Problem Set 1 - Problem 1

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1 Classify a model from a journal

1.1 Mathematical Model

In this paper, the authors develop a theoretical model for measuring the average effect of peer ability on wages by considering the optimization of the firm's utility subject to workers' maximization on their expected wage. Then based on the basic model, the authors construct a regression model for the empirical analysis following.

$$\ln w_{iojt} = a_i + \gamma \bar{a}_{\sim i,ojt} + x\prime_{iojt}\beta + \omega_{ot} + \delta_{jt} + \theta_{oj} + \nu_{iojt} \tag{1}$$

where $\ln w_{iojt}$ is the individual log real wage, x_{iojt} is a vector of time-varying characteristics with an associated coefficient vector β, i indexes workers, o indexes occupations, j indexes firms, t indexes time periods, and a_i is a worker fixed effect. Besides, $\bar{a}_{\sim i,ojt}$ refers to the average worker fixed effect in the peer group which excludes individual i. The coefficient γ is the parameter of interest and measures the spillover effect in wages, which counts both the direct effect of peer ability on wages when holding peer effort constant and the social multiplier effect arising from workers' effort reactions in response to increases in the current effort of their peers. Moreover, ω_{ot} is the time-varying occupation effects that capture diverging time trends in occupational pay differentials. δ_{jt} is the time-varying firm fixed effects which control for shocks that are firm-specific. θ_{oj} is the firm-specific occupation effects, and ν_{iojt} is the error term of this equation.

Based on this formula, the authors further consider the impact of variation of changes in peer quality for workers who remain with their peer group, induced by other workers joining or leaving the peer group, and develop the following equation by assuming all firms contains only two occupations:

$$\Delta \overline{\ln \omega}^s_{ojt} - \Delta \overline{\ln \omega}^s_{o\prime jt} = \gamma(\Delta \bar{\tilde{a}}^S_{ojt} - \Delta \bar{\tilde{a}}^S_{ojt}) + (\Delta \bar{\nu}^S_{ojt} - \Delta \bar{\nu}^S_{ojt}) \tag{2}$$

where $\tilde{a}^S_{ojt}$ is the peer group quality purged from effects of observables (x_{iojt}) and occupation-specific shocks common to all firms in the economy (ω_{ot}).

Moreover, considered the possible existence of time-varying peer group-specific

wage shocks correlated with shocks to peer group quality, the authors enhance the first equation by conditioning on the full set of time-varying peer-group fixed effects p_{ojt} and obtain the following equation for the data analysis in the second part of the paper:

$$\ln w_{iojt} = a_i + \gamma \bar{a}_{\sim i,ojt} + x_{iojt}^T \beta + p_{ojt} + \epsilon_{iojt} \tag{3}$$

where ϵ_{iojt} is the error term.

1.2   Exogenous and Endogenous Variables

Here are the exogenous variables in the equations above: $\ln w_{iojt}$, x_{iojt}, a_i, $\bar{a}_{\sim i,ojt}$, ω_{ot}, δ_{jt}, θ_{oj}, and p_{ojt}.

The following is the list of endogenous variables of the equations: β, γ, ν_{iojt}, and ϵ_{iojt}.

1.3   The Characteristics of the Model

This model is a dynamic model because it contains time-varying variables such as the time-varying peer-group fixed effects p_{ojt}, the vector of time-varying characteristic x_{iojt}, and so on.

This model is a linear model because the equation $\ln w_{iojt} = a_i + \gamma \bar{a}_{\sim i,ojt} + x_{iojt}^T \beta +_{ojt} +\epsilon_{iojt}$ is a polynomial with highest exponent equal to 1, and it can be converted to the form of $y = kx + b$, which is the standard format of a linear equation.

This model is deterministic since its parameters do not contain randomness, and is determined only by the set of inputs and initial conditions. Regardless of the times of simulations, the same set of input parameter values and initial conditions will always result in the same outputs.

1.4   A Missing Variable or Feature

I think one feature that may affect the wages is the educational level of a worker in a peer group. For example, usually a person with a higher level of education may result in a relatively higher base salary in a position as the level of his/her education may lead to different efficiency when working. Besides, the education level may impact one's conception of peer pressure as well as the potential of working harder. For example, one from a university with a large academic pressure may be more elastic to pressure and can bear more pressure than his/her peer.

References

[1] Cornelissen, Thomas, Christian Dustmann, and Uta Schönberg, Peer Effects in the Workplace, *American Economic Review,* **107 (2):** 425-56, 2017.