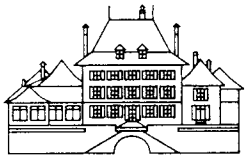

STUDIENZENTRUM GERZENSEE
STIFTUNG DER SCHWEIZERISCHEN NATIONALBANK

Program for Beginning Doctoral Students in Economics 1997

Exam in Macroeconomics

Tuesday, August 12, 1997, 09.00 - 11.00

1. You are allowed to use all material that you want (lecture notes, books, etc.) with the exception of PC's.

2. Please **do not** mention your name on top of the pages, but use your identification number from the enclosed list. The reason is that the exams will be graded anonymously.

3. Good luck!

Prof. Robert G. King, University of Virginia
Prof. Sergio Rebelo, University of Rochester

Summer 1997

Studienzentrum Gerzensee
Macroeconomics
Midterm Examination

There are 120 points on this examination, which is roughly one point per minute over two hours. Part A of the exam contains short questions for a total of 42 point: there are 6 short questions worth 7 points each. TFU means "true, false or uncertain": your answer should indicate which is the correct description of the assertion and explain why. Part B of the exam contains three long questions: the first is worth 40 points; the second is worth 14 and the third is worth 24 points.

Please be concise and to the point in your answers; also be sure to write neatly and with large enough letters so that your answers can be read without a magnifying glass!

A. Short Answer Questions:

(1) TFU. Labor and output display high correlation at the business cycle frequencies, but not at lower frequencies.

(2) TFU. If $x_t = \rho x_{t-1} + e_t$ with e_t being white noise, then the effect of an innovation on the forecast of future x is given by $E_t x_{t+k} - E_{t-1} x_{t+k} = \rho^{k-1} e_t$.

(3) TFU. The effect of applying the HP filter to a time series is to (a) increase the variance of high frequency components and (b) reduce the variance of low frequency components.

(4) Global stability always implies local stability

(5) In an overlapping generations model capital accumulation always leads to dynamic inefficiency because agents have finite horizons.

(6) In the Hansen-Rogerson indivisible labor model the presence of lotteries generally implies that employed and unemployed agents always have the same level of consumption.

B. Longer Questions

1. *The Neoclassical Growth with Exogenous Savings*

Consider the following version of the neoclassical growth model with exogenous savings:

$$Y_t = AK_t^{1-\alpha}\left(NX_tM_t\right)^{\alpha}$$

$$X_{t+1} = \gamma_x X_t$$

$$M_{t+1} = \gamma_m M_t$$

$$I_t = s[Y_t - \delta K_t]$$

$$K_{t+1} = (1-\delta)\,K_t + I_t$$

where M is the number of households in the population.

(a) Rewrite the model in per capita quantities (denoted by lower-case letters) and determine its fundamental dynamic equation.

(b) Compute the steady-state level of per capita capital, k. How does it change in response to a decrease in s?

(c) How does a change in s affect the convergence towards a steady-state?

(d) Compute the golden-rule level of per capita capital, by maximizing the steady-state level of consumption.

(e) Consider the problem of the representative firm. Derive an expression for the real interest rate and the real wage. What is the real interest rate associated with the golden-rule?

(f) Is the model's steady-state consistent with the Kaldor facts?

(g) Linearize the fundamental dynamic equation around the steady-state capital stock and show that the economy is locally stable.

(h) Make the savings rate endogenous by postulating a time separable utility function. Characterize the steady state of the resulting model. How does this steady state compare with the one associated with the "golden rule"?

2. *A Stochastic Version of the Solow Model*

Consider the following stochastic version of the Solow model with a 100% depreciation rate on capital:

$$K_{t+1} = s_t A K_t^{1-\alpha}$$

where s_t is an i.i.d. random variable that can take on a value s_L with probability 1/3 and s_H ($s_L < s_H$) with probability 2/3.

(a) What (log)linear difference equation describes the dynamics of capital near the steady state?

(b) Use the linearized solution to characterize the stationary (limiting) distribution of the capital stock.

3. *Consumption theory with durable goods.*

Suppose that agents derive utility from two goods, one of which last for two periods. Thus, their life-time utility function takes the form

$$U_t = \sum_{j=0}^{\infty} \beta^j u(c_{t+j}, s_{t+j})$$

where c_t denotes the consumption of nondurables and s_t denotes the service flow from the durable good. The services are assumed to be proportional to the stock of durables at the start of the period, $s_t = \theta d_{t-1}$, where d_t is the stock of durables. This stock of durables evolves according to:

$$d_t = (1 - \delta)d_{t-1} + i_t$$

where i_t is the investment in new durable goods. The relative price of a new durable (in terms of nondurables) is p_t. The assets of the individual evolve according to:

$$a_{t+1} = (1 + r_t)[a_t + y_t - c_t - i_t]$$

where r_t is the real interest rate. All incomes, prices and interest rates are assumed to be known with certainty.

(a) Working by analogy with investment theory (the implicit rental price of capital), determine the cost of obtaining a unit of durable services at date t+1, at date t+2, etc.

(b) What is the effect on this cost, which we can call p^s_{t+k}, of the durables prices p_{t+k} and p_{t+k+1} as well as the interest rate r_{t+k}? Explain why each of these factors is relevant.

(c) Why is the quantitity of initial period services predetermined?

(d) Show how to use this implicit price to write the asset accumulation equation in terms of service flows rather than investment flows.

(e) Display the first-order conditions for optimal consumption of nondurables and services from durables, using the modified asset accumulation equation derived in the previous part.

(f) Why might this theory, modified to include uncertainty about income, predict a very strong relationship between lagged shocks to income and current period purchases of consumer durables?