Contribution of increasing education, delayed union formation and adverse economic conditions to variation in Belgian period fertility, 1960-2000

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Education & Fertility: Mechanisms, Causal Pathways, Aggravating Circumstances

- Reasons for postponement and decline of period fertility (Mills, Rindfuss, McDonald & te Velde 2011; Blossfeld, Mills & Klijzing 2005; McDonald 2006; Lesthaeghe & Neels 2002):
  - introduction and diffusion of contraceptive technology
  - rising enrollment and educational attainment
  - increasing labour force participation (including incompatibility between caring for children and labour force participation, expected increase in earnings and wage penalties, loss of training opportunities and depreciation of job-specific human capital)
  - shift to an 'individualistic family model'; the changing role and position of children (child becoming locus of emotional and financial investment)
  - rising gender equity in education and labour market under institutional constraints (e.g. lack of childcare and supporting policies; low benefit levels and/or rigid labour markets)
  - variation in economic context and housing markets
  - changing partnership patterns (incl. higher separation/divorce, lack of suitable partners as a result hypogamy/hypergamy and increasing education)
  - declining real wages
- Little quantitative evidence on the contribution of these potential causes to macro-level trends in fertilty tempo (Ni Bhrolchain & Beaujouan 2012)

Education & Fertility: Mechanisms, Causal Pathways, Aggravating Circumstances

- Reverse causation: early childbearing impeding education (Cohen, Kravdal & Keilman 2011)
- Negative selection on (un)observable factors jointly affecting education and timing of first birth (family background, career preferences, genetic factors,…)
  (Braakmann 2011, Tropf 2015, Rijken & Liefbroer 2009, Grönqvist & Hall 2013)
- Causal pathways (Black, Devereux & Salvanes 2008, Blossfeld & Huinink 1991, Cygan-Rehm & Maeder 2013, Braakmann 2011, Monstad, Propper & Salvanes 2008, McCrary & Royer 2011, Grönqvist & Hall 2013, Behrman & Rozsenzweig 2002; Fort, Schneeweiss & Winter-Ebmer 2011):
  - Incarceration effect
  - Incompatibility student-parent roles
  - Increase in permanent income versus substitution effect and quality-quantity trade-off
  - Increasing bargaining power for women in households
  - Multiplier effect on household income through positive assortative mating
  - Knowledge of contraception and reproductive health
  - Reduction in reproductive life span after education

Education & Fertility: Mechanisms, Causal Pathways, Aggravating Circumstances

- Empirical evidence from natural experiments relying on exogenous variation in education (e.g. compulsory schooling reforms, month/quarter of birth, enrolment patterns,…) (Black, Devereux & Salvanes 2008, Blossfeld & Huinink 1991, Cygan-Rehm & Maeder 2013, Braakmann 2011, Monstad, Propper & Salvanes 2008, McCrary & Royer 2011, Grönqvist & Hall 2013, Behrman & Rozsenzweig 2002; Fort, Schneeweiss & Winter-Ebmer 2011; Skirbekk, Kohler & Prskawetz 2004; Geruso, Clark & Royer 2011):
  - consistent findings regarding fertility tempo: postponement of first births away from teenage motherhood; increasing fertility rates between ages 20-30 and 35-40, suggesting that education shifts sequence of transitions in early adulthood into older ages
  - inconsistent findings regarding fertility quantum: effect ranges from negative over neutral to positive between countries/periodsconsidered, suggesting contextual factors are important

- Recession induced postponement and recuperation (Sobotka, Skirbekk & Philipov 2011, Neels, Theunynck & Wood 2013; Vikat 2004; Verick 2009; Aassve, Cottini & Vitali 2013)
  - prolonged enrolment in education
  - increasing unemployment, deteriorating job conditions and overeducation (entailing relative income deprivation and delayed entry into established labour market positions and intended career trajectories, particularly among higher educated)
  - reduced public expenditure (unemployment and parental leave benefits, childcare,…)
  - procyclical effect largely limited to younger age-groups and higher educated

Education & Fertility: Mechanisms, Causal Pathways, Aggravating Circumstances

- Changes in values orientations and living arrangements (Lesthaeghe & Van De Kaa 1986, Lesthaeghe & Surkyn 1988, Van de Kaa 2001, Mulder 2003; Oppenheimer, Kalmijn & Lim 1997; Oppenheimer 2003)
  - education associated with rising individualism/postmaterialist values
  - postmaterialism not directly associated with lower fertility intentions
  - indirect effect through changes in living arrangements/ frequent spells of single living: may affect family formation indirectly
  - variation in economic conditions may induce changes in living arrangements

Research Question

Contribution of educational expansion, economic conditions and changes in living arrangements to macro-level change in synthetic parity progression ratio to first births and mean age at first birth?

Data & Methods

- 2001 Belgian Census (N=3.500.000 women) (Deboosere & Willaert, 2004)
- Time frame: first birth hazards between ages 15-50 in period 1960-2000
- Individual-level effects:
  - age baseline (centered age 15, cubic effect)
  - enrolment (time-varying) (Blossfeld et al. 2001, Black et al.)
  - educational level (Becker 1960)
  - duration since graduation (quadratic effect) (Skirbekk et al. 2004, Ni Bhrolchain et al. 2012)
  - education*baseline interaction
  - partnership status (ever in co-residential union, time varying)
  - duration since first union (quadratic effect)
- Macro-level effects:
  - exogenous variation in annual unemployment rate (OECD, Sobotka et al. 2011, Singer & Willet 2003)
  - lags of 1 year (recession induced postponement) and 10 years (compensation)
  - cross-level interaction age*unemployment lag 1
  - cross-level interaction education*unemployment lag 10

Methodology

- Discrete-time hazard model (logit) of first birth hazards:

$$ln\left[\frac{\hat{h}_i^t}{1-\hat{h}_i^t}\right] = a + \sum bX \qquad \hat{h}_i^t = \frac{e^{a+\sum bX}}{1+e^{a+\sum bX}}$$

- Simulated SPPR1 and MAC1-series based on fitted hazards by age/year:

$$\widehat{SPPR}_1^t = 1 - \prod_{i=0}^{35}\left(1-\hat{h}_i^t\right) \qquad \widehat{MAC}_1^t = 14{,}5 + \sum_{i=0}^{35}\frac{\left(\hat{S}_{i+1}^t - \hat{S}_i^t\right)}{\widehat{SPPR}_1^t}\frac{i+(i+1)}{2}$$

- Assessing fit between observed and simulated time-series:

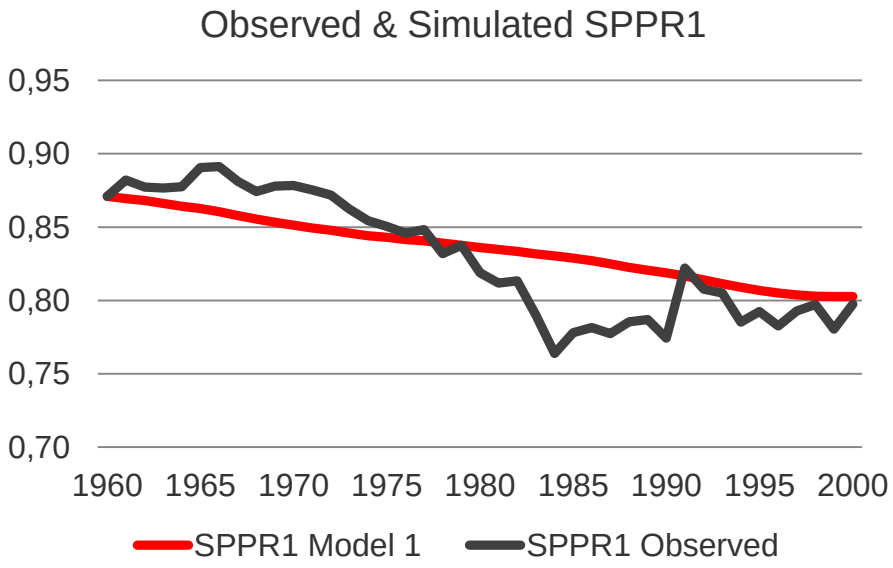
r zero-order correlation

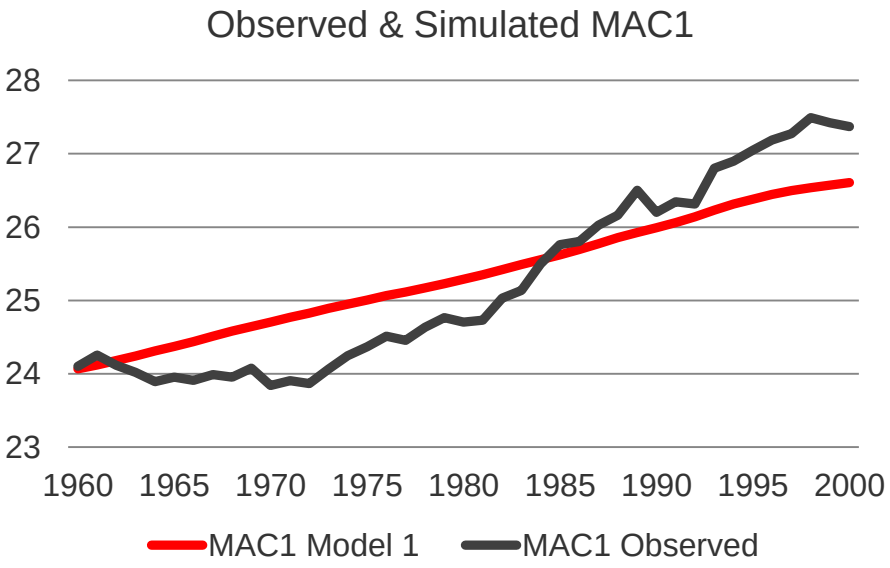
r_{dif} correlation between first-order differenced time-series

|e| mean absolute deviation

SPPR1 and MAC1: Observed and Simulated Time-series

Model 1: Centred age (cubic specification)
Education (time-varying enrolment, level & duration since leaving quadratic)



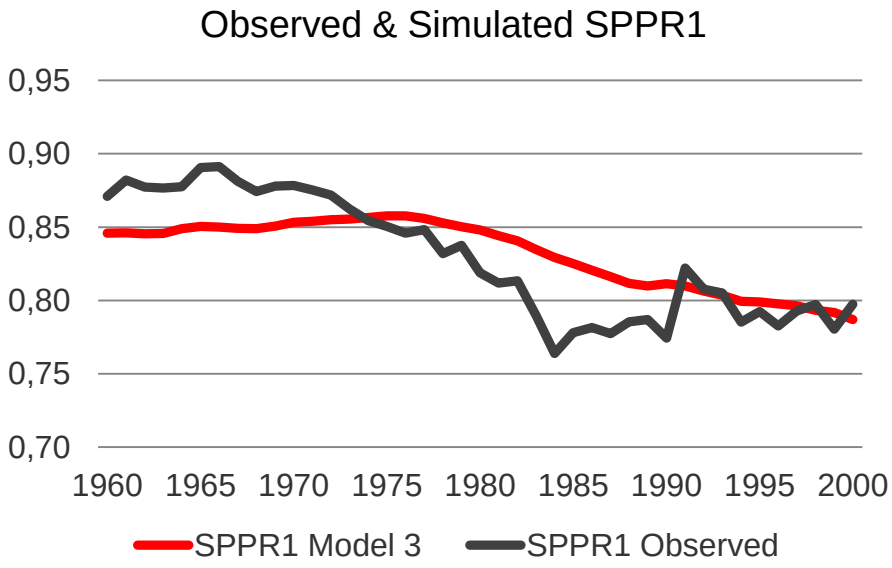


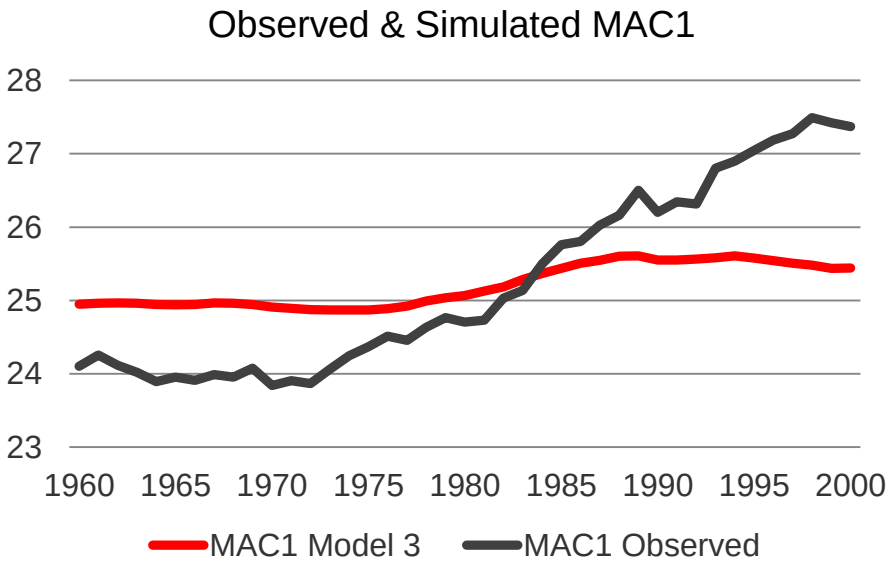
R = 0,8694
R^2 = 0,7559
Rdif = 0,1039
|e| = 0,0211 (0,0380 under Constant Schedule)

R = 0,9567
R^2 = 0,9152
Rdif = 0,3094
|e| = 0,5013 (1,1247 under Constant Schedule)

SPPR1 and MAC1: Observed and Simulated Time-series

Model 3: Centred age (cubic specification)
Partnership (ever co-residential union, duration since first partnership quadratic)



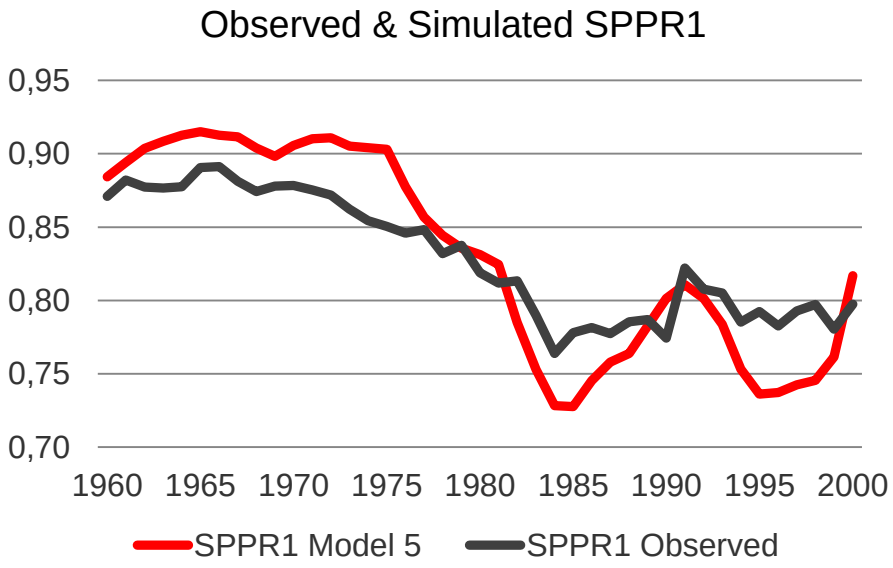


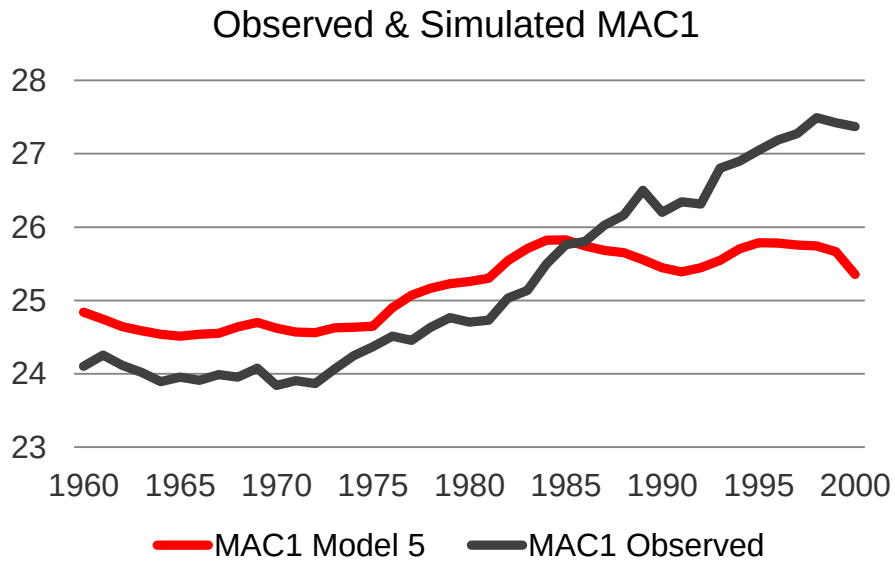
R = 0,7777
R^2 = 0,6048
Rdif = 0,1483
|e| = 0,0229

R = 0,9251
R^2 = 0,8559
Rdif = 0,4172
|e| = 0,8537

SPPR1 and MAC1: Observed and Simulated Time-series

Model 5: Centred age (cubic specification)
Unemployment Rate (lagged 1 year)



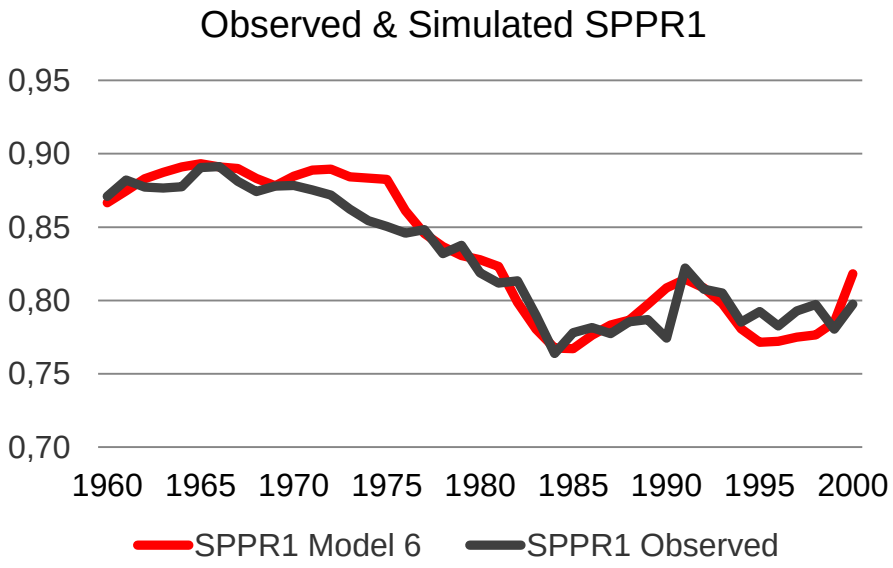


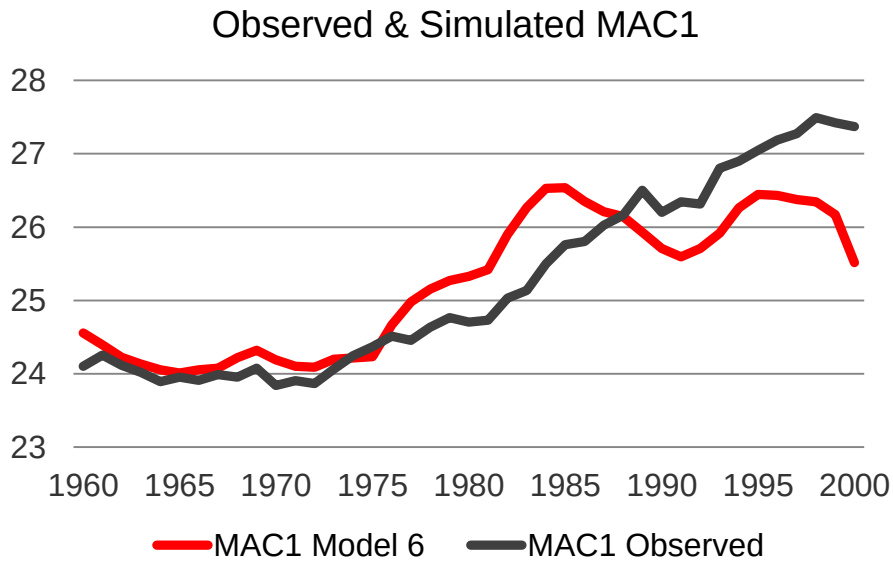
R = 0,9561
R^2 = 0,9251
Rdif = 0,3843
|e| = 0,0266

R = 0,8644
R^2 = 0,7471
Rdif = 0,3689
|e| = 0,7457

SPPR1 and MAC1: Observed and Simulated Time-series

Model 6: Centred age (cubic specification)
Unemployment Rate (lagged 1 year, Age*Unemployment Rate)



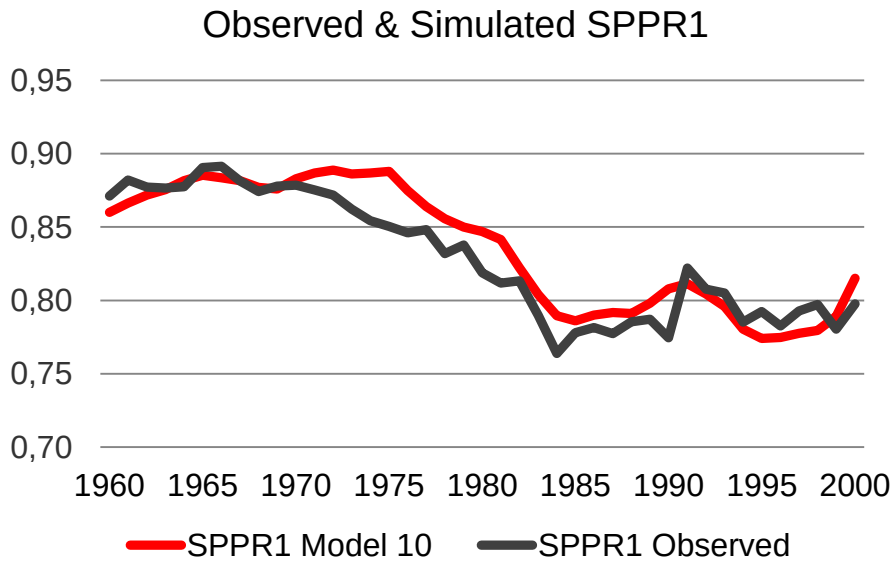


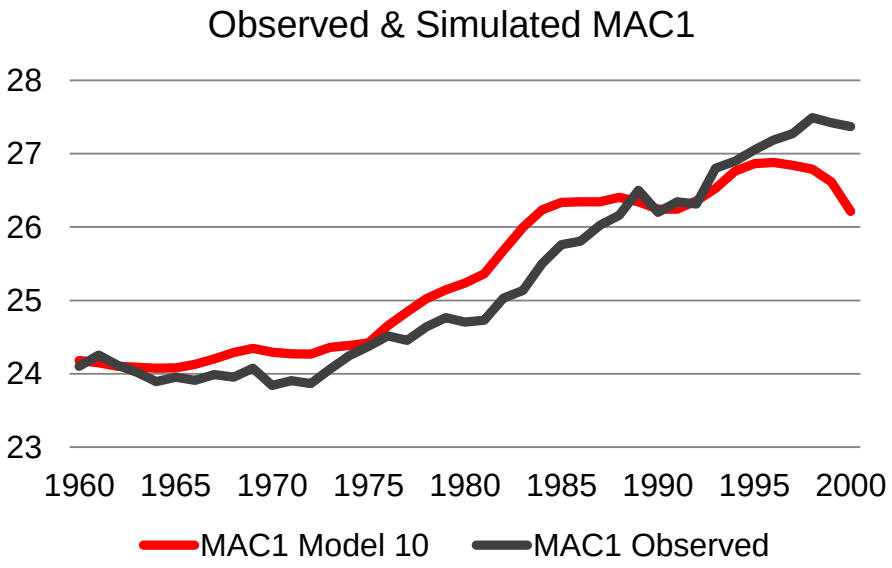
R = 0,9618
R^2 = 0,9142
Rdif = 0,3961
|e| = 0,0095

R = 0,8638
R^2 = 0,7462
Rdif = 0,3698
|e| = 0,5090

SPPR1 and MAC1: Observed and Simulated Time-series

Model 10: Centred age (cubic specification)
Education (time-varying enrolment, level & duration since leaving)
Partnership (ever partnered, duration since first partnership)
Unemployment Rate (lagged 1 year, Age*Unemployment Rate)



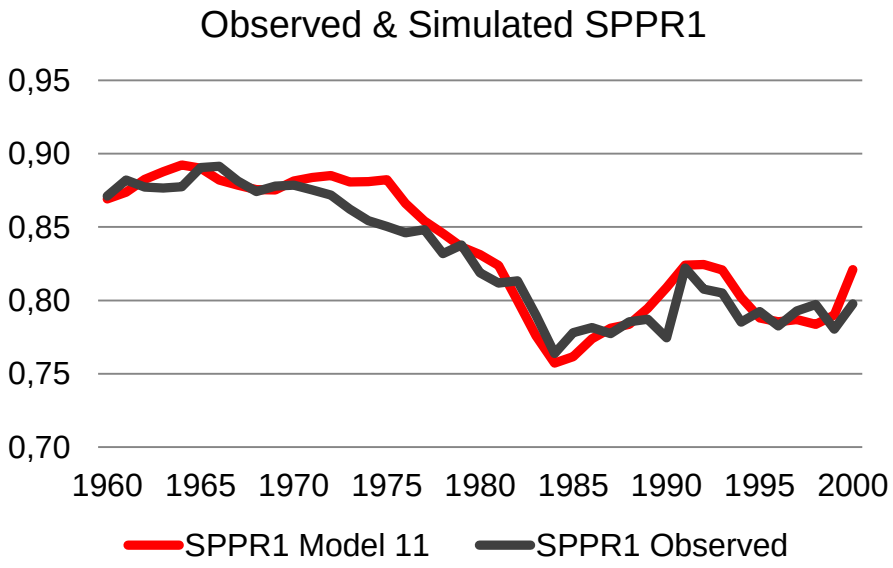


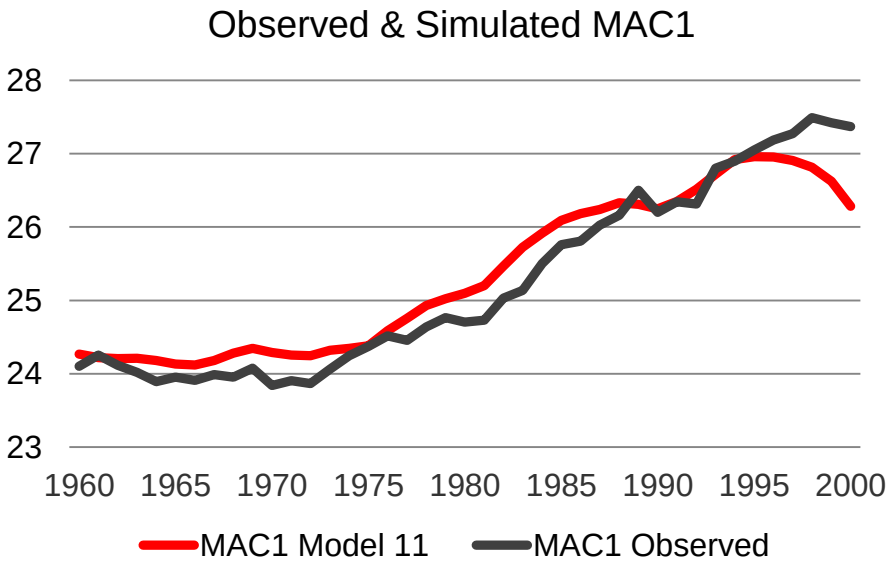
R = 0,9329
R^2 = 0,8703
Rdif = 0,4009
|e| = 0,0125

R = 0,9515
R^2 = 0,9053
Rdif = 0,4260
|e| = 0,3422

SPPR1 and MAC1: Observed and Simulated Time-series

Model 11: Centred age (cubic specification)
Education (time-varying enrolment, level & duration since leaving)
Partnership (ever partnered, duration since first partnership)
Unemployment Rate (lagged 1 & 10 years + Age*Unemployment Rate)





R = 0,9586
R^2 = 0,9189
Rdif = 0,4715
|e| = 0,0095

R = 0,9712
R^2 = 0,9432
Rdif = 0,4449
|e| = 0,2832

Decline of SPPR1 and fertility postponement: Educational Expansion under Adverse Economic Conditions

Educational expansion:

- requires joint consideration of:
  - time-varying enrolment (Blossfeld & Huinink 1991; Black et al. 2008)
  - attainment (Becker 1960)
  - duration since leaving (quadratic) or 'social age' (Skirbekk et al. 2004, Ní Bhrolchain & Beaujouan 2012)
- educational expansion correctly captures long-term trend in SPPR1 & MAC1: relevant dimension for long-term projection
- cannot account for temporal acceleration/deceleration in SPPR1/MAC1 trends:
  - high fertility in 1960s
  - low fertility in 1975-1990 and mid 1990s

Economic Context

- procyclical among women < 30 years affecting period fertility (Neels et al. 2013, Aassve et al. 2013)
- compensation among women >30 years reducing effect on cohort fertility (Sobotka et al. 2011)
- economic conditions accounts for period acceleration/deceleration in SPPR1/MAC1:
  - mean absolute deviation/year in SPPR1: < 1 percentage point
  - mean absolute deviation/year in MAC1: < 0,30 years

Delayed Union Formation: limited impact on SPPR1 and particularly MAC1-trends

Thank you for your attention!

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Appendix A Model Fit Statistics SPPR1

	Model specification:										
	1	*2*	*3*	*4*	*5*	*6*	*7*	*8*	*9*	*10*	*11*
Individual-level covariates											
Centered age (cubic specification)	•	•	•	•	•	•	•	•	•	•	•
In education (time-varying)	•	•		•				•		•	•
Educational level	•	•		•				•		•	•
Duration since graduation (quadratic)	•	•		•				•		•	•
*Education level*baseline hazard function*		•		•				•		•	•
Partnership status (time-varying)			•	•					•	•	•
Duration since 1st partnership (quadratic)			•	•					•	•	•
Macro-level covariates											
Unemployment (lagged 1 year)					•						
*Unemployment (lagged 1 year)*Age-group*											
*. urlag1*age1519*						•	•	•	•	•	•
*. urlag1*age2024*						•	•	•	•	•	•
*. urlag1*age2529*						•	•	•	•	•	•
*. urlag1*age3034*						•	•	•	•	•	•
*. urlag1*age3539*						•	•	•	•	•	•
*. urlag1*age4044*						•	•	•	•	•	•
*. urlag1*age4549*						•	•	•	•	•	•
*Unemployment (lagged 1 year)*Age-group*Education*							•				
*Unemployment (lagged 10 years)*Age-group*											
*. urlag10*age3034*											•
*. urlag10*age3539*											•
*. urlag10*age4044*											•
*. urlag10*age4549*											•
Correlation between fitted and observed SPPR1											
R, not differenced	0,8694	0,8674	0,7777	0,8003	0,9561	0,9618	0,9620	0,9624	0,9354	0,9329	0,9586
R^2, not differenced	0,7559	0,7523	0,6048	0,6405	0,9251	0,9142	0,9255	0,9263	0,8749	0,8703	0,9189
R, 1-year differencing	0,1039	0,0736	0,1483	0,2374	0,3843	0,3961	0,3633	0,3801	0,3997	0,4009	0,4715
Mean Deviation	0,0211	0,0224	0,0229	0,0229	0,0266	0,0095	0,0129	0,0115	0,0117	0,0125	0,0095

Appendix B Model Fit Statistics MAC1

	Model specification:										
	1	*2*	*3*	*4*	*5*	*6*	*7*	*8*	*9*	*10*	*11*
Individual-level covariates											
Centered age (cubic specification)	•	•	•	•	•	•	•	•	•	•	•
In education (time-varying)	•	•		•				•		•	•
Educational level	•	•		•				•		•	•
Duration since graduation (quadratic)	•	•		•				•		•	•
*Education level*baseline hazard function*		•		•				•		•	•
Partnership status (time-varying)			•	•					•	•	•
Duration since 1st partnership (quadratic)			•	•					•	•	•
Macro-level covariates											
Unemployment (lagged 1 year)					•						
*Unemployment (lagged 1 year)*Age-group*											
*. urlag1*age1519*						•	•	•	•	•	•
*. urlag1*age2024*						•	•	•	•	•	•
*. urlag1*age2529*						•	•	•	•	•	•
*. urlag1*age3034*						•	•	•	•	•	•
*. urlag1*age3539*						•	•	•	•	•	•
*. urlag1*age4044*						•	•	•	•	•	•
*. urlag1*age4549*						•	•	•	•	•	•
*Unemployment (lagged 1 year)*Age-group*Education*							•				
*Unemployment (lagged 10 years)*Age-group*											
*. urlag10*age3034*											•
*. urlag10*age3539*											•
*. urlag10*age4044*											•
*. urlag10*age4549*											•
Correlation between fitted and observed MAC1											
R, not differenced	0,9567	0,9495	0,9251	0,9739	0,8644	0,8638	0,9473	0,9465	0,8674	0,9515	0,9712
R^2, not differenced	0,9152	0,9016	0,8559	0,9485	0,7471	0,7462	0,8973	0,8959	0,7523	0,9053	0,9432
R, 1-year differencing	0,3094	0,1842	0,4172	0,4443	0,3689	0,3698	0,3761	0,3618	0,4063	0,4260	0,4449
Mean Deviation	0,5013	0,5052	0,8537	0,4491	0,7457	0,5090	0,4035	0,3665	0,4915	0,3422	0,2832