Economics 270c

Development Economics

Lecture 10 – March 20, 2007

Lecture 1: Global patterns of economic growth and development (1/16)

The political economy of development

Lecture 2: Inequality and growth (1/23)
Lecture 3: Corruption (1/30) – Guest lecture by Ben Olken
Lecture 4: History and institutions (2/6)
Lecture 5: Democracy and development (2/13)
Lecture 6: Ethnic and social divisions (2/20)
Lecture 7: Economic Theories of Conflict (2/27)
Lecture 8: War and Economic Development (3/6)

Human resources

Lecture 9: Human capital and income growth (4/3)
Lecture 10: Increasing human capital (4/10)
Lecture 11: Health and nutrition (3/13)
☆Lecture 12: The Economics of HIV/AIDS (3/20)
Lecture 13: Labor markets and migration (4/17)

Lecture 14: Environment and development (4/24)
Lecture 15: Social Learning and Technology Adoption (5/1)

- Referee report #3 will be graded after the break
- Problem set #1 will be posted by tomorrow (sorry for the slight delay), and is due after spring break

Lecture 10 outline

(1) HIV/AIDS and economic development

(2) Impacts of HIV/AIDS on labor productivity – two approaches: observation (Fox et al. 2004), and anti-retroviral (ARV) intervention (Thirumurthy et al 2005)

(3) Macroeconomic impacts of HIV/AIDS (Young 2005)

(1) HIV/AIDS in Africa

- Of the 42 million people worldwide thought to be HIV+, it is estimated that 25 million are in Sub-Saharan Africa

Figure 1: HIV Prevalence & Incidence by Region[1]

Region	Total No. (%) Living with HIV/AIDS end of 2004	Newly Infected in 2004	Adult[9] Prevalence Rate
Global Total	**39.4 million (100%)**	**4.9 million**	**1.1%**
Sub-Saharan Africa	25.4 million (64%)	3.1 million	7.4%
South/South-East Asia	7.1 million (18%)	890,000	0.6%
Latin America	1.7 million (4%)	240,000	0.6%
Eastern Europe/Central Asia	1.4 million (4%)	210,000	0.8%
East Asia	1.1 million (3%)	290,000	0.1%
North America	1.0 million (3%)	44,000	0.6%
Western/Central Europe	610,000 (2%)	21,000	0.3%
North Africa/Middle East	540,000 (1%)	92,000	0.3%
Caribbean	440,000 (1%)	53,000	2.3%
Oceania	35,000 (<1%)	5,000	0.2%

(1) HIV/AIDS in Africa

- Of the 42 million people worldwide thought to be HIV+, it is estimated that 25 million are in Sub-Saharan Africa

- In some countries in southern Africa (e.g. Botswana, Swaziland), it is claimed that over 30% are HIV+

Counting HIV+ people in Kenya

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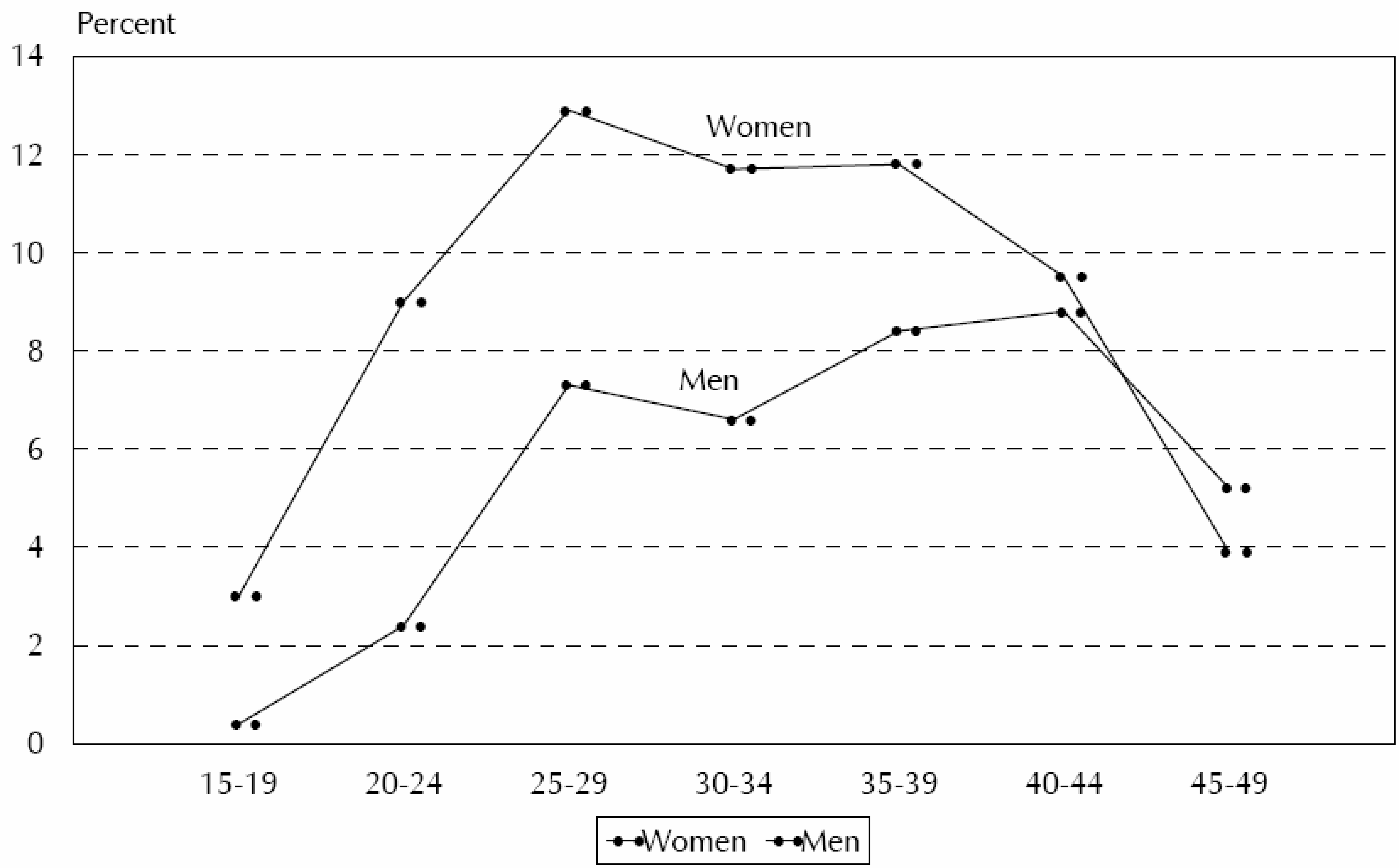
  – This data indicates that “only” **6.7%** of Kenyan 15-49 year olds tested are HIV+

Figure 13.1 HIV Prevalence by Age Group and Sex



KDHS 2003

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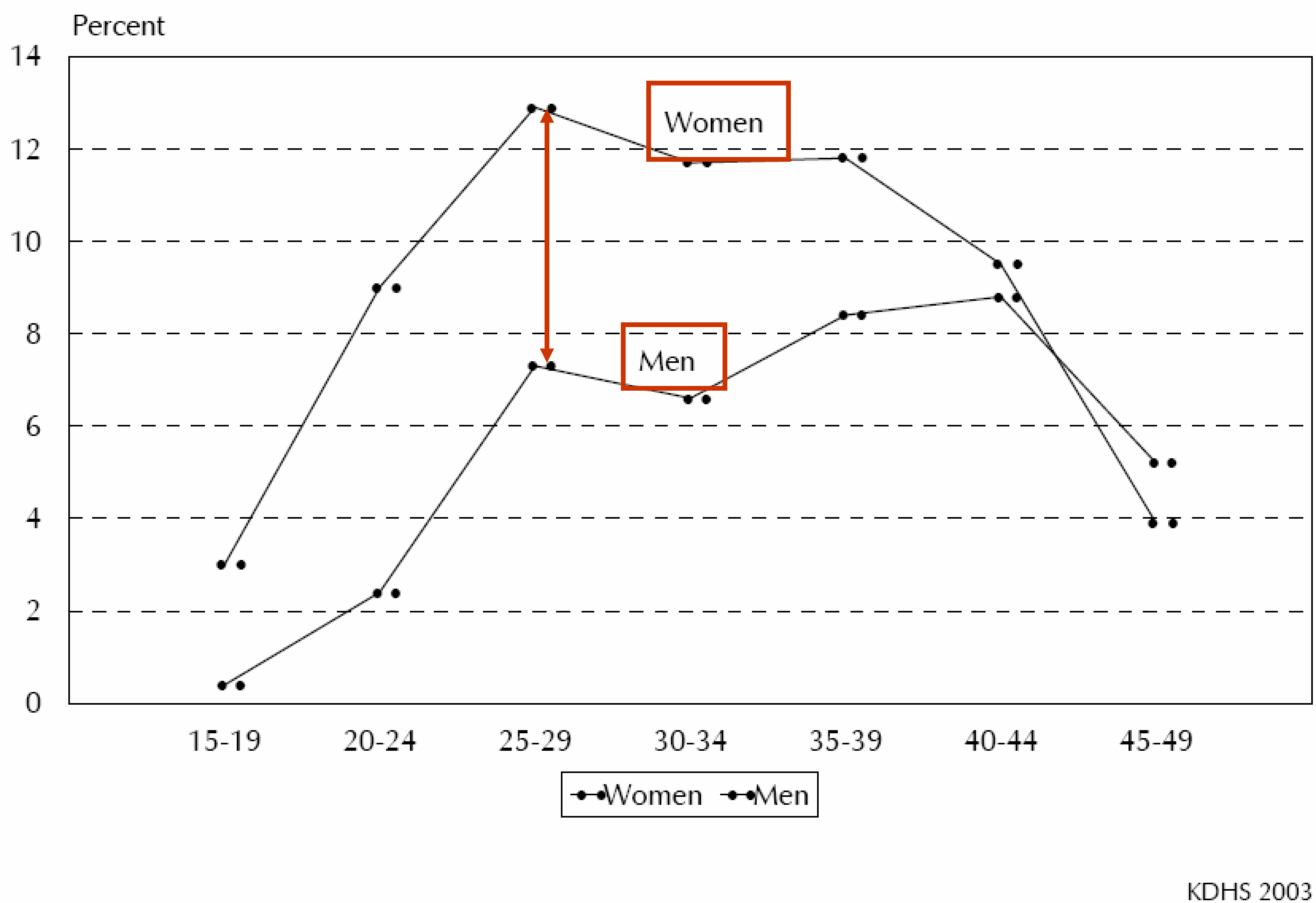

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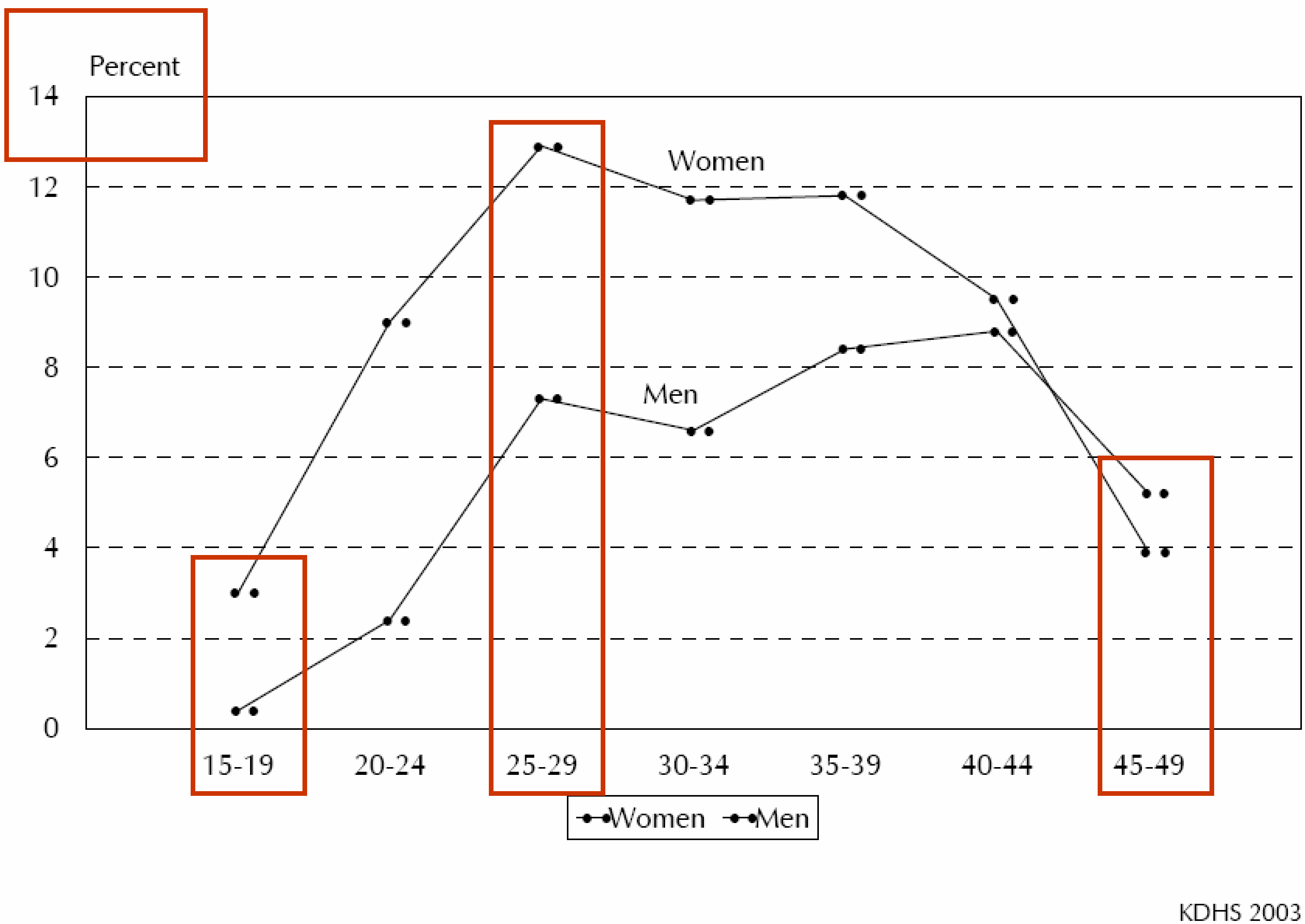

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- Based on antenatal clinic survey data, the official UNAIDS estimate of HIV+ adults in Kenya by late 2001 was 15.0%

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  – This data indicates that “only” 6.7% of Kenyan 15-49 year olds tested are HIV+!

- Which of the two numbers is closer to the truth?

Table 13.4 HIV prevalence by selected socioeconomic characteristics

Percentage HIV positive among women and men age 15-49 who were tested, by socioeconomic characteristics, Kenya 2003

	Women		Men		Total	
Socioeconomic characteristic	Percent HIV positive	Number	Percent HIV positive	Number	Percent HIV positive	Number
Residence						
Urban	12.3	779	7.5	716	10.0	1,495
Rural	7.5	2,372	3.6	2,135	5.6	4,507
Education						
No education	4.4	396	2.7	156	3.9	552
Primary incomplete	9.3	1,052	3.4	982	6.4	2,034
Primary complete	10.6	784	5.9	660	8.5	1,444
Secondary+	8.2	918	5.2	1,053	6.6	1,972
Employment						
Currently working	9.6	1,844	5.9	2,007	7.6	3,851
Not currently working	7.4	1,307	1.5	844	5.1	2,151
Wealth quintile						
Lowest	3.9	505	3.4	431	3.6	937
Second	8.5	580	4.2	501	6.5	1,082
Middle	7.1	597	2.2	528	4.8	1,125
Fourth	9.7	663	4.3	624	7.1	1,287
Highest	12.2	806	7.3	765	9.8	1,571

HIV/AIDS and economic growth

- The HIV/AIDS epidemic could affect economic growth through various channels:

  (1) Human capital levels could fall if more educated people are more likely to die

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  (2) Labor productivity drops due to AIDS-related morbidity, increased job turnover

  (3) Shorter time horizons, reducing investment rates (potentially in the human capital of the next generation)

  (4) Fertility impacts (in what direction? Physiological changes could reduce it, more unsafe sex the opposite)

  (5) The capital-labor ratio increase → real wages?

  (6) Productivity, institutions, politics, instability, policy?

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  - The total sample is 271 workers. 54 died or retired due to HIV/AIDS

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  - The total sample is 271 workers. 54 died or retired due to HIV/AIDS. In the statistical analysis, these are the "treated" group ($T_{i1}=1$).

Table I Study population

Parameter	Cases		Comparison pluckers		
	Value	SD	Value	SD	*P*-value
n	54		217		
Age (mean)*	35.74	7.26	37.33	8.17	0.21
Years of service (mean)*	5.15	3.37	6.20	2.42	0.06
Sex (proportion male)	61%		71%		0.16

* Dates computed as date on last day of observation.

Table I Study population

	Cases $T_{i1}=1$ AIDS		Comparison pluckers $T_{i1}=0$ No AIDS		
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Age (mean)*	35.74	7.26	37.33	8.17	0.21
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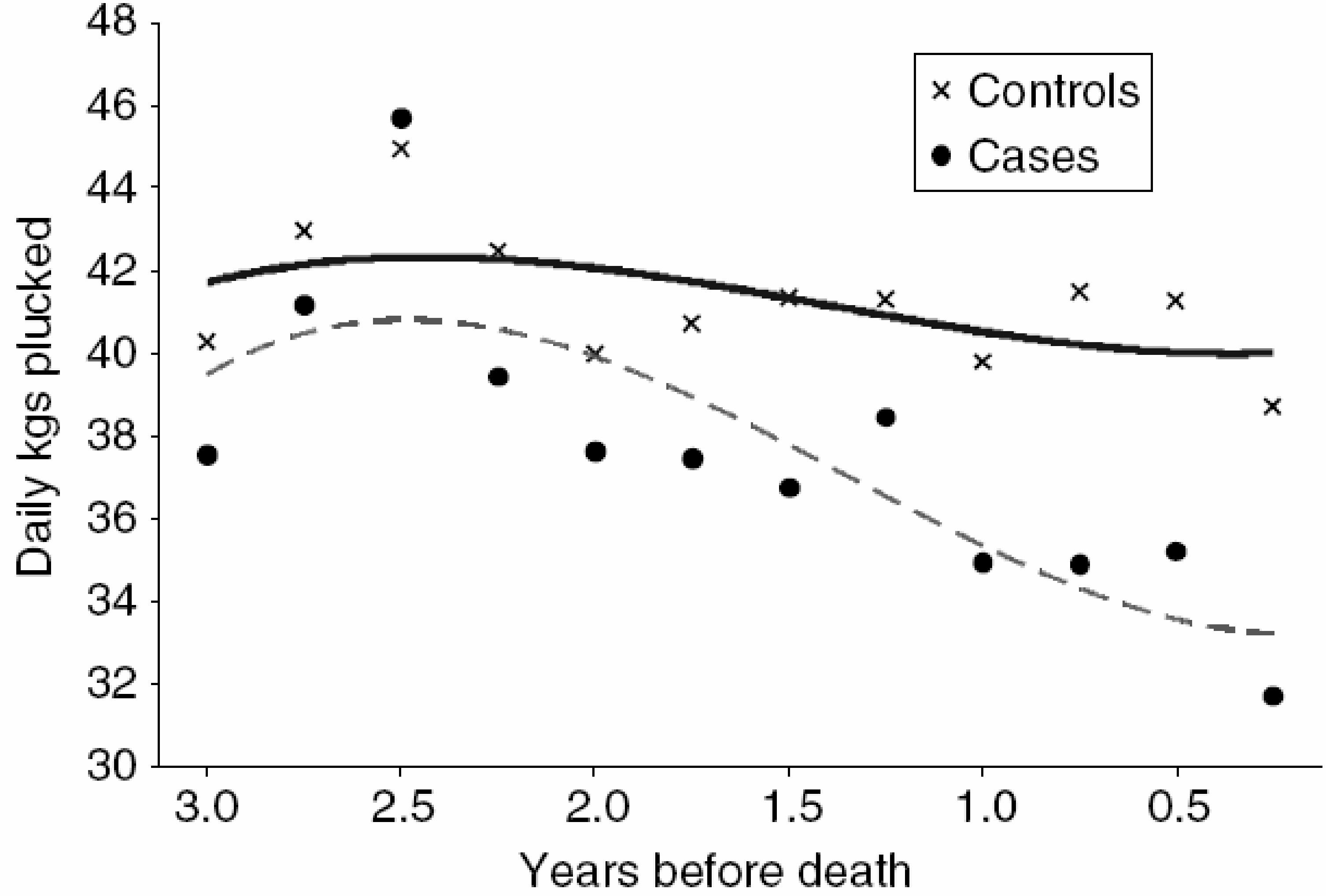
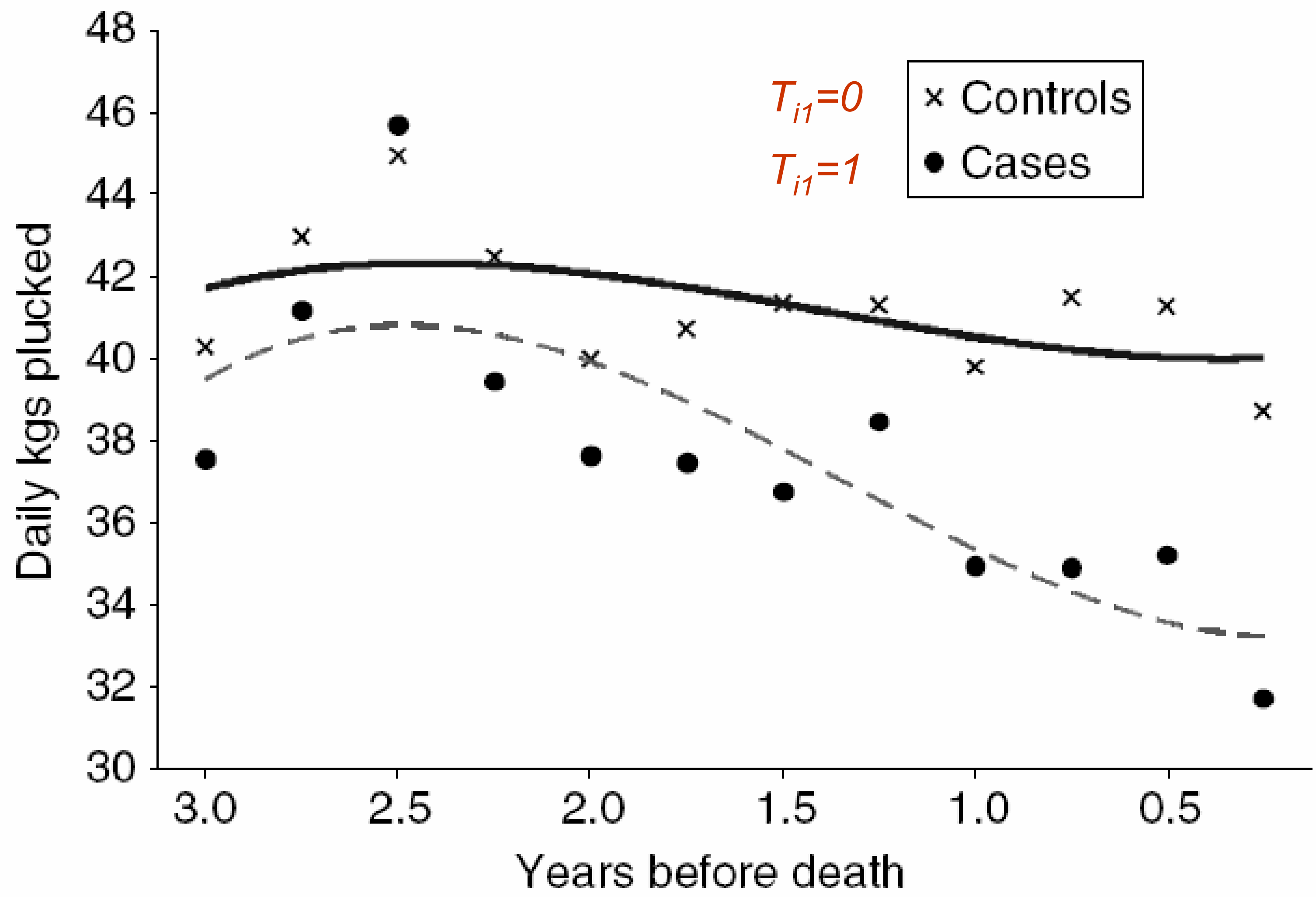


Figure 1 Mean kilograms of tea plucked per day on days of plucking for cases and controls (univariate analysis – curves are trend lines fit using polynomial regression for each group. Note that vertical access scale begins at 30 kg/day).



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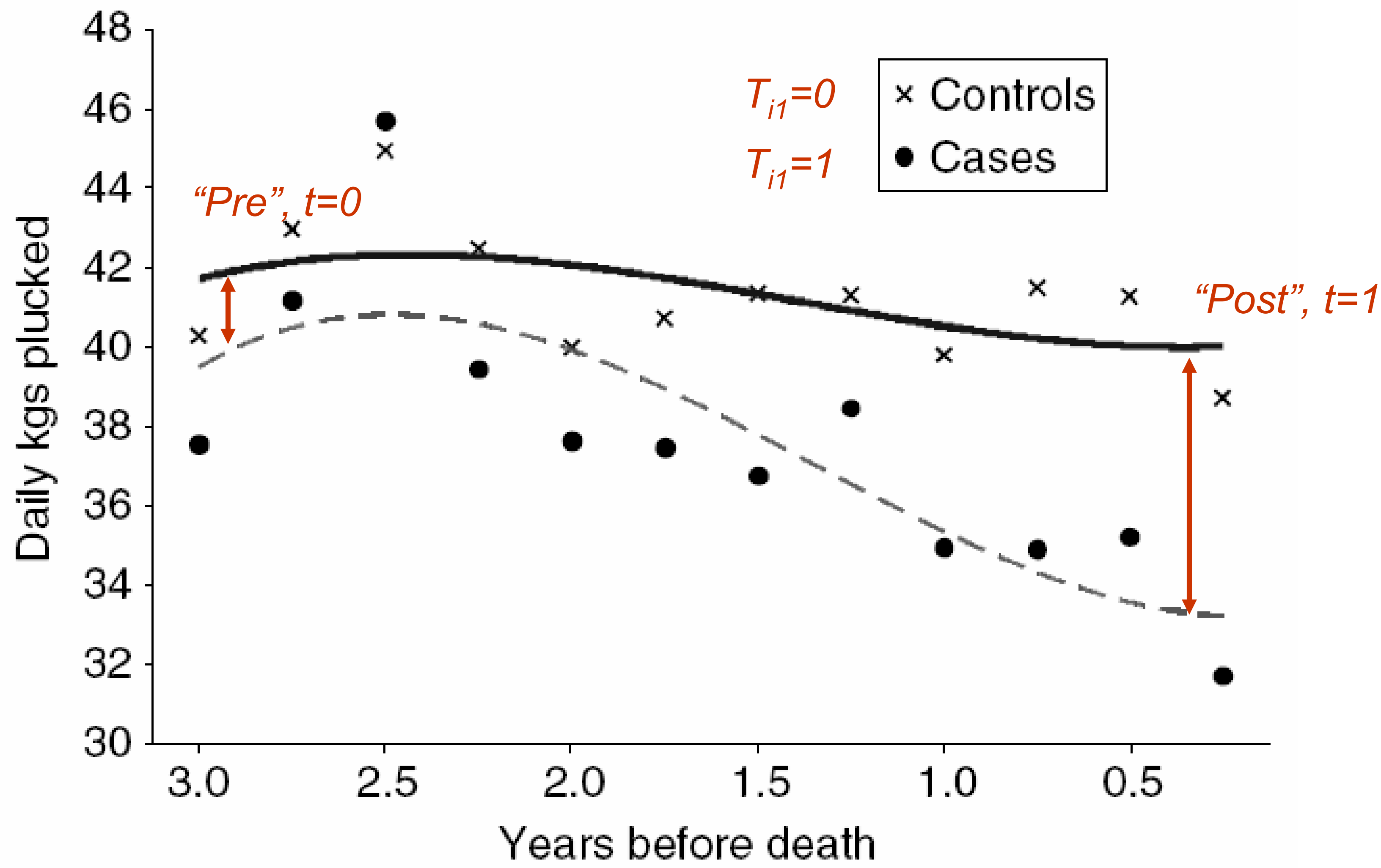

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Table 2 Adjusted differences between cases and comparison pluckers on days plucking at 6-month intervals prior to AIDS-related termination*

Years before termination	Difference†	Percentage difference‡	SE	*P*-value
3.0 years	−1.689	−4%	2.732	0.536
2.5 years	0.466	1%	2.224	0.834
2.0 years	2.400	6%	1.956	0.220
1.5 years	4.113	10%	1.871	0.028
1.0 years	5.605	13%	1.940	0.004
0.5 years	6.876	16%	2.191	0.002
Near termination	7.927	19%	2.684	0.003

* The final regression model included age, a dummy variable for matched group, the variables for time and a dummy variable to indicate pluckers who went on to an AIDS-related termination.
† Difference in kilograms.
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- Sick workers have family member "helpers". So estimates are again likely to be lower bounds
- Is the assumption of no time-varying omitted variables reasonable? E.g., AIDS victims have higher absenteeism three years prior. What is the right "counterfactual"?

Thirumurthy et al (2005) on ARV treatment

- Study the labor market impacts of the introduction of ARV treatment in rural Kenya (near Eldoret)
- Patients with very low CD4 counts were phased into ARV treatment starting in 2001-2002, with a large expansion in late 2003 (Indiana University project)

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- Patients with very low CD4 counts were phased into ARV treatment starting in 2001-2002, with a large expansion in late 2003 (Indiana University project)

- 266 households with at least one HIV patient, and 503 households representative of the local population

- How do individual health status (BMI, CD4), and labor market outcomes, change after initiation of ARVs?

Table 1. Comparison of Random Sample and HIV Sample

	Random Sample		HIV Sample		
	Mean	Std. Error	Mean	Std. Dev.	P-value
Number of households	503		266		
Household Structure (includes members entering between round 1 and round 2)					
Household size	6.04	0.13	5.45	0.15	0.0038
Average age of household members	24.93	0.57	23.78	0.56	0.1794
Number of under-18 children	3.32	0.10	3.02	0.11	0.0597
Percent of under-18 children who are orphans	6.9%		29.4%		0.0000
Number of extended family members in household	0.92	0.06	1.14	0.09	0.0432
Number of children living outside household	1.92	0.12	1.58	0.15	0.0949
Household Head Characteristics					
Male household head	81%		54%		0.0000
Single household head	22%		50%		0.0000
Age of household head	47.94	0.69	44.84	0.850	0.0062
Asset Ownership (round 1)					
Quantity of land owned (acres)	6.82	0.47	4.72	0.55	0.0054
Percent landless	13.2%		27.2%		0.0000
Value of land owned (shillings)	650,237	44,416	571,555	73,285	0.3316
Value of livestock owned (shillings)	61,401	4,194	36,571	4,148	0.0001

Notes: P-value from t-test for equality of means for Random sample and HIV sample.

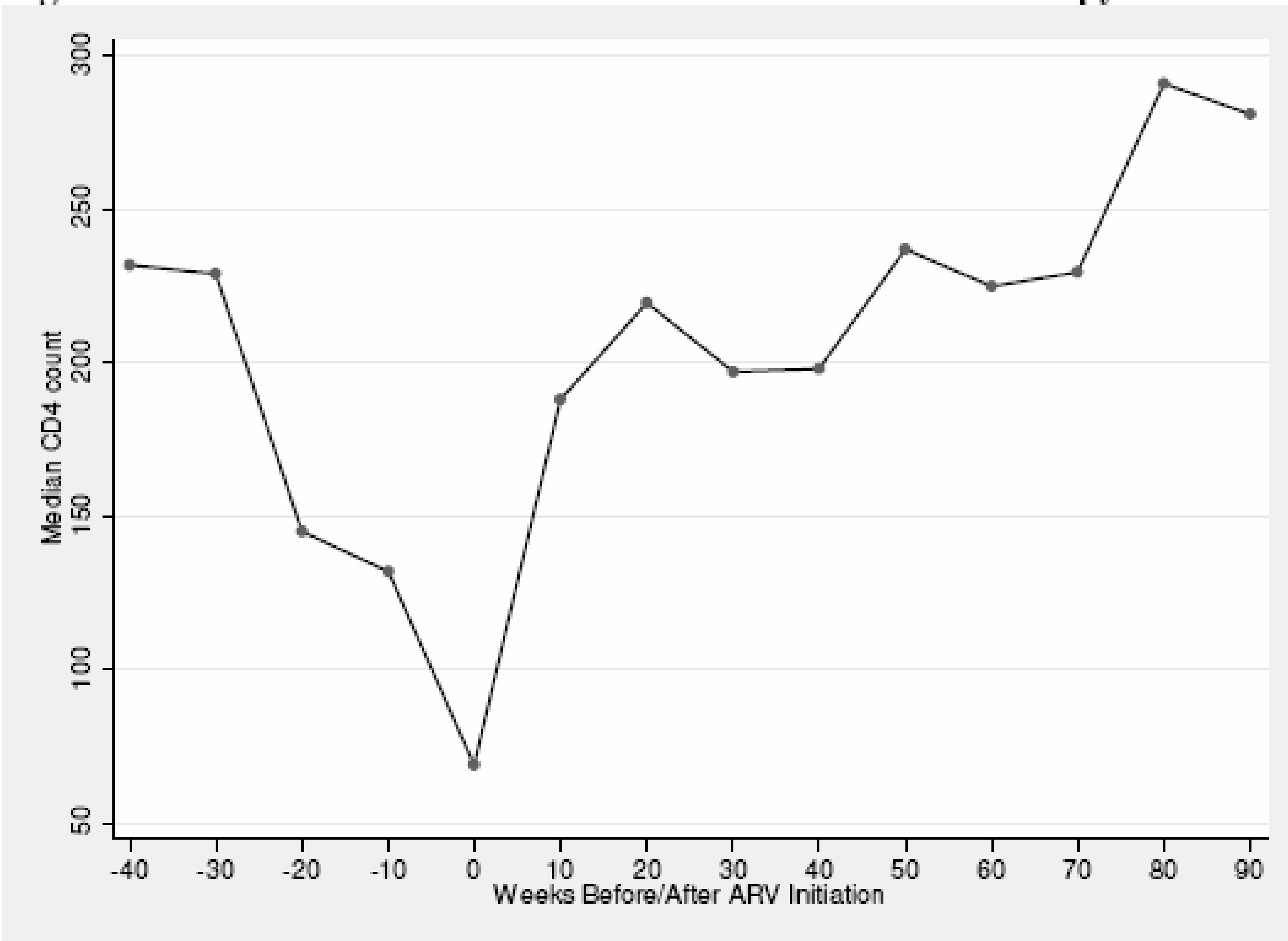
Thirumurthy et al (2005) on ARV treatment

- Two rounds of survey data collection, separated by roughly 6 months (in 2004-2005)

- They focus their analysis on people who had just been phased into ARVs in Round 1 (those on ARVs for fewer than 100 days at that point). They were close to death before ARVs and experience large immediate gains

- Focus on health gains, labor supply effects on the treated, and on their household members. Are these estimated effects lower or upper bounds?
  - Limitations: small sample size, infrequent data collection, if ARV's given too late often no effect

Figure 2. CD4 Count Before and After Initiation of ARV Therapy



Source: AMPATH Medical Records System for Mosoriot HIV Clinic.

Figure 3. BMI Before and After Initiation of ARV Therapy

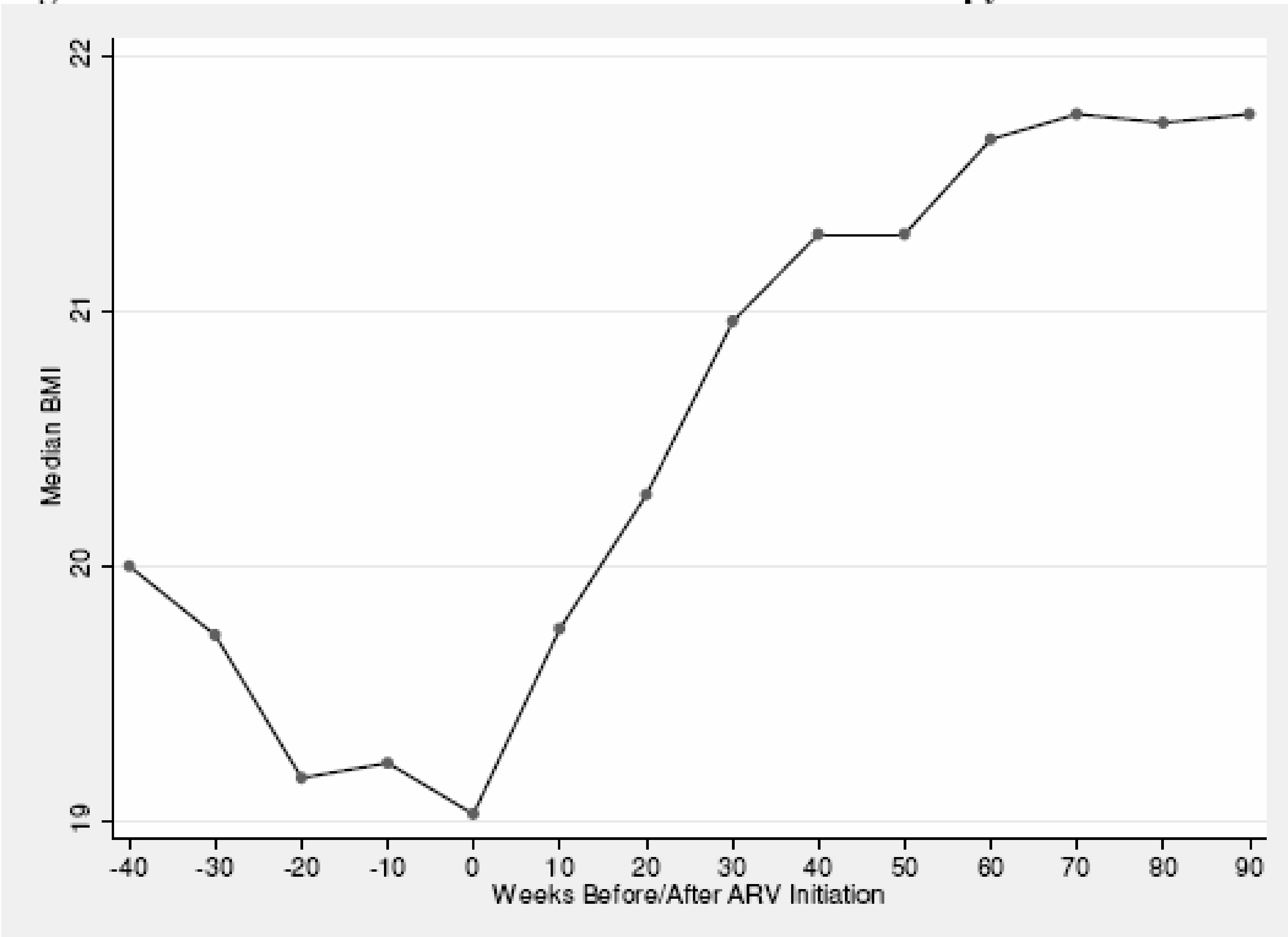


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Table 2. Impact of ARV therapy on CD4 count and BMI

	(1)	(2)
Dependent variable:	CD4	BMI
	F.E.	F.E.
On ARVs at least 1 month		0.38
		(2.65)***
On ARVs at least 2 months		0.18
		(1.18)
On ARVs at least 3 months	126.72	-0.10
	(10.60)***	(0.61)
On ARVs at least 4 months		0.21
		(1.29)
On ARVs at least 5 months		0.06
		(0.43)
On ARVs at least 6 months	-9.11	0.45
	(0.55)	(3.25)***
On ARVs at least 7 months		0.29
		(2.46)**
On ARVs at least 8 months		0.30
		(2.14)**
On ARVs at least 9 months	41.34	0.53
	(2.31)**	(3.71)***
On ARVs at least 10 months		0.14
		(0.93)
On ARVs at least 11 months		0.22
		(1.45)
On ARVs at least 12 months	7.45	0.27
	(0.37)	(1.79)*
On ARVs at least 15 months	38.71	0.08
	(1.31)	(0.50)
On ARVs at least 18 months	0.42	0.09
	(0.01)	(0.52)
Constant	87.48	19.53
	(12.56)***	(275.93)***
Observations	458	2678
Number of patients	183	164
R-squared	0.52	0.34

Individual fixed effects (F.E.) regressions for ARV patients in our sample.

Equation 3 assumes that the response to treatment will be identical for all ARV recipients in the sample. However, as noted earlier, patients have been on treatment for varying lengths of time during round 1 and the largest health improvement occurs for those just beginning treatment. Thus, we also estimate an equation in which ARV recipients who had been on ARVs for less than 100 days in round 1 (represented by $ARV_{<100,i}$) can experience a different change in labor supply than ARV recipients who had been on ARVs for more than 100 days in round 1 ($ARV_{>100,i}$). This distinction divides the ARV sample into two roughly equal samples, and distinguishes between patients experiencing large and small health improvements. The following modified version of equation 3 is thus estimated:

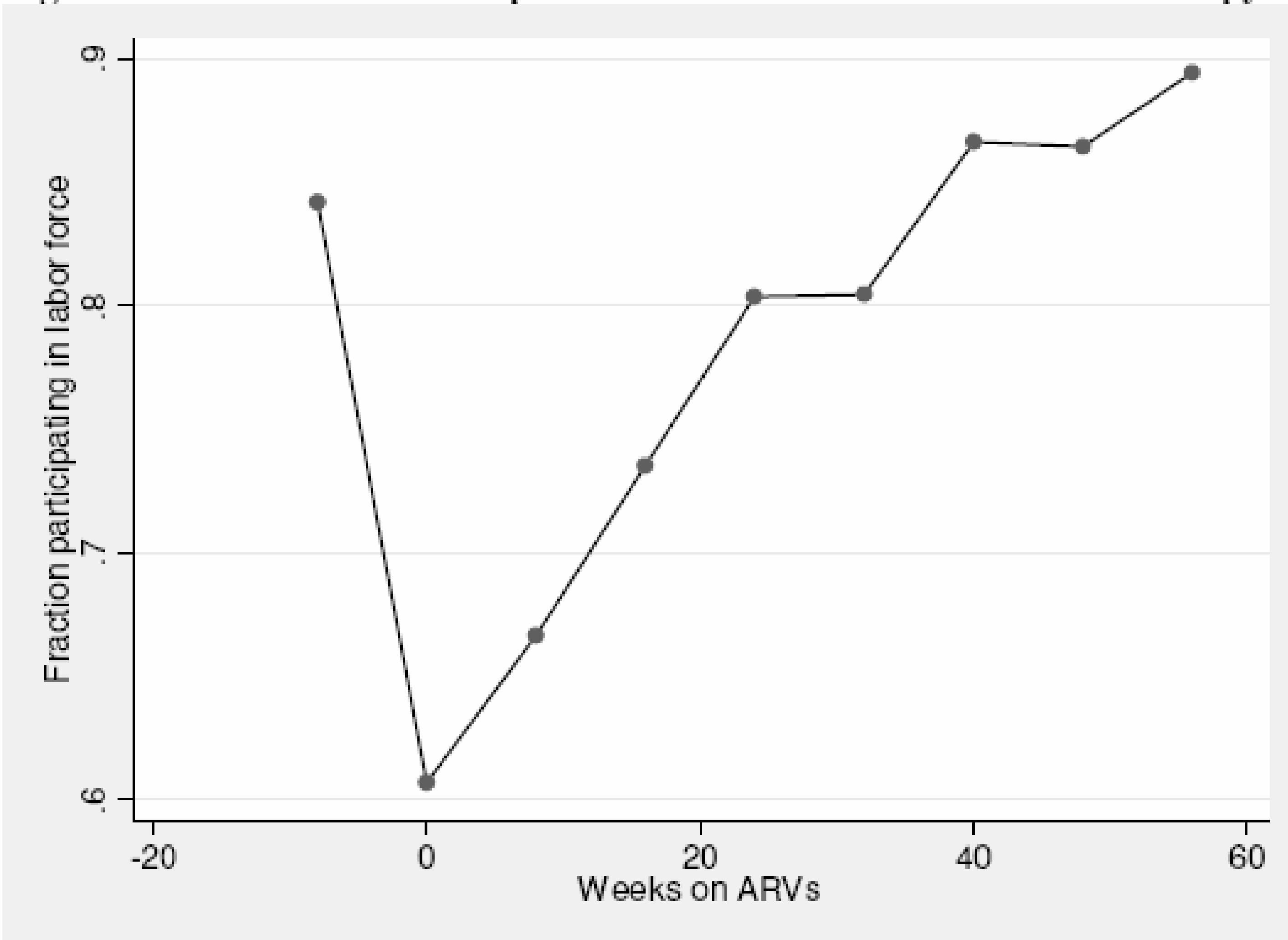
$$L_{it} = \alpha_i + \beta_1(ARV_{<100,i} * ROUND2_t) + \beta_2(ARV_{>100,i} * ROUND2_t) + \beta_3 ROUND2_t + \sum_{\tau=1}^{10} \gamma_\tau MONTH_t^\tau + \varepsilon_{it}. \quad (4)$$

Table 8. Impact of ARV Therapy on Labor Supply, with Individual Fixed Effects

	(1)	(2)	(3)	(4)	(5)
Dependent Variable:	LFP	Hours	LFP	Hours	Hours
	Individual F.E.				F.E.
Round 2 * Patient on ARVs	0.082	3.651			
	(2.58)***	(1.65)*			
Round 2 * Patient on ARVs < 100 days in Round 1			0.167	6.934	3.328
			(3.89)***	(2.31)**	(0.93)
Round 2 * Patient on ARVs > 100 days in Round 1			0.013	0.992	-0.025
			(0.33)	(0.36)	(0.01)
Constant	0.878	35.863	0.878	35.871	41.971
	(35.90)***	(21.05)***	(36.00)***	(21.07)***	(23.25)***
Observations	3070	3070	3070	3070	2668
Number of adults	1535	1535	1535	1535	1334
R-squared	0.03	0.05	0.03	0.06	0.10

Notes: Absolute value of t-statistics in parentheses (* significant at 10%; ** significant at 5%; *** significant at 1%). Dependent variable *LFP* indicates whether the individual was engaged in any income-generating activity in the past week and *Hours* is total number of hours devoted to income-generating activities in the past week. Regressions include individual fixed effects (F.E.), round 2 indicator variable, and month-of-interview indicator variables. Sample includes observations for 70 HIV-positive patients not receiving ARV therapy. There is a separate explanatory variable for this group (interacted with round 2).

Figure 4. Labor Force Participation Rates Before and After ARV Therapy



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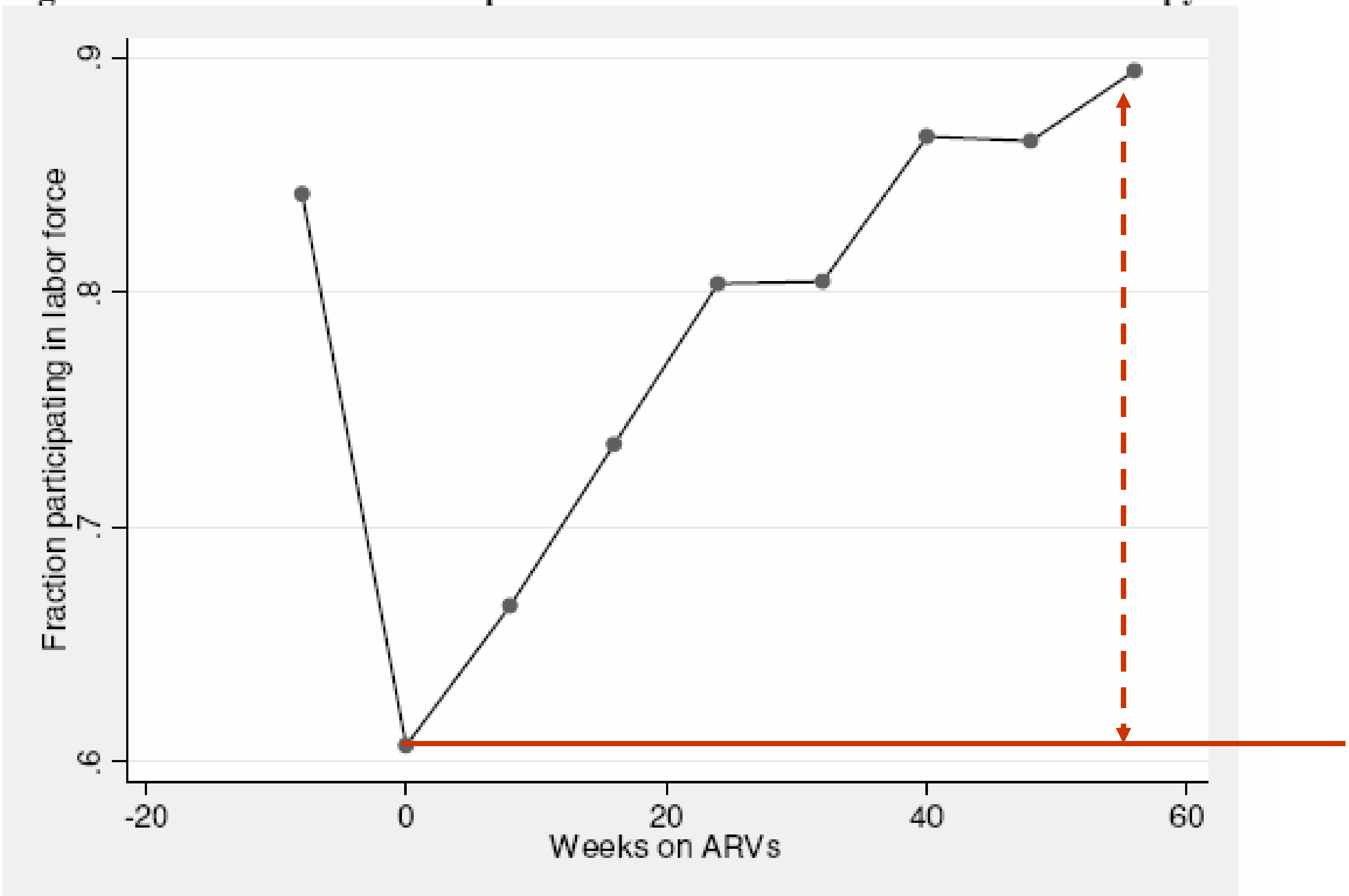

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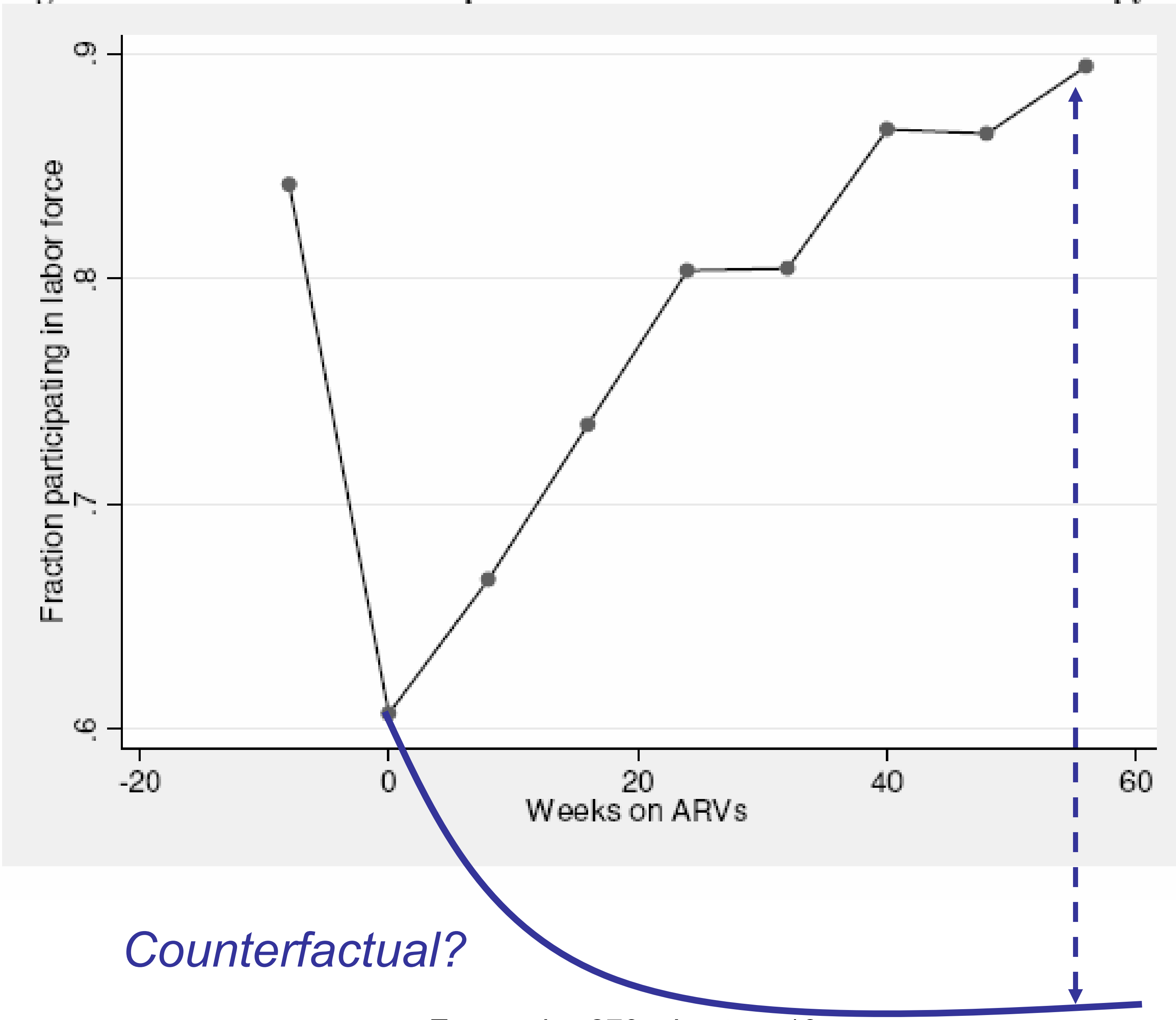


Table 15. Impact of ARV Therapy on Family Labor Supply

	(1)	(2)	(3)	(4)	(5)	(6)
Panel A. Adults						
Dependent variable:	LFP			Hours		
	All adults	Men	Women	All adults	Men	Women
ARV hh (<100 days) * Rd. 2	-0.087	-0.030	-0.146	2.020	5.498	-1.117
	(1.25)	(0.34)	(1.59)	(0.57)	(1.09)	(0.26)
ARV hh (>100 days) * Rd. 2	0.013	-0.082	0.085	2.405	0.708	3.584
	(0.25)	(1.27)	(1.07)	(0.70)	(0.13)	(0.91)
Constant	0.924	0.990	0.855	37.234	43.530	30.653
	(31.21)***	(25.83)***	(22.31)***	(16.57)***	(14.12)***	(11.94)***
Observations	3107	1589	1518	3107	1589	1518
R-squared	0.67	0.69	0.67	0.75	0.75	0.71
Panel B. Boys						
Dependent variable:	LFP			Hours		
	All boys	8-12 years	12-18 years	All boys	8-12 years	12-18 years
ARV hh (<100 days) * Rd. 2	-0.142	-0.159	-0.167	-3.762	-3.785	-4.066
	(1.46)	(1.13)	(1.40)	(1.41)	(1.36)	(1.05)
ARV hh (>100 days) * Rd. 2	-0.108	-0.227	-0.056	-3.458	-8.644	-0.484
	(1.22)	(2.08)**	(0.49)	(1.47)	(3.16)***	(0.16)
Constant	0.852	0.819	0.877	20.080	16.705	22.301
	(14.99)***	(8.11)***	(15.44)***	(9.59)***	(5.09)***	(9.17)***
Observations	1226	488	738	1226	488	738
R-squared	0.65	0.67	0.65	0.69	0.70	0.69

Young (2005) “The Gift of Dying”

- Highly controversial take on the HIV/AIDS epidemic

- Motivation: many African countries with the worst HIV/AIDS epidemics (e.g., Botswana, Uganda) have recently had the fastest per capita economic growth. Has HIV/AIDS really hurt their growth at all?

- Basic idea: plug HIV/AIDS-related changes into a standard growth model and simulate impacts on the economy. Uses parameters for South Africa (the country with the greatest number of HIV positive people, and one with good micro-data)

Young (2005) "The Gift of Dying"

- Example: the Black Death in 14th Century Europe reduced British population 50% in 30 years, and dramatically boosted real wages for a century afterwards

- Two main effects of HIV/AIDS are emphasized:

  (1) HIV/AIDS could increase the capital/labor ratio, boosting real wages in the economy

  -- Key assumption: no capital or labor mobility (or else the K/L ratio would not necessarily change)

  (2) HIV/AIDS reduces fertility dramatically. This is the key driving force in the model.

  -- High prevalence will reduce unsafe sex, and thus reduce fertility. Is this plausible? No clear evidence

II. Model: Becker and Solow

I model household behavior in the Beckerian tradition, assuming that couples, endowed with human capital E_m (male) and E_f (female) and financial resources Y, derive utility from the quantity of children n, the "quality" of children q (as measured by their human capital), individual leisure l_m and l_f, and material consumption C_m. In a one-period framework, each couple maximizes

$$(2.1) \quad U(n, q, l_m, l_f, C_m)$$

subject to the non-linear budget constraint

$$(2.2) \quad l_m W_m + l_f W_f + n t_f W_f + n q P_q + P_c C_m \leq Y + T^*(W_m + W_f)$$

where the W_i are the returns to labour market participation (functions of E_i), P_c and P_q the financial costs of consumption and quality, T the individual endowment of time, and t_f the time cost of fertility, which I assume is borne principally by women. I will use household surveys to estimate a simple utility-consistent system of demand and then use it to predict behavior.

(2.3) Male Labour Supply = $LM(W_m/P_c)$

Female Labour Supply = $LF(W_f/P_c)$

Fertility = $F(W_f/P_c)$

Children's Education = $Q(W_f/P_c)$

To close the model, one must specify the evolution of the macroeconomy and, in particular, the capital stock. Here, any number of frameworks could be used to motivate the savings rate, e.g. overlapping generations with or without actuarially fair market interest rates, intergenerational insurance, and/or accidental bequests. I heroically sweep these issues aside and, following Solow, assume that the savings rate, by some combination of private and public sector behavior, remains fixed. This allows me to focus on the mechanisms emphasized in this paper, e.g. fertility and education, and their impact on overall future consumption possibilities. The element left unexamined, the evolution of the savings rate, will determine the ultimate allocation of these consumption possibilities across generations.[4]

III. Data and Estimation Strategy

I estimate the model using the microdata files of the South African 1995 October Household Survey (OHS) and the 1998 Demographic and Health Survey (DHS).[5] The OHS provides a variety of personal and behavioral information on each household member (e.g. age, sex, education, labour force participation, income, fertility, etc), as well as recording recent deaths in the household. Most of the data reported in this survey are consistent with other sources,[6] but the reported retrospective fertility histories are very low (i.e. appear to involve incomplete reporting) and cannot match the historical population distribution. Thus, I use the DHS, whose primary focus is fertility, to estimate that aspect of behavior.[7]

Table I: Estimation of the Beckerian Elements of the Model

	(1)	(2)	(3)	(4)	(5)	(6)
	Before-tax ln Wages per Hour	After-tax ln Wages per Hour	Male Hours of Work	Female Hours of Work	Fertility	Children's Completed Education
Model	interval regression	interval regression	Poisson	Poisson	Poisson	ordered probit
age	.0820 (.0028)	.0666 (.0028)	.1737 (.0037)	.2125 (.0057)	.5134 (.0081)	.0354 (.0081)
age^2	-.0008 (.0000)	-.0006 (.0000)	-.0021 (.0000)	-.0026 (.0001)	-.0096 (.0002)	-.0006 (.0001)
E	.0379 (.0044)	.0341 (.0042)				
E^2	.0082 (.0003)	.0070 (.0003)				
sex	-.2190 (.0095)	-.1768 (.0094)				
Wage Index			.1710 (.0078)	.4399 (.0134)	-.3538 (.0140)	1.1382 (.0378)
year of birth					-.0031 (.0013)	.0292 (.0016)
HIV					-1.633 (.1896)	

VI. Simulation

In the pages that follow I simulate the evolution of the South African economy under a variety of circumstances. I consider five scenarios: (1) "No HIV" - the path taken absent the epidemic; (2) "HIV" - the economy with the HIV epidemic; (3) "No Becker" - the economy with the epidemic, but with no endogenous response to changes in wages, i.e. all education, fertility, and participation decisions by educational class kept at their values along the No HIV path;[41] (4) "No Fertility" - the No-Becker scenario, but with the added dimension that HIV does not have the negative effect on fertility estimated earlier in section IV; and (5) "Full Education" - the HIV path, but without the assumption that children's education is interrupted at the time of their parents' death. The components and assumptions that enter into the simulations are summarized in

Figure 6.2: Wage per Unit of Effective Labour (1995 = 1)

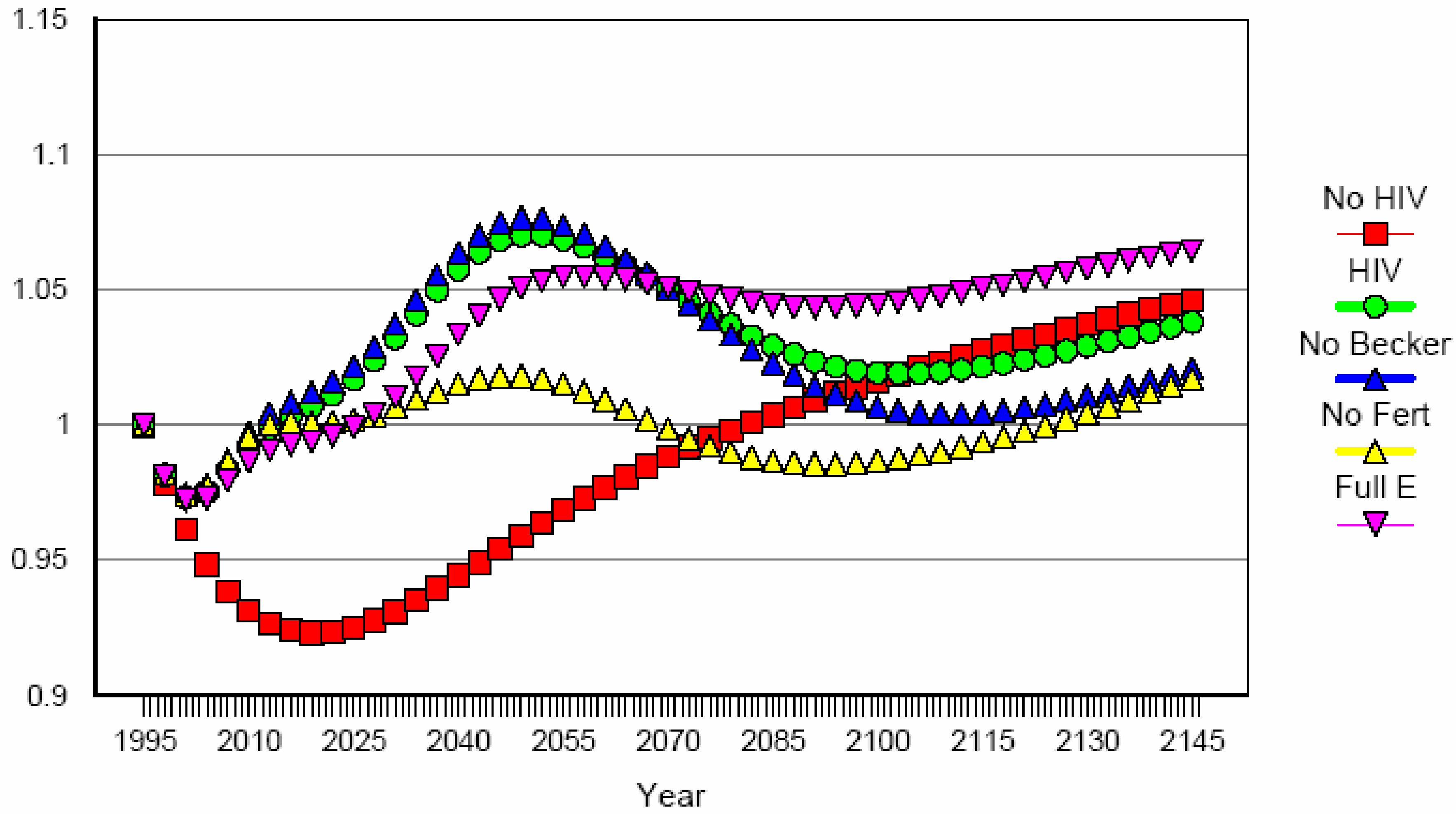


Figure 6.4: GDP per Capita (relative to No HIV)

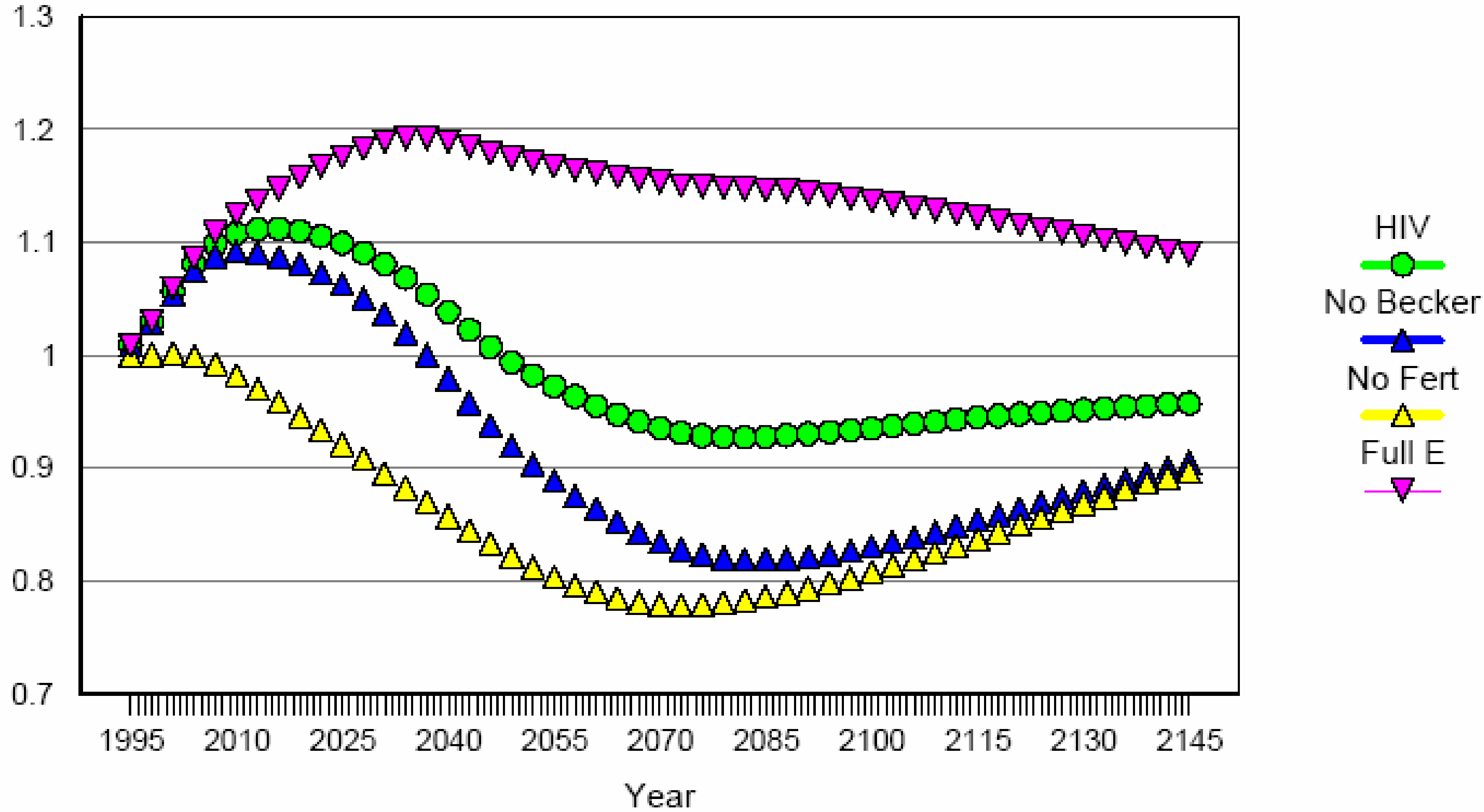
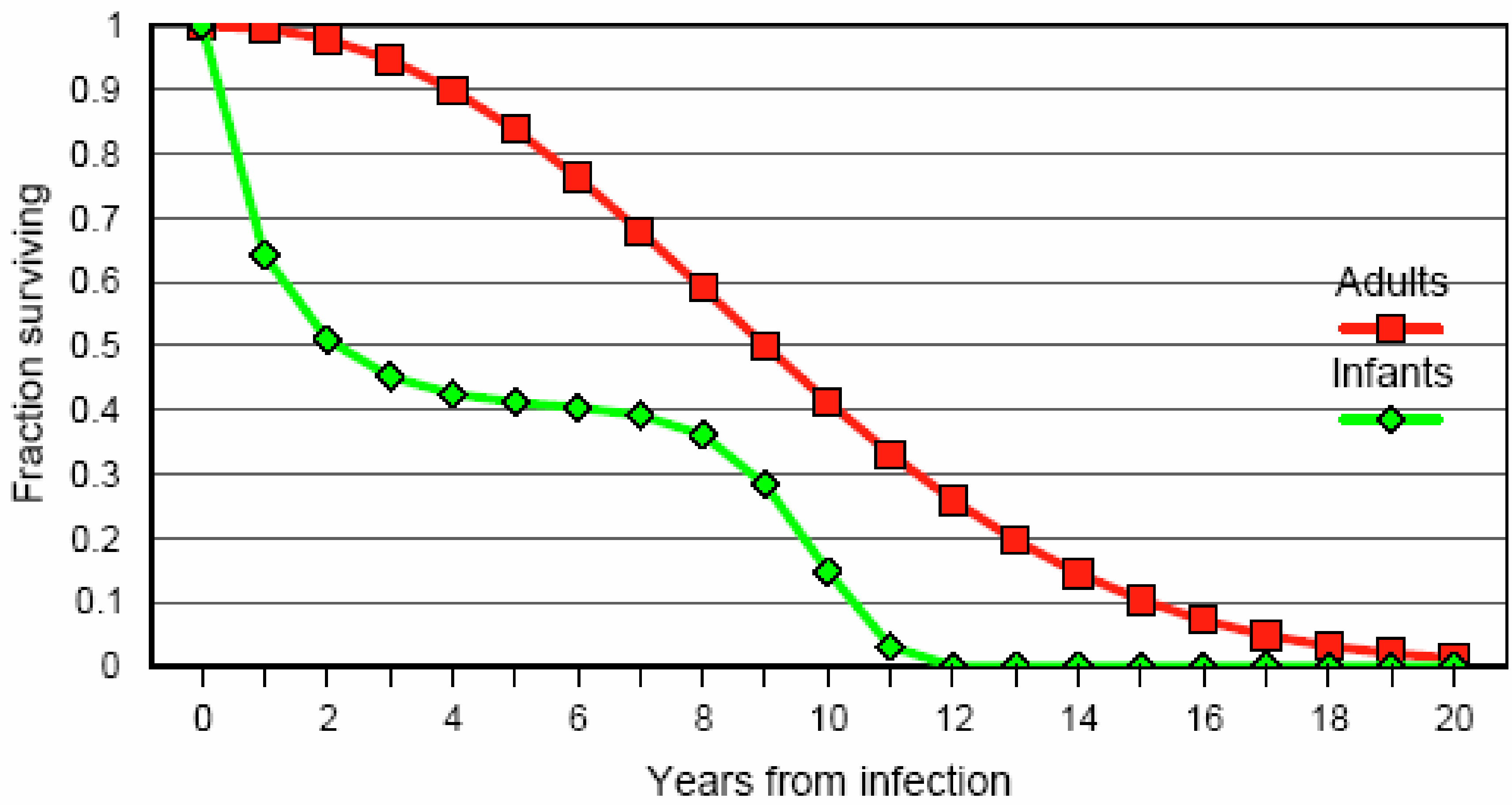


Table III: Alternative Consumption Possibilities

	Percentage Increase in Living Standards in Perpetuity	Retroviral Expenditures per AIDS Patient (2004 US$)
Full Education	6.6	$11000
HIV	5.6	$8800
No Becker	4.3	$7000
No Fert	-3.0	NA

Notes: NA - not applicable, as it is not possible to support a retroviral programme while maintaining the living standards of the No-HIV path.

Figure 5.2: Cumulative Survival Rates

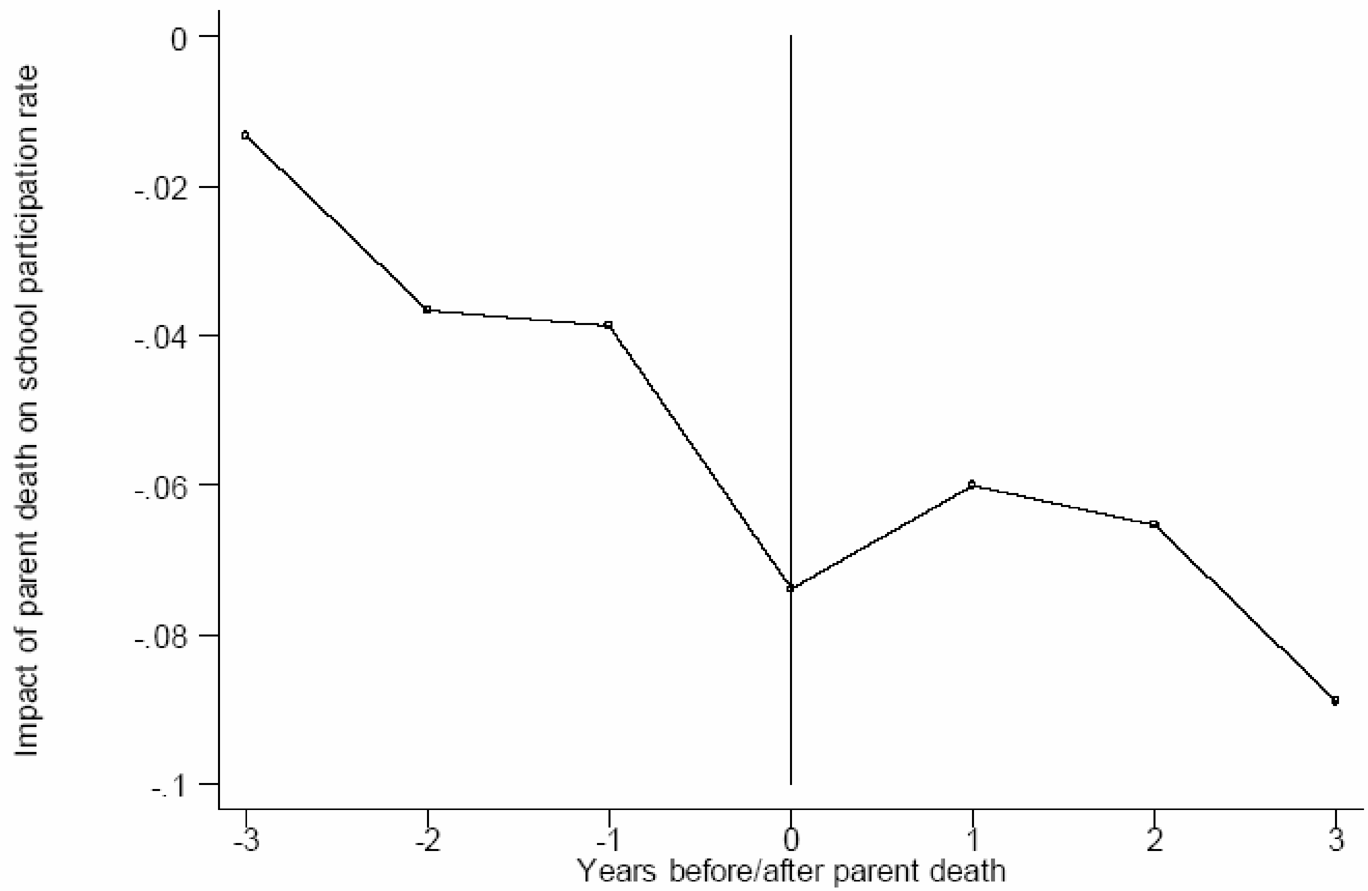


S: UNAIDS 2002.

Table 1. Ordinary Least Squares Coefficients Predicting the Impact of Parent Death on School Participation

Variable	Full Sample (1)	Full Sample (2)	Restricted Sample (3)	Restricted Sample (4)	Restricted Sample (5)	Restricted Sample (6)
3 Years Before Death	–0.013		0.007			
	(0.026)		(0.036)			
2 Years Before Death	–0.037		–0.037			
	(0.029)		(0.038)			
1 Year Before Death	–0.039		–0.037			
	(0.030)		(0.041)			
Year of Parent Death	–0.074*		–0.054			
	(0.031)		(0.041)			
1 Year After Death	–0.060*		–0.054			
	(0.030)		(0.043)			
2 Years After Death	–0.065*		–0.071			
	(0.033)		(0.049)			
3 Years After Death	–0.089*		–0.070			
	(0.040)		(0.059)			
Before Parent Death		–0.021		–0.032	–0.031	–0.025**
(1–2 years)		(0.015)		(0.019)	(0.019)	(0.009)
After Parent Death		–0.055**		–0.054*	–0.053*	–0.036**
		(0.017)		(0.022)	(0.022)	(0.012)

<u>Figure 1:</u> Parent death and school participation over time (relative to four years prior to parent death)



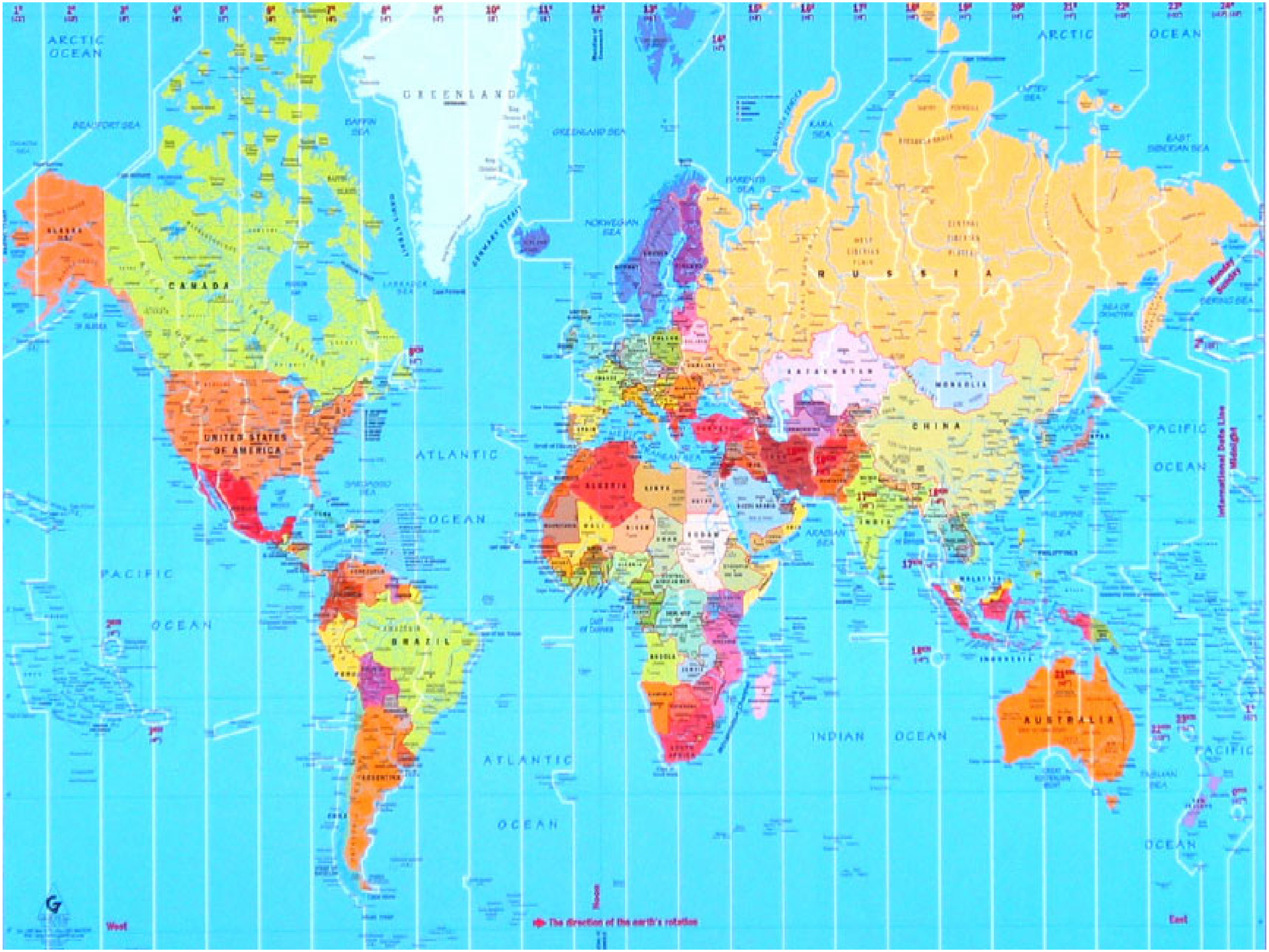
Whiteboard #1

Whiteboard #2

Whiteboard #3

Whiteboard #4

Whiteboard #5


ARCTIC OCEAN
BEAUFORT SEA
BAFFIN SEA
GREENLAND
GREENLAND SEA
NORWEGIAN SEA
BARENTS SEA
KARA SEA
LAPTEV SEA
EAST SIBERIAN SEA
BERING SEA
SEA OF OKHOTSK
ALASKA
CANADA
UNITED STATES OF AMERICA
BRAZIL
ARGENTINA
ALGERIA
LIBYA
SUDAN
ANGOLA
SOUTH AFRICA
RUSSIA
KAZAKHSTAN
MONGOLIA
CHINA
INDIA
INDONESIA
AUSTRALIA
PACIFIC OCEAN
ATLANTIC OCEAN
INDIAN OCEAN
ARABIAN SEA
TASMAN SEA
International Date Line
Midnight
West
East
Noon
The direction of the earth's rotation