Matr.-Nr. _____ **Name:** _____

Examination	**20305: Economics of Growth**
Semester:	**Winter Semester 2012/2013**
Examiners:	**Prof. Dr. Dr. h. c. Gerhard Schwödiauer**
The following aids may be used:	**None.**
Time:	**120 minutes**

This exam consists of two mandatory parts, A and B.

Part A comprises 14 multiple choice problems. Do not mark more than one answer to any of the questions, otherwise the solution will be considered false. For every correct answer you obtain 1 point. For a wrong answer or no answer you get 0 points. In order to get a passing grade on Part A at least 7 points are needed.

Part B consists of 1 analytical problem.

The total grade on this exam is a weighted average of the grades on the two parts with a weight of 2/3 for Part A and 1/3 for Part B.

Make sure that this copy of the exam bears your matriculation number and name in the appropriate fields at the top of this page.

Good luck!

Part A

1. One of Kaldor´s stylized facts is that the real value of the material capital stock per worker

   ☐ a) is constant over long periods of time;
   ☐ b) grows at a constant rate over long periods of time;
   ☐ c) falls at a constant rate over long periods of time.

2. Assume that GDP is determined by a neo-classical production function $Y = F(K, L)$ and that the labor force L grows at a constant rate $n > 0$. If net investment is $\dot{K} = sY$, $0 < s < 1$, the steady-state growth rate of K is

   ☐ a) equal to n;
   ☐ b) bigger than n;
   ☐ c) smaller than n.

3. The Solow-Swan model predicts that if an otherwise unchanged closed economy experiences a rise of its saving rate to a permanently higher level, then

   ☐ a) the growth rate of GDP per capita will be permanently higher than before;
   ☐ b) the average growth rate of GDP over the following ten years will be higher than before;
   ☐ c) consumption per capita will at first be lower but eventually be higher than it would have been without the increase in the saving rate.

4. The Penn World data 1960-2000 show that between the countries' average (over time) growth rates of GDP per capita and average investment rates there is

   ☐ a) no correlation;
   ☐ b) a positive correlation;
   ☐ c) a negative correlation.

5. If $f(k)$ denotes GDP per unit of effective labor as a function of $k = K/AL$, with $\dot{A}/A = g$, $\dot{L}/L = n$ and the depreciation rate δ, then

$$f'(k) < n + g + \delta$$

   ☐ a) is a criterion for the stability of the steady-state k;
   ☐ b) implies that k is a steady state which does not maximise consumption per effective labor;
   ☐ c) means that k may be an optimum steady state in Ramsey's sense.

6. Assume that in a private-ownership economy with perfectly competitive markets, the representative consumer maximises the present value of instantaneous utility

$$u(c) = \ln c\,.$$

   The consumer's subjective discount rate is 0.05, the growth rate of population and labor force is 0.01, the rate of Harrod-neutral technical progress is 0.02. GDP is produced according to a Cobb-Douglas production function with capital share of $\frac{2}{3}$, and a depreciation rate of 10%. Which of the following statements is correct? In steady-state equilibrium,

   ☐ a) the real rate of interest is 6%, and the capital stock grows at a rate of 3%;
   ☐ b) the real rate of interest is 8%, and real incomes per capita grow at a rate of 1%;
   ☐ c) the real rate of interest is 8%, and aggregate consumption grows at a rate of 3%.

7. Assume that empirical evidence for highly developed industrial economies showed a positive correlation between long-run growth rates of real per-capita income and saving rates. This would

☐ a) be compatible with a neo-classical model of the Solow-Swan-type;
☐ b) be compatible with a neo-classical model assuming exogenous technical progress and optimising consumers;
☐ c) be compatible only with a model of the AK-type.

8. Assume that in a private-ownership economy with perfectly competitive markets final output is produced with a private production function

$$Y = AK^{\alpha}L^{1-\alpha},\ \alpha = \frac{2}{3};$$

L is constant and equal to 1, and the producers do not realise that their total factor productivity depends on the aggregate capital stock such that

$$A = \gamma K^{1-\alpha},\ \gamma = 0.15.$$

The representative consumer maximises the present value of instantaneous utility

$$u(c) = c^{4/5}$$

using a subjective discount rate of 0.02; the capital stock depreciates at a rate of 5%. Under these circumstances the equilibrium growth rate of GDP turns out to be

☐ a) 0%;
☐ b) 15%;
☐ c) 25%.

9. For the economy of problem 8, the socially optimal growth rate is

☐ a) 5%;
☐ b) 40%;
☐ c) 50%.

10. Consider an economy in which final output Y is produced with physical capital K and human capital H according to the production function

$$Y = AK^{\alpha}H^{1-\alpha}, \quad 0 < \alpha < 1,$$

$H = hL$, where L is the constant number of workers (households). Final output is used for investment in physical and human capital; both capital stocks depreciate at the same rate. Households maximise an intertemporal utility function of the same type as in problem 8. Which of the following statements is correct?

- ☐ a) With a constant total factor productivity A, the steady state growth rate of GDP is zero.
- ☐ b) In spite of a constant A, a constant positive growth rate of GDP is possible in equilibrium.
- ☐ c) With a constant A, a positive steady state growth rate of GDP is possible only if the working population L is big enough.

11. Assume that homogeneous final output is produced by price-taking firms with a technology

$$Y = AL^{1-\alpha}X^{\alpha}, \quad 0 < \alpha < 1,$$

where $X = \left[\sum_j \left(a_j x_j\right)^{\alpha}\right]^{1/\alpha}$ for a large constant number N of differentiated inputs $(j = 1,\ldots,N)$ produced by price-making firms at constant marginal and average costs. After k_j innovations the productivity of input j is

$$a_j = q^{k_j}, \qquad q > 1.$$

If you define the aggregate input productivity index as

$$Q = \sum_j \left(a_j\right)^{\alpha/(1-\alpha)},$$

then the Solow residual g is

- ☐ a) $g = \dot{A}/A$;
- ☐ b) $g = \dot{A}/A + \alpha\dot{Q}/Q$;
- ☐ c) $g = \dot{A}/A + (1-\alpha)\dot{Q}/Q$.

12. Given that in the economy of problem 11 the usual assumptions about optimising consumers are fulfilled and the marginal costs of raising the probability of innovations are proportionate to the level of technology already reached. Then, for given A and L,

☐ a) a positive permanent shock to A results in a permanently higher equilibrium growth rate of GDP.
☐ b) a positive permanent shock to L results in a permanently lower equilibrium growth rate of GDP per person.
☐ c) a higher growth rate $\dot{Q}/Q$ of aggregate input productivity is compensated by a fall in $\dot{X}/X$ so that $\dot{Y}/Y$ does not change.

13. Suppose that the following regression equation is estimated

$$g_i = \alpha y_i + \sum_j \beta_j x_{ij} + \varepsilon_i$$

using the Penn World data 1960-2000, where g_i is country $i's$ average growth rate of GDP per capita from 1960 to 2000, y_i is country $i's$ GDP per capita in 1960, and x_{ij} are control variables. If the estimate of α is significantly negative then this

☐ a) is compatible with the predictions of the Solow-Swan model;
☐ b) proves that the AK-Model is correct;
☐ c) is incompatible with the club-convergence hypothesis.

14. Under the conditions specified in problems 11 and 12, an increase in the size q of an innovation implies

☐ a) a higher equilibrium real rate of interest and a higher real growth rate;
☐ b) a higher equilibrium real rate of interest and an unchanged real growth rate;
☐ c) a higher equilibrium real growth rate, but a lower real rate of interest.

Part B

Assume that final output *Y* is produced according to the production function

$$Y = K^{\alpha} X^{1-\alpha}, \quad 0 < \alpha < 1,$$

where *X* is intermediate input produced with the technology

$$X = bY, \qquad b > 0.$$

Assume further that the producers of final and intermediate goods are profit-maximising price takers.

1. Show that in equilibrium $Y = AK$, and determine A!

2. Calculate and compare the private and social marginal productivities of capital!

3. Assume that consumers maximise the present value of instantaneous utility $u(c) = \ln c$ at a subjective discount rate of 2% and that the capital stock K depreciates at a rate of 10%. Assume further that population is constant, $\alpha = \frac{1}{2}$, and $b=1$. Calculate and compare the equilibrium growth rate of Y for a decentralised market economy and the growth rate implemented by a benevolent social planner!

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