Université des Sciences Sociales de Toulouse
MPSE
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DEA Macroéconomie II — Cours de Franck Portier

Final Exam

I – Problem – Technological shocks, Preference shocks and the endogeneity of TFP *(12 points)*

We consider here a variation of the simple analytical RBC model. We study a model economy $\mathcal{A}$ populated with a representative household and a representative firm. The firm has a Cobb-Douglas technology:

$$Y_t = Z_t K_t^{\gamma} N_t^{1-\gamma} \tag{1}$$

where K_t is capital, N_t labor input, and Z_t the stochastic Total Factor Productivity (TFP). All profits of the firm are distributed to the household. Capital evolves according to

$$K_{t+1} = I_t \tag{2}$$

where I_t is investment in period t.

The representative household works N_t and consumes C_t. Preferences are given by

$$U = E_0 \sum_{t=0}^{\infty} \beta^t \left[\log C_t - \chi_t N_t\right] \tag{3}$$

where χ_t is a preference shock. Capital is accumulated by the household and rented to the firm.

Let κ denote the real rental rate of capital, P the price of the final good and W the nominal wage.

1 – Write down the budget constraint of the household and the profit function of the firm

2 – Derive FOCs of the utility and profit maximization

3 – Define a competitive equilibrium of this economy

4 – Solve the model and show that the equilibrium process of output is $y_t = z_t + \gamma y_{t-1} - (1-\gamma)\chi_t$ (1) (dropping constants and with the notation $x = \log X$)

5 – Assume $y_{-1} = 0$, $z_t = 0\ \forall t$, $\chi_t = 0\ \forall t$, except $\chi_0 = 1$. Draw the time path on χ, z and y. Explain why y is persistent

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We now consider an economy $\mathcal{B}$, in which the TFP is not exogenous at the aggregate level, but given by $Z_t = \overline{Y}_t^{\theta} X_t$, where X is the exogenous part of TFP and $\overline{Y}_t^{\theta}$ act as an externality. More precisely, $\overline{Y}$ is taken as given by firms and households, but one has at the competitive equilibrium $\overline{Y} = Y$

6 – What is the economic interpretation of this externality?

7 – Solve for the competitive equilibrium and give the equilibrium process of output (again in logs). Comment

8 – Assume that an economist observes the economy $\mathcal{B}$, with externality, but thinks that he is observing economy $\mathcal{A}$, and is therefore using equation (1) to understand the data. Draw the response of observed TFP z_t, of y and χ if $y_{-1} = 0$, $x_t = 0\ \forall t$, $\chi_t = 0\ \forall t$, except $\chi_0 = 1$.

9 – How to interpret the positive correlation between observed TFP and output? Could such an economist believe (wrongly) that technological shocks are driving part of the response of the economy? Discuss.

II – Questions *(12 points)*

Please propose a structured answer to each question, with as much economic content as possible. Please define the main terms and use math if needed.

1. Ricardian Equivalence
2. The government budget constraint and inflation
3. Why can money have a positive price in an overlapping generation model

III – Discussion – About Gali's 1999 AER Paper (Technology, Employment, and the Business Cycle: Do Technology Shocks Explain Aggregate Fluctuations?) *(12 points)*

In a 1999 AER paper, Jordi Gali is estimating the following VAR:

My empirical model interprets the observed variations in (log) productivity (x_t) and (log) hours (n_t) as originating in two types of exogenous disturbances—technology and nontechnology shocks—which are orthogonal to each other, and whose impact is propagated over time through various unspecified mechanisms. That idea is formalized by assuming that the vector $[\Delta x_t, \Delta n_t]'$ can be expressed as a (possibly infinite) distributed lag of both types of disturbances:

$$(23)\quad \begin{bmatrix} \Delta x_t \\ \Delta n_t \end{bmatrix} = \begin{bmatrix} C^{11}(L) & C^{12}(L) \\ C^{21}(L) & C^{22}(L) \end{bmatrix} \begin{bmatrix} \varepsilon_t^z \\ \varepsilon_t^m \end{bmatrix} \equiv \mathbf{C}(L)\boldsymbol{\varepsilon}_t$$

where $\{\varepsilon_t^z\}$ and $\{\varepsilon_t^m\}$ denote, respectively, the sequences of technology and nontechnology shocks. The orthogonality assumption (combined with a standard normalization) implies $E\boldsymbol{\varepsilon}_t\boldsymbol{\varepsilon}_t' = I$. Furthermore, the identifying restriction that the unit root in productivity originates exclusively in technology shocks corresponds to $C^{12}(1) = 0$. In other words, the matrix of long-run multipliers $\mathbf{C}(1)$ is assumed to be lower triangular.

The specification in (23) is based on the assumption that both productivity and hours are integrated of order one, so that first-differencing of both variables is necessary to achieve stationarity.

1 – Explain why it is useful to decompose the VAR innovations into two orthogonal components

2 – Explain what are the assumptions made by Gali to get sequences of technology and nontechnology shocks. Are these assumptions reasonable?

Some of the results of the estimation are given in the following table

TABLE 1—CORRELATION ESTIMATES: BIVARIATE MODEL

	Unconditional	Conditional	
		Technology	Nontechnology
Panel A: First-differenced labor			
Hours	−0.26**	−0.82**	0.26**
	(0.08)	(0.12)	(0.12)
Employment	−0.02	−0.84**	0.64**
	(0.07)	(0.26)	(0.13)
Panel B: Detrended labor			
Hours	−0.26**	−0.81**	0.35*
	(0.08)	(0.11)	(0.20)
Employment	−0.02	−0.35	0.38
	(0.07)	(0.49)	(0.56)

Notes: Table 1 reports estimates of unconditional and conditional correlations between the growth rates of productivity and labor input (hours or employment) in the United States, using quarterly data for the period 1948:1–1994:4. Standard errors are shown in parentheses. Significance is indicated by one asterisk (10-percent level) or two asterisks (5-percent level). Conditional correlation estimates are computed using the procedure outlined in the text, and on the basis of an estimated bivariate VAR for productivity growth and labor-input growth (Panel A) or productivity growth and detrended labor input (Panel B). Data sources and definitions can be found in the text.

3 – Present in words the results.

4 – What do we learn with those results? What type of model can explain those results? What type of model is unlikely to explain them?