Tempo and the Economy: Decomposing the effect of economic shocks on births into tempo and quantum (extended abstract for EPC 2014)

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Abstract

What fraction of the decline in births rates during the Great Recession is due to postponement? It is difficult to obtain reliable estimates using existing methods, because noise tends to dominate signal in measured annual fluctuations in tempo effects. Indeed, the Bongaarts-Feeney method tells us implausibly that the intensity of fertility, adjusted for tempo, actually increased in Greece, Spain, and the United States. Our new approach incorporates information from economic time series to decompose short-term fertility change into tempo and quantum effects.

1 Introduction

Hard economic times have in recent decades been associated with fewer births, particularly during the Great Recession. An often asked, but still unanswered, question is the extent to which the babies not being born in the recession will be born later or simply forgone?

The period tempo-adjustment methods introduced by Bongaarts and Feeney aim to provide estimates of the level of fertility that would have occurred in a period in the absence of changes in fertility timing. Thus, in

an ideal world, if we observed total fertility rate falling from 1.9 to 1.6 and that the associated tempo-adjusted fertility rates fell by 0.2 children, then we could attribute a decline of 0.2 children to changes in quantum, and the remaining 0.1 decline to tempo. Thus, the decomposition would suggest that one-third of the change was due to increases in fertility postponement, with the implication being that these births would be delayed but not be lost to their perspective parents and the reproductive capacity of the population.

In practice, however, the estimates of tempo from year to year, and their accompanying estimates of quantum, tend to show substantial fluctuations from year to year. As B&F put it,

> Since the adjustment is sensitive to small errors in $r_p(t)$, the annual adjusted estimates tend to contain seemingly random fluctuations.

Figure 1 illustrates these fluctuations for the recent decade in a number of countries hit hard by the recession. There are two striking problems with the tempo-adjusted TFR visible in the figure. The first is that quantum is estimated to rise (not fall as expected) after the onset of the recession. The second feature is that the tempo-adjusted TFR shows more variablility than the observed TFR. This is again the opposite of our expectations that controlling for timing changes should reduce the variability of births, not increase it.

Figure 2 provides another illustration of the difficulties of using the Bongaarts-Feeney measures as a means of separating tempo and quantum effects. In this figure we look at changes in economic conditions in the United States during the 25 years prior to the recession. Increases in unemployment are correlated with declines in the birth rate. Furthermore, increases in unemployment are also correlated with changes in tempo – showing that the BF metric is able to pick up on the tendency to postpone births in hard times. However, as in Figure 1, the timing of fertility tends to "overreact" relative to total fertility, hiding any effect of hard times on fertility quantum (or even showing a slightly positive effect).

The final panel in Figure 2 shows the clear negative relationship between estimated tempo and quantum. This effect is driven by the "seemingly random fluctuations" tempo estimates. A negative relationship runs counter to our expectations that quantum and tempo reactions to shocks should be positively correlated.

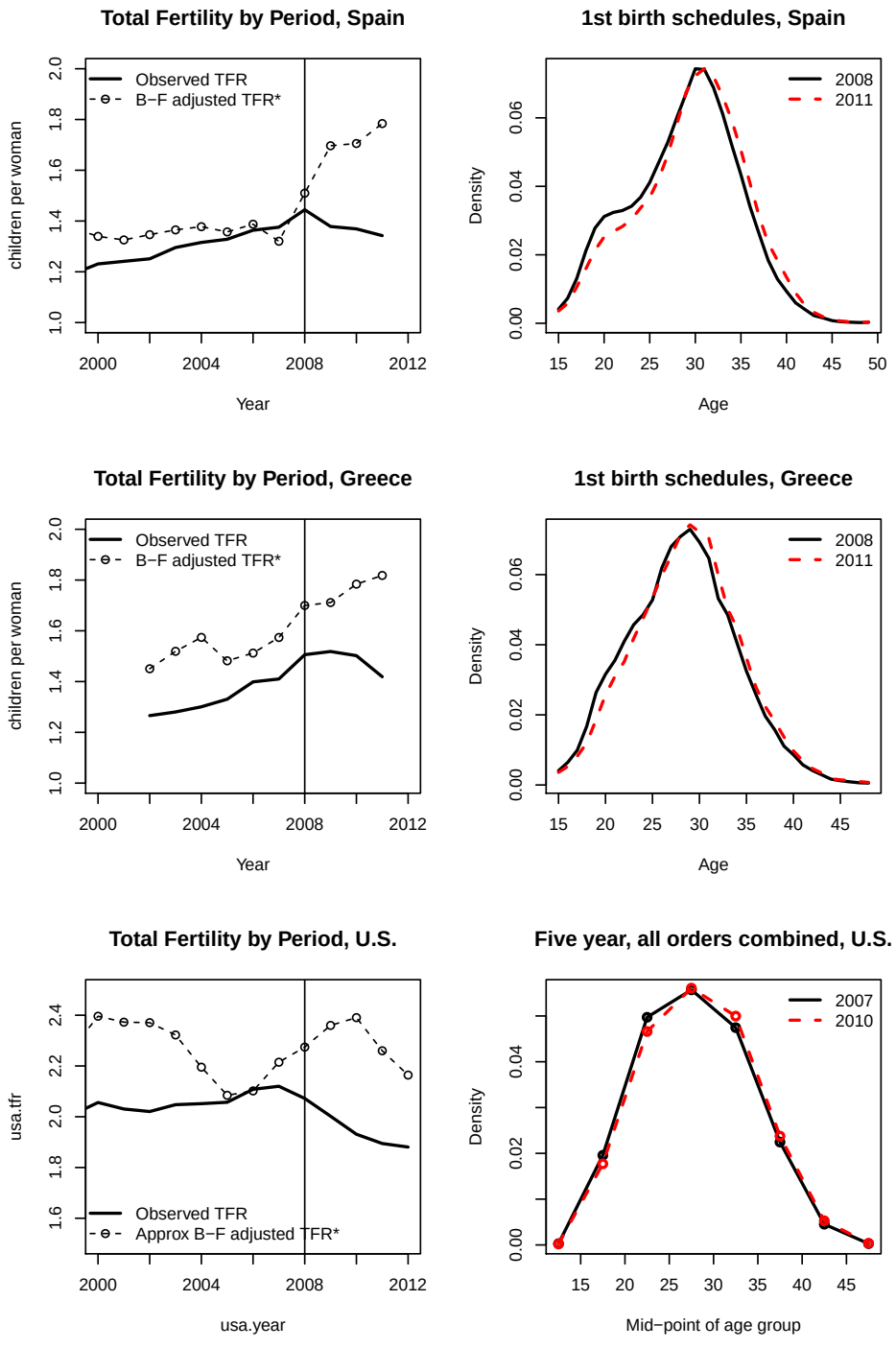

Figure 1: Fertility and tempo-adjusted fertility during the Great Recession in Spain, Greece, and the United States

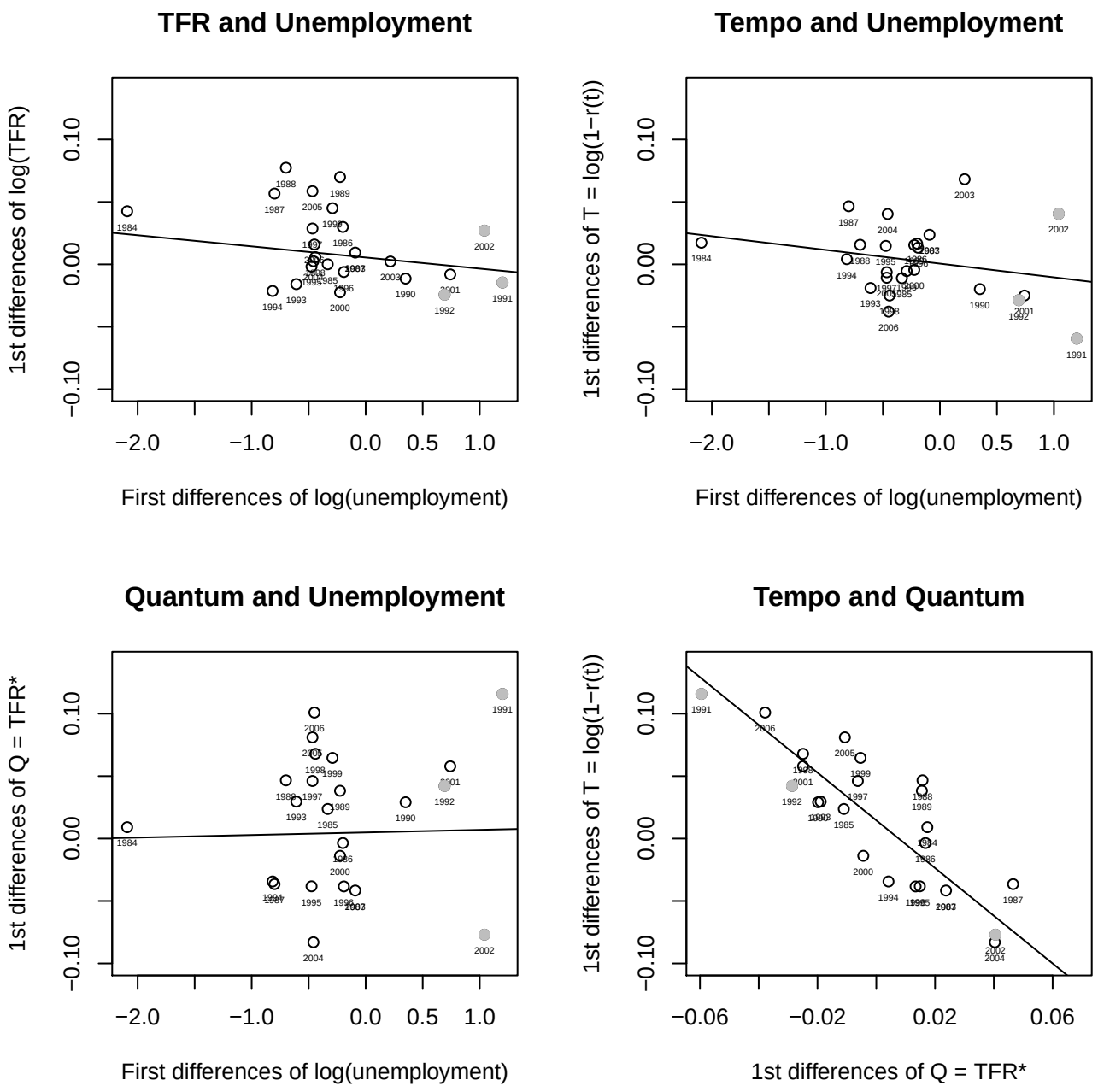

Figure 2: Interrelationships in the United States between changes in economic conditions and changes in total fertility, tempo, and quantum. Years following recessions marked in grey.

In the proposed research we plan to analyze the relationship between tempo, quantum, and economic conditions and use these observed relationships to obtain better estimates of how to decompose the effect of economic conditions into fertility postponement and fertility reductions.

Two approaches that may help bound tempo fluctuations are:

(1) Bounding tempo changes so that quantum does not change in the opposite direction. This would involve truncated the estimated tempo change to explain no more than the observed fertility change, giving an upper bound for fluctuations in tempo.

(2) Estimating tempo changes directly from economic time series. For example, using unemployment rates, one can regress tempo changes on economic changes and then predict the tempo changes that would have been observed if the only influence had been the economy. This should give a conservative estimate for fluctuations in tempo.

2 Formal background: Decomposing Fertility Change into Tempo and Quantum changes

The BF adjustment is

$$TFR^*(t) = \frac{TFR(t)}{1 - r(t)}$$

where TFR is the total fertility rate, $r(t)$ is the rate of postponement, and TFR^* is the tempo-adjusted fertility rate, interpreted as the hypothetical period TFR that would have been observed if the rate of postponement had been zero.

Rearranging, and substituting $Q(t)$ for TFR^* and $T(t)$ for $1 - r(t)$, one can write,

$$TFR(t) = Q(t) \cdot T(t),$$

or

$$\log TFR(t) = \log Q(t) + \log T(t)$$

Taking time derivatives,

$$\frac{TFR'(t)}{TFR(t)} = \frac{Q'(t)}{Q(t)} + \frac{T'(t)}{T(t)}.$$

So, the proportional change in the TFR over time is equal to the sum of the proportional change in quantum and timing effects.

One can analyze the decomposition by looking at it as a decomposition not only of annual year-to-year change but also as a decomposition of variance. Let $Z = TFR'/TFR(t)$, $X = Q'(t)/Q(t)$, and $Y = T'(t)/T(t)$. Then, from above we have

$$Z = X + Y.$$

In terms of variances, we then have

$$\sigma_Z^2 = \sigma_X^2 + \sigma_Y^2 + 2\sigma_{XY},$$

where the σ^2 terms are variances and σ_{XY} is the covariance between our quantum and tempo terms.

If we can constrain σ_{XY}, then this also constrains the variances of tempo and quantum, in effect smoothing annual fluctuations to be consistent with assumptions about the correlation between tempo and quantum changes.