

14.662 (Spring 2015): Problem Set 1

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Due Friday February 27

1. Wage Density Decomposition Methods

This exercise is designed to give you some practice with decomposition methods discussed in class and recitation.¹ Some of the data and code you'll need can be found in a .zip file on the course website. Please hand in any additional code you write. As usual with empirical work, you'll need to make some subjective decisions in applying these methods (e.g. price deflators, kernels, bandwidths, etc.). Please be sure to mention these in your responses.

- (a) The data set *men7988.dta* contains information on male earnings in 1979 and 1988. Begin by plotting a kernel-based estimate of the density of log hourly wages in each of these years.² Draw a line on your graph to denote the minimum wage level in each year. Your results should look similar to Figure 4a in DiNardo, Fortin, and Lemieux (1996).
- (b) Group the data into cells of education and potential experience as follows:
 - i. Education: high school dropout, high school graduate, some college, college or more
 - ii. Potential experience: 0-9 years, 10-19 years, 20-29 years, 30+ years

Let X_{it} denote a vector of 12 dummies for each education \times experience cell, omitting the high school dropout category. Estimate quantile regressions of the form:

$$Q_{\ln w_{it}}(\tau|X_i) = \alpha^\tau + X'_{it}\beta_t^\tau$$

for each decile τ and each $t \in \{1979, 1988\}$. Plot your estimated $\hat{\beta}_t^\tau$ in two sets (one for each year) of four graphs (one for each experience group), each with three series (one for each education group, relative to the omitted category) that consist of nine data points (one for each τ). Discuss your plots.

- (c) Use the DFL re-weighting method to simulate the wage distribution that would have prevailed in 1988 if the distribution of education and experience had not changed since 1979. Graph this counterfactual wage distribution along with the actual distribution from part (a). Interpret your results in light of your plots in part (b) and your knowledge of trends in educational attainment during this period.
- (d) Discuss the limitations of the quantile regression analysis in part (b) and explain why they motivate the development of unconditional quantile regression methods.
- (e) Install the Firpo, Fortin, and Lemieux (2009) RIF regression package *rifreg.ado* and use it to estimate the unconditional quantile effects from the model in part (b). Plot these estimates and compare them with the plots from part (b).
- (f) Use your density estimates from part (a) and the procedure outlined in recitation to manually construct RIF regression estimates of the effect of education on the unconditional deciles of the wage distribution in 1988. Compare these results to those you obtain from the canned *rifreg* command. Are these wage data well-suited for the FFL procedure? Why or why not?

¹Some of these questions are adopted from a replication exercise developed by Nicole Fortin, which can be found on her [UBC website](#).

²Be sure to think carefully about how you weight each observation. See the original DFL paper for guidance.

2. Skill-biased Technical Change

Many have argued that recent technological advances (for example, computers) complement skilled labor, such that the rising demand for skill can be partly explained by a decline in these technologies' prices. We'd like a model of skill-biased technical change with implications that we can test to check this story.

Consider an economy in which aggregate manufacturing output is given by

$$Y = \left((K^\theta + L^\theta)^{1/\theta} \right)^\alpha H^{1-\alpha}$$

for $\theta \leq 1$ and $\alpha \in (0, 1)$. Here H and L are the aggregate supply of high- and low-skilled labor, respectively, and K is the aggregate stock of machinery that automates certain manufacturing tasks. Assume H and L are supplied inelastically. K is supplied perfectly elastically at rental rate r .

- Write the first-order condition for K under perfect competition.
- Defining $\omega \equiv rK/\alpha Y$ as capital's share of the K and L share of production, derive an expression for how $\ln K$ responds to changes in $\ln H$ and $\ln L$.
- Under what condition is K increasing in H and decreasing in L ? Provide some intuition for this result.
- Now consider an alternative aggregate production function given by

$$Y = \left(K^\rho + \left((H^\nu + L^\nu)^{1/\nu} \right)^\rho \right)^{1/\rho}$$

for $\rho, \nu \leq 1$. What does this functional form imply about capital-skill substitution patterns that's different from the model in (a)? How does K respond to changes in the relative supply of high skill labor (holding $H + L$ fixed) when the skill wage premium is positive?

- How does the capital/output ratio $W \equiv rK/Y$ respond to changes in the relative supply of high-skilled labor in the model in (d)? What about in the model in (a)? How might we use this to test for skill-biased technical change?

3. Liquidity-Constrained Job Search

Consider a simplified discrete-time search model where jobs last indefinitely once found. Individuals have a subjective time discount rate of δ and flow utility of $u(c_t) - \psi(s_t)$ where c_t denotes consumption in period t , s_t represents the individual's search effort (normalized as the probability of finding a job) and u and ψ are strictly concave and convex, respectively. Agents are initially unemployed at $t = 0$ with assets A_0 . An agent who enters period t without a job first chooses s_t and learns whether or not she has become employed. If she has, she begins working in period t at the exogenous wage of w_t and remains employed at all future periods. If she fails to find a job she receives an unemployment benefit $b_t < w_t$ and the problem repeats. Agents can save or borrow in each period at the fixed interest rate r , but are potentially constrained by a lower bound on assets L .

- Write the value function of assets A_t for an employed individual in recursive form.
- Write the maximization problem characterizing optimal search for an individual entering period t with assets A_t and no job. Use this to write the value function for an individual who fails to find a job at the start of period t in recursive form.
- Derive and interpret the first-order condition of the optimal search problem. How is optimal search intensity affected by an exogenous increase in A_t (such as a windfall cash grant)? What does testing $\partial s_t^*/\partial A_t = 0$ tell us?
- How is optimal search intensity affected by an exogenous increase in the benefit level b_t ? By an exogenous increase in wages w_t ? Write an expression linking $\partial s_t^*/\partial A_t$, $\partial s_t^*/\partial b_t$, and $\partial s_t^*/\partial w_t$ and interpret.
- How is optimal search intensity affected by an exogenous increase in a future benefit level b_{t+j} ? What does testing $\partial s_t^*/\partial b_{t+j} = 0$ tell us?

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14.662 Labor Economics II
Spring 2015

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