Does temperature affect fertility via the economy?

Elaborating on the role of female labor supply and productivity

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Abstract

Women are still devoting more time than men to childrearing. That makes women's time spent at work crucial for their fertility decisions. At the same time, the global temperature has been rising, affecting labor supply and productivity. In this study, we investigate whether temperature influences fertility through its effect on the female labor supply (number of hours worked) and productivity. We also test the adaptation hypothesis. According to the latter, couples' fertility in warmer climates may be less affected by higher temperatures. We employ individual-level data from the IPUMS-USA for the period 2002-2019 and temperature data from the World Bank between 1901 and 2001. The obtained results show that temperature affects fertility mainly in the category of women who work full-time in jobs with lower educational demands. We found no effect on fertility for women of either higher or lower education, who work part-time. We also found some evidence in favor of the adaptation hypothesis.

Introduction

Research question

- The mean ambient temperature of the Earth is anticipated to increase from 3 to 6 $^{\circ}C$ in the coming decades.
- Apart from other important aspects, environmental changes are also expected to affect human fertility.
- Papers thus far have considered the effect of temperature on fertility solely through biological channels.
- This study asks whether higher temperatures influence fertility outcomes through the impact on female labor supply and labor productivity.

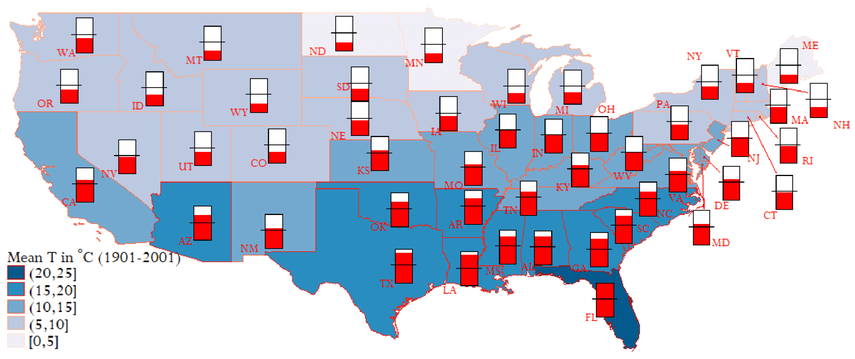

Figure 1: The mean temperature per US state for the periods 1901-2001 and 2002-2019. The map depicts the mean temperature between 1901 and 2001. The framed-rectangle charts represent the mean temperature between 2002 and 2019.

The intuition behind

High temperatures have a negative impact on labor supply and the level of labor productivity. Both are related to the opportunity cost, the substitution effect and the income effect. Moreover, an extra hour of work weighs upon a worker's productivity even more at a higher level of working hours: the marginal productivity of labor decreases at an increasing rate in higher levels of hours worked. Finally, productivity deteriorates under the effect of higher temperatures.

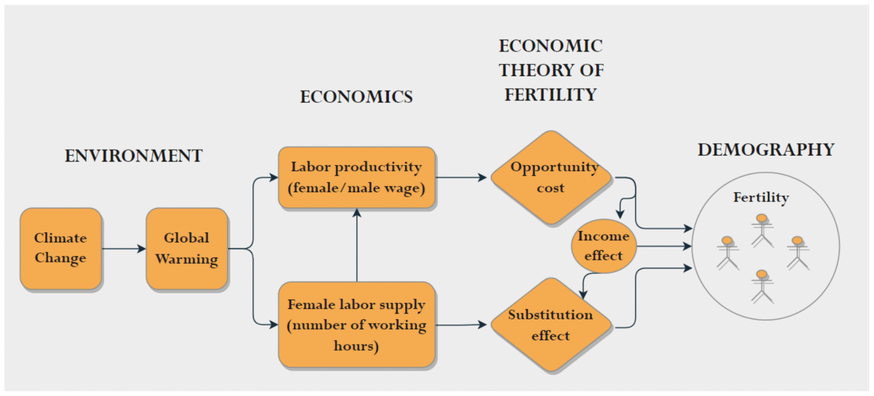

Figure 2: A potential economic channel that links climate change with fertility

Data and Method

Data

We employ socio-economic and demographic individual-level data (438,120 married couples with women aged 18-49) from the IPUMS-USA database (2002-2019). Data on annual temperature (mean and maximum) per US state were retrieved from the World Bank (1901-2001).

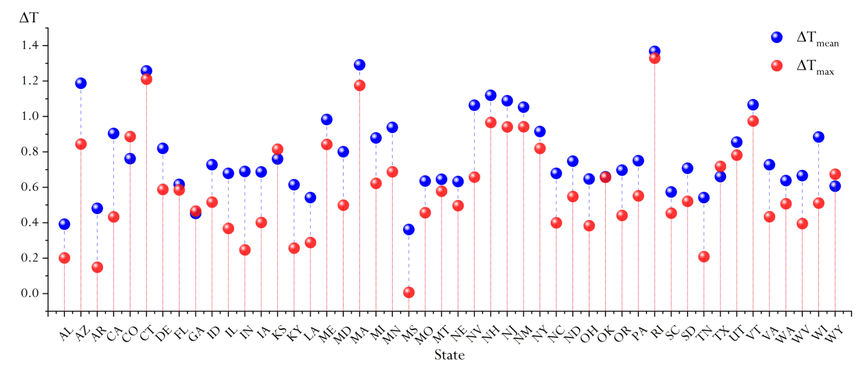

Figure 3: The mean and maximum temperature difference between 1901-2001 and 2002-2019, by US state. Estimates were conducted by the authors.

Method

We conduct repeated cross-section regression analysis at the individual-level.

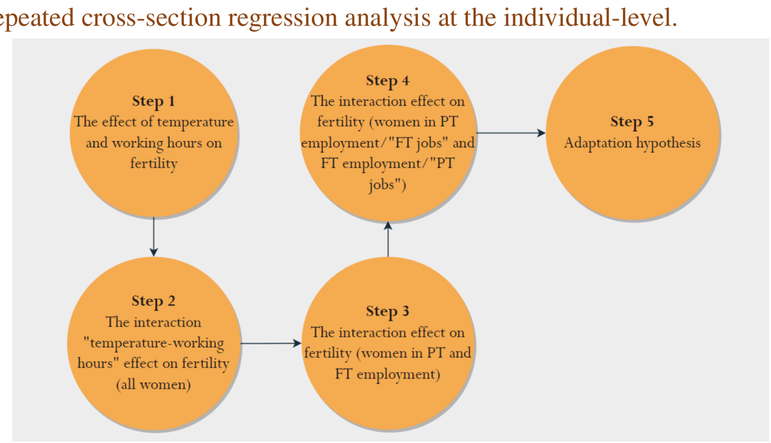

Figure 4: The steps of the empirical analysis

Results

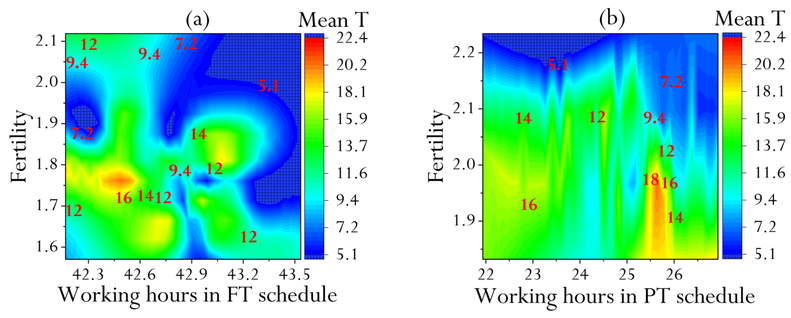

Figure 5: Contour plots. T denotes temperature. FT: full-time; PT: part-time.

Working hours:	(1) Any	(2) Any	(3) <40	(4) ⩾ 40	(5) <40 in "FT jobs"	(6) ⩾ 40 in "PT jobs"	(7) Assess adaptation[a]	(8) Assess adaptation[b]
ln(T)	-.132**							
	(.059)							
ln(wwh)	-.088***	-.108***	-.095***	.023	-.108***	.258***	-.115***	.162**
	(.003)	(.005)	(.006)	(.027)	(.032)	(.096)	(.025)	(.072)
ln(wwh)*T_{mean}		.034***	.036***	-.039	.003	-.296**		
		(.005)	(.007)	(.034)	(.034)	(.121)		
ln(wwh)*$T_{ad\text{-}mean}$							.031	-.270**
							(.034)	(.134)
R^2	0.210	0.210	0.233	0.210	0.463	0.385	0.463	0.385
Number of obs.	146,738	146,738	59,792	86,946	3,206	7,019	3,206	7,019

Table 1: The dependent variable (binary) denotes the number of own child/children (if any) of age $\leqslant 1$. T is the average of the annual mean temperature by state and year for the period 2002-2019; wwh refers to the number of weekly working hours for women. FT: full-time; PT: part-time. T_{mean} is a binary that takes the value 1 for each state ranked in the top 24 warmest states according to their annual mean temperature recorded in the period 2002-2019; it takes 0 otherwise. $T_{ad\text{-}mean}$ is a binary that takes the value 1 for the 12 states that were ranked with the lowest difference in mean temperatures between the periods 2002-2019 and 1901-2001; it takes 0 otherwise.[a]We test the adaptation hypothesis for wives who work less than 40 hours per week in "FT jobs" [b]We test the adaptation hypothesis for wives who work equal to or more than 40 hours per week in "PT jobs". "FT" and "PT jobs" refers to jobs in which most of the women recorded in the IPUMS-USA database work FT and PT, respectively. Other control variables that have been included: age, age square, education, wage and wage square; all for both spouses. The mean total family income by state; a dummy for race; a dummy for Hispanics; a dummy for years, a dummy for states, and their interaction. Robust s.e. at the individual level in parentheses. *** p-value< 0.01, ** p-value< 0.05, * p-value< 0.1.

We found that temperature affects, via labor supply and labor productivity, mainly the category of women who work full-time in occupations with lower educational demands (col. 6 and 8). On the adaptation hypothesis: for the women in col. 8, the effect is substantial and less negative (-.270**) than in col. 6 (-.296**). The observed reduction of the interaction effect in those states that display the smallest mean temperature increase between the periods 1901-2001 and 2002-2019 suggests an adaptive behavior. The discrepancy between the two coefficients reveals the size of adaptation: .026. Figure 6 provides us a plausible explanation of the obtained results:

- In panel (a), women face a growing opportunity cost and a decreasing substitution effect relative to the income effect for each additional hour of work. The prevalence of the increasing opportunity cost over the gains from the decreasing substitution effect across the curve, explains why fertility falls with wwh (col. 3: -.095***).
- In panel (b), women face a declining opportunity cost with an extra hour of work (compare the slope of the tangent of the highly-educated wives with that of the 45 degree dashed line). The decreasing or zero opportunity cost explicates the fertility increase with wwh (col. 4: .023).

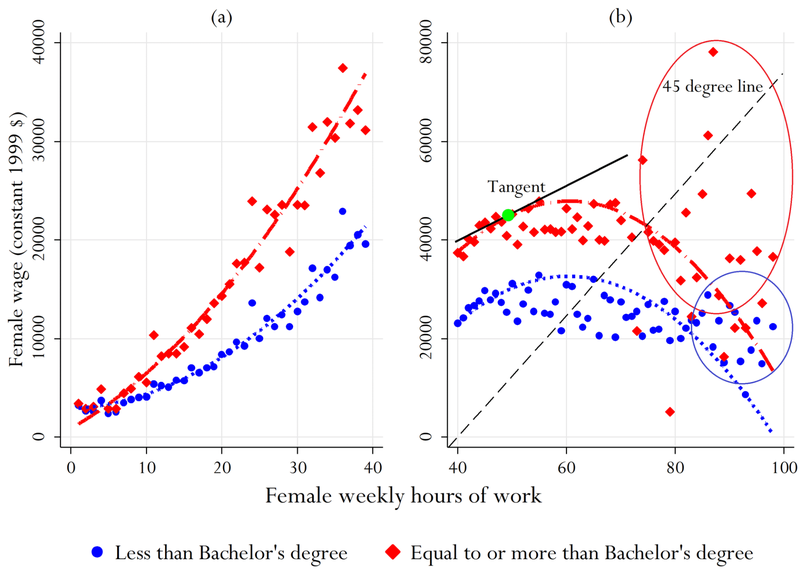

Figure 6: The relationship between female wage and female weekly hours of work by level of education. The lines represent the fit of each correlation. The diagonal dashed line represents the 45° degree line. The solid line is the tangent of the upward segment of the curve.

Conclusions

- Although women with PT employment status have higher fertility on average than women with FT employment, an extra working hour in a PT or FT schedule decreases or increases fertility, respectively.
- This paper aligns with other studies on climate change, showing that global warming affects mainly the most vulnerable individuals.
- Policy implications. A better understanding of fertility differences due to changes in the female labor supply and labor productivity in the wake of higher temperatures could aid in the formulation of more effective fertility policies.