Second birth rates in Denmark
1981 — 1994

*The effect of education*

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Overview

- Background
- Data and Methods
- Results
- Discussion/Concluding Remarks
Background
General background information on DK

- TFR lowest in 1983 (1.38), highest in 1994 (1.81) (Statistics Denmark, 2002)
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- Coverage 75 per cent for kindergartens, 50 per cent for day nurseries
Hypothesis

- Expect positive effect of education on second birth rates. Such results have been found for other Western European Countries:
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  - Postponement of first birth due to education
  - Biological limitations $\implies$ births have to be *squeezed* together
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- Duration perspective
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  - Biological limitations $\Rightarrow$ births have to be squeezed together
- Duration perspective
  - *Is there more to time-squeeze than age?*
Data and Methods

- The Fertility of Women and Couples Dataset
- The study population
- The sample size
- (In)dependent variables
- Age at first birth
- Educational attainment
- Partnership status
- Median age at first child
- Statistical Methods (1)
- Statistical Methods (2)
The Fertility of Women and Couples Dataset

- Register-based, Statistics Denmark
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- Register-based, Statistics Denmark
- Socio-demographic characteristics for each year 1981-1994 for all women in fertile age range (13-49)
- Permanent address in Denmark
- Information on births from Register of Population Statistics+Medical Register of Birth and Death
- Coverage complete for children born 1960- (Knudsen, 1993)
The study population

- All women of Danish origin, one-child mothers 1981-1994
The study population

- All women of Danish origin, one-child mothers 1981-1994
- Only single-births considered
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- All women of Danish origin, one-child mothers 1981-1994
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- Only women of age 17-40 at first birth
The study population

- All women of Danish origin, one-child mothers 1981-1994
- Only single-births considered
- Only women of age 17-40 at first birth
- Follow-up until end of 1994 or age 45
The sample size

- 329,440 one-child mothers
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- 1.3 million records
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- 1.3 million records
- 208,390 second births
(In)dependent variables

- age at first delivery (1)
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- age at first delivery (1)
- age by the end of each year (2)
(In)dependent variables

- age at first delivery (1)
- age by the end of each year (2)
- duration estimated as (2)-(1) + 0.5
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- age by the end of each year (2)
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- union/partnership status
- educational attainment/in education, October previous year
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- age at first delivery (1)
- age by the end of each year (2)
- duration estimated as (2)-(1) + 0.5
- union/partnership status
- educational attainment/in education, October previous year
- same for the partner, if any
(In)dependent variables

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- age by the end of each year (2)
- duration estimated as (2)-(1) + 0.5
- union/partnership status
- educational attainment/in education, October previous year
- same for the partner, if any

for each calendar year: whether the second birth occurred
### Age at first birth

<table>
<thead>
<tr>
<th>Age (first birth)</th>
<th>Frequency</th>
<th>Percent</th>
</tr>
</thead>
<tbody>
<tr>
<td>17-19</td>
<td>19,052</td>
<td>5.8</td>
</tr>
<tr>
<td>20-23</td>
<td>94,100</td>
<td>28.6</td>
</tr>
<tr>
<td>24-27</td>
<td>126,778</td>
<td>38.5</td>
</tr>
<tr>
<td>28-31</td>
<td>64,336</td>
<td>19.5</td>
</tr>
<tr>
<td>32-35</td>
<td>19,440</td>
<td>5.9</td>
</tr>
<tr>
<td>36-40</td>
<td>5,734</td>
<td>1.7</td>
</tr>
</tbody>
</table>
Educational attainment

<table>
<thead>
<tr>
<th>Education</th>
<th>Frequency</th>
<th>Percent</th>
</tr>
</thead>
<tbody>
<tr>
<td>high further</td>
<td>9,202</td>
<td>2.8</td>
</tr>
<tr>
<td>sh/m. further</td>
<td>57,641</td>
<td>17.5</td>
</tr>
<tr>
<td>vocational</td>
<td>104,458</td>
<td>31.7</td>
</tr>
<tr>
<td>no/low degree</td>
<td>138,898</td>
<td>42.2</td>
</tr>
<tr>
<td>under education</td>
<td>19,241</td>
<td>5.8</td>
</tr>
</tbody>
</table>

Note: This is the educational attainment at the end of the year where the first birth occurred.
## Partnership status

<table>
<thead>
<tr>
<th>Type of cohabitation</th>
<th>Frequency</th>
<th>Percent</th>
</tr>
</thead>
<tbody>
<tr>
<td>Single</td>
<td>32,932</td>
<td>10.0</td>
</tr>
<tr>
<td>Cohab. w. common child</td>
<td>128,303</td>
<td>39.0</td>
</tr>
<tr>
<td>Cohab. wo. common child</td>
<td>20,255</td>
<td>6.2</td>
</tr>
<tr>
<td>Married</td>
<td>147,950</td>
<td>44.9</td>
</tr>
</tbody>
</table>

Note: The type of cohabitation is registered by the end of the year where the first child is born, not at the actual time of first birth.
## Median age at first child

<table>
<thead>
<tr>
<th>Education</th>
<th>Median age at first child</th>
</tr>
</thead>
<tbody>
<tr>
<td>high further</td>
<td>30</td>
</tr>
<tr>
<td>sh/m. further</td>
<td>28</td>
</tr>
<tr>
<td>vocational</td>
<td>25</td>
</tr>
<tr>
<td>no/low degree</td>
<td>23</td>
</tr>
<tr>
<td>under edu</td>
<td>25</td>
</tr>
</tbody>
</table>

Note: Educational attainment by the end of the year where the first birth occurred.
proportional hazards:

$$\lambda_i(t) = \exp [\lambda_0(t) + \beta' x_i(t)]$$
**Statistical Methods (1)**

- **Proportional hazards:**
  \[ \lambda_i(t) = \exp [\lambda_0(t) + \beta' x_i(t)] \]

- Due to discrete nature of data, we model \( P_{it} \) - the cond. probability of delivering the second child in a calendar year given that the year is reached, *discrete-time hazard rate*, (Allison, 1982).

  \[ \log \left[ -\log (1 - P_{it}) \right] = \lambda_i(t) = \lambda_0(t) + \beta' x_i(t) \]
Software: SAS: "PROC GENMOD" with binomial distribution and complementary log-log link function.
**Statistical Methods (2)**

- **Software**: SAS: "PROC GENMOD" with binomial distribution and complementary $\log\log$ link function.

- The observed probability for each combination of covariates, $k$, is $P_k = x_k/n_k$. 
Statistical Methods (2)

- **Software:** SAS: "PROC GENMOD" with binomial distribution and complementary log-log link function.
- The observed probability for each combination of covariates, \( k \), is \( P_k = \frac{x_k}{n_k} \).
- Concept of "Deviance/DF" is used as criterion for the model fit being satisfactory.
Results

- Main effects Models
- Age at first birth and duration (1)
- Age at first birth and duration (2)
- Time-squeeze for highly educated? (20-27)
- Time-squeeze for highly educated? (28-31)
- Time-squeeze for highly educated? (32-35)
- Time-squeeze for highly educated? (36-40)
- Age at first birth and duration revisited
Main effects Models

<table>
<thead>
<tr>
<th>Current education</th>
<th>M1</th>
<th>M2</th>
<th>M3</th>
</tr>
</thead>
<tbody>
<tr>
<td>high further</td>
<td>1.41</td>
<td>1.47</td>
<td>1.29</td>
</tr>
<tr>
<td>sh./m. further</td>
<td>1.29</td>
<td>1.34</td>
<td>1.28</td>
</tr>
<tr>
<td>vocational</td>
<td>1</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td>no/low degree</td>
<td>0.87</td>
<td>0.97</td>
<td>0.97</td>
</tr>
<tr>
<td>under edu</td>
<td>0.59</td>
<td>0.69</td>
<td>0.66</td>
</tr>
<tr>
<td>Deviance/DF</td>
<td>16.5</td>
<td>5.2</td>
<td>2.1</td>
</tr>
</tbody>
</table>

M1: Controlled for duration (baseline), period, age at first birth.

M2: M1 + further control for partnership status.

M3: M2 + further control for partner’s education.
Age at first birth and duration (1)

Interaction between age (at first birth) and baseline duration

- Age at first birth and duration (1)
- Time-squeeze for highly educated? (20-27)
- Time-squeeze for highly educated? (28-31)
- Time-squeeze for highly educated? (32-35)
- Age at first birth and duration (36-40)

Conclusion
## Age at first birth and duration (2)

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<tr>
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<th>Interaction model</th>
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<td>0.66</td>
<td>0.68</td>
</tr>
<tr>
<td>Deviance/DF</td>
<td>2.1</td>
<td>1.8</td>
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Time-squeeze for highly educated? (20-27)

Age at first birth 20–27 years

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- Age at first birth and duration revisited
Time-squeeze for highly educated? (28-31)

Age at first birth 28–31 years
Time-squeeze for highly educated? (32-35)
Time-squeeze for highly educated? (36-40)

Age at first birth 36–40 years

- Main effects Models
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Conclusion
Further interaction with education changed Deviance/DF from 1.7 to 1.8.
Conclusion
Other possible explanations?

- No evidence of a *time-squeeze* as explanation for the higher second birth rates among higher educated was found.
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