Childbearing and Labor Market:

Time and Space Dynamics

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The purpose of the paper

- is to study how the labor market transformed in households’ income influences on fertility, generated by
  - increased female labor market participation;
  - growing period of professional education;
  - increasing labor mobility;
  - space and time transitions of income potential;
  - response of a gain of labor market’s tightness on fertility (the Easterlin hypothesis).
How incomes influence fertility I

**Time dynamics** as postponing or accelerating of childbearing:

- within one generation, when families compare their current earnings with the earnings in previous and nearest future periods.
- through the generations, when households belonging to the younger generation compare their earnings relatively to earnings of the parental generation (the Easterlin hypothesis).
TFR in Sweden. 1970-2008
TFR and cohort ratio in 1972
TFR and cohort ratio in 1990
TFR and cohort ratio in 1968-2008
How incomes influence fertility II

**Space diffusion** is considered

- in transition of fertility norms across municipalities as a first-order spatial autocorrelation;
- influencing of relative cohort sizes in surrounding municipalities on fertility norms in a given one;
- and cross-municipal influence of space diffusion of income generated by labor mobility.
Comparing of the fertility dynamics in pairs of municipalities with the short distances between them
Comparing of the fertility dynamics in pairs of municipalities with the short distances between them.
The literature review

Spatial dimension of fertility
The paper by Waldorf and Franklin (2002), where the Easterlin model of fertility is tested by using data for 18 Italian regions by spatial diffusion of fertility taken into account.

Easterlin hypothesis
- D.J. Macunovich (1998) reviewed 185 published articles with 76 empirical analyses of the hypothesis and concluded that results are mixed.
- Waldorf and Byun (2005) made meta-analysis of 334 empirical papers and concluded that negative effect is more robust.
The contribution of the paper

- the analysis of spatial interdependence of fertility;
- the Easterlin hypothesis as the long-run income impact;
- the relation between current income and fertility is also studied;
- using of panel data which allow monitoring space diffusion of fertility norms across time in “three dimensions”;
- municipal level of data.
Definitions

- **Total fertility rate** \((TFR)\) is the sum of the age-specific fertility rate \((SFR)\) for women in the ages 16-49 years old
  \[
  TFR = \sum_{i=16}^{49} SFR_i
  \]

- **Cohort ratio** \((R)\) is the number of men of age 35 to 64 year divided by the number of men of age 15 to 34 at time \(t-2\)
  \[
  R_{jt} = M_{35-64, \text{jt}} / M_{15-34, \text{jt}}
  \]

- **Average income** per capita in the municipality in 20+ age group is corrected by CPI \((1982=100)\) and logged
The model

\[ TFR = f(TFR, W \cdot TFR, R, V \cdot R, I, V \cdot I, X, t). \]

Where \( TFR \) is fertility rate. \( R \) is relative cohort size, \( X \) is a matrix of explanatory variables. \( W \) is a \( n \times n \) matrix that summarizes the spatial morphology that is of relevance for diffusion across \( n \) municipalities, and the \( n \times n \) matrix \( V \) summarizes the spatial morphology relevant for labor movements.
Weight matrices

- $W_N$ is based on contiguity
  - $w_{ij} = 1/k_i$ if $i, j$ share a common border, $k_i$ is the number of municipalities bordering $i$;
  - and $w_{ij} = 0$ otherwise.
- $V_N$ is based on spherical distances between municipalities, weighted by population
  - where $d_{ij}$ is a spherical distances between $i$ and $j$ municipality.
    \[ v_{ij}(t) = \frac{Pop_j(t) / d_{ij}}{\sum_j Pop_j(t) / d_{ij}} \]

- For panel data we use and, $t = 1..19$ for the period 1981-2008.
Empirical Specification

- **Spatial lag model SAR(2,1) for panel data**

\[
TFR_t = \varphi_1 TFR_{t-1} + \varphi_2 TFR_{t-2} + \gamma W_{NT} TFR_{t-1} + \mu R_{t-1} + \\
\lambda V_{NT} R_{t-1} + \theta \ln I_{t-1} + \vartheta V_{NT} \ln I_{t-1} + X_{t-1} \beta + g(t)i + \varepsilon_t
\]

- Where \( W_{NT} = I_T \otimes W_N \); \( V_{NT} = I_T \otimes V_N \); 

\( I_T \) is identity matrix of dimension \( T \), \( E(\varepsilon_{it})=0 \) and 
\( E(\varepsilon_{it}\varepsilon_{jt})=\sigma^2 I_{NT} \), \( t=1..NT \); \( \otimes \) is a Kronecker product
Marginal spatial effects in the short-run

- The short-run effect of the lagged $TFR$ is
  \[
  \frac{\partial TFR_t}{\partial TFR_{t-1}} = \gamma W' + \varphi I_N
  \]

- The marginal effects of cohort size ratio and log-income on fertility are
  \[
  \frac{\partial TFR_t}{\partial R_{t-1}} = \lambda V' + \mu I_N
  \]
  and
  \[
  \frac{\partial TFR_t}{\partial \ln(I)_{t-1}} = \gamma V' + \theta I_N
  \]
The long-run effects

- can be estimated only in the models with time specific fixed effects or incorporation of GDP growth instead of time trend.
- The equation below provides the long-run spatial effects in the presence of non-zero parameter of the spatially lagged variable.

\[
\frac{\partial TFR}{\partial R} = \left[ \left( (1 - \sum_{k=1}^{2} \phi_k I_N) - \gamma W \right)^{-1} (\lambda V + \mu I_N) \right]'
\]
Stationarity condition

\[ |\lambda_j| < 1 \]

\[ \lambda_j = \frac{\varphi_1 + \gamma \mu_i \pm \sqrt{(\varphi_1 + \gamma \mu_i)^2 + 4\varphi_2}}{2} \]

- Where \( \{\mu_i\}, i=1..N \) is a set of the eigenvalues of the matrix \( W \). Thus, it is sufficient to estimate maximum and minimum value of \( \lambda \).
Empirical method

- The estimation of the panel data models with spatially lagged dependent variables is based on the method of moments techniques (GMM) because of autocorrelation of explanatory variables.

- Arellano-Bond dynamic panel-data estimation where lag equaled 1 and lag equaled 2
Sets of exogenous variables

First set
- \( \text{Log\_Income}_{t-1} \)
- Relative cohort \( t_{-1} \)
- Share of flow of out/inmigrated women 16-49 age \( t_{-1} \)

Second set
- \( \text{Log\_Income}_{t-1} \)
- Relative cohort \( t_{-1} \)
- Share of flow of out/inmigrated women 16-49 age \( t_{-1} \)
- Share of women 16-49 with post secondary education more than 3 years \( t_{-1} \)
- Share of women 16-49 with education less than 9 years \( t_{-1} \)
### GMM estimates for log(TFR) - fragment

Panel data estimates without space weighted elements.

<table>
<thead>
<tr>
<th>Variables</th>
<th>1981-2008</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>1</td>
</tr>
<tr>
<td></td>
<td>Coeff.</td>
</tr>
<tr>
<td><strong>No spatial effects</strong></td>
<td></td>
</tr>
<tr>
<td>Number of observations</td>
<td>6596</td>
</tr>
<tr>
<td>Wald $\chi^2$</td>
<td>8406</td>
</tr>
<tr>
<td>LnTFR$_{t-1}$</td>
<td>0.095*</td>
</tr>
<tr>
<td>LnTFR$_{t-2}$</td>
<td>0.148****</td>
</tr>
<tr>
<td>Weighted Ln TFR$_{t-1}$</td>
<td></td>
</tr>
<tr>
<td>Ln(I$_{t-1}$)</td>
<td>0.961****</td>
</tr>
<tr>
<td>Weighted Ln(I$_{t-1}$)</td>
<td></td>
</tr>
<tr>
<td>$R_{t-1}$</td>
<td>-0.225****</td>
</tr>
<tr>
<td>Weighted $R_{t-1}$</td>
<td>-0.660</td>
</tr>
</tbody>
</table>

*** means p-value less than 0.0001, ** - 0.001, * - 0.01, * - 0.1.
Estimates of time-space dynamics in the model describing TFR as a SAR (2,1) process

<table>
<thead>
<tr>
<th>Variables</th>
<th>Coeff.</th>
<th>St. dev.</th>
<th>Direct</th>
<th>Indirect</th>
<th>Total</th>
<th>Direct</th>
<th>Indirect</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>TFR (t-1)</td>
<td>0.032*</td>
<td>0.015</td>
<td>0.032</td>
<td>0.014</td>
<td>0.132</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Weighted TFR (t-1)</td>
<td>0.430****</td>
<td>0.032</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>TFR (t-2)</td>
<td>0.086****</td>
<td>0.014</td>
<td>0.086</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Ln((I_{t-1}))</td>
<td>-0.319*</td>
<td>0.154</td>
<td>-0.319</td>
<td>0</td>
<td>-0.319</td>
<td>-0.382</td>
<td>-0.323</td>
<td>-</td>
</tr>
<tr>
<td>Weighted Ln((I_{t-1}))</td>
<td>0.328</td>
<td>0.272</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>0.706</td>
<td></td>
</tr>
<tr>
<td>R (t-1)</td>
<td>-0.042</td>
<td>0.065</td>
<td>-0.042</td>
<td>0</td>
<td>-0.042</td>
<td>-0.050</td>
<td>-0.042</td>
<td>-</td>
</tr>
<tr>
<td>Weighted R (t-1)</td>
<td>-0.708</td>
<td>0.610</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>0.093</td>
<td></td>
</tr>
<tr>
<td>The share of flow of out/inmigrated women 16-49 age (t-1)</td>
<td>1.328**</td>
<td>0.526</td>
<td>1.328</td>
<td></td>
<td></td>
<td>1.594</td>
<td>1.343</td>
<td>2.937</td>
</tr>
<tr>
<td>The share of women 16-49 with postsecondary education more than 3 years (t-1)</td>
<td>0.978****</td>
<td>0.281</td>
<td>0.978</td>
<td></td>
<td></td>
<td>1.174</td>
<td>0.989</td>
<td>2.163</td>
</tr>
<tr>
<td>The share of women 16-49 with education less than 9 years (t-1)</td>
<td>1.067****</td>
<td>0.274</td>
<td>1.067</td>
<td></td>
<td></td>
<td>1.281</td>
<td>1.079</td>
<td>2.360</td>
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<tr>
<td>Intercept</td>
<td>1.798****</td>
<td>0.541</td>
<td>1.798</td>
<td></td>
<td></td>
<td></td>
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</tr>
</tbody>
</table>

Number of observations: 6322
Wald \(\chi^2\): 9615
Stationarity: Accepted
Main results

- the existence of a spatial positive autocorrelation of fertility across municipalities ⇔
  - declining or rising of fertility in one municipality affects neighboring municipalities in the same direction;
- the indirect spatial effect and the direct effect in the short-run explain 0.014% and 0.032% of relative changes of total fertility rates, correspondently;
- a weak direct effect of the inverted Easterlin hypothesis.
- a weak negative direct effect of earnings on total fertility rates.
Conclusions

- a set of factors, determining total fertility rates, influences it in the same direction as in a given municipality so in the surrounding municipalities;
- the inverted Easterlin hypothesis has been supported. It has the short-run direct effect, and the long-run direct and indirect effects.
- Earnings have a negative direct effect. It means the dominating substitution effect in the choice between female labor supply and childbearing as a households’ production despite the fact that the family policy in Sweden provides opportunities to combine them.