Number: _____

Economics 302
Intermediate Macroeconomics
Gerald McIntyre, Ph.D.

Department of Economics
University of British Columbia
Spring 2012

First Exam, Thursday February 9, 2012 – Answers

Write your number from the sign-in sheet at the top of this exam. Read all directions carefully. You have 80 minutes to complete this exam. There are several choices on the exam – choose well. Put all numerical answers in a box. Show all of your work! Total points: 58.

Part A: **Identification**. Provide a short definition for **2** of the following **3** terms (3 points each, 6 points total).

1. M2: M1 (currency plus demand deposits and other checkable accounts) + small time deposits, savings deposits, money market mutual funds, money market deposit accounts.

2. Fisher Effect: in the long run the real interest rate is determined by the supply and demand for loanable funds (in a closed economy) so that there is a one-to-one relationship between inflation and the nominal interest rate.

3. Conditional convergence: cross-country studies fail to show that output per worker in many countries convergences to output per worker in rich countries, there is evidence that countries converge to their own steady states as determined by their own savings rates, population growth rates, rates of depreciation, capital share and technological progress.

Part B: **True, False, Uncertain and Explain**. Answer **2** of the following **3** questions. (8 points each, 16 points total; all credit for the explanation)

4. In the long run a decrease in government saving of $1 causes investment to fall by $1.

Uncertain. Much depends on how the decrease in government saving arises, whether Ricardian Equivalence holds and the form of the Keynesian consumption function.

Suppose the fall in government savings is due to a $1 tax cut. From $Y - C - G = I(r)$ we can see national saving changes to the extent consumption changes. Using the Keynesian consumption model where $C = a + b(Y - T)$ we have $\Delta C = -b\Delta T > 0$ so national saving and investment fall by $b\Delta T < 0$.

If, however, consumers are Ricardian and not Keynesian, then they will save all of the tax cut to cover their future tax liability (or the future tax liability of their children or their dynasty) and $\Delta C = 0$, meaning national saving and investment do not change.

If the decrease in government saving is due solely to an increase in government spending by $1 then from $Y - C - G = I(r)$ we can see that investment is crowded out one-for-one if the consumption function is Keynesian (as written above) and does not depend (negatively) on the real interest rate. The idea is that an increase in government spending, reduces government saving and national saving by $1 causing a $1 shortage of loanable funds, which bids up the real interest rate until $1 of investment demand is crowded out. If, on the other hand, the consumption function was $C = a + b(Y - T) - \theta r$ where $\theta > 0$ then private saving would be a positive function of the real interest rate. The shortage of loanable funds due to the additional government spending would again bid up the real interest rate, which would encourage households to reduce consumption, that is, save more and, partially, replace the lost government saving. In this case, investment would still be crowded out but by less than one-for-one.

5. In the Solow growth model, if in the steady state the marginal product of capital is 0.10, the depreciation rate is 0.05 per year, the rate of population growth is 0.04 per year, and the efficiency of labour grows 0.02 per year, then currently alive generations will likely resist any policies that would move the economy to the Golden Rule.

False. MPK = 0.10 while $\delta + n + gE = 0.11$ so MPK $< \delta + n + g_E$. Since we have diminishing MPK the economy presently has too much capital vis-à-vis the golden rule. A fall in the saving rate, which would immediately increase in consumption, would be necessary to move the economy to the golden rule. Thus current generations would not resist this policy since their immediate consumption would increase.

6. In the Solow growth model with labour augmenting technological change the real wage and the real rental price paid to capital both grow at the rate of technological progress in the steady state.

False.

We have $Y = K^a(EL)^{1-a}$ and so since W/P = MPL we have $W/P = (1 - a)K^aE^{1-a}L^{-a} = (1 - a)Y/L$. Then using the growth trick we have $g_{W/P} = g_Y - g_L = (g_E + g_L) - g_L = g_E$ so the first part of the statement is true; the real wage and the marginal product of labor grow at the rate of technological progress.

As for R/P = MPK we have $R/P = aK^{a-1}(EL)^{1-a} = ak^{a-1}$ where k = K/EL. Since k is constant in the steady state, the real rental price of capital and the marginal product of capital are constant in the steady state. We can see this graphically since the MPK is the slope of the production function and in the steady state, k is not changing, so the slope is not changing.

Part C: **Analytic Questions** Answer the next **3** questions (12 points each, 36 points total).

7. Suppose a war reduces a country's labour force but does not directly change its total capital stock. Describe the *immediate* impact on total output, output per worker, consumption per worker, and investment per worker. Next, describe the adjustment process for all of these variables during the transition to the steady state.

With fewer workers but the same capital stock total output must fall ($Y = K^{a}L^{1-a}$). Since k = K/L and L falls we can see that k rises, that is, capital per worker rises because there are few workers due to the war but the same capital stock. This indicates that the economy has jumped to a capital stock per worker above the steady state. When k increases, output per worker increases, so y increases. Investment per worker also increases since i = sy and y has increased. We cannot tell what happens to consumption per worker as we do not know were the golden rule steady state is located vis-à-vis the original steady state.

As for the adjustment process to the steady state due to the linear breakeven investment line and the curvature of the saving function it must be the case that breakeven investment exceeds saving so the capital stock per worker is falling for two reasons: more is depreciating than can be replaced by saving and new workers are being born who must be given capital from existing workers. Together these imply that capital per worker is falling during the adjustment, so output y = f(k) is also falling. Total output is rising, however, the total capital stock is not falling and the labor force is increasing due to population growth. Investment per worker falls, this is why the capital stock per worker falls but the effect on consumption is unknown since we do not know whether the economy is moving closer to or farther from the golden rule.

8. Suppose real GDP in an economy can be described by a Cobb-Douglass production function with capital share of GDP equal to one-third.

    a. If the economy saves 27% of national income and population growth, depreciation and the growth of efficiency workers are all 1% per year find the steady state levels of the capital stock per effective worker, output per effective worker, consumption per effective worker and saving per effective worker.

    $0.27k^{1/3} = 0.03k$ yields k = 27, y = 3, c = (1 – 0.27)(3) = 2.19, and saving 0.27(3) = 0.81.

    b. Find the values for all of these variables at the golden rule steady state.

    The two conditions for the golden rule are either MPk = (δ + n + gE) = 0.03 or the golden rule saving rate = α = 1/3. Using the first we get:

    $(1/3)k^{-2/3} = 0.03$ or $k^{-2/3} = 0.09$, so $k = (1/0.09)^{3/2} = 37.04$, y = 3.33, c = 2.22 and saving per worker is 1.11.

9. In the early 19th century Thomas Malthus predicted that population growth would outstrip the Earth's ability to produce, leading to the impoverishment of humanity.
    a. Use the Solow model of economic growth *without technological change* to analyze Malthus' claim, if the term "impoverishment" means a decline in income per capita.

An increase in the population growth rate will reduce output per worker in the Solow model of economic growth without technological change. So this model confirms Malthus.

    b. What does your result in part (a) tell us about Malthus' model as a description of the *real world* since the time he wrote?

The result in part a) demonstrates that Malthus was wrong in that his result depends on no technological progress which we know has taken place since he wrote. Put another way, his impoverishment argument only holds if there is no technological change.

    c. Describe Michael Kremer's model of the relationship between the size of population and the level of income per capita over the course of many centuries. Does Kremer's model confirm or refute Malthus' model? Why or why not?

Kremer argues that the larger the population the more geniuses, the more innovators and inventors, the greater the chance that previous technological advances will be remembered and improved on. Thus, income per capita should be higher with higher populations and this is true. He presents provocative evidence from Australia, Tasmania and Flinders Island to support his claim that those regions with higher populations, namely, Australia, had higher income per capita while smaller populations on Tasmania and Flinders Island regressed. Kremer refutes the Malthusian claim that the relationship between population and income per worker should be negative.