When Death was Postponed: The Effect of HIV Medication on Work, Savings and Marriage

Mette Ejrnæs
(University of Copenhagen)

Mette Gørtz
(University of Copenhagen)

Esteban García-Miralles
(Banco de España)

Petter Lundborg
(Lund University)

April 25, 2024 - Workshop Banco de España – CEMFI

Motivation

Over the last century, global life expectancy has been increasing

- Explanations: Rising incomes, health insurance, medical innovation
- Life expectancy $\Rightarrow$ human capital (Becker 1964, Ben-Porath 1967) $\Rightarrow$ economic growth (e.g. Kalemli-Ozcan 2002, Soares 2005, Weil 2007)
- Uncertainties about remaining lifespan may have implications for incentives to work, save, and marry (e.g. Blundell & MaCurdy 1999, Browning & Crossley 2001, Dynan et al. 2002, Low et al.2018)

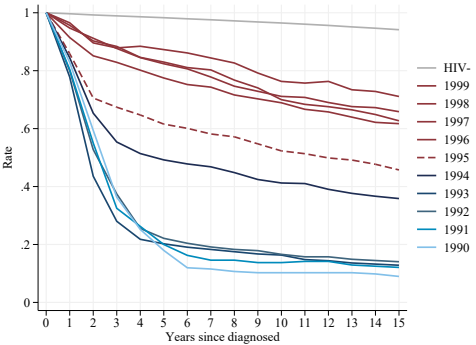
This paper: Causal effect of an increase in life expectancy due to a medical innovation (not mediated by improved health)

Context: New effective treatment for HIV

- Until mid 90s HIV was a deadly condition
- In 1995 a new medication, HAART, was introduced
- Unexpected and drastic improvement in survival rates following HIV diagnosis

$\Rightarrow$ **HIV changed from deadly disease to chronic condition**

Survival by year of diagnosis



Source: Danish register data

Context: New effective treatment for HIV

Public knowledge about positive impact of HAART:

People who had been planning to die sooner rather than later
– quitting their jobs, cashing in their insurance policies,
running their credit cards to the limit,
avoiding fresh romances or clinging to old relationships
– began finding themselves back in the business of living,
with all its complications.

"From the AIDS Conference, Talk of Life, not Death"
Published in New York Times, July 15, 1996.

This paper

Strategy: Compare individuals diagnosed **before** or **after** 1995.
They all experience a shock but their life expectancy differs markedly.

- Not driven by poor health/medication $\Rightarrow$ focus on healthy patients
- Not driven by calendar time $\Rightarrow$ DDD with matched HIV–

Results: Higher life expectancy leads to:

- Increased labor
- No effects significant on savings
- Delayed partnering

Contribution to the literature

1. Impact of life expectancy on work and savings

(Baranov et al. 2015, Baranov and Kohler 2018, Papageorge et al. 2021)

⇒ We study a developed country

⇒ Focus on representative HIV+ (excl. drug addicts)

⇒ High-quality register data

⇒ Novel evidence on marriage outcomes

2. Impact of life expectancy on human capital investment

(e.g. Fortson 2011, Jayachandran and Lleras-Muney, 2009 and Oster et al. 2013)

⇒ We consider other major life choices: work, savings, and marriage

⇒ From a well-defined medical breakthrough

Outline

1. Sample restriction: healthy HIV+ patients
2. Identification: Triple Difference
3. Results
4. Policy implications

Unique Data

1. Danish administrative registers from 1981
   - Longitudinal data on entire population
   - Socio-economic outcomes: Employment, income, education, wealth
   - Marital status (marriage and cohabitation)
   - Hospital records
2. Medical data on HIV patients
   - Clinical database with all HIV patients started in 1995
     (with retrospective information + imputation)
   - Observe immune system health: CD4 counts from blood test
     Focus on individuals diagnosed when still healthy, and expected to remain so

Health status and CD4 count

Status	CD4
HIV–	500-1500
HIV+	500-1500 $\downarrow$
Start HAART	$<$350
AIDS	$<$200

$\Rightarrow$ Asymptomatic threshold somewhere between 200 and 350

Papageorge et al. (JHR 2019) "women in the treatment group [CD4 300-399] have yet to reach CD4 counts where they would experience physical illness"

Sample of analysis

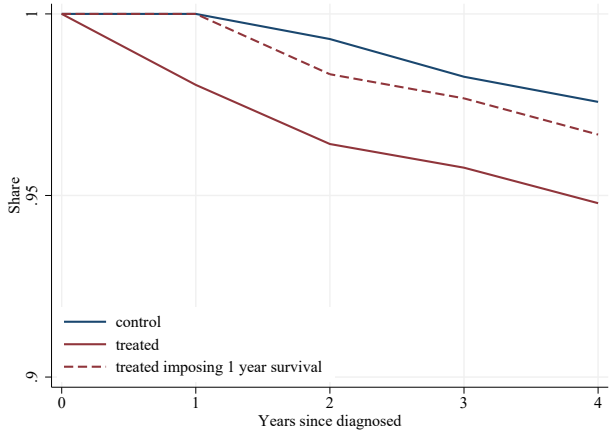
- 1,932 individuals diagnosed between 1990 and 1999 (excl. drug-addicts)
- 596 have CD4$\geq$400 when diagnosed
- Control: Diagnosed 1990-1994. 289 individuals (230 balanced)
- Treated: Diagnosed 1995-1999. 307 individuals (213 balanced)

Baseline sample of analysis (we show robustness to alternative choices):

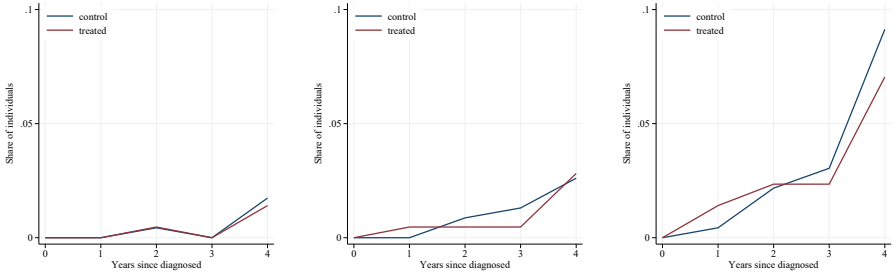
- Balanced = [-4,4]
- Keep control group post 1995
- Keep those who receive HAART medication

Survival probability

Individuals in the (unbalanced) sample are diagnosed early enough that mortality is low. By construction, control group survives at least 1 year



Share of individuals below symptoms thresholds



(a) CD4<200 **(b)** CD4<250 **(c)** CD4<300

Both groups have small and similar share below symptoms threshold

Balance Test (t-1)

	Control (1)	Treated (2)	Difference (3)	*P-value* (4)	HIV– (5)
Demographics					
Age	33.60	34.54	-0.94	0.27	34.04
Male	0.82	0.80	0.02	0.53	0.81
Years of education	11.6	11.8	-0.21	0.37	12.1
Dane	0.93	0.91	0.03	0.26	0.96
Economic outcomes					
Employed	0.68	0.68	0.00	0.97	0.81
Earnings (diff. HIV–)	-29,519	-27,701	-1,820	0.87	169,700
Earnings (quartile)	2.17	2.30	-0.12	0.25	2.24
Home Owner	0.24	0.27	-0.02	0.56	0.49
Stocks Ownership (diff. HIV–)	-0.03	-0.06	0.03	0.25	0.16
Marital					
Married	0.13	0.18	-0.06	0.10	0.44
Cohabiting	0.07	0.10	-0.03	0.27	0.23
Health					
Hospital visit	0.14	0.14	0.00	0.97	0.139
Psychologist	<0.01	<0.01	0.00	0.99	0.002
Psychiatry	0.02	0.03	-0.01	0.66	0.008
Charlson Index	<0.01	0.02	-0.02	0.08	0.006
Infections	<0.01	<0.01	-0.01	0.14	0.001
DANHIV					
CD4 Count	619	620	-1.08	0.95	–
Heterosexual	0.43	0.44	-0.01	0.82	–
Observations	230	213			443,000

HIV diagnoses over time

Outline

1. Sample restriction: healthy HIV+ patients
2. Identification: Triple Difference
3. Results
4. Policy implications

Dynamic Triple Difference Strategy

Identification comes from comparing:

1. Period before and after diagnosis: $\rightarrow$ *Time*
2. Diagnosed pre-1995 (control) or after-1995 (treated): $\rightarrow$ *Treat*
3. HIV+ and HIV– synthetic control (cohort, year, sex, educ.): $\rightarrow$ *Inf*

$$Y_{it} = \alpha_0 + \sum_{j \neq -1} \beta_j \cdot Treat_{it} \cdot Inf_{it} \cdot Time_{t=j} + \sum_{j \neq -1} \gamma_j \cdot Inf_{it} \cdot Time_{t=j} + \sum_{j \neq -1} \eta_j \cdot Treat_{it} \cdot Time_{t=j}$$

$$+ \sum_{j \neq -1} \theta_j \cdot Time_{t=j} + \phi_1 \cdot Treat_{it} \cdot Inf_{it} + \phi_2 \cdot Inf_{it} + \phi_3 \cdot Treat_{it} + X_{it} \cdot \Phi_4 + \epsilon_{it},$$

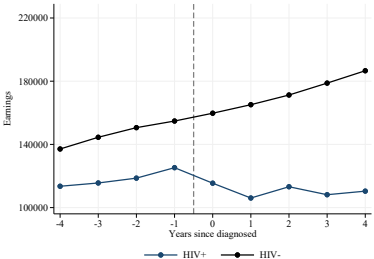
where X_{it} contains age, sex and citizenship

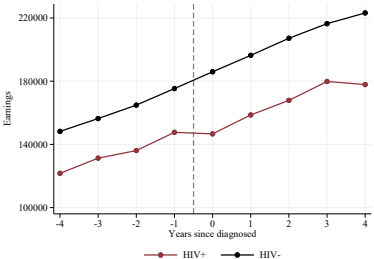
Robustness

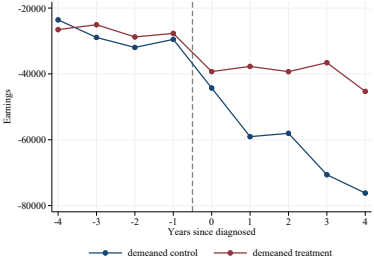
Outline

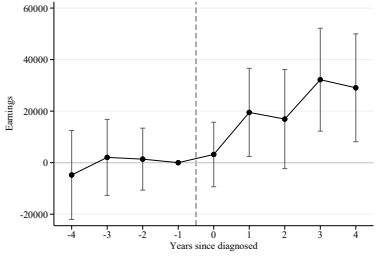
1. Sample restriction: healthy HIV+ patients
2. Identification: Triple Difference
3. Results
4. Policy implications

Labor market outcomes: Earnings



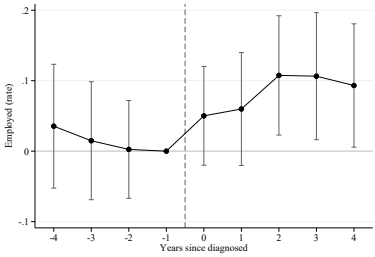




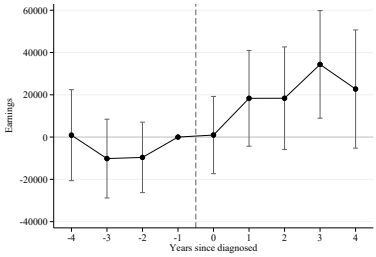


Labor market outcomes

Employment



Earnings (cond. particip.)



Employment detail | Earnings (con. part.) detail

Labor market outcomes

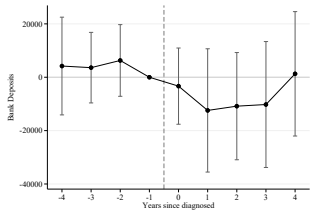
	Estimate (1)	Mean (2)
Employment	0.0753***	0.663
	(0.028)	
Earnings	23,897***	130,918
	(7,706)	
Earnings (cond. part.)	23,909***	180,733
	(8,879)	
Obs.	4,394,390	4,394,390
N. Clusters	439,439	–

- Individuals substitute towards leisure as life expectancy is reduced

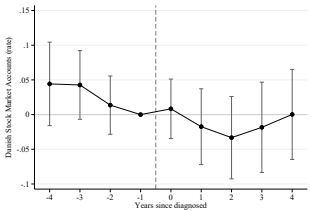
Savings outcomes

(Insignificant) reduction in deposits and stocks. No effect on housing

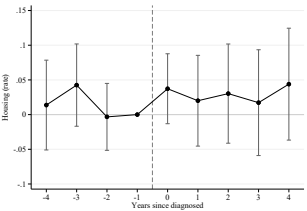
Bank Deposits



Stock Ownership



Housing Ownership

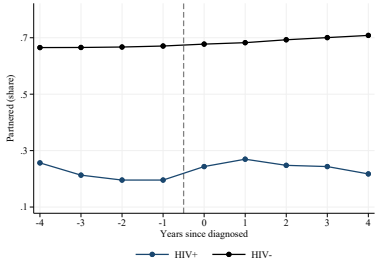


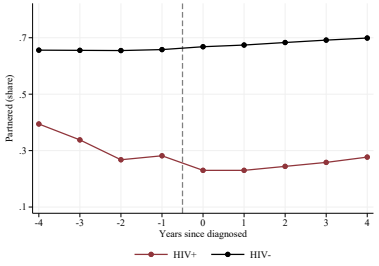
What explains these results?

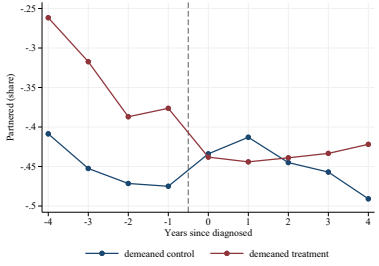
Pooled estimates | Detailed figures

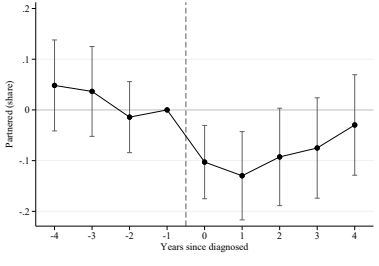
- Still too healthy? Sample with low CD4
- Precautionary savings / bequest motives?
- Institutional context?

Marital outcomes: Partnership (married+cohabitation)









Marital outcomes

	Full Sample (1)	Mean (2)
Partnered	-0.104***	0.24
	(0.036)	
Married	-0.0596*	0.15
	(0.032)	
Cohabiting	-0.0441**	0.09
	(0.022)	
Divorce	-0.0086	0.03
	(0.010)	
Obs.	3,990,987	3,990,987
N. Clusters	443,443	443,443

Married | Cohabiting | Divorce | Hetero/homo

- Partnership as insurance mechanism
- Increased value of leisure + leisure complementarities with partner

Outline

1. Sample restriction: healthy HIV+ patients
2. Identification: Triple Difference
3. Results
4. Policy implications

Assessment of medical innovations

We have shown that economic behaviors change in *anticipation* of future access to medical technologies (before actually receiving it)

$\Rightarrow$ This incentive effect may impact assessment of medical innovations

We compare employment trajectories after HIV *diagnosis* in two scenarios: with and without HAART medication

$\Rightarrow$ Incentive effect amounts to at least 19% of total effect on employment during the first 15 years after an HIV diagnosis.

illustration

Conclusion

This paper:

- We study the the causal effect of improved life-expectancy
- In the context of a sudden medical innovation to treat HIV

We find:

- Improved labor outcomes, muted savings responses, delayed partnership
- Evidence that informs models of household behavior and projections
- Implication: Incentive effect affects assessment of medical innovations

Thank you!

esteban.garcia.miralles@bde.es

Imputation of CD4 pre 1995

Medical register starts in 1995 $\rightarrow$ CD4 not observed before 1995

We impute CD4 counts backwards using:

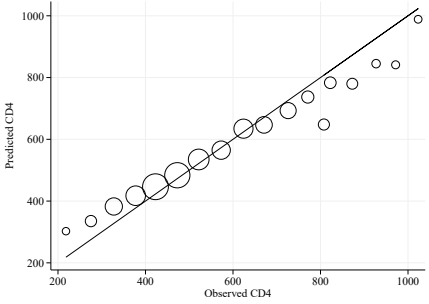
$$CD4_{it} = \alpha + \beta_1 time + \beta_2 time^2 + \phi_i + \epsilon_{it}$$

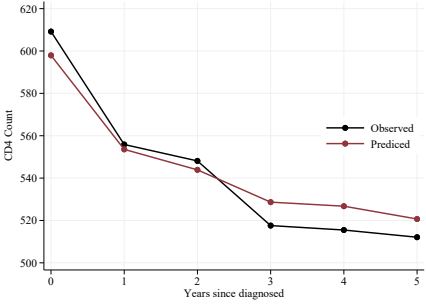
$time \rightarrow$ years since diagnosis
$\phi_i \rightarrow$ individual fixed effect

We use CD4 counts *just* to define sample of analysis (healthy HIV+)

see fit back

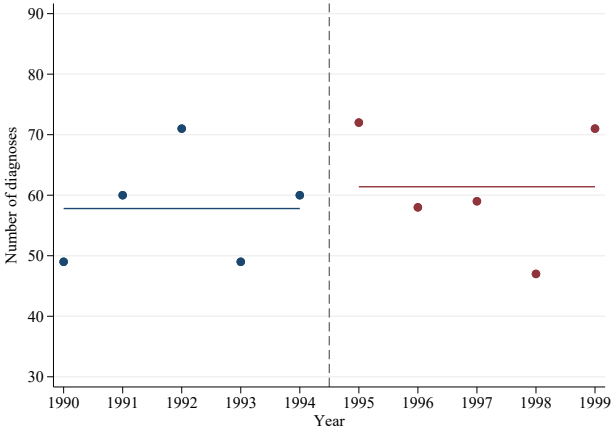
CD4 Imputation Fit





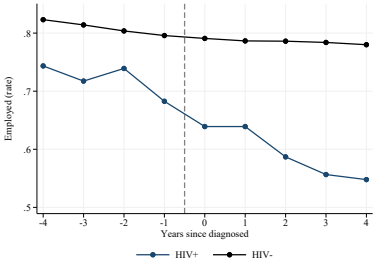
back

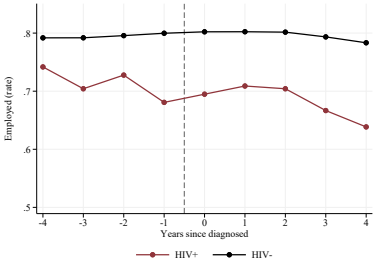
Frequency of HIV diagnosis for analysis sample

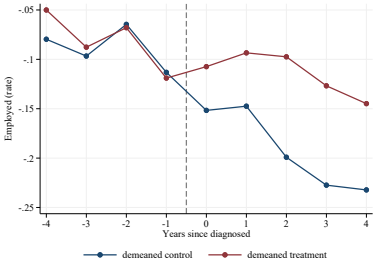


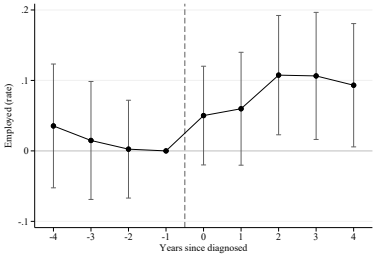
back

Labor market outcomes: Employment



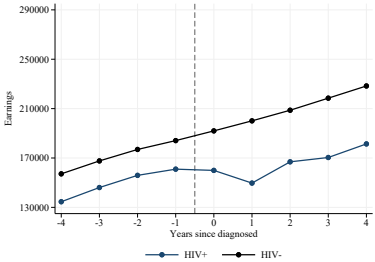


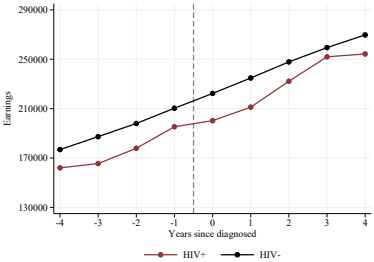


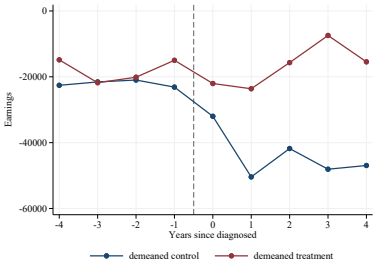


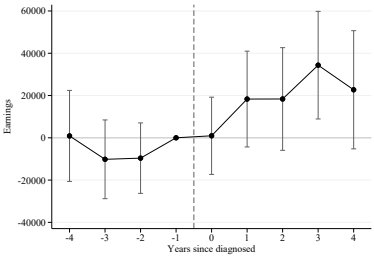
back

Labor market outcomes: Earnings conditional on participation





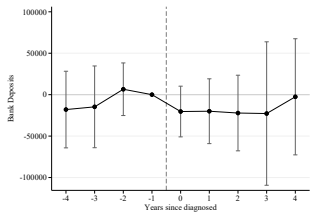




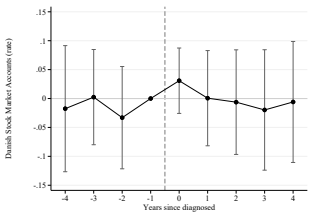
back

Sample diagnosed with low CD4 counts. Savings outcomes

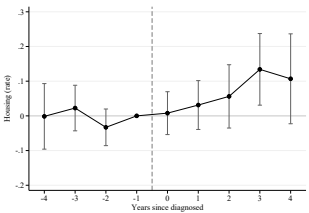
Bank Deposits



Stock Ownership

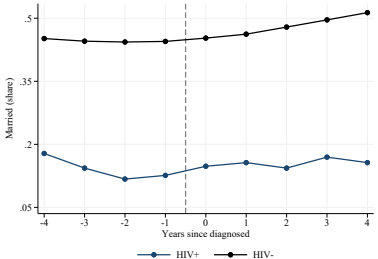


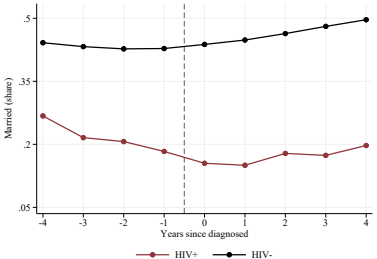
Housing Ownership

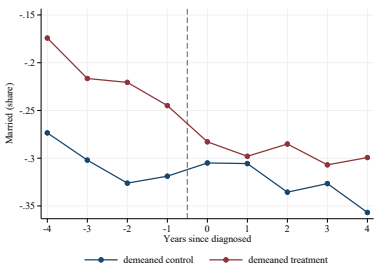


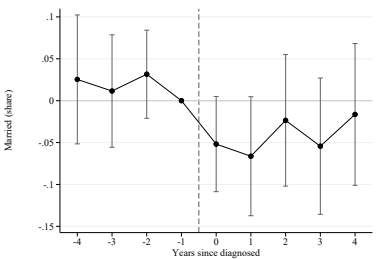
back

Marriage



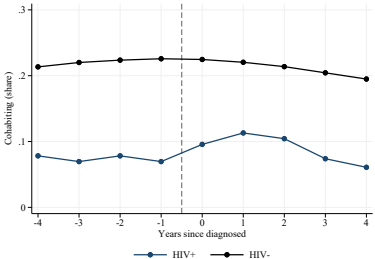


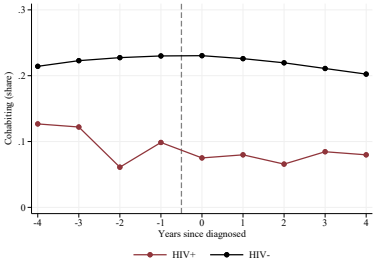


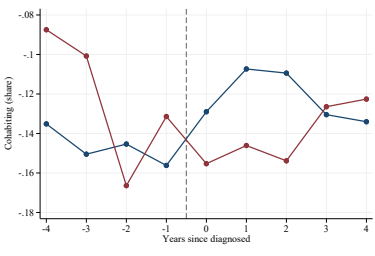


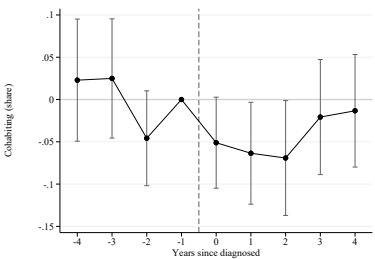
back

Cohabitation



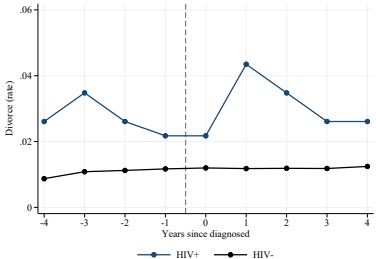


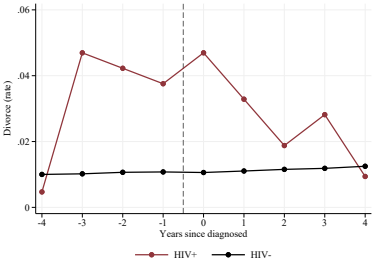


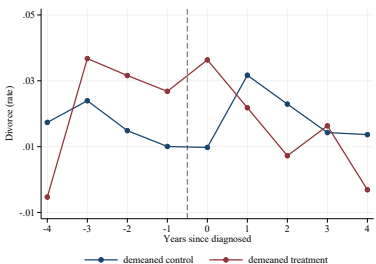


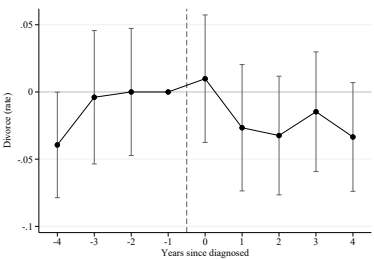
back

Divorce









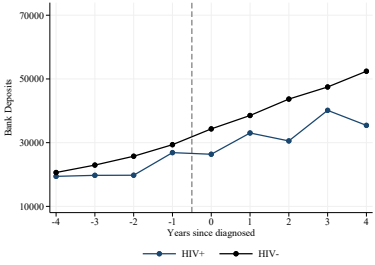
back

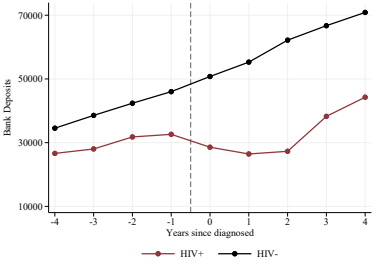
Savings outcomes

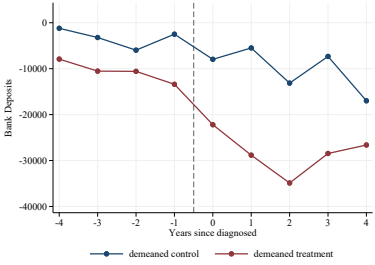
	Estimate (1)	Mean (2)
Any Stocks	-0.0330	0.119
	(0.0245)	
Bank Accounts	-6,415	26,882
	(7,537)	
Home Ownership	0.0213	0.267
	(0.0307)	
Obs.	4,394,390	4,394,390
N. Clusters	439,439	–

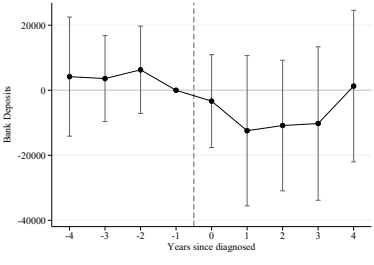
Back

Savings outcomes: Bank Accounts Balances



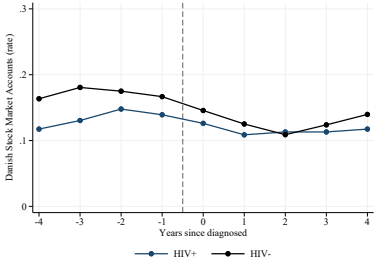


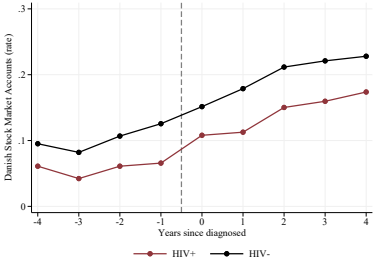


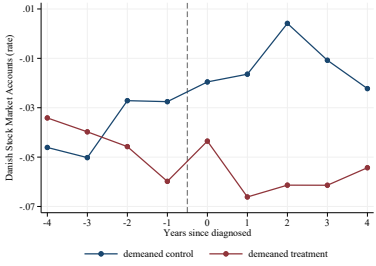


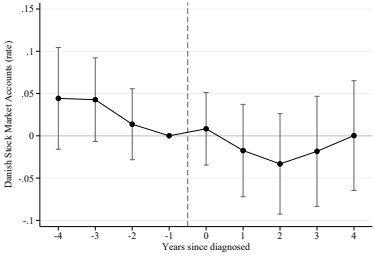
back

Savings outcomes: Stock Ownership



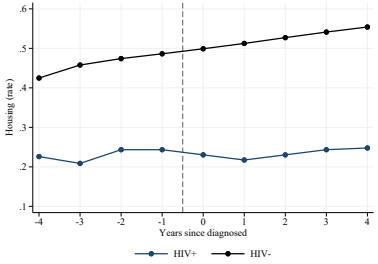


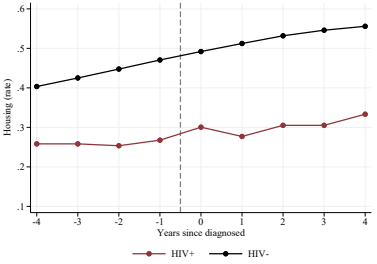


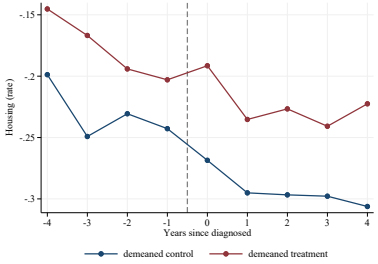


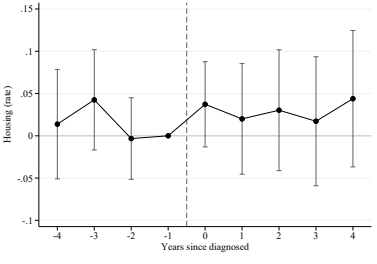
back

Savings outcomes: Housing Ownership



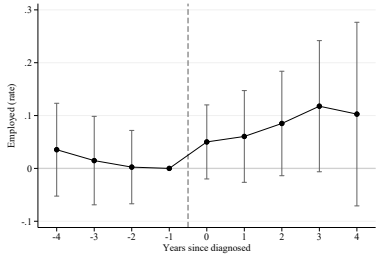


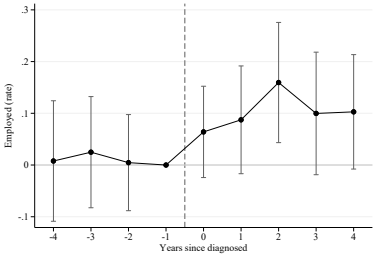


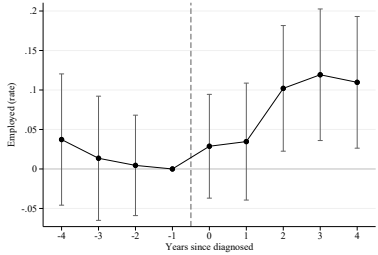


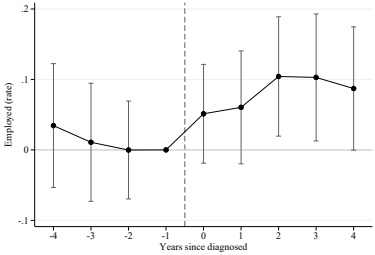
back

Robustness to alternative definitions (Employment)



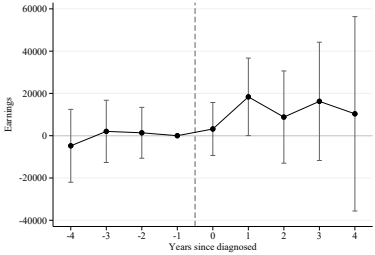


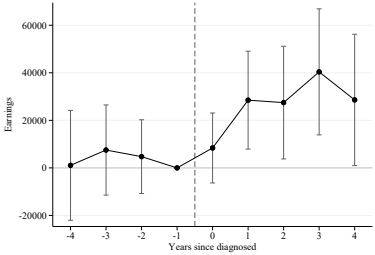


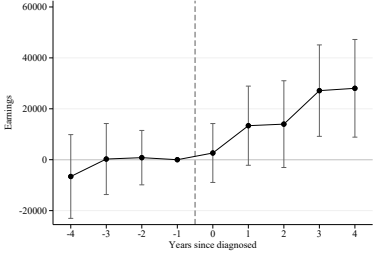


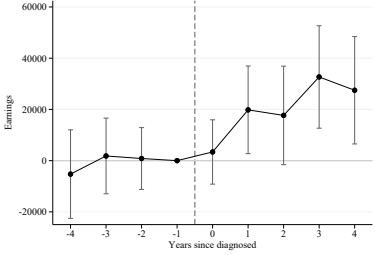
back

Robustness to alternative definitions (Earnings)



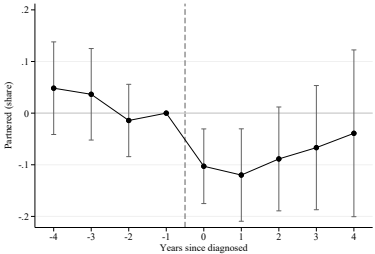


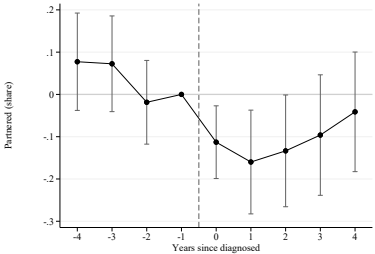


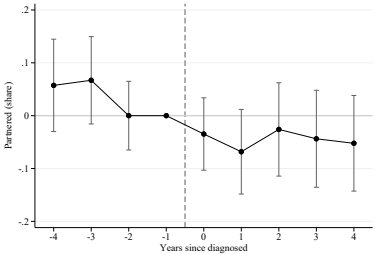


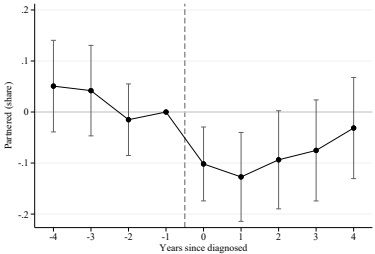
back

Robustness to alternative definitions (Partnered)









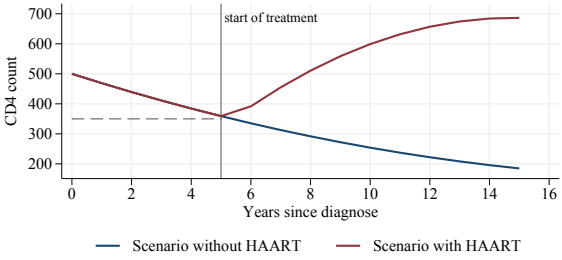
back

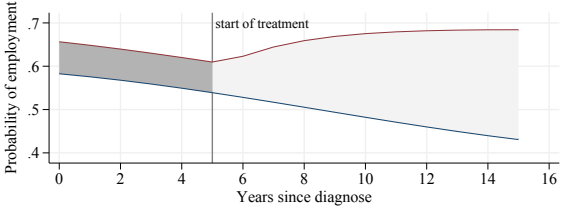
Marital outcomes

	Full Sample (1)	Hetero (2)	MSM (3)	Mean (4)
Partnered	-0.104***	-0.119**	-0.0922**	0.24
	(0.036)	(0.057)	(0.044)	
Married	-0.0596*	-0.0634	-0.0574	0.15
	(0.032)	(0.050)	(0.041)	
Cohabiting	-0.0441**	-0.0559	-0.0349	0.09
	(0.022)	(0.039)	(0.022)	
Divorce	-0.0086	-0.0134	-0.0036	0.03
	(0.010)	(0.017)	(0.012)	
Obs.	3,990,987	1,891,890	2,099,097	3,990,987
N. Clusters	443,443	210,210	233,233	443,443

Married Cohabiting Divorce Back

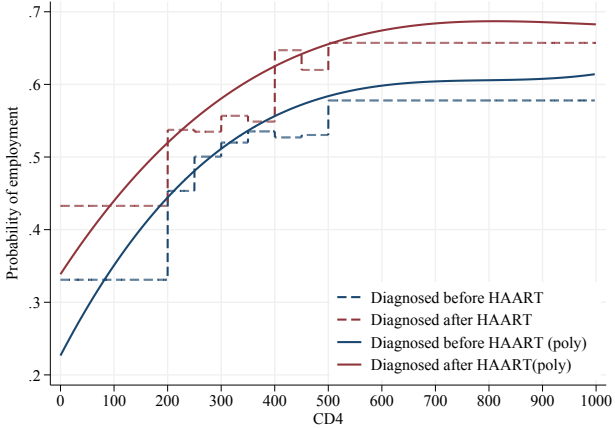
Assessment of medical innovation in the presence of anticipation effects





empl. & CD4 back

Assessment of medical innovation in the presence of anticipation effects



back