

Rebirth after Disaster: Models of Post-Pandemic Fertility and Marriage

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Talk for “Demographic Aspects of the COVID-19 Pandemic
and its Consequences”

Monday, November 30, 2020

Thanks

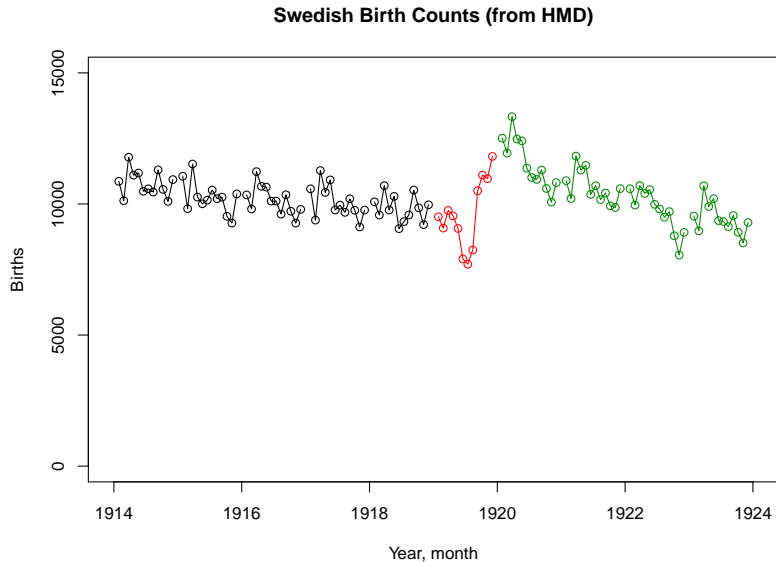
- ▶ Paola Di Giulio and Wittgenstein Centre for the invitation
- ▶ Ron Lee, Tom Cassidy, and Nathan Seltzer for many useful discussions

Agenda

- ▶ Some examples from present and past
- ▶ Models?
 1. Descriptive (“rescheduling” vs. “postponement”)
 2. Demographic dynamics (revisiting Lee’s moving target)
 3. Contagious behavior (revisiting Hernes)
- ▶ Conclusions and possible directions

Some examples from the past and present

Sweden and the Spanish Flu



Immediate boom, which lasts

Historical Bust and Bounce of US Marriages



Delayed boom, which also lasts

What is happening today?

- ▶ We don't know births, yet.
- ▶ But we can see weddings

Marriages in my childhood home (Lane County, Oregon).

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sept
2019	86	82	115	112	163	267	259	284	266
2020	95	114	90	78	126	153	156	275	166

Big declines, on the order of 40 percent.

Our questions for demography after the pandemic

- ▶ Will there be a baby and/or wedding “boom”?

Our questions for demography after the pandemic

- ▶ Will there be a baby and/or wedding “boom”?
- ▶ Will cohorts “recuperate”?

Our scaled-back questions that we hope models can answer

- ▶ *Under what conditions might there be a boom or bounce?*
- ▶ *What dynamics or assumptions would we need for cohorts to recuperate?*

1. Descriptive Models

“Rescheduling” (What non-demographers imagine)

```
age          x
            /
x x x x    x x x

period totals
1 1 1 1 0 2 1 1
```

What does this assume?

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What does this assume?

- ▶ All births occur, just later than planned.

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What does this assume?

- ▶ All births occur, just later than planned.
- ▶ Instant return to “old normal”.

“Postponement” (What demographers like Bongaarts and Feeney imagine)

```
age          x x x
             /
           x x x x

           period totals
          1 1 1 1 0 1 1 1
```

What does this assume?

“Postponement” (What demographers like Bongaarts and Feeney imagine)

```
age          x x x
             /
           x x x x

           period totals
         1 1 1 1 0 1 1 1
```

What does this assume?

- ▶ All births occur, just later than planned.
- ▶ We stay at the “new normal”

2. Models that combine demography and behavior

Ron Lee's "moving target"

Ingredients:

- ▶ Cohorts have a target family size
- ▶ Unfulfilled fertility happens at a constant rate
- ▶ Birth timing and period level is an output of model, not an input.

An equation relating flow of births to stock of children

fertility = rate \times (unachieved family size target)

$$\begin{aligned}f_x &= \alpha \times (T - F_x) \\ &= 0.3 \times (2.0 - 1.0)\end{aligned}$$

f_x birth rate \times years after onset of childbearing

α rate at which unachieved desires are achieved,
constant by duration

T desired family size target (Ron lets T vary by period).

F_x children already born

Innovation: to model epidemic, we let α vary by period.

A simple example of a cohort $\alpha = 1/2$, $T = 1$

	period		
	3		1/16
duration	2		1/8
	1	1/4	
	0	1/2	

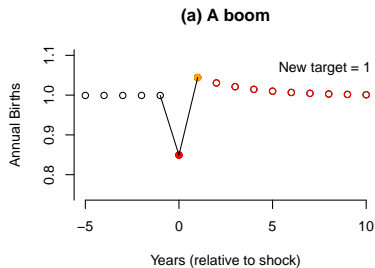
Filling in the Lexis surface

		period			
	3	1/16	1/16	1/16	1/16
duration	2	1/8	1/8	1/8	1/8
	1	1/4	1/4	1/4	1/4
	0	1/2	1/2	1/2	1/2
		---	---	---	---
total		1	1	1	1

Recovery after a zero-fertility year

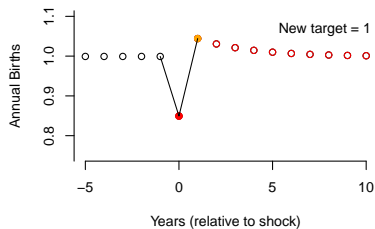
		period			
	3	1/16	0	1/8	1/8
duration	2	1/8	0	1/4	1/4
	1	1/4	0	1/2	1/4
	0	1/2	0	1/2	1/2
		---	---	---	---
total		1	0	3/2	5/4 ...

A simulated boom, after 15% decline with no change in target

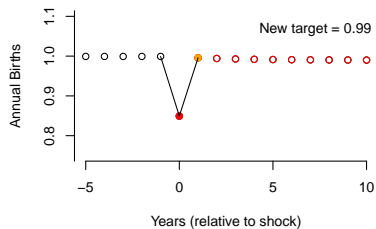


No boom, but return to previous level, if target declines just slightly

(a) A boom

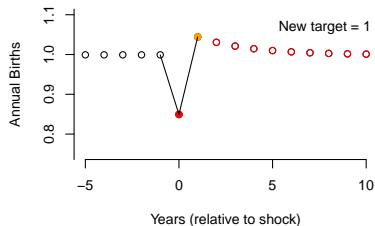


(b) A bounce

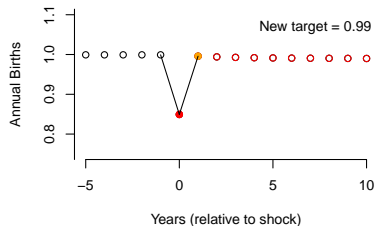


Even a small decline in target can overwhelm rebound

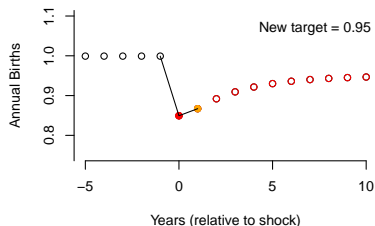
(a) A boom



(b) A bounce

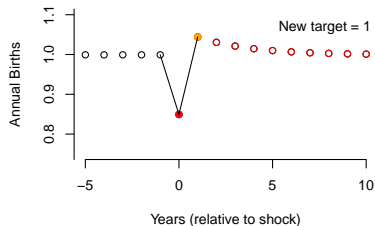


(c) A whimper

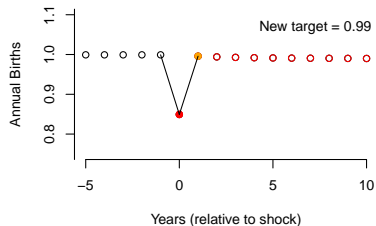


A larger decline in target can make fertility continue to fall

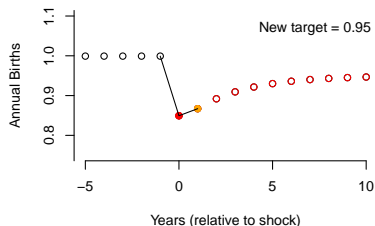
(a) A boom



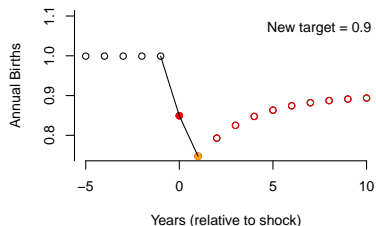
(b) A bounce



(c) A whimper



(c) A thud



Moving Target Model, preliminary conclusions

- ▶ Super simple model, but still creates complicated dynamics
- ▶ Even small changes in target have very large effects
- ▶ Perhaps, boom after Spanish Flu in Sweden consistent with no change in target.
- ▶ Covid today? Target expected to decline, making boom unlikely. (Recovery, whimper or thud?)

Moving Target Model, preliminary conclusions

- ▶ Super simple model, but still creates complicated dynamics
- ▶ Even small changes in target have very large effects
- ▶ Perhaps, boom after Spanish Flu in Sweden consistent with no change in target.
- ▶ Covid today? Target expected to decline, making boom unlikely. (Recovery, whimper or thud?)
- ▶ But, who knows? Maybe Trump's demise and pandemic's end will bring a new spring? And targets will increase.

3. Diffusion models for behavioral change

Endogenous targets?

Can we have the target as an output of a model, rather than an input?

Endogenous targets?

Can we have the target as an output of a model, rather than an input? Yes. “Social contagion” or “social diffusion” models produce eventual cohort levels as an output.

Hernes modeled marriage as a social contagion

- ▶ No target
- ▶ We just “seed” the behavior, and it spreads as cohort ages
- ▶ Age effect

marriages = unmarried · marriage rate (contagion, age)

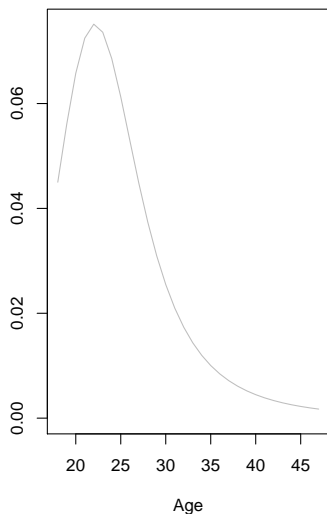
$$p_x = (1 - P_x) \cdot a(P_x)e^{-bx}$$

p_x are marriages aged x

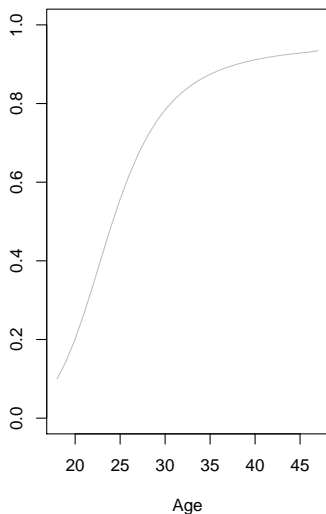
P_x are cumulative marriages by age x

A sample Hernes schedule

Proportion marrying at each age



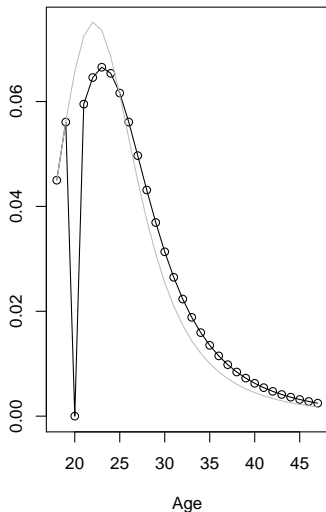
Cumulative proportion



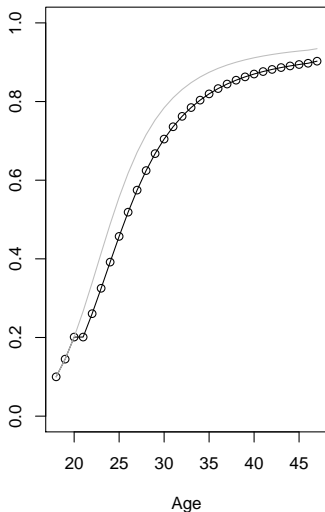
Can ask what happens if a shock occurs

A big shock, e.g., for cohort born in year 2000

Proportion marrying at each age
(with big shock)

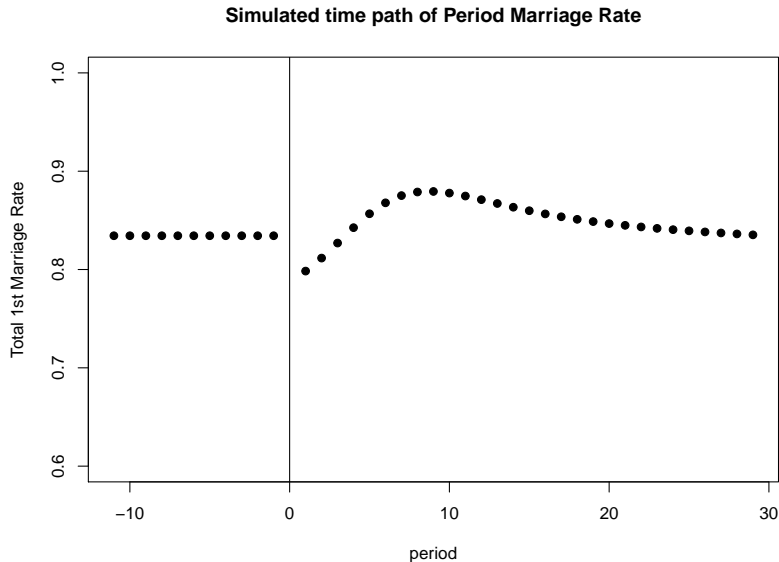


Cumulative proportion
(with big shock)



No boom, only some recuperation. (endogenous target)

A Bust and Boom in Period Marriages



As cohorts tend to bust and recuperate in rough synchrony

Two specific conclusions

1. Lee model suggests period birth rebound will depend very strongly on what happens to target.
2. Hernes model suggests period partnership rebound could happen even if cohorts don't recuperate.

Broader lessons

- ▶ Unpredictability: anything goes right after the pandemic ends
- ▶ Patience: even short-lived shock could reverberate for years
- ▶ Lagged effects even stronger in real world – epidemic won't suddenly end for everyone at the same time (e.g., Great Recession)

Future theoretical directions

- ▶ Extension: cohort diffusion across whole of Lexis surface?
- ▶ Mathematics: perturbation analysis of differential equations?
- ▶ Two-stage process: entrance into childbearing (“marriage”), and then fertility?

Leontine's harsh tweet



Monica Alexander @monjalexander · Nov 24



Thinking/writing about formal demography and realize I don't have a good definition for what it is. Definitions in standard books (and people's lecture notes I found on Google) vary quite a bit. #poptwitter any thoughts or references to point to?



Leontine Alkema @LeontineAlkema · Nov 24



Formal demography: Elegant mathematics to solve a demographic problem under assumptions that never hold true in practice or using data without measurement error

Statistical demography: Formal demography extended to real populations and using data with measurement errors



A gentler conclusion: empirical work and formal work are complementary. Models can help us work through our thinking and point us to what we want to measure.

Measurement Coda: The return of fertility intentions?

- ▶ A high frequency birth intentions barometer?
- ▶ Extending to cohabitations and marriage?

Thank you