The seemingly uncorrelated trends of the wage rates and the labour supply for married women over time (the left figure) is misleading. The fitted line of the scatter plots of wage rates and hours of work (the right figure) may not represent the actual labour supply curve.

The reason is that other relevant factors behind labour supply are not held constant, and the endogeneity problems have not been taken into account. After modelling the interaction between the representative husband and wife, and allocating sample selection, unobserved individual heterogeneity, and simultaneity bias, I find consistent, significant and positive causal effects of wages on labour supply.

**Motivation**

**Comparative Statics and Hypotheses**

The FOC give the optimal hours of work (h*): equation:

\[ \frac{\partial W}{\partial h^*} = \beta \left( h^* - h \right)^{-1} - \alpha h^* + \frac{\partial \alpha}{\partial h} h + \frac{\partial \beta}{\partial h} \left( h^* - h \right) = 0 \]

Implicit differentiation yields:

- The partial effects of own wages on labour supply (hours-wage elasticity): \( \frac{\partial h^*}{\partial w} \) and \( \frac{\partial h^*}{\partial h} \)

- The sign is uncertain. When \( h^* \) is low, it is positive; when \( h^* \) is high, it could be negative, i.e., a backwards-bending labour supply curve is possible.

The partial effects of husband's wages on wife's labour supply (cross-wage elasticity):

\[ \frac{\partial h^*}{\partial w_h} = \frac{\partial h^*}{\partial w} \left( \frac{\partial w_h}{\partial h} \right) + \frac{\partial h^*}{\partial h} \left( \frac{\partial w_h}{\partial h} \right) \]

It is negative. It becomes smaller when the wife's wages dominate her husband's wages, or she works longer, or the couple relation gets worse.

**Hypotheses on married women's labour supply:**

1. The labour supply curve could be backwards-bending.
2. The couple relation plays a vital role in the wife's labour supply decision and the partial effects of her husband's wages.

**Empirical Analysis**

The data source is the PSID family surveys from 2005 to 2015. I construct a panel data set containing 3618 married women aged between 17 and 65 who lived with their husbands.

<table>
<thead>
<tr>
<th>Variable</th>
<th>Source</th>
<th>Mean</th>
<th>Std. Dev.</th>
<th>Min</th>
<th>Max</th>
<th>Observations</th>
</tr>
</thead>
<tbody>
<tr>
<td>Work hours</td>
<td>Overall</td>
<td>3.59</td>
<td>0.40</td>
<td>0</td>
<td>4.72</td>
<td>N=3740</td>
</tr>
<tr>
<td>Between</td>
<td>3.59</td>
<td>0.40</td>
<td>0</td>
<td>4.72</td>
<td>N=4862</td>
<td></td>
</tr>
<tr>
<td>Within</td>
<td>3.59</td>
<td>0.23</td>
<td>0.77</td>
<td>1.08</td>
<td>N=2878.81</td>
<td></td>
</tr>
<tr>
<td>Work wages</td>
<td>Overall</td>
<td>0.29</td>
<td>0.06</td>
<td>0.41</td>
<td>1.07</td>
<td>N=3740</td>
</tr>
<tr>
<td>Between</td>
<td>0.29</td>
<td>0.06</td>
<td>0.41</td>
<td>1.07</td>
<td>N=4862</td>
<td></td>
</tr>
<tr>
<td>Within</td>
<td>0.29</td>
<td>0.04</td>
<td>0.23</td>
<td>0.37</td>
<td>N=2878.81</td>
<td></td>
</tr>
</tbody>
</table>

**Identification Challenge I: Sample Selection**

We observed wages and hours of work only for the employed women who were self-selected into the labour force. The hours of work equation:

\[ \ln(\text{wife, work, hours}) = \beta_0 + \beta_1 \ln(\text{wife, wages}) + Z_{\text{wife}} + u \]

whether or not we observed wages and hours of work depends on an individual's working decision. The selection equation:

\[ \text{wife, work, hours} = \begin{cases} \text{wife, work, hours} & \text{if } \quad \text{wife, work, hours} \neq 0 \\ 0 & \text{otherwise} \end{cases} \]

Adding the selection variable (the inverse Mills’s ratio or the predicted value of working probability) into the hours of work equation helps to correct the sample selection bias (Model 2).

**Identification Challenge II: Unobserved Individual Heterogeneity**

The unobserved individual-specific and time-invariant characteristics, such as the preference for work, family tradition, and habits, could bias the estimated effects of wages on labour supply.

The panel data fixed effects model controls for the individual heterogeneity by including the individual-level fixed effects component a in the model and, it could be eliminated by first-differencing or demeaning method. (Model 3)

\[ \ln(\text{wife, work, hours}) = \beta_0 + \beta_1 \ln(\text{wife, wages}) + \gamma_1 \text{selection, variable}_1 + Z_{\text{wife}} + a + \epsilon \]

**Identification Challenge III: Idiosyncratic Error and Simultaneity**

What we observed in the labour market were the equilibrium wages and hours of work that are determined by the interaction of labour supply and labour demand curves. The shift of the labour demand is due to the unobserved individual idiosyncratic error, such as the competency and ability of married women. We need to separate labour supply from labour demand to identify the causal effects of wages on labour supply.

I use demand shifters as instruments and run the two stage least squares regression (2SLS). (Model 4)

**Extension: Dynamic Labour Supply**

First-differencing of the dynamic model leads to endogenous problem.

\[ \Delta \ln(\text{wife, work, hours}) = \beta_0 + \beta_1 \ln(\text{wife, wages}) + \Delta Z_{\text{wife}} + \Delta \epsilon \]

Using the GMM-type instruments (the second lag of the dependent variable or the differencing of the second lag), I obtain the 2SLS estimate for the causal effects of own wages on labour supply that is similar to the static model.

**Finding I: Consistent Causal Effects of Wages on Labour Supply**

The evidence of a backwards-bending labour supply curve: the hours-wage elasticities approach zero or even negative when hours or wages are very high.

**Finding II: Evidence of Backwards-bending Labour Supply Curves**

**Finding III: Idiosyncratic Error and Simultaneity**

The evidence of a backwards-bending labour supply curve: the hours-wage elasticities approach zero or even negative when hours or wages are very high.

**Finding IV: Dynamic Labour Supply**

The evidence of a backwards-bending labour supply curve: the hours-wage elasticities approach zero or even negative when hours or wages are very high.

**Identification Challenge I: Sample Selection**

The evidence of a backwards-bending labour supply curve: the hours-wage elasticities approach zero or even negative when hours or wages are very high.

**Identification Challenge II: Unobserved Individual Heterogeneity**

The evidence of a backwards-bending labour supply curve: the hours-wage elasticities approach zero or even negative when hours or wages are very high.

**Identification Challenge III: Idiosyncratic Error and Simultaneity**

The evidence of a backwards-bending labour supply curve: the hours-wage elasticities approach zero or even negative when hours or wages are very high.

**Identification Challenge IV: Dynamic Labour Supply**

The evidence of a backwards-bending labour supply curve: the hours-wage elasticities approach zero or even negative when hours or wages are very high.