

Ec 453 Theories of Growth and Development I
Fall 2005, Homework 0

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I) Total world population is estimated to be around 5 billion humans currently. Supposing that the average rate of population growth was 0.005 since Adam and Eve, give a precise answer on how many years ago did Adam and Eve live?

Suppose that you were told that the above data on the average growth rate for the world population is wrong and it should read 0.05, rather than 0.005. How would your calculation change?

II) Consider an economy of two sectors: agriculture and industry. Suppose that both goods are traded; the economy is open to foreign trade; and operates under perfectly competitive conditions. Agricultural good is exported and industrial good is imported. Assume further that the production technology of the economy is such that the industrial sector is more capital intensive than the agricultural sector, i.e., the capital-labor ratio in industry is higher relative to that of agriculture. Finally, assume that labor is homogenous and the labor market is competitive.

1. Draw a hypothetical equilibrium of the economy in an Edgeworth-Bowley box. Be sure to portray all the information with regards to the sectoral structure in your graph. Clearly show the set of Pareto Optimum allocations, and define the concept of Pareto efficiency in this context. Especially, clearly mark whether the Pareto efficiency locus is concave or convex with respect to the horizontal axis.
2. Given that industry is more capital intensive, would you expect that the industrial wages should be higher in comparison to the rural wages, since high capital use in industry would lead to higher productivity?
3. Express analytically what you understand from the phrase, "*the economy... operates under perfectly competitive conditions.*"
4. Consider the competitive equilibrium. Would you expect the trade balance to hold automatically? Suppose that as part of a stabilization programme, the government plans to devalue the exchange rate by 10%. What would you expect to happen?
5. Now suppose that industry is protected by a tariff. Who will relatively benefit more in industry - industrial producers or workers? How is the trade balance affected when measured in world prices? How is it affected when measured in domestic (*i.e.*, tariff-inclusive) prices?
6. Suppose that there is an increase in the labor force by, say 10%. Assuming that the world terms of trade have not changed, what can you say about the levels of output across the two sectors? What do you expect to happen to the real wages? Real profits?

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1) Suppose that in a particular firm output Q is produced by the function $F(K, L)$.

- (i) Show that if $F(.,.)$ represents constant returns to scale technology, then output per labor ($q = K/L$) can be expressed as a function of the capital per labor ($k = K/L$) alone; that is $q = f(k)$.
- (ii) Show that under profit maximization subject to the competitive conditions, the firm will satisfy the following

$$f'(k) = r$$
$$f(k) - kf'(k) = w$$

- (iii) Prove that under constant returns with perfect competition, profits must be zero.

2) Observe the well-celebrated Cobb-Douglas production function with

$$Q = K^\alpha L^\beta$$

Prove that this technology admits increasing returns to scale if $\alpha+\beta>1$; constant returns to scale if $\alpha+\beta=1$; and decreasing returns to scale if $\alpha+\beta<1$.

3) Neoclassical growth theory sees the per capita differences across countries as a result of differences in capital per labor (saving rate differences) and gaps in technology. We have seen in lecture notes that, given a Cobb-Douglas representation of national output, per capita output can be expressed by

$$\frac{Y}{N} = k_y^{\alpha} A^{1-\alpha}$$

where k_y is capital output ratio; and A is an index depicting the level of technology. International evidence suggests that the capital share in output, α , is roughly 0.3; and k_y is governed by the saving rates. Given this formula, and assuming that technology is readily available for all countries, find data on per capita levels and saving rates (savings as a ratio to the GDP) of the following countries: US, Turkey, India, Ethiopia, and Zambia. How does the above neoclassical formula fare in predicting and explaining your data in terms of per capita income differences between US and the remaining countries? How can you improve the predictive powers of the above formula?