Problem Set 3

Due: Sunday, 30 March, 23:59

- Prepare concise answers.

- State clearly any additional assumptions, if needed.

- You are encouraged to collaborate in groups but the final write-up should be individual.

- Submit your solutions, along with any code (if applicable), in a **single pdf file** through **Moodle**. If you choose to write your solutions by hand, please make sure your scanned answers are legible.

- Grading scale:

5.5	default grade
6	absolutely no mistakes and particularly appealing write-up
	(clear and concise answers, decent formatting, etc.)
5	more than a few mistakes,
	or single mistake and particularly long, wordy answers
4	numerous mistakes,
	or clear lack of effort (e.g. parts not solved or not really attempted)
1	no submission by due date

Problem 1

This is a continuation of the last problem set, based on Griliches and Mairesse (1995, NBER Working Paper 5067, "Production Functions: The Search for Identification"). You can download the data from Moodle either in ASCII format GMdata.RAW or in Stata format GMdata.dta. There are nine variables: *index* (firm ID), *sic3* (3 digit SIC), *yr* (year $\in \{73, 78, 83, 88\}$), *ldsal* (log of deflated sales), *lemp* (log of employment), *ldnpt* (log of deflated capital), *ldrnd* (log of deflated R&D), *ldinv* (log of deflated investment). Compared to the last exercise, we add time fixed effects:

$$ldsal_{it} = \alpha_i + \beta_1 lemp_{it} + \beta_2 ldnpt_{it} + \beta_3 ldrst_{it} + \sum_{\tau=1}^{T} f_t \, \mathbf{1} \{t = \tau\} + u_{it} \,, \tag{1}$$

where $\mathbf{1} \{t = \tau\}$ for $\tau = 1 : T$ are time-dummies.

(a) Compare the modeling of unit- and time-fixed effects in Eq. (1). How does the addition of time-fixed effects relate to the incidental parameters problem (IPP)?

(b) Construct a balanced panel dataset, and take first differences of Eq. (1). What happens to α_i and the year dummies?

(c) Suppose for a moment that you added a dummy for the computer industry to the model: $\delta d357_{it}$, where $d357_{it}$ is a dummy variable equal to one if firm i belongs to industry (3-digit SIC code) 357. Does this have an effect on the IPP? How does implied specification for first differences change? Do your conclusions change if we consider time-varying effects of the industry-dummy, $\delta_t d357_{it}$?

(d) Using the balanced panel, re-compute the FE-W estimator, the RE estimator and the respective standard error estimates.

(e) Conduct the Hausman test, comparing the RE- and FE-W-estimators. What do you conclude?
Hint: note that you need the estimated covariances of the RE- and FE-W-estimators to set up this hypothesis-test.

(f) Is there support for the null hypothesis of constant returns to scale, $\mathcal{H}_0 : \beta_1 + \beta_2 = 1$?
Hint: note that you need the estimated covariance of $\hat{\beta}_1$ and $\hat{\beta}_2$ to set up this hypothesis-test.