# Tutorial 3
# Difference-in-differences

## Exercise 1 : Measuring the effect of age-specific employment protection on firms' incentives to train older workers

Using French individual data, Messe and Rouland (2014) try to properly identify the effect of stricter employment protection among older workers on firms' incentives to engage in firm specific-skills. Specifically, they study the impact of the 1999 French Delalande tax change. Since its introduction in 1987[1], French firms have to pay a tax to the unemployment insurance system laying off workers aged 50 and above, known as the Delalande tax[2]. The amount of the tax is proportional to the worker's gross wage at the time of layoff. Since 1992, firms are exempted from the tax for workers hired after the age of 50 if they are laid off later on. It is only due if the worker is employed under a permanent contract and only the private sector is concerned. The 1999 change resulted in an increase in the tax schedule for firms with more than 50 workers. Table 1 shows how the amount of the tax has varied after the reform.

Table 1 – Delalande tax schedule according to the age of the laid off worker (monthly gross wage)

| | | Worker's age | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | | 50 | 51 | 52 | 53 | 54 | 55 | 56-57 | 58 | 59 |
| Jan. 1993-Dec. 1998 | All firm sizes | 1 | 1 | 2 | 2 | 4 | 5 | 6 | 6 | 6 |
| Since Jan. 1999 | More than 50 employees | 2 | 3 | 5 | 6 | 8 | 10 | 12 | 10 | 8 |
| | Less than 50 employees | 1 | 1 | 2 | 2 | 4 | 5 | 6 | 6 | 6 |

Source : legislative texts.
Notes : For each age group, the table displays the tax due by the firm to the unemployment insurance system if it lays a worker off. The tax is a function of previous wages, and is stated in months of gross wages.

**a.** How could we estimate the effect of stricter employment protection on older workers' training rates using the 1999 institutional change ?

1. Since January 2008, the Delalande tax no longer exists.
2. The threshold-age was 55 in 1987 but was lowered to 50 after the 1992 reform.

**b.** Provide some descriptive statistics that allow to compute roughly the Difference-in-differences estimator of this effect for workers aged 45-49 years old and for those aged 50-54 years old.

**c.** Estimate this effect using a OLS regression first for workers aged 45-49 years old and then for those aged 50-54 years old.

**d.** What is the key assumption for this estimator to be a valid measure of the causal effect of stricter employment protection on older workers' training rates ?

**e.** Find a way of testing this assumption using a placebo test. Does it provide empirical evidence that this assumption holds in that case ?

**f.** We could argue that workers in small and large firms face different work environments that may make the common trend assumption not credible. To make these two groups of workers more comparable, combine nearest-neighbour matching approach with DiD model. Does this approach improve the balancing property ? According to this approach, what is the effect of stricter employment protection on training rates among workers aged 45-49 years old ?

# Exercise 2 : Estimating the effect of minimum legal drinking age on rates of motor vehicle fatalities among 18-20 years old

Carpenter and Dobkin (2011) analyzed the effects of changes in the minimum legal drinking age on rates of motor vehicle fatalies among 18-20 year olds, using state-level panel data from the National Highway Traffic Administration's Fatal Accident Reporting System. The outcome is the incidence of deaths in motor vehicle crashes among 18-20 year-olds (per 100,000 residents), for each state plus the District of Columbia, over the period 1970 to 1983. There were several changes in the minimum legal drinking age during this time period, with variability in the timing of changes across states.

Carpenter and Dobkin (2011) use a difference-in-differences strategy to estimate the effects of lowering the minimum legal drinking age from 21 to 18. Their model is :

$$y_{it} = \alpha_i + \beta_t + \gamma b_{it} + \delta d_{it} + \epsilon_{it}$$

$\alpha_i$ is a time-invariant state-specific fixed effect, $\beta_t$ is a year-specific fixed effect, $b_{it}$ is the current rate of beer taxation in state $i$ in year $t$. $d_{it}$ is the interaction between

state dummies and the time at which each state $i$ has lowered the minimum legal drinking age from 21 to 18.

**a.** What is the meaning of the parameter $\delta$ ?

**b.** Why computing valid standard errors is not straightforward in that case ?

**c.** Do a Wald test using clustered standard errors at state level for the two parameters $\gamma$ and $\delta$.

**d.** Do the same test but using a Bias-Reduced Linearization correction to make inference more valid in spite of the low number of clusters.