ECON-810: Problem Set 3 Solutions

Fernando de Lima Lopes*, Stefano Lord Medrano†, and Yeonggyu Yun‡

University of Wisconsin-Madison

February 15, 2022

Data Assignment

1. Using your PSID data, run a series of distributed lag regressions to examine how job loss impacts earnings.

   - There are other variables you can merge into your PSID data set to ID layoffs, but lets do something simple to get started. Define an individual to have been laid off if they worked full-time for at least three consecutive years and then had a decline in annual hours of at least 25 percent in the fourth year. To avoid other shocks, lets not include individuals who saw an increase in the number of household members (e.g., they had a child). Define the control group in an analogous way expect in the fourth year the individual did not have a 25 percent decline in hours. Using these definitions of a treatment and control group, estimate the impact of job loss on earnings. How do your estimates compare to the ones reported in Davis and Von Wachter (2011) or Huckfeldt (2022)? Why do you think they may differ?

   Answer: We are using a sample from 1970 to 2015. An individual is a full-time worker if the amount of worked hours is at least 2,000 hours in a year.[1] We identify that there are some household that had a change in their composition in terms of having more or less kids in given year. We dropped those households that experienced a change in the number of kids. Also, we dropped the SOE oversample. Finally, we classified as treated unit an individual that worked full-time for at least three consecutive years and then had a decline in annual hours of at least 25 percent[2] in the fourth year. With our previous criteria, we end up with a subsample of 64,076 observations, 12,131 individuals.

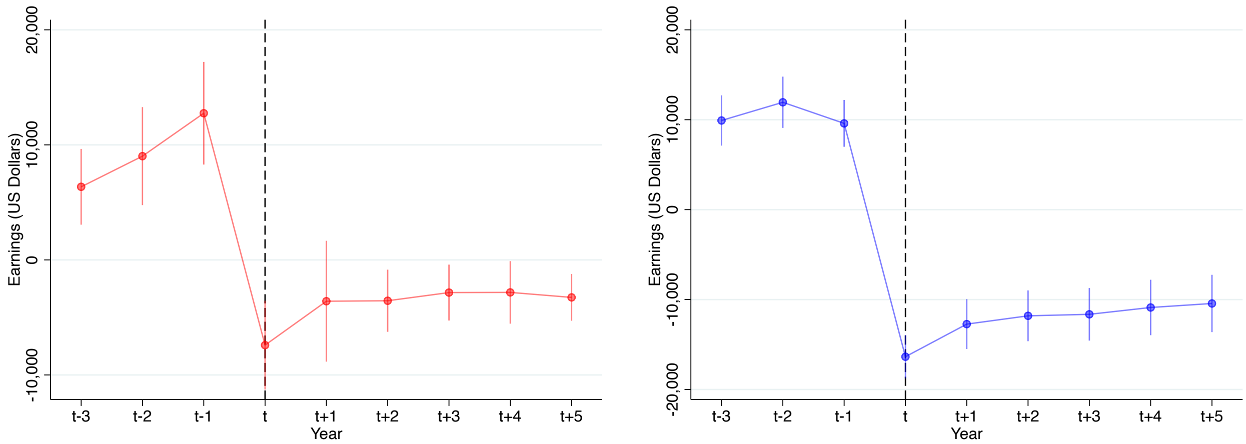
   We estimate the following distributed lag regression for earnings:

$$y_{i,t} = \alpha_i + \gamma_t + \sum_{s=-3}^{5} \delta_s D_{i,s} + \varepsilon_{i,t},$$

*Email: fllopes@wisc.edu.
†Email: lordmedrano@wisc.edu.
‡Email: yyun23@wisc.edu.

[1] 2,000 hours = 8 hours × 5 days × 52 weeks − 80 hours. The 80 hours corresponds to 2 weeks of vacation.
[2] The cumulative sum of hours worked by the fourth year is less than 7,500 hours.

where $y_{i,t}$ represents earnings, α_i and γ_t represents individual and time fixed effects, $D_{i,s}$ is a dummy variable that takes the value of 1 if we are s months before/after the treatment, and $\varepsilon_{i,t}$ represents the error term. Figure 1a presents the estimated coefficients for the distributed lags. Figure 1b displays the estimates for the distributed lags if we drop the constraint of no changes in household composition.



(a) $\hat{\delta}_s$

(b) $\hat{\delta}_s$

Figure 1: Estimated coefficients

Consistent with the results presented in Davis and Von Wachter (2011) and Huckfeldt (2022), there is an important contraction of earnings after the layoff and the individuals do not recover the pre-treatment level of earnings even after 5 years of the unemployment shock. The estimated loss on earnings is, approximately, \$7,400 dollars for the first subsample and \$16,400 for the second subsample. This is also consistent with our previous findings in problem set 2.

Model Simulation Assignment

1. Write down the definition of equilibrium for this economy.

   Answer: A Recursive Equilibrium in this economy is a set of individual policy functions for savings and borrowing $\{b'_{i,t}(\omega, z, \vec{h})\}_{t=1}^{T}$, job search choice $\{\hat{\omega}_{i,t}(\omega, z, \vec{h})\}_{t=1}^{T}$, labor market tightness function $\{\theta_t(\omega, \vec{h})\}_{t=1}^{T}$, a public insurance transfer to unemployed z, a proportional tax rate τ, and a distribution of individuals across states $\mu : \mathcal{T} \to [0, 1]$ such that

   (a) Households' decisions rules are optimal.

   (b) The labor market tightness satisfies the firms' free entry condition.

   (c) The distribution of individuals across states μ is consistent with individual policy functions.

   (d) The tax rate τ is such that the government has a balanced budget.

2. Prove that the equilibrium is *Block Recursive*.

   Proof. We will assume that we have a given tax rate τ. We will proceed as outlined in Braxton et al. (2020) by showing that the individual policy functions and the labor market tightness do not depend on the distribution of individuals across states μ.

The value function of individuals at the terminal period T is given by

$$V_{i,T}(\omega, z, \vec{h}) = \frac{\left(w(\omega, \vec{h}) + z\right)^{1-\sigma} - 1}{1-\sigma},$$

which does not depend on μ since τ is given. In the labor market, the firm's value function is independent of the aggregate distribution μ and is given by

$$J_T = (1-\omega) f(\vec{h}).$$

Given this value to the firm of a match, the labor market tightness will also be independent of the aggregate distribution μ, and is given by

$$\theta_T(\omega, \vec{h}) = p_f^{-1}\left(\frac{\kappa}{(1-\omega) f(\vec{h})}\right).$$

An unemployed individual at age $T-1$ makes a labor market search choice over piece rates ω such that

$$\max_{\tilde{\omega}} p\left(\theta_T(\tilde{\omega}, \vec{h})\right) W_{i,T}(\tilde{\omega}, z', \vec{h}) + \left(1 - p(\theta_T(\tilde{\omega}, \vec{h}))\right) U_{i,T}(z', \vec{h}),$$

which has a solution by the Extreme Value Theorem since $\tilde{\omega} \in [0,1]$. Applying the same arguments and by working backwards from $T-1, \ldots, 1$ we complete the proof. ■

3. Solve the model above using the suggested parameters below and report the following:

   Note: One change we make in simulation is that we calibrate the probability of human capital to increase while employed to be 0.4. The baseline calibration value of 0.05 induces new-born individuals who are unemployed and have zero asset and the lowest level of human capital not to work for the rest of their lives. With higher level of probability, they are more incentivized to apply for jobs that the firms post vacancies because they can expect their future earnings to increase over the life cycle.

   To simulate an unbalanced panel of individuals with different ages at each point of time, we generate a random sequence of individual ages of length 1,000 and update them for 300 periods. An individual who reaches the age of 120 quarters is replaced with a new-born in that process. Then we throw away 180 periods of simulated data as burn-ins and present data from the last 120 periods.

   (a) Make a histogram of the distribution of assets from your simulated data.
   Answer: Figure 2 displays the distribution of assets in our simulated data.

   (b) Make a histogram of the distribution of wages from your simulated data.
   Answer: Figure 3 displays the distribution of wages in our simulated data.

   (c) What is the unemployment rate in your economy?
   Answer: The quarterly unemployment rate is 15.1750%.

   (d) Plot average earnings and assets over the life-cycle from your model. How do the earnings data compare to your age earnings profile from the PSID?
   Answer: Figure 4a displays the average earnings over the life-cycle while Figure 4b presents the average asset holdings over the life-cycle. The results are qualitatively similar to our previous findings on the age earning profiles from the PSID (i.e., Problem Set 1). The earnings profile is mostly increasing in age and the asset accumulation has the inverse U-shaped form that we got in previous assignments, though we see a fall in both graphs around the age of 24 years.

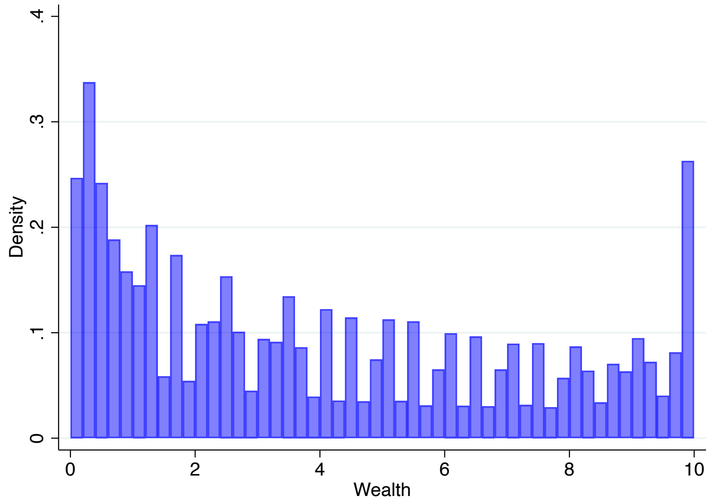


Figure 2: Distribution of assets

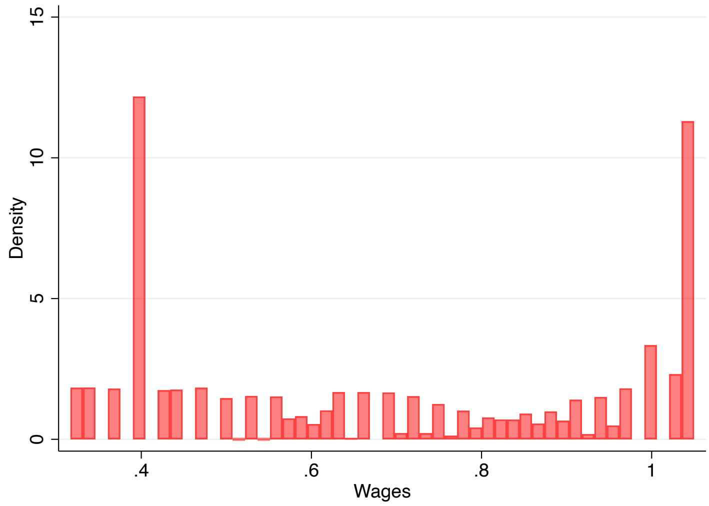
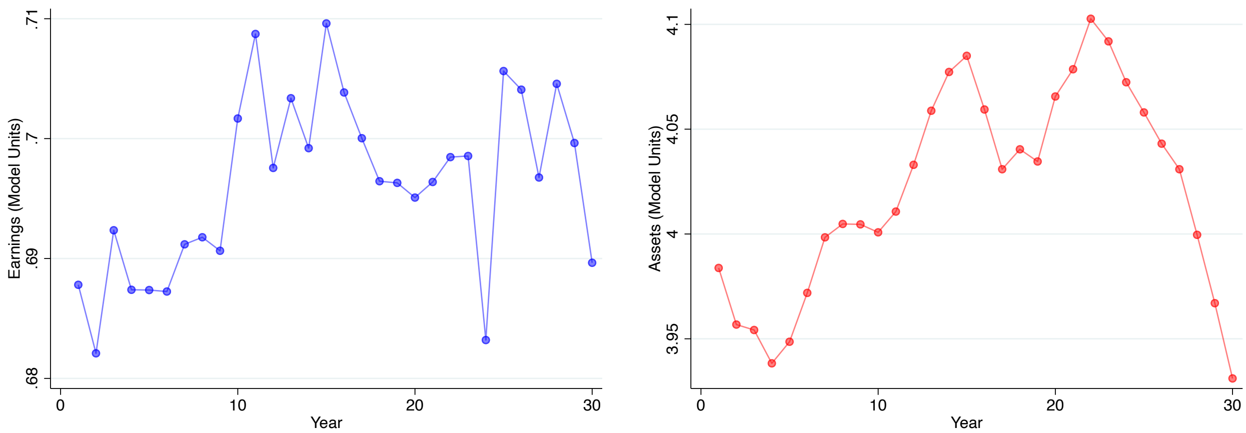


Figure 3: Distribution of wages



(a) Earnings profile

(b) Assets profile

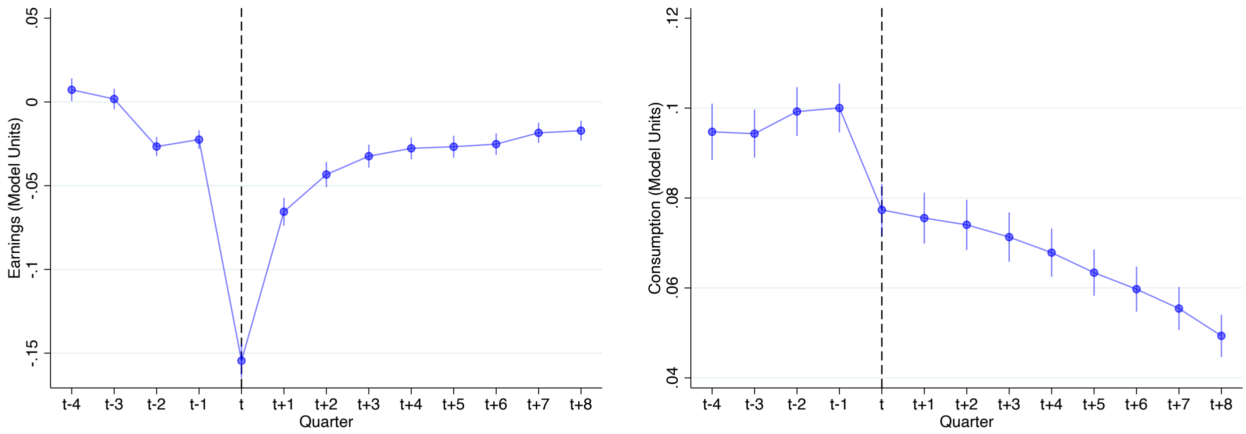
Figure 4: Average earnings and assets over the life-cycle

(e) In your simulated data, what is the average gain in earnings when employed? How does this compare to your data estimate from last week's assignment?

Answer: The average gain in earnings when employed is 0.0382 which represents an increase of 5.1011%. In the previous assignment, we got an average increase in earnings of 1.5914% and in the PSID sample the increase was of 8.7377%.

(f) In your simulated data, make a graph of earnings around job loss (following an individual for 4 quarters before job loss to 8 quarters after job loss). How does the graph compare to the estimates from Davis and Von Wachter (2011) and your estimates from Data Assignment of the assignment?

Answer: In Figure 5a we present the evolution of earnings around job loss using a distributed lag regression. The results are similar to those presented in Davis and Von Wachter (2011) and with our estimates using the PSID subsample; however, it is worth mentioning that in the model we get a quick recovery; however, the agent does not recovers fully from the unemployment shock in 2 years. We consider this quick recovery coming from a rapid increase in human capital once an agent is employed. Under our parametrization, the expected future values of employment are high and hence, agents are willing to take jobs with lower piece rates to get employed.



(a) Earnings around job loss

(b) Consumption around job loss

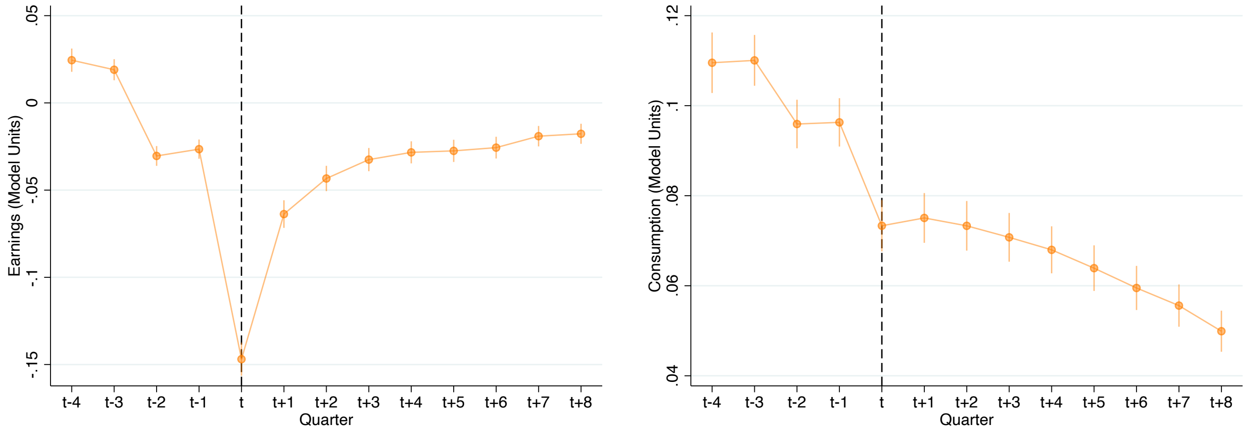
Figure 5: Earnings and consumption around job loss

(g) In your simulated data, make a graph of consumption around job loss.

Answer: Figure 5b displays how consumption responds around job loss. There is an important contraction in consumption on impact but it decreases more over time; which might be consistent with the response to a negative income effect. One puzzle here is that there is no evidence of consumption recovery while we see a very quick recovery of earnings. We conjecture that the fall in human capital while unemployed might have caused this and this calls for a further investigation.

(h) Increase the transfer to the unemployed by 10%. How do the above graphs of earnings and consumption around job loss change? What happens to the unemployment rate in your economy?

Answer: In Figure 6 we display the evolution of earnings and consumption around job loss, respectively. In this particular case, we have a larger unemployment benefit that goes from 0.40 to 0.44 (i.e., an increase of 10%). The dynamics are similar, but, the contraction is less strong with higher unemployment benefits. Instead of experiencing a contraction on impact in earnings of -0.1545, we have a contraction of -0.1469. As expected, the unemployment rate rises to 15.2417% in the simulated data with higher unemployment benefits.



(a) Earnings around job loss

(b) Consumption around job loss

Figure 6: Increasing unemployment benefits

References

J. C. Braxton, K. F. Herkenhoff, and G. M. Phillips. Can the Unemployed Borrow? Implications for Public Insurance. Technical report, National Bureau of Economic Research, 2020.

S. J. Davis and T. M. Von Wachter. Recessions and the Cost of Job Loss. Technical report, National Bureau of Economic Research, 2011.

C. Huckfeldt. Understanding the Scarring Effect of Recessions. *American Economic Review*, 112(4):1273–1310, 2022.

Appendix I: Data

```
/// Econ 810: Advanced Macroeconomic Theory
/// Professor: Carter Braxton
/// Problem Set 3: Directed search and insurance against job loss
/// Authors: Fernando de Lima Lopes, Stefano Lord-Medrano, Yeonggyu Yun
/// Date: 02/12/2023

////////////////////////////////////////////////////////////////////////////
* Housekeeping
* Clear workspace
clear all

* Set directory
cd "/Users/smlm/Desktop/Datasets - Metrics/PSID data"
use pequiv_long.dta
////////////////////////////////////////////////////////////////////////////
* Part 1: Definition of treatment and control group
* Define panel
```

```
rename x11101LL id
xtset id year, yearly
* Drop SEO oversample (see page 372 of Codebook for the Cross-National
* Equivalent File)
drop if x11104 == 12
* Create indicator for full time
gen full_time = 0
by id: replace full_time = 1 if e11101 >= 2000
* Drop non responders and identify changes in number of childs in HH
drop if d11107 == .s
by id: gen members = d11107 - d11107[_n-1]
by id: egen change = sum(abs(members))
by id: drop if change != 0
by id: gen work_years = sum(full_time)
by id: gen worked_hours = sum(e11101)
by id: gen num_years = sum(year - year[_n-1])
by id: gen laid_off = 0
by id: replace laid_off = 1 if (e11101 + e11101[_n-1] + e11101[_n-2] + e11101[_n-3] <= 7500) & (full_time[_n-1]+full_time[_n-2]+full_time[_n-3] == 3)
by id: egen treated = sum(laid_off)

* Generate indicators for DL
by id: gen minus_3 = 0
by id: replace minus_3 = 1 if laid_off[_n+3] == 1
by id: gen minus_2 = 0
by id: replace minus_2 = 1 if laid_off[_n+2] == 1
by id: gen minus_1 = 0
by id: replace minus_1 = 1 if laid_off[_n+1] == 1
by id: gen minus_0 = 0
by id: replace minus_0 = 1 if laid_off == 1
by id: gen plus_1 = 0
by id: replace plus_1 = 1 if laid_off[_n-1] == 1
by id: gen plus_2 = 0
by id: replace plus_2 = 1 if laid_off[_n-2] == 1
by id: gen plus_3 = 0
by id: replace plus_3 = 1 if laid_off[_n-3] == 1
by id: gen plus_4 = 0
by id: replace plus_4 = 1 if laid_off[_n-4] == 1
by id: gen plus_5 = 0
by id: replace plus_5 = 1 if laid_off[_n-5] == 1
* Run DL regression
rename i11110 earnings
xtreg earnings i.year minus_3 minus_2 minus_1 minus_0 plus_1 plus_2 plus_3 plus_4 plus_5, fe vce(robust)
coefplot, vertical keep(minus_3 minus_2 minus_1 minus_0 plus_1 plus_2 plus_3 plus_4 plus_5) nolabel recast(connected) xline(4) ytitle("Earnings") xtitle("Year") color(blue%50) graphregion(fcolor(white))
* Extra: Quantify the effect during recessions
by id: gen recession = 0
by id: replace recession = 1 if year == 1970 & year == 1974 & year == 1980 & year == 1982 & year == 1991 & year == 2001 & year == 2008
by id: gen dl_recession_m3 = recession*minus_3
by id: gen dl_recession_m2 = recession*minus_2
by id: gen dl_recession_m1 = recession*minus_1
by id: gen dl_recession_0 = recession*minus_0
by id: gen dl_recession_p1 = recession*plus_1
by id: gen dl_recession_p2 = recession*plus_2
by id: gen dl_recession_p3 = recession*plus_3
by id: gen dl_recession_p4 = recession*plus_4
by id: gen dl_recession_p5 = recession*plus_5
```

```
xtreg earnings i.year minus_3 minus_2 minus_1 minus_0 plus_1 plus_2 plus_3
    plus_4 plus_5 dl_recession_m3 dl_recession_m2 dl_recession_m1 dl_recession_0
    dl_recession_p1 dl_recession_p2 dl_recession_p3 dl_recession_p4
    dl_recession_p5 , fe vce(robust)
coefplot , vertical keep(minus_3 minus_2 minus_1 minus_0 plus_1 plus_2 plus_3
    plus_4 plus_5) nolabel recast(connected) xline(4) ytitle("Earnings") xtitle("
    Year") color(blue%50) graphregion(fcolor(white))

////////////////////////////////////////////////////////////////////////////////
* Part 2: Work with simulated data from the model
clear all
cd "/Users/smlm/Desktop/Datasets - Metrics/PSID data/PS3"
import delimited using Simulated_panel
* Histogram of distribution of assets
twoway histogram wealth, color(blue%50) graphregion(fcolor(white) lwidth(none))
graph export "/Users/smlm/Desktop/Datasets - Metrics/PSID data/PS3/Histo_Assets.
    pdf", as(pdf) name("Graph") replace

* Histogram of distribution of wages
twoway histogram earnings, color(red%50) xtitle("Wages") graphregion(fcolor(
    white) lwidth(none))
graph export "/Users/smlm/Desktop/Datasets - Metrics/PSID data/PS3/Histo_Wages.
    pdf", as(pdf) name("Graph") replace

* Compute unemployment rate
egen urate = mean(unemployment)
display urate

* Average earnings increase
xtset id year, quarterly
by id: gen gain = earnings - earnings[_n-1] if unemployment == 0
summ gain
summ earnings if unemployment == 0
by id: gen shock = 0
by id: replace shock = 1 if (unemployment+unemployment[_n-1]+unemployment[_n-2]+
    unemployment[_n-3]) == 1
by id: gen first = sum(shock) == 1 & sum(shock[_n-1]) == 0
by id: gen minus_4 = 0
by id: replace minus_4 = 1 if first[_n+4] == 1
by id: gen minus_3 = 0
by id: replace minus_3 = 1 if first[_n+3] == 1
by id: gen minus_2 = 0
by id: replace minus_2 = 1 if first[_n+2] == 1
by id: gen minus_1 = 0
by id: replace minus_1 = 1 if first[_n+1] == 1
by id: gen minus_0 = 0
by id: replace minus_0 = 1 if first == 1
by id: gen plus_1 = 0
by id: replace plus_1 = 1 if first[_n-1] == 1
by id: gen plus_2 = 0
by id: replace plus_2 = 1 if first[_n-2] == 1
by id: gen plus_3 = 0
by id: replace plus_3 = 1 if first[_n-3] == 1
by id: gen plus_4 = 0
by id: replace plus_4 = 1 if first[_n-4] == 1
by id: gen plus_5 = 0
by id: replace plus_5 = 1 if first[_n-5] == 1
by id: gen plus_6 = 0
by id: replace plus_6 = 1 if first[_n-6] == 1
```

```
by id: gen plus_7 = 0
by id: replace plus_7 = 1 if first[_n-7] == 1
by id: gen plus_8 = 0
by id: replace plus_8 = 1 if first[_n-8] == 1

* Earnings around job loss
xtreg earnings i.year minus_4 minus_3 minus_2 minus_1 minus_0 plus_1 plus_2 plus_3 plus_4 plus_5 plus_6 plus_7 plus_8, fe vce(robust)
coefplot, vertical keep(minus_4 minus_3 minus_2 minus_1 minus_0 plus_1 plus_2 plus_3 plus_4 plus_5 plus_6 plus_7 plus_8) nolabel recast(connected) xline(5) ytitle("Earnings (Model Units)") xtitle("Quarter") color(blue%50) graphregion(fcolor(white))

* Consumption around job loss
xtreg consumption i.year minus_4 minus_3 minus_2 minus_1 minus_0 plus_1 plus_2 plus_3 plus_4 plus_5 plus_6 plus_7 plus_8, fe vce(robust)
coefplot, vertical keep(minus_4 minus_3 minus_2 minus_1 minus_0 plus_1 plus_2 plus_3 plus_4 plus_5 plus_6 plus_7 plus_8) nolabel recast(connected) xline(5) ytitle("Consumption (Model Units)") xtitle("Quarter") color(blue%50) graphregion(fcolor(white))


* Use aggregated data from simulated panel
clear all
use "Aggregates_Simulated_Data.dta"
* Earnings profile
twoway connected earnings year, color(blue%50) ytitle("Earnings (Model Units)") graphregion(fcolor(white) lwidth(none))
graph export "/Users/smlm/Desktop/Datasets - Metrics/PSID data/PS3/Earnings_Profile.pdf", as(pdf) name("Graph") replace
* Asset profile
twoway connected assets year, color(red%50) ytitle("Assets (Model Units)") graphregion(fcolor(white) lwidth(none))
graph export "/Users/smlm/Desktop/Datasets - Metrics/PSID data/PS3/Assets_Profile.pdf", as(pdf) name("Graph") replace
```

Listing 1: Data part (Stata)