Dynamic Fertility Modeling of Shocks Using Moving Target Models

(with Application to Covid-19 and Abortion Restriction)

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Motivating questions

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- Will there be a baby bounce after Covid bust? How long will it last?
- How will abortion bans affect fertility – in the short- and long-term?
- Goal is stylized, formal models to help understand how the impacts of shocks unfold over time.

The need for dynamic modeling

- Much modern analysis, uses tempo/quantum models like Bongaarts-Feeney, Ryder, ...
- Useful but lack temporal dynamics
  (no necessary relationships between year t and year $t+1$)

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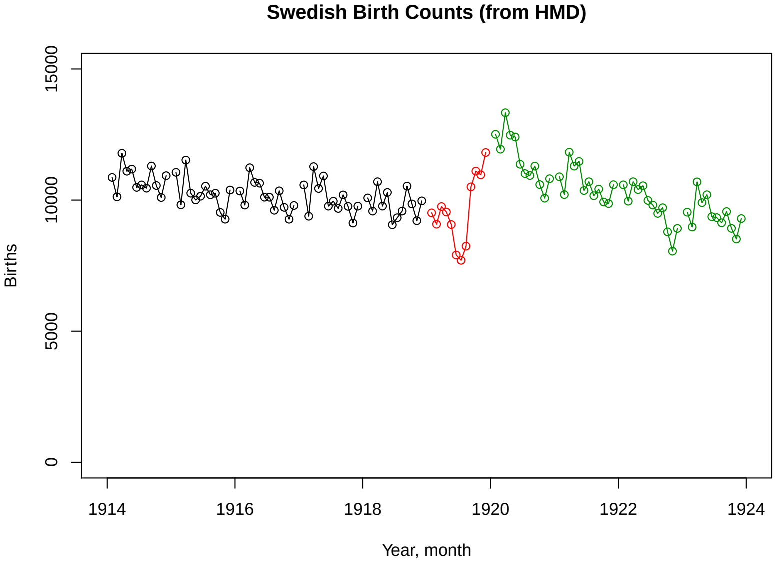
- Much modern analysis, uses tempo/quantum models like Bongaarts-Feeney, Ryder, ...
- Useful but lack temporal dynamics (no necessary relationships between year t and year $t+1$)
- In late-70s, Ron Lee introdued "Moving target" or "stock adjustment" models. More behavioral and provide dynamics.
- We extend these models for analysis of fertility shocks.

Sweden and the Spanish Flu



Immediate boom, with some persistence

An equation relating flow of births to stock of children

$$\begin{aligned} \text{fertility} &= \text{rate} \times \ (\text{unachieved family size target}) \\ f_x &= \alpha \quad\ \times \ (D - F_x) \\ &= 0.3 \ \times \ (2.0 - 1.0) \end{aligned}$$

- f_x birth rate x years after onset of childbearing
- α rate at which unachieved desires are achieved, constant by duration
- D desired family size target (Ron lets T vary by period).
- F_x children already born

Innovation: to model shocks, we let "fulfillment rate" 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

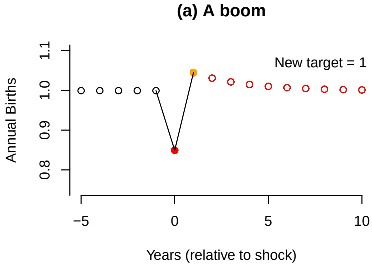
```
                  period

         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
```

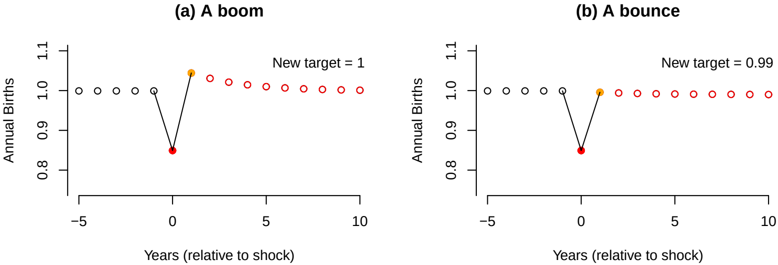
Recovery after a zero-fertility year

		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	...

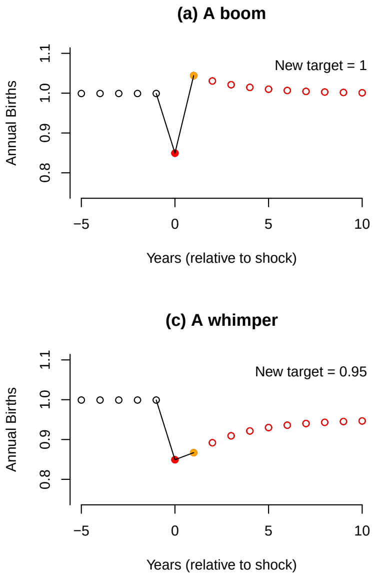
A simulated boom, after 15% decline with no change in target



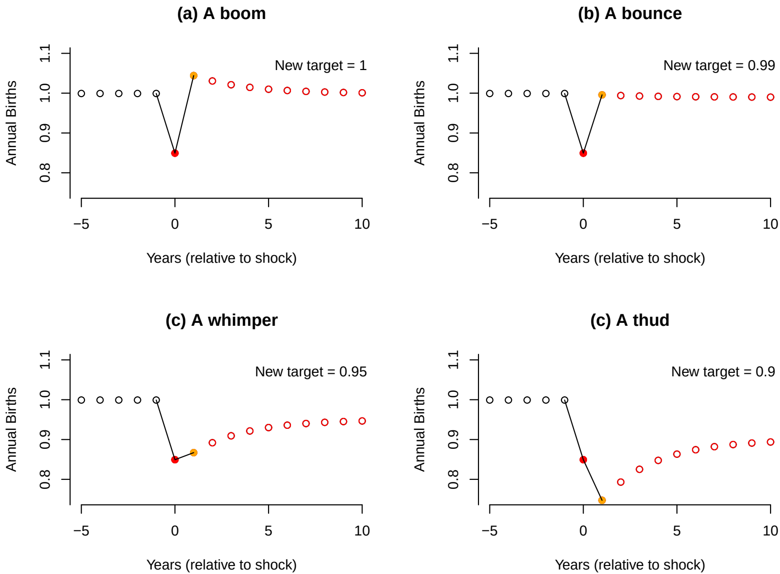
No boom, but return to previous level, if target declines just slightly



Even a small decline in target can overwhelm rebound



A larger decline in target can make fertility continue to fall



Moving Target Model, preliminary conclusions

- Super simple model, but still creates complicated dynamics
- Even small changes in target have very large effects
- Boom after Spanish Flu in Sweden consistent with perhaps very small increase in target.

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- Boom after Spanish Flu in Sweden consistent with perhaps very small increase in target.
- Covid today? A wide variety of possible outcomes, depending on mixture of compensation and changed targets.

Extension #2: Unintended births

$$f_x(t) = \beta(t) + \alpha \left[D - F_x(t) \right]$$

- Additive unintended birth rate (β), can vary over time
- For simplicity, same at every duration (no x index)
- Here, target and fulfillment rate time-constant.

Extension #2: Unintended births (Dynamics)

$$f_x(t) = \beta(t) + \alpha \left[D - F_x(t)\right]$$

- Unintended births today influence intended births tomorrow thru F_x.
- Short-run: an increase in β will increase fertility at all durations x
- Long-run: compensation by lower intended fertility at later durations x

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BUT . . .

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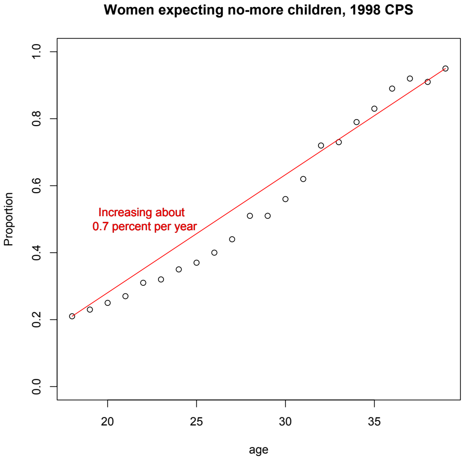
BUT ...
Lack of distinction between mistimed and unwanted births $\rightarrow$ *over-compensation*, no increase in life-time fertility.

Distinguishing timing and number failures

- Early on, mostly "mistimed" (to women still wanting kids)
- Later, mostly "unwanted" (to women who are "done")

A linear pattern?



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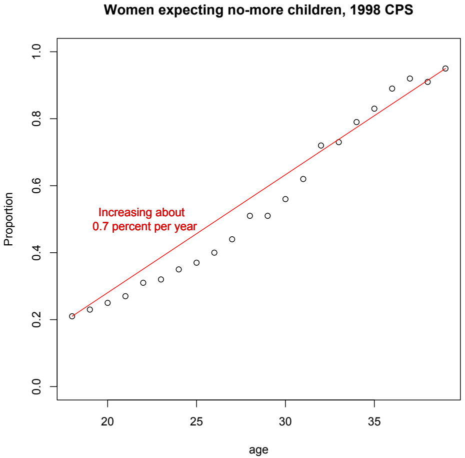

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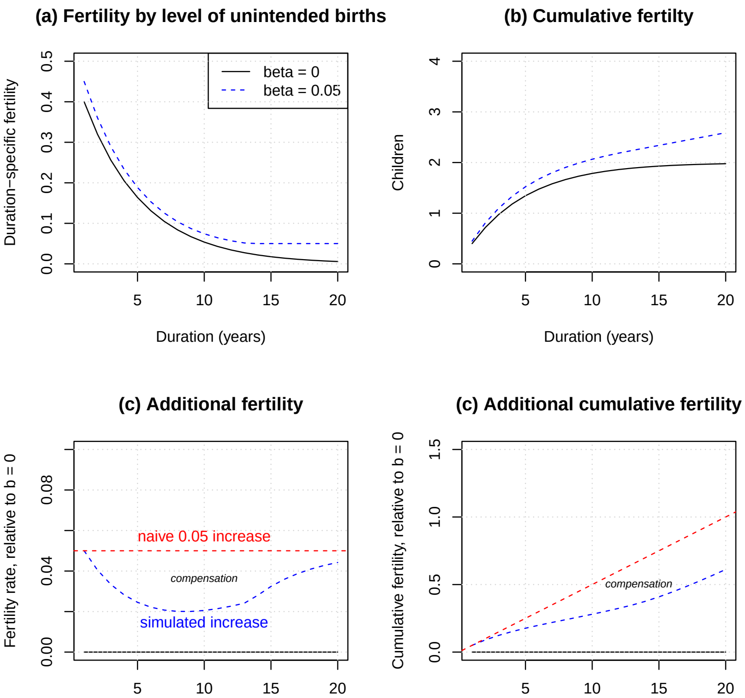
Next slide, a simulation that includes compensation only for mistimed births (using linear duration/age assumption)


(a) Fertility by level of unintended births
Duration−specific fertility
0.0
0.1
0.2
0.3
0.4
0.5
5
10
15
20
Duration (years)
beta = 0
beta = 0.05
(b) Cumulative fertilty
Children
0
1
2
3
4
5
10
15
20
Duration (years)
(c) Additional fertility
Fertility rate, relative to b = 0
0.00
0.04
0.08
naive 0.05 increase
compensation
simulated increase
5
10
15
20
(c) Additional cumulative fertility
Cumulative fertility, relative to b = 0
0.0
0.5
1.0
1.5
compensation
5
10
15
20

Period fertility dynamics

- Short term spike: all cohorts increase at once (before any compensation)
- Medium term: damping effect as early unintended births get compensated by fewer intended births at older ages
- Long term: higher equilibrium birth rate (by about half of increase in unintended births in our simulation).

Caveats: we don't include

- Behavioral response to change in abortion access
(contraceptive use and sexual behavior).
- Change in targets
(to avoid overshooting?)
- Dependence on which "kind" of unintended births affected
(unwanted or mistimed)

Conclusions

- Fertility shocks take time to play out
- Important to distinguish between short- and long- term effects
- Stylized formal models help us understand these dynamics
- For future work: (i) realistic parameters, (ii) endogenize unwanted/mistimed births, (iii) link age and duration.