, the rate on long-term sovereign debt is 11% and inflation is 3%

Lowest bound on externality benefit 12% per annum.

Slide 12

MR7 Something to talk about when you get back - how did you construct the numbers? The ones for "just externalities" don't really make sense - one time they're higher than the "total" irr, which I don't think is possible

Martin Rotemberg, 28/06/2011

END

Bounding financial return on deworming

- Benefits:
  - Higher labor market earnings in the treatment group, spillovers.
  - Gains for those not earning wages
  - Other health benefits
- Costs:
  - (i) deworming pills and delivery (plus deadweight loss of raising government revenue);
  - (ii) the opportunity cost of time spent in school and not working
  - Assume fully productive by 18 and can earn $1.26/day

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1. Unclear whether we should be including the second cost.

Financial return on deworming

- The social internal rate of return ranges from 21.3%-74.1% (considering wage productivity gains in wage earning sample) to 41.9%-103.4% (total earnings gains in the full sample) per annum.
- Real interest rates in Kenya are roughly 10-12%
- Rates of return considering cross-school externality benefits alone range from 20.4% (wage productivity gains in wage sample) to 102.3% (earnings gains).
- Externality benefits alone appear to justify fully subsidizing school-based deworming.

World Bank-6/2011 Worms at Work 15

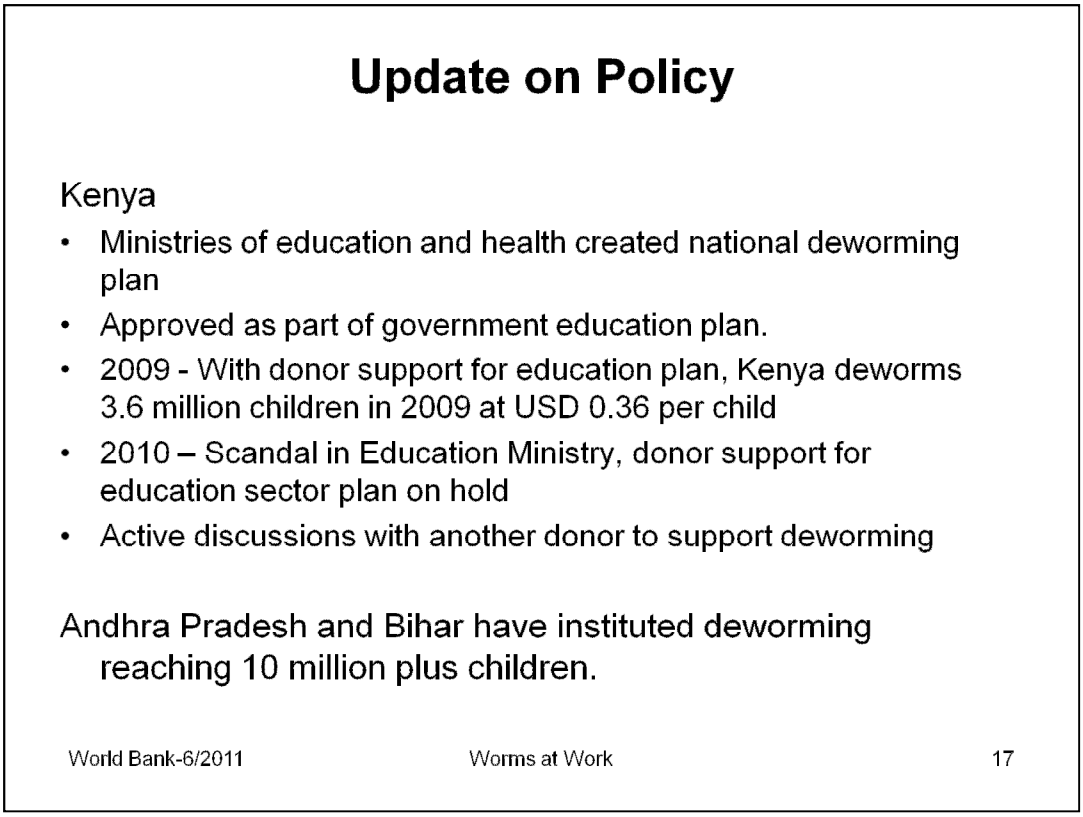
1. The externality estimates are lower bounds because we ignore within-school externalities (which we showed in the 2004 paper are very large), ignore externalities beyond 6km, and ignore other beneficiaries (e.g., the younger children in Ozier 2010, and other older community members or school-aged kids who were not enrolled in schools and thus not in our sample).

Implications

- Health investments for children above age 0-3 can still have large impacts on future living standards.
- Shift in occupation suggests active matching in labor markets.
- Can compare adult outcomes for participants, neighbors, under no subsidy, full subsidy, and (eventually) cost sharing
- Externality benefits alone justify full subsidy
- From evidence to policy……

World Bank-6/2011 Worms at Work 16

1. Need further investigation of other investments in child health (water, sanitation and hygiene programs, mosquito nets)
2. High returns, but not macroeconomically transformative



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Policy change within Kenya:

1. Prime Minister announces Kenya's commitment to deworming at World Economic Forum 2009

2. $1mm allocated for deworming in gov't budget

3. National school health policy established

4. Cross-sector deworming committee created to oversee program (Ministries of Education and Health and partners)

5. Press conferences held by Ministry leaders