The Australian National University

Centre for Economic Policy Research

DISCUSSION PAPER

The Millennium Bub

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DISCUSSION PAPER NO. 531
August 2006

ISSN: 1442-8636
ISBN: 1 921262 03 6

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ABSTRACT

How much do non-medical factors affect the timing of conceptions, births and deaths? To test this, we estimate the effect of the millennium on conceptions, births and deaths. With a highly flexible empirical specification, we find large and significant increases in conceptions and births, and suggestive evidence of an effect on deaths.

JEL Codes: I12, J13

Keywords: conceptions, births, deaths, timing, millennium

1. Introduction

Over recent centuries, no date has attracted as much attention as the millennium. Amidst warnings of computer malfunctions, millions of revelers took to the streets to watch fireworks and celebrate the beginning of the year 2000.[1]

But did the millennium also affect births and deaths? At the time, media attention was given to whether the event might have an effect on births, with reporters vying to identify the first babies of the millennium. There were also suggestions that the millennium might have had an effect on deaths, as people willed themselves to stay alive long enough to see the new millennium (Hershey 2000, cited in Kopczuk and Slemrod 2003).[2]

The global attention devoted to the millennium provides a unique opportunity to test the elasticity of conceptions, births and deaths with respect to non-medical factors. Using data from Australia, one of the first countries to witness the new millennium, we test whether the number of conceptions, births and deaths rose in the first few weeks of the year 2000. We find that this auspicious date, taking into account the normal drivers of these events, had significant impacts on conceptions and births demonstrating the role of non-medical factors in influencing their timing.

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[1] Some have argued that the millennium technically began in the year 2001. However, given that global attention focused almost exclusively on the year 2000, we refer to this as the "millennium". To the extent that some of the effects we test for actually occurred in 2001, it will attenuate our estimates.

[2] Other studies have found that changes in taxes and benefits can affect the timing of births (Dickert-Conlin and Chandra 1999; Gans and Leigh 2006a), marriages (Sjoquist and Walker 1995; Alm and Whittington 1995) and deaths (Kopczuk and Slemrod 2003; Gans and Leigh 2006b).

2. Empirical Strategy

To test the impact of the millennium on recorded births, we use daily data on the number of Australian births and deaths. These data are collected by state and territory registries, and compiled by the Australian Bureau of Statistics. The data cover all 10,592 days from 1 January 1975 to 31 December 2003. The average number of births per day is 671.114, and the standard deviation is 113.872. The average number of deaths per day is 327.082, and the standard deviation is 43.139. We opt to focus on the raw number of births and deaths, rather than on the rate. This has the advantage that we do not introduce noise into our series through mis-measurement of the total population, which is only available on a monthly basis (since most of our analysis compares the end of December with the beginning of January, it would be undesirable to use a different denominator for the two months).

When analyzing the effect of the millennium on conception, we assume that conception occurs 266 days prior to birth. There are two limitations in this strategy: many pregnancies are longer or shorter than 266 days, and not all pregnancies are carried to term. Nonetheless, the presence of any substantial "millennium effect" on conception should show up as an increase in the birth rate on or after September 23, 2000 (which in that year fell 266 days after January 1).

Different factors might cause conceptions, births and deaths to be shifted. Conception is the most straightforward: an increase in the number of conceptions occurring in January 2000 could be caused by anything from an excess of millennial champagne to relief that the Y2K bug proved toothless. A rise in the number of births might be caused either by the strategic timing of conception by parents in March/April

1999, or by agreement between doctors and parents to shift the timing of medical inductions or caesarian section procedures. Deaths may be shifted either because patients will themselves to stay alive longer, or because they and their families agree to keep life support machines operating until the beginning of the millennium.[3]

Econometrically, it is important to hold several other factors constant if we are to estimate the effect of the millennium. Conceptions, births and deaths may be affected by the day of the week (eg. Sunday might differ from Monday), the day of the year (eg. January 1 might differ from January 2), and the annual period (eg. Dec 1998-Jan 1999 might differ from Dec 1999-Jan 2000). We estimate the effect of the millennium with a very flexible specification, including indicator variables for the day of the week (7 values) and the day of the year (366 values).[4] We also include an annual indicator variable (29 values).[5] Our estimating equation is:

$$Y_i = I_i^{Millennium} + I_i^{DayOfWeek} + I_i^{DayOfYear} + I_i^{Annual} + \varepsilon_i \qquad (1)$$

Where Y_i is the number of conceptions, births or deaths on day *i*, and the indicator variables respectively denote the millennium (one in January 2000, zero otherwise), the day of the week, day of the year, and the annual period.

We estimate the regression both with the dependent variable as the number of deaths, and the log of the number of deaths. By using all data over a twenty-nine-year

[3] We are not aware of any policy changes that might have created an incentive to shift the timing of births, deaths or conceptions during this period. Our analysis does not span multiple tax years, since the Australian tax year runs from July 1 to June 30.

[4] Since our focus is on effects that might be specific to 28 June, 29 June, and so on, we define a day of the year variable that is unaffected by leap years. In leap years and non-leap years, the day of year variable is 59 for February 28, and 61 for March 1. In leap years, the day of year variable takes the value of 60 for February 29.

[5] We use the term "annual fixed effects" because the effect usually spans calendar years. When analyzing conceptions, we focus on the window around September 23, so the annual effects are simply year fixed effects. However, when analyzing births and deaths, we focus on the window around January 1, so our annual fixed effects are offset by six months (e.g., the window Dec 1998-Jan 1999 has one fixed effect, the window Dec 1999-Jan 2000 has another fixed effect).

period, we are able to precisely identify day of week, day of year, and annual effects, and distinguish these effects from the millennium effect.

Table 1 presents the results from our analysis. In Panels A and B, the dependent variable is the number of conceptions, births and deaths. Panel A analyses a 7-day window (December 25 to January 7), while Panel B analyses a 28-day window (December 4 to January 28). In Panel C the dependent variable is the log of the number of conceptions, births or deaths, over a 7-day window. In Panel D the dependent variable is the log of the number of conceptions, births or deaths, over a 28-day window.

Table 1: Did the millennium affect conceptions, births or deaths?

	Conceptions	**Births**	**Deaths**
Panel A: Dependent variables in levels, 7-day window			
Millennium	23.491	79.513**	11.217
	[15.120]	[39.059]	[8.719]
Observations	435	406	406
R-squared	0.95	0.83	0.63
Panel B: Dependent variables in levels, 28-day window			
Millennium	15.813*	32.758**	8.351
	[9.238]	[15.899]	[5.429]
Observations	1653	1624	1624
R-squared	0.92	0.86	0.56
Panel C: Dependent variables in logs, 7-day window			
Millennium	0.038*	0.124**	0.037
	[0.023]	[0.057]	[0.027]
Observations	435	406	406
R-squared	0.95	0.84	0.63
Panel D: Dependent variables in logs, 28-day window			
Millennium	0.028**	0.048**	0.027
	[0.014]	[0.024]	[0.017]
Observations	1653	1624	1624
R-squared	0.93	0.88	0.56

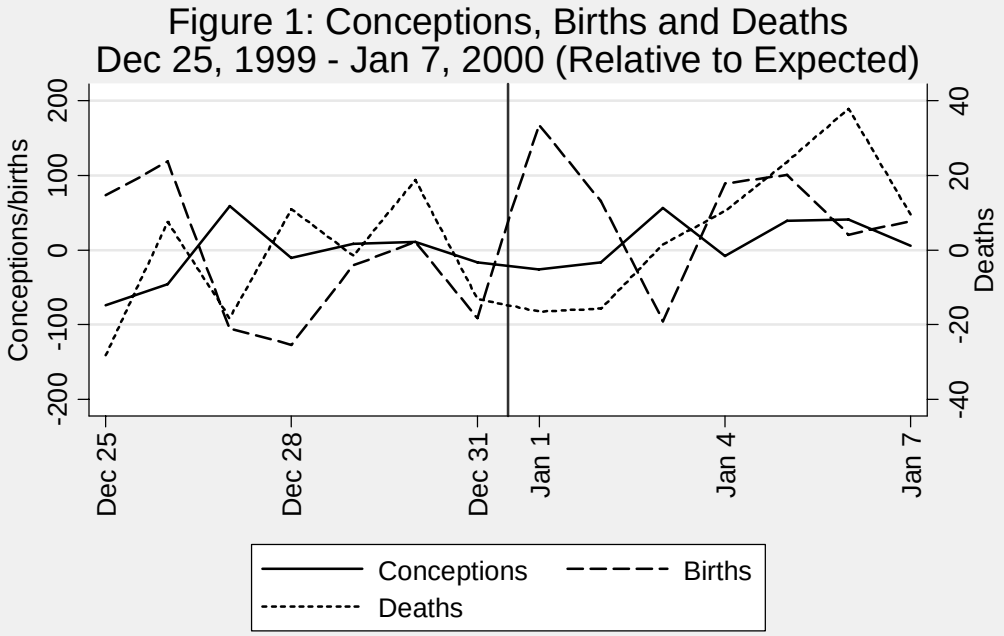
Notes: Robust standard errors in brackets. * significant at 10%; ** significant at 5%; *** significant at 1%. All specifications control for day-of-week, day-of-year, and annual fixed effects (see text for details).

Across all specifications, the coefficients are positive, suggesting that the millennium was associated with higher numbers of conceptions, births and deaths.

However, only the conception and birth effects are statistically significant at conventional levels (for deaths, t-statistics are in the range 1.3 to 1.6).

The magnitude of the conception and birth effects are also economically significant, and suggest that the millennium increased the conception rate by 16-23 per day, and the birth rate by 32-80 per day. In percentage terms, the millennium increased the number of conceptions by 3-4 percent, and the number of births by 5-12 percent, with the strongest effects occurring in the seven-day window.

Figure 1 depicts the seven-day results graphically, plotting the residuals from separate regressions of conceptions, births and deaths on a vector of day of week, day of year, and annual fixed effects. For births, the effect is strongly concentrated on January 1, while for conceptions and deaths, the effect is more spread out over the first week of January. In the case of conceptions, this may also reflect some degree of mis-measurement, since we are estimating conception rates based on births 266 days later.



Note: Graph shows residuals from a regression of daily birth/death numbers on day of week, day of year and annual fixed effects.
Conceptions are imputed from birth rates 266 days later.

3. Conclusion

This paper has shown that the timing of conceptions, births (and perhaps even deaths) responds not only to financial incentives, but also to non-monetary factors. In the first week of the millennium, the number of conceptions rose by 4 percent, and the number of births rose by an astonishing 12 percent. In particular, the sharp increase in the birth rate on January 1, 2000 suggests that the precise timing of childbirth may be highly responsive to non-medical factors. This suggests that any economic or medical studies of the timing of births, conceptions, and perhaps deaths will need to take account of auspicious dates.

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