Assignment 6 (due November 12th)

## Instructions

This problem set covers the topic of matching and is an extension of Couch and Placzek (2010) (henceforth CP) who using several matching techniques study the income loss after job displacement. For each exercise you should provide estimates, report standard errors, and briefly interpret the results. Unless specified differently use pre-programmed Stata functions.

## Matching

The work of CP revisits the findings of Jacobson, LaLonde, and Sullivan (1993) (henceforth JLS), one of the seminal papers in the empirical literature of job displacement. The main interest of JLS is to investigate the earnings loss caused by worker displacement. Using the administrative records from the state of Pennsylvania and adopting program evaluation techniques they conclude that workers who were part of mass employment reductions experience long-term losses averaging to 25% per year. They distinguish job separations caused and not caused by mass-layoffs and recover earning losses using workers who stayed as the control group.[1] The model was specified as follows:

$$w_{it}^A = \mu_i + \sum_{k \geq -4}^{6} \phi_k L_{it}^k + \sum_{l \geq -4}^{6} \psi_l M_{it}^l + \beta X_{it} + \rho_t + \varepsilon_{it}, \tag{1}$$

where $w_{it}^A$ is the log of annual salary of worker $i$, $L_{it}^k$ and $M_{it}^l$ are dummy variables for each year preceding and following the layoff and mass-layoff respectively, and $X_{it}$ is a vector of personal characteristics.

CP propose a new view on the worker displacement and extend JLS analysis by including matching estimators. They argue that numerous papers report that workers who experience displacement are systematically selected and thus the losses reported in JLS might be too high.[2] CP define displaced workers as the treatment group, whereas those who didn't separate from the firm are treated as the control group. Given the propensity scores, $p(X)$, CP match workers who experience displacement with control group. The average treatment effect on the treated takes form:

$$\alpha_{TT} = E\big[E[w_{1i}^A|D_i = 1, p(X_i)] - E[w_{0i}^A|D_i = 0, p(X_i)]|D_i = 1\big], \tag{2}$$

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[1] Workers need to additionally satisfy requirements regarding labor experience (minimum 6 years), age (no older than 40 years) and industry (non-agricultural). Mass-layoffs are defined for firms with more than 50 workers as quarterly reduction of employment that exceeds 33%. For more information see JLS.

[2] See, for instance, Gibbons and Katz (1991), Lengermann and Vilhuber (2002), and Abowd, McKinney, and Vilhuber (2005).
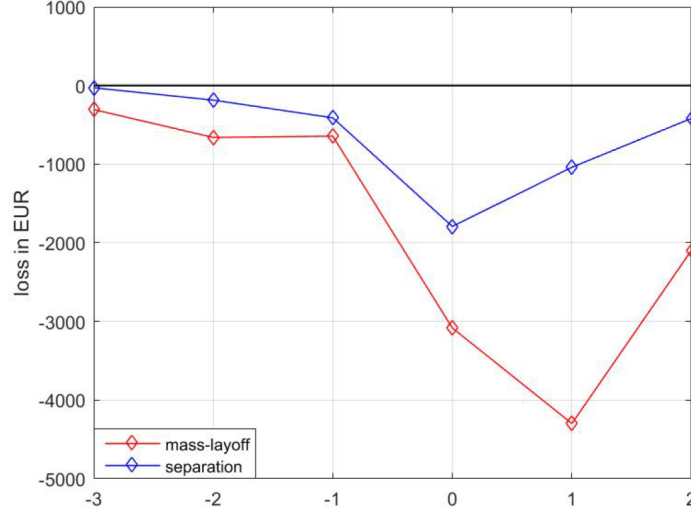
Figure 1: Annual earnings losses for separators and mass-layoffs - VWH 1995-2001. Time 0 marks the event of displacement.

where $D_i$ takes value 1 if worker was displaced (either mass-layoff or separation) and zero otherwise. $\alpha_{TT}$ was computed for each $t$ prior and after the displacement. In Equation (1) the first year of the data is the reference point, hence to estimate difference in outcome $w_i^A$ relative to the first year of the sample they propose the following Differenced Average Treatment Effect on the Treated estimator:

$$\alpha_{DATT} = \Big[ E[w_{1it}^A | D_i = 1, p(X_i)] - E[w_{1it_0}^A | D_i = 1, p(X_i)]$$
$$- E[w_{0it}^A | D_i = 0, p(X_i)] - E[w_{0it_0}^A | D_i = 0, p(X_i)] | D_i = 1 \Big]. \tag{3}$$

Your task, described below, is to revisit the findings of CP using different data.

**Data.** The dataset `assignment6.dta` is based on the records provided by the Veneto Workers Histories (hereafter VWH), a large administrative panel that includes all individuals working in Italian region of Veneto over the years 1975–2001. `assignment6.dta` contains a subsample of panel of workers who in 1999 were subject to mass employment reduction, separated from the firm without being part of mass-layoff, or stayed with the same employer. It is a panel for years 1995–2001. Mass layoffs are defined with the use of endogenous separation rate, as in JLS and von Wachter et al. (2009). Displaced workers satisfy the requirements imposed by the literature. Year 1999 was chosen arbitrarily. For the detailed description of the sample see the Appendix. Figure 1 presents the results of Model (1) for separated and mass-layoff workers in `assignment6.dta`. Before the displacement (0 on the horizontal axis) both separated and mass-layoff workers do not differ from stayers with respect to annual wage. In the year of displacement, separated workers experience almost 2,000 EUR loss in earnings, however the difference disappears after 2 years. Workers subject to mass employment reduction denote much higher earnings loss and after two years following the displacement their annual salary still didn't recover.

# Exercise

The following exercise revisits the findings of Figure 1 with the use of matching techniques, in the spirit of CP. Note that we introduced two types of displaced workers (mass-layoff and separated), hence in every point of the exercise you need to estimate ATT or DATT separately for both groups.

1. Compute propensity score index and check the balancing property with the use of `pscore` command for arbitrarily chosen year. Use gender, decile of 1995 earnings, decade of birth (dummies for 50's, 60's and 70's) and interaction of gender and decile of earnings as your covariates $X_i$. Comment the output of `pscore` function.

2. Estimate $\alpha_{TT}$ using nearest neighbor and kernel matching. Comment the differences between the nn and kernel estimates.
   $\Big[$ *Hint: Estimate $\alpha_{TT}$ separately for each year prior and after the displacement.* $\Big]$

3. Estimate $\alpha_{DATT}$ from Equation 3 using both nearest neighbor and kernel matching. Comment the differences between the nn and kernel estimates.

4. Plot your results from Point 2 and Point 3 and relate them to the findings of Figure 1. Does the JLS Model (1) in fact overestimate the earnings loss after displacement? Relate to the findings of Couch and Placzek (2010). For the sake of clarity plot estimates of $\alpha_{TT}$ and $\alpha_{DATT}$ separately.


# Appendix

## Matching - Data

File `assignment6.dta` is a panel of workers aged no more than 45 at the time of displacement (year=1999) working in non-agricultural sector between 1995 and 2001. List of variables:

- `id` - unique person indentifier

- `annual_salary` - annual real earnings (in 2003 EUR) of worker, winsorized at $99^{th}$ percentile level

- `stay` - equal 1 if individual wasn't displaced in year 1999 and 0 otherwise

- `separation` - equal 1 if individual permanently separated from her employer in 1999 without being part of mass employment reductions

- `mass_layoff` - equal 1 if individual was part of mass-layoff in 1999