**Mock Exam – Answers**

**Group I**

(2 points) Consider an economy that grows in the long run according to the hypotheses of the Solow model and whose production can be described through the following function:

Y = A. K^α. (h.L)^(1-α)

The variables Y, K, h and L represent, respectively, the level of output, physical capital, human capital per capita and the active population. The constant A, which represents the level of technology, is equal to 1 and the elasticity of GDP in relation to physical capital is equal to 0.8. There is no unemployment in the economy.

Assuming that human capital per capita remains constant and equal to 1, that the depreciation rate is 3.5% and that the active population grows at 0.5% per year, calculate the value of the investment rate compatible with a steady state situation in which the capital-product coefficient is equal to 4.

**Answer:**

****

**With *A*=1, *h*=1 e *α*=0,8, comes**

**, from where**

****

**Calculations of steady state:**

***sf(k) = (n+d)K***

**from where**

***s*(*k\**)0,8 = (n+d)*k\****

***s*(*k\**)0,8 = (0,005+0,035)*k\****

***s*(*k\**)0,8 = 0,04*k\****

****

****

**(*k\**)0,2 = 25*s***

**Calculation of investment (savings)**

**Given, then**

****

**Given**

** (data given for the problem)**

**and  (previous calculation)**

**then**

**25*s* = 4, or**

***s* = 0,16**

**The rate of investment compatible with the steady state is 16%.**

(1.5 points) Briefly present the main differences that can be established between the Harrod-Domar and Solow models in terms of their conclusions..

**Harrod-Domar: growth is driven by investment (calibrated by the capital/output ratio). The more investment, the higher the rate of growth. Factors of production are complementary, not substitutable, and s, v and δ are independent. K/L is constant. Does not include a mechanism of adjustment within the model for situations when investment is higher or lower than de desirable rate.**

**Solow: factors of production are substitutable (same growth rates are possible at different combinations of factors of production). The importance of labour is made explicit. If investment forces the capital/output ratio out of its steady state, the model adjusts automatically back to steady state through a steady state path. In steady state, K/L does not change, so growth is driven by growth of the labour force.**

(1.5 points) Explain why, according to the Solow model, it is not possible for an economy to continue to increase its level of productivity indefinitely based solely on the accumulation of physical capital.

**Read Jones and Vollrath. (2013), Introduction to Economic Growth. Norton. 3rd edition (available in pdf from Aquila).**

**Decreasing returns + capital/labour ratio moving out of steady – adjustment back to steady state.**

**Group II**

(2 points) Indicate on which variables and parameters technical progress depends on the Romer model, briefly explaining each one.

**Technical progress on the Romer model is given by the equation**

**dA / dt = θ. LAλ. AΦ**

**, according to which technical progress (adding new ideas to the existing stock of ideas) depends on the variables LA = number of researchers and A = existing stock of ideas; the parameters λ and φ, which express the scale effect of the variables LA and A, respectively; and the constant θ, which represents the component of the researchers' productivity that does not depend on the number of researchers or on the stock of existing ideas.**

(1.5 points) Suppose an economy that behaves according to the Romer model and in which λ = 1, φ = 0.5 and the population grows at a constant rate of 1.5% per year. Knowing that the economy is in a steady state (“balanced growth path”), calculate the rate of growth of the product per capita of this economy.

**In the path of balanced growth, the growth rate of the product per capita is equal to the growth rate of the stock of ideas (pace of technical progress) and both are given by the following formula: gy = gA = λ \* n / (1-φ ). In the case of this economy, λ.n / (1-φ) = 1 \* 0.015 / (1-0.5) = 0.03. Therefore, the rate of growth of the product per capita in this economy is 3% per year.**

(1.5 points) Suppose an economy that behaves according to the Romer model and in which, starting from the steady state (“balanced growth path”), the number of researchers undergoes a sudden increase due to a new policy of attracting researchers foreigners. Explain the short and long term effects of this increase on the GDP growth rate per capita and the mechanisms that explain these effects.

**Read Jones and Vollrath. (2013), Introduction to Economic Growth. Norton. 3rd edition (available in pdf from Aquila).**

**In the short term, the sudden increase in LA causes an increase in the pace of technical progress, as additional new researchers generate a greater relative amount of new ideas (compared to the existing stock of ideas) than previously. That is, dA increases relative to A, so r (A) = dA / A increases. This higher pace of technical progress translates, through the production function, into an increase in the growth rate of the product per capita. However, over time, this effect is diluted as a result of the new ideas thus generated being incorporated into the stock of ideas A, making r (A) (and, consequently, r (y)) converge back to their values. steady state, where gy = gA = λ \* n / (1-φ). In short, there is an acceleration of economic growth in the short term that dissipates in the long term.**

**Group III**

(1.5 points) Between 2014 and 2017, the economy of country X grew in per capita terms of 14350 u.m. to 14450 u.m .. Calculate the average annual growth rate of this economy in this period.

**ln(14450/14350)/3 = 0,0023 = ~0,2%**

(1.5 points) Consider that the global CO2 emissions in 2015 were 10 billion tons. Calculate the product growth rate per capita between 2015 and 2040 which is compatible with: a) a maximum level of emissions of 12 billion tons in 2040; b) a world population growth rate of 1% over the period; and c) and a reduction in CO2 emissions per unit of product at an annual rate of -2.3%.

$r\left(E\right)=\frac{ln\left(\frac{E\_{2040}}{E\_{2015}}\right)}{t}=\frac{ln\left(\frac{12}{10}\right)}{25}=0.007$**3 = ~0,7%**

**r(E/Y) = r(E) – r(Y) = -0,023 ⬄ r(Y) = 0,0073 + 0,023 = 0,0303 = ~3%**

**r(L) = 0,01**

**r(Y/L) = (Y) – r(L) = 0,0303 – 0,01 = 0,0203 = ~2%**

(2 points) Briefly comment on the following statement: If the market works efficiently, the change in relative prices will create incentives for the transition to clean energy sources, solving the problem of climate change.

**Group IV**

(2 points) Briefly comment on the following statement: As the Asian crisis of the late 1990s shows, state intervention in industrial policy is doomed to failure.

**Some authors, like Krugman, argue that industrial policy in the four Asian Tigers led exclusively to expansion of factors of production rather an increase in their productivity. According to them, this would lead to the exhaustion of the system. Lin and others argue that significant departure from comparative advantages (significant market distortion) lead to industrial policy failure. Ha/Jon Chang, Wade, Amsden and others argue that the Asian crisis was triggered by the financialization and property bubble becoming substitutes for industrial policy. Therefore, industrial policy was abandoned because a more speculative, more volatile and more vulnerable way of generating profits substituted for the Asian model of industrial policy. None of them explains why this process of financialization, leading to a speculative bubble, took place – need to go back to Marx’s crisis theories (fall in the rate of profits because of overproduction, underconsumption or the increase in the organic composition of capital) to explain this. In any case, there were successes and failures in industrial policy, but the Asian crisis was not originated in those.**

(1.5 points) Indicate whether the following statement is correct and, if it contains inaccuracies, correct it: the S80 / S20 indicator is a measure of the ratio between the income of the poorest 80% of a population and that of the 20% most thus reflecting a situation of greater equality of income the greater its value.

**S80/S20 = income of the richest 20% divided by the income of the poorest 20%, reflecting a situation of greater inequality of income the greater the value.**

(1.5 points) Distinguish between a "pay as you go" and a "fully funded" systems of social security.

**PAYG: pay as you go) social security system (“repartição” in PT)**

**the workers pay a part of their wages to the SS system (the “TSU”); the SS system transfers all this amount to the old people (retired), according to specific rules, not necessarily related to the amount the retired have previously paid during working life (there are “social pensions”);**

**that is: the workers (young people) transfer this amount to the retired (old people), intergenerational transfers.**

**Fully Funded social security system (“capitalização” in PT)**

**the workers pay a part of their wages to the SS system, that accumulates financial funds, capitalized in the financial markets;**

**SS system pays old-age pension to the retired population according to the amount they had previously contributed to the system and capitalised; no intergenerational transfers**