



Wittgenstein Centre

FOR DEMOGRAPHY AND  
GLOBAL HUMAN CAPITAL



# Use and success of assisted reproductive technology by education in Spain, and their link to delayed transitions to adulthood

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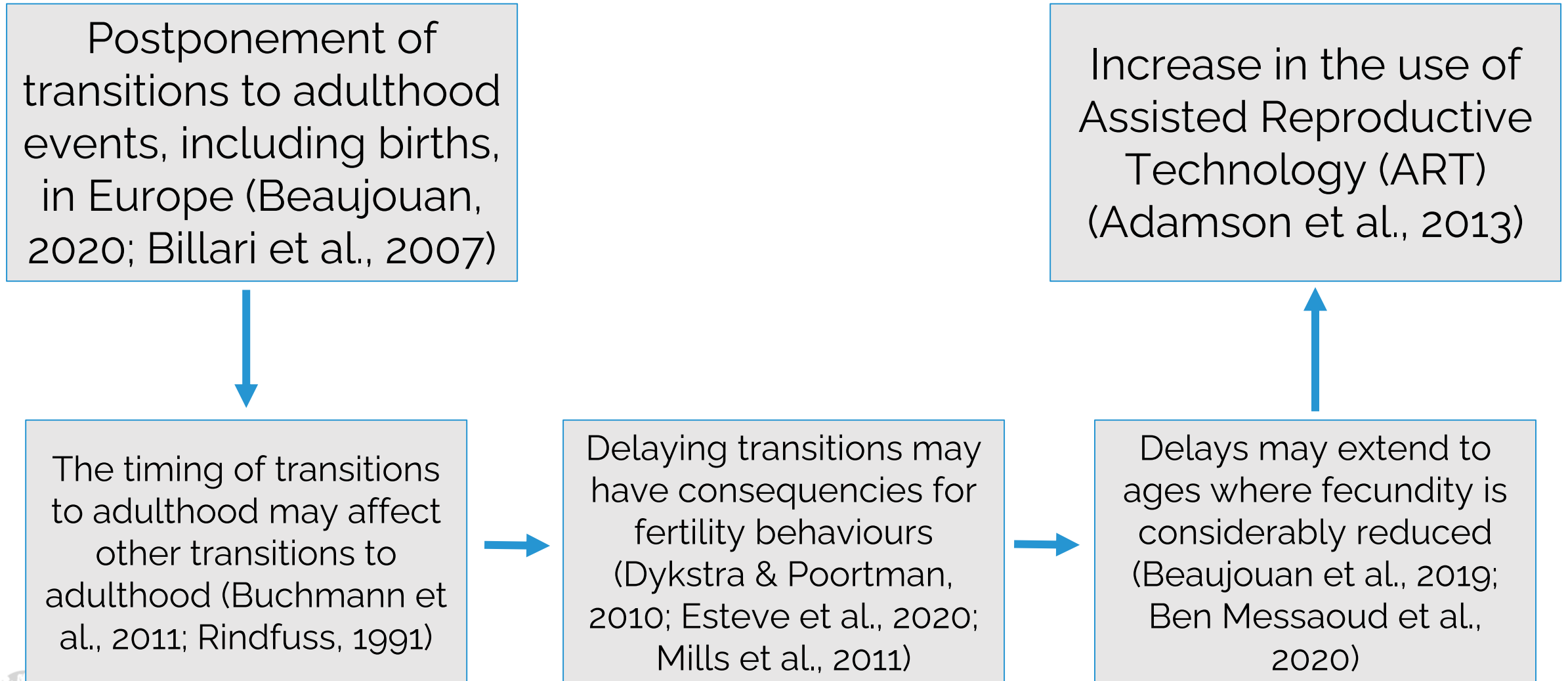
# 1. Motivation and hypotheses

Postponement of transitions to adulthood events, including births, in Europe (Beaujouan, 2020; Billari et al., 2007)

Increase in the use of Assisted Reproductive Technology (ART) (Adamson et al., 2013)



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Postponement of transitions to adulthood events, including births, in Europe (Beaujouan, 2020; Billari et al., 2007)



Increase in the use of Assisted Reproductive Technology (ART) (Adamson et al., 2013)

**H1: The age at experiencing transitions to adulthood events influences the probability of using ART throughout life**



# 1. Motivation and hypotheses

## Women's educational attainment

Highly educated women ...

... spend **more time in formal education** (Ní Bhrolcháin et al., 2012)

... tend to face higher **opportunity costs** (Becker, 1993; Gustafsson et al., 2006)

... tend to invest more in their **professional careers** before having children (Kreyenfeld, 2002; Mills et al., 2011)

... tend to have more **economic resources** to afford infertility treatments (Chambers et al., 2014)

... tend to have different **lifestyles and preferences** (Billari et al., 2018)

They tend to **delay more** the transitions to adulthood events (Brons et al., 2017; Ferraretto et al., 2023)

They may be more likely to use ART thorough life (Goisis et al., 2020; Groes et al., 2017).

They may be **more inclined** to use ART

Delays in life transitions may lead them to use ART more often than women with lower education



# 1. Motivation and hypotheses

## Women's educational attainment

Highly  
educated  
women ...

**H2: The effect of the age at  
experiencing transitions to  
adulthood events on the  
probability of using  
infertility treatments varies  
by educational level.**

They may be more  
likely to use ART  
through life  
(Goisis et al., 2020;  
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Delays in life  
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# 1. Motivation and hypotheses

## Women's educational attainment

### ART outcomes

Highly educated women use ART **later**



ART effectiveness declines with age (Kocourkova et al., 2014; Leridon, 2017)



Lower probability to achieve a live birth

Highly educated women have some characteristics that make them more likely to achieve a live birth

- Better previous **health** status.
- Able to **affront more cycles** or extended treatments.
- Better **understanding** of the process.
- **Flexible schedules** to accommodate clinic appointments.
- **Proximity** to clinics.



Higher probability to achieve a live birth



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Women's educational attainment

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Higher probability to achieve a live birth

**H3: Highly educated women are more likely to achieve a live birth following ART**





# 1. Motivation and hypotheses

Spain is characterised by:

1. Very **late transitions to adulthood**:
  - Age at leaving the parental home: 29.8 (Eurostat, 2021).
2. **Lowest-low** and **latest-late** fertility. First motherhood: 31.1 (Eurostat, 2019).
3. Increased **use of ART** during the last decades (Devolder, 2022; Alon et al., 2021).

Spanish regulation of MAR:

1. The **public system** covers:
  - 6 IUI attempts.
  - 3 IVF cycles.
  - For childless women or mothers with a different partner up to the age of 40.
2. The public system has long **waiting lists** (Alon et al., 2021).
3. Private system has a large bank of **donated eggs** (Degli Esposti et al., 2017).



# 1. Motivation and hypotheses

**H1.** The age at first stable job, leaving the parental home and first co-resident partnership positively impact the probability of using assisted reproduction over the life course.

**H2.** The effect of the age at experiencing transitions to adulthood events on the probability of using infertility treatments varies by educational level.

**H3.** Highly educated women have higher cumulative live birth rates than the lower educated.



## 2. Data and Methods

### 2018 Spanish Fertility Survey (INE)

Retrospective longitudinal survey including information on women and men aged between 18 and 55. Sample = 14,556 women.

**Main explanatory variables:** Age at first stable job, age at leaving the parental home, age at first co-residential partnership.

**Variable to be explained:** used of ART (In vitro fertilization and intracytoplasmic injection).

**Analytical sample:** Women aged  $\geq 24$  (n = 12,930)

**Main explanatory variables:** Educational attainment, age at using ART

**Variable to be explained:** at least a live birth following ART treatment (cumulative live birth rates).

**Analytical sample:** Women aged  $\geq 24$  (n = 498).

Controls: cohort, country of birth, parity (and type of clinic).



## 2. Data and Methods

RQ 1. Are individuals delaying transitions to adulthood more likely to use ART?

RQ 2. Are there any differences in the relationship between delaying transitions and ART usage by educational level?

Event history analysis -> piece-wise models.

Time of exposure [Age 24, Age 49 / age at survey / age at ART ]

$$M1: h_j(t|Events, Z) = h_0(t) \times \exp(\varphi t Event_{i,t} + \gamma Z_i)$$

$$M2: h_j(t|Educ, Events, Z) = h_0(t) \times \exp(\beta Educ_i + \varphi t Event_{i,t} + \gamma Z_i)$$

$$M3: h_j(t|Educ, Events, EducxEvents, Z) = h_0(t) \times \exp(\beta Educ_i + \varphi t \mathbf{Events}_{i,t} + \beta Educ_i \times \varphi t \mathbf{Events}_{i,t} + \gamma Z_i),$$

Where j and i index intervals and individuals, respectively,  $h_0(t)$  is the baseline hazard function,  $Z_i$  is a vector of controls (cohort, country of birth and parity),  $\beta$

is the coefficient of interests and  $\gamma$  is a vector of coefficients for the control variables.



## 2. Data and Methods

RQ 3. Are highly educated women more likely to achieve a live birth than low educated women?

Event history analysis -> cox regression models.

Time of exposure [Age at starting the treatment; Age 49 / age at survey / age at live birth ]

$$h(t) = h_0(t) \times \exp(\beta_{\text{Educ}} + \varphi_{\text{Age}}(i,t) + \beta_{\text{Educ}} \times \varphi_{\text{Age}}(i,t) + \gamma Z_i),$$

where  $h_0(t)$  is the baseline hazard function,  $\text{Age}(i,t)$  is the age at using ART grouped into three categories: 24-33, 34-43, and 44-49,  $Z_i$  is a vector of controls (country of birth and cohort, the type of clinic women went to).

Linear probability models -> cumulative live birth rates (CLBR) percentage of women having at least one child through ART treatments regardless of the number of cycles undertaken and whether the birth occurred thanks to an infertility treatment (Malizia et al., 2009).



# 3. Results

## Timing and occurrence of transitions to adulthood by educational level

All women aged 43 or more	Low education	Intermediate education	High education	Total
Mean age at completing education	15.4 <sup>***</sup>	19.3 <sup>***</sup>	24.2	20.3
Mean age at the first job	23.2 <sup>***</sup>	23.2 <sup>***</sup>	24.1	23.7
Mean age at first stable job	29.1 <sup>*</sup>	27.8	27.8	28.1
Mean age at leaving the parental home	23.7 <sup>***</sup>	24.9 <sup>***</sup>	26.6	25.3
Mean age at first co-resident partner	24.7 <sup>***</sup>	26.3 <sup>***</sup>	28.4	26.7
Mean age at first child	26.5 <sup>***</sup>	27.9 <sup>***</sup>	31.2	28.8
Having ever used IVF/ICSI (%)	2.0% <sup>***</sup>	3.6% <sup>***</sup>	6.2%	4.3%
N	2027	1463	2847	6338
Women using ART (all ages)				
Share with live birth after IVF/ICSI (%)	46.0%	53.0%	59.6%	56.2%
Mean age at IVF	34.3 <sup>*</sup>	36.7	36.2	36
Share using private clinics (%)	49.4% <sup>***</sup>	65.5% <sup>**</sup>	81.0%	72.9%
N	78	98	321	498

Notes: Sample: Women aged 43+. Results are weighted. Mean age at the event only includes women who experienced that event.

Statistical significance tested with respect to the high education. <sup>\*\*\*</sup>: Sig. <=0.001. <sup>\*\*</sup> Sig. <=0.01. <sup>\*</sup>Sig. <=0.05- <sup>+</sup>: Sig.<= 0.1.



# 3. Results

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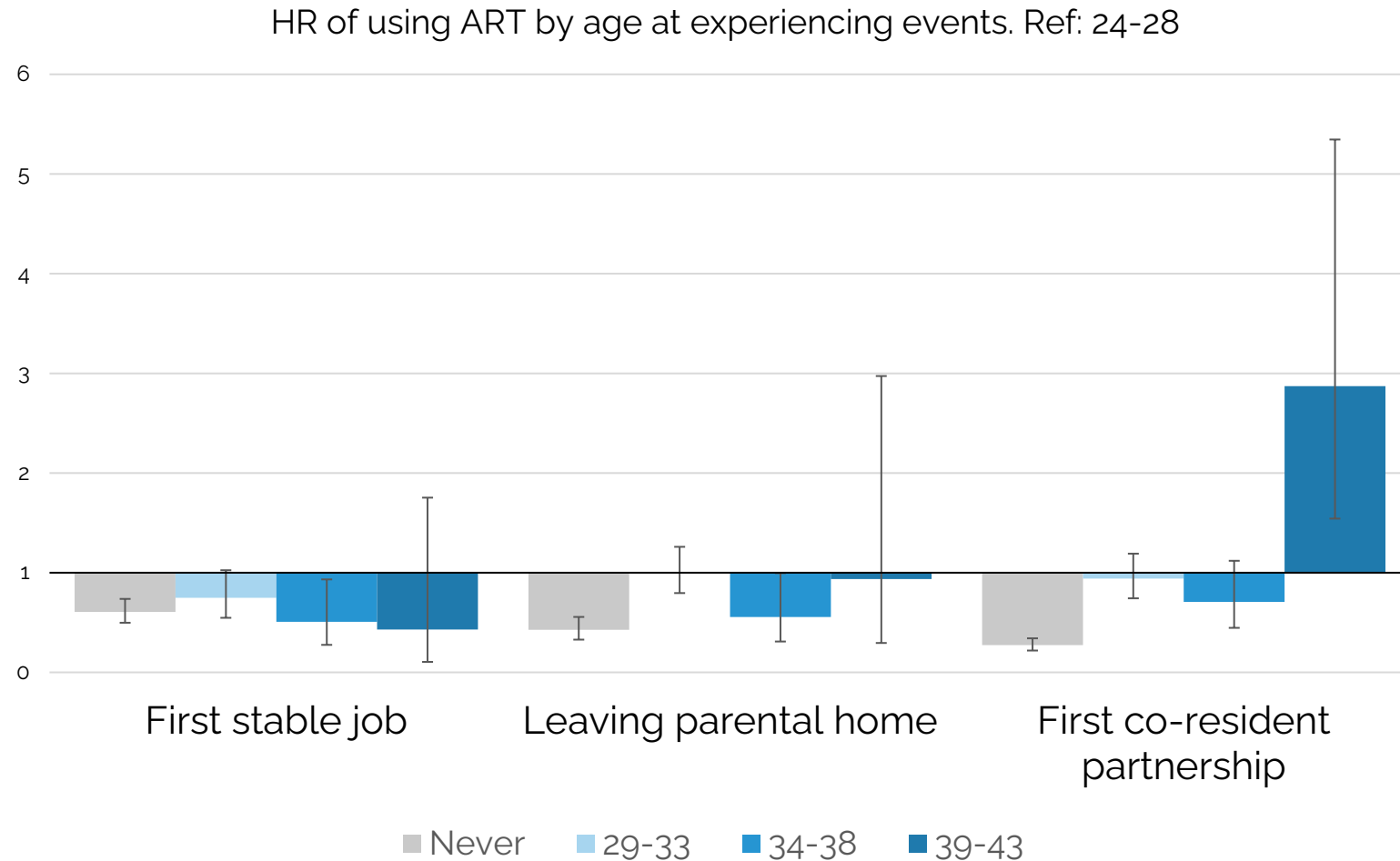
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# 3. Results

## Delays in age at transitions to adulthood and use of ART



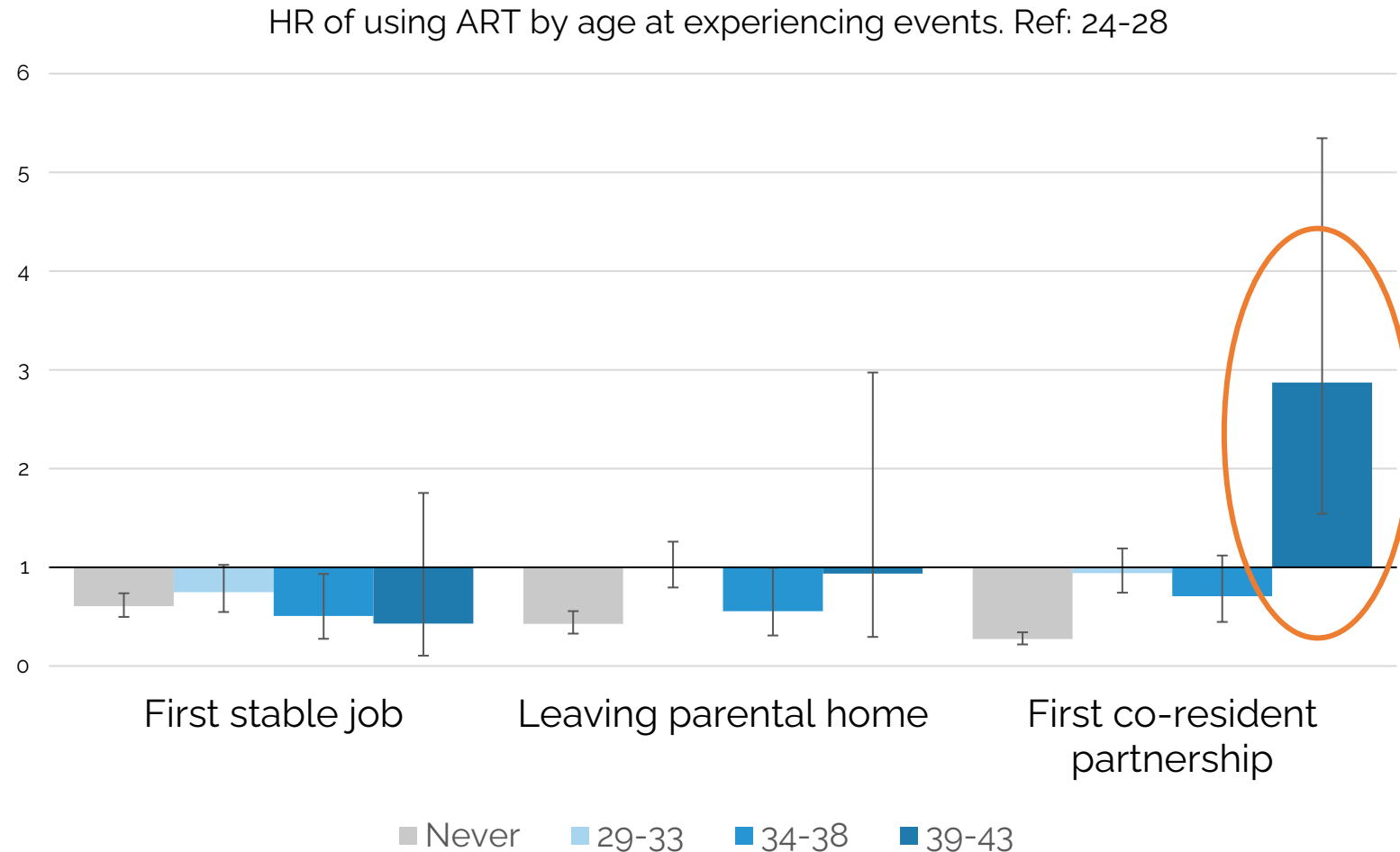
Notes: Controls: cohort, country of birth, parity. Confidence intervals: 95%.





# 3. Results

## Delays in age at transitions to adulthood and use of ART



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# 3. Results

## Variations in the effect of delays on ART usage by level of education

HR of using ART by age at experiencing first coresidential partnership by level of education.

_t	exp(b)	Std. err.
NeverExperienced*Low/Int educ	0.33	0.06
NeverExperienced*High educ	0.24	0.03
Before 29*Low/Int educ	()	()
Before 29*High educ	()	()
29-38*Low/Int educ	0.92	0.19
29-38*High educ	0.83	0.11
39-49*Low/Int educ	1.97	1.18
39-49*High educ	2.88***	1.04

Notes: Controls: cohort, country of birth, parity. \*\*\*: Sig. <=0.001. \*\* Sig. <=0.01. \*Sig. <=0.05- +: Sig.<= 0.1.



# 3. Results

## Outcomes of ART by level of education

HR of achieving at least a live birth by age at starting treatment and level of education.

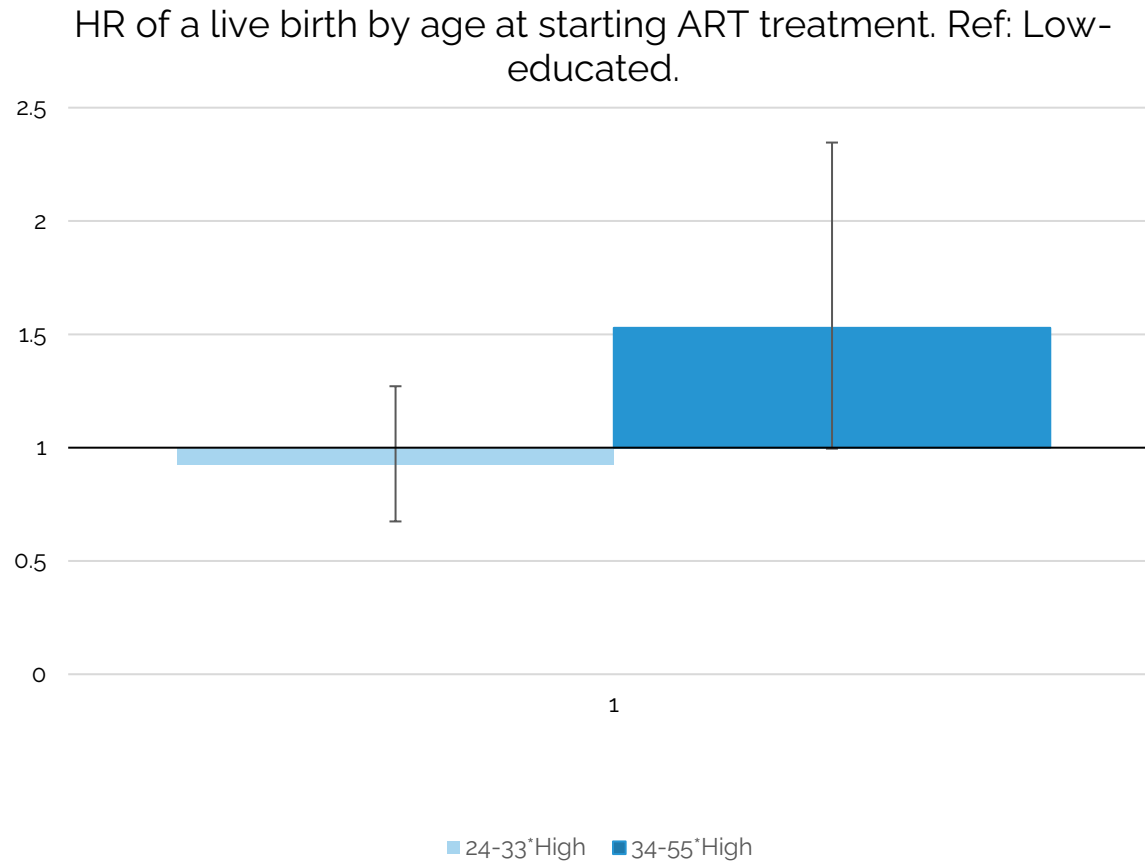
	Model 1		Model 2		Model 3	
	HR	Std.Err.	HR	Std.Err.	HR	Std.Err.
Age at starting ART treatment						
24-33	(Ref.)					
34-55	0.808 <sup>+</sup>	0.099	0.798 <sup>+</sup>	0.099	0.589 <sup>*</sup>	0.138
Educational level						
Low/Int educ	(Ref.)					
High educ			1.141	0.145	0.967	0.156
Age ART * Educ						
34-55*High educ					1.531	0.416
Type of clinic						
Private	(Ref.)					
Public					0.955	0.136

Notes: Controls: cohort, country of birth, parity. \*\*\*: Sig. <=0.001. \*\* Sig. <=0.01. \*Sig. <=0.05- +: Sig.<= 0.1.



# 3. Results

## Outcomes of ART by level of education



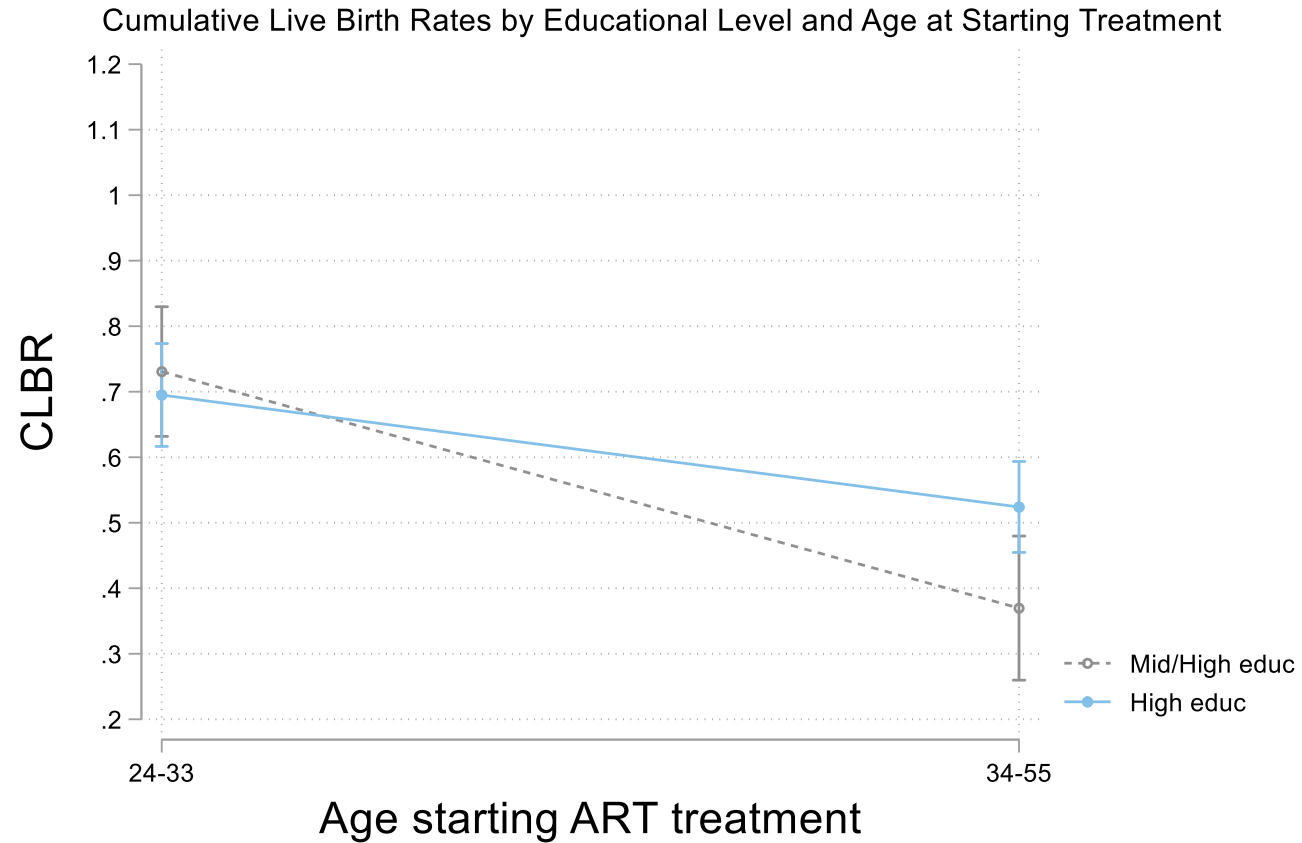
Notes: Controls: cohort, country of birth, parity, duration. Confidence intervals: 95%.



# 3. Results

## Outcomes of ART by level of education

Cumulative Live Birth Rates



Notes: Controls: cohort, country of birth, parity. Confidence intervals: 95%.



## 4. Conclusions

1. Delays in partnership formation influence the probability of using ART.
  - Robustness check: age at first relationship.
  - Delays in age at leaving parental home and first stable job do not seem to affect the probability of using ART.
  - Confirms importance of partnership formation patterns for fertility (Nishikido et al., 2022) and for the use of MAR (Pelikh et al., 2023).
2. The effect is higher among highly educated women.
3. Women with high education may overcome the negative effects of age at using ART on the probability of achieving a live birth.
  - Possible reasons: possibility to afford more cycles, previous health status, flexible jobs, etc.



# Thank you!

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