Economics 304
Homework #4 - Desired Capital, Investment, and Goods Market Equilibrium

Due Wednesday, 2/15 at the beginning of class – you must hand in homework in the section you are registered in - no late papers accepted!

Instructions: Please show all work or points will be taken off. Good luck!

1. PART I (35 points total – 5 points for each part and 10 points for the diagram) You own a golf course in Florida and you need to determine how many golf carts you need to buy to maximize profits. Please answer the following questions given the information below.

A brand new golf cart costs 600 rounds of golf and the rate of depreciation is 16% (.16).

The real interest rate is 4% (use .04 in calculations).

The expected marginal product of capital is given by \( \text{MPK} = 500 - 5K \).

a) What is the user cost of capital and what is it expressed in??

\[
\text{UC} = (r + d) \cdot P_k = (0.04 + 0.16) \cdot 600 = 120
\]

b) How many golf carts should you buy to maximize profits (i.e., what is \( K^* \))? 

Draw a graph (the uc / MPK graph) depicting the state of affairs and label this initial profit maximizing point as point A.

A completely labeled and correct graph is worth 10 points.
c) Now suppose the (local) government with all their financial shortfalls embarks on a campaign to raise revenue to fund the fire department by imposing a so-called "luxury tax" (we know it as \( t \)) equal to 20% of gross revenue. What happens to the profit maximizing number of golf carts? Please show all work and label as point B on your uc/MPK graph.

\[
U_C = \frac{(1 + t) P_K}{1 - t} \\
= \frac{(0.04 + 0.1b) 600}{1 - 0.2} \\
= 150 - 500 - 5K \\
k = 70
\]

d) Now explain why your profit maximizing \( K^* \) has changed. Please be specific using the firm’s profit maximizing condition (explain the intuition). Start your answer with “If I did not change my capital input (my \( K^* \)), then I would not be ………(you can finish the rest)…………….”

If I did not change my capital input (my \( K^* \)), then I would not be meeting the profit maximizing condition. In this case \( UC = MPK \) .

I have to decrease my input capital until \( UC = MPK \).

e) The Federal government, knowing all about the financial pains encountered by state and local governments given the Great Recession, decide to offer an investment tax credit equal to 30% (this is in addition to the tax already imposed by the local government). What is your desired capital stock (\( K^* \)) now? (Hint: An investment tax credit effectively reduces the price of capital to the firm – think of it as this - under the investment tax credit - you buy a golf cart (cost = 600 rounds of golf) and you get a 30% rebate from Uncle Sam so the investment tax credit adjusted price of the golf cart is now 420 rounds of golf \([(1 - 0.30 ) \times 600 = 420] \). Please show all work again and label this as point C on your uc/MPK diagram.

\[
UC = \frac{(1 + t + d) (1 - ITC) P_K}{1 - t} \\
= \frac{(0.104 + 0.1b)(1 - 0.3) 600}{1 - 0.2} \\
= 105 - 500 - 5K \\
k = 70
\]

1. PART 2 (NEW GRADER – 35 points – 5 for f) and g) 10 for h) and 15 for graph)) Draw a desired investment diagram (completely labeled with all the shift variables noted next to the function in parentheses with signs (+ or -)) depicting the initial equilibrium as point A (simply draw a negatively sloped \( I^D \) curve going through point A). Label the initial real interest rate as \( r_A^* = 0.04 \) (as is given above) and the initial level of desired investment as \( I^d_A \). Note importantly that we do not have numbers for desired investment, but that’s ok, we are focusing on the change in desired investment, given the same real rate = .04. Be sure to include all of the shift variables in parentheses next to this initial \( I^D \) function.

A completely labeled and correct graph is worth 15 points.

Then show, as point B, the new level of desired investment, at the same real rate = .04.
f) Why did the level of desired investment change, even though the real rate of interest did not? Please be specific using the equation that connects the desired capital stock \( (K^*) \) to desired investment (as we did in class (equation 4.6... in text)).

Label this (new) level of desired investment as \( I^d_b \) (again, we don't have specific numbers for \( I^d_n \). Be sure to include all of the shift variables in parentheses next to your new \( I^d \) function.

Finally, show how the investment tax credit maps to your desired investment diagram and label this final point as point C. Label this (new) level of desired investment as \( I^d_C \) (again, we don't have specific numbers for \( I^d_C \)). Make sure you include all of shift variables in parentheses next to your new \( I^d \) function.

\[ I^d = K^* - K + dK_t \]

From part a to part b, we can know when \( t \) increases from 0 to 0.12, \( v \) stays constant, resulting in a decrease in \( K^* \). According to \( I^d = K^* - K + dK_t \), the investment decreases.

From part b to part c, we can also know the investment will change result from the change in ITC (increase) and let \( v \) stays the same.

g) Suppose that the Federal Reserve had a goal to get the capital stock (the number of golf carts purchased) back to its initial level as in part b (this would keep the economy from overheating). Given all the changes (the imposition of the tax by the local government and the investment tax credit offered by the Federal Government), what would they have to do to the real rate of interest to achieve their objective? Please show all work and I am looking for a specific number (i.e., \( r = ? \)).

\[
120 = \frac{(r+0.16)(1-0.2)(1-0.3) \times 100}{1-0.2} = (r+0.16)(0.7) \times 100
\]

\[ 120 - 0.8 = (1+0.16)0.7 \times 100 \]

\[ r = \frac{120 + 0.8}{0.7 \times 100} - 0.16 = 0.0685 \approx 0.0686 \]

h) (10 points) Finally, explain how this most previous development (a change in \( r \)) would influence your two diagrams and why. Don't show on your TWO diagrams, I am asking for a discussion (this question is worth ten points!)

Past \( r = 0.04 \)

Now \( r = 0.0686 \)

The UC/MPK graph, when \( r \) increase, UC decrease. Therefore, it makes \( K \) decrease. The \( r \) change cause the movement along on MPK. The Shift is caused by Total Factor Productivity (A) and Animal Spirit (AS).

The desired investment diagram, when \( r \) increase then \( I^d \) decrease. The \( r \) change cause the movement along on \( I^d \). The shift is caused by depreciation (d), Investment Tax Credit (ITC), Price of Capital (Pc), Tax (t), Total Factor Productivity (A) and Animal Spirit (AS).
2. (50 points total – 5 points each part except part f = 10 points + diagram = 10 points) A closed economy has full employment level of output (Y) of 2000 (we got this from chapter 3 - the interaction of labor supply and demand...aka, the scarecrow!). Government purchases, G, are 200, taxes (T) are also 200 (G and T are our exogenous variables). Desired consumption (C^d) and investment (I^d) are:

\[ C^d = 400 + 0.5(Y - T) - 600r \]

\[ I^d = 600 - 400r \]

\( a) \) Solve for the desired savings function in intercept - slope form (note, the intercept is an integer).

\[ S = \{ 400 + 0.5(Y - T) - 600r \} - 200 \]

\[ = 2000 \{ 400 + 0.5(2000 - 200) - 600r \} - 200 \]

\[ = 2000 \{ 400 + 900 - 600r \} - 200 \]

\[ = 2000 - 1300 + 600r - 200 \]

\[ = 500 + 600r \]

\( b) \) Name all the shift variables that are implicitly in the intercept of your savings function along with whether they share a positive or negative relationship with desired savings.

\[ + \text{ positive relationship } \]

\[ - \text{ negative relationship } \]

\[ S \{ Y, \alpha, Y^f, \alpha^f, CC, G, T \} \]

\( c) \) Now solve for the goods market clearing interest rate. Please show all work.

Draw a desired savings/investment diagram locating this initial equilibrium and point A.

A correct and completely labeled diagram is worth 10 points

\[ S = I \]

\[ 500 + 600Y = 600 - 400Y \]

\[ 1000Y = 100 \]

\[ Y = 0.1 \]

\( d) \) We know that GDP (Y) is comprised of C + I + G given our closed economy assumption. Calculate the level of C, I, and G respectively along with the percent of each, relative to GDP.

\[ C = 400 + 0.5(Y - T) - 600Y \]

\[ = 400 + 0.5(2000 - 200) - 600 \cdot 0.1 \]

\[ = 1240 \]

\[ I = 600 - 400Y \]

\[ = 600 - 400 \cdot 0.1 \]

\[ = 560 \]

\[ G = 200 \]

\[ \frac{1240}{2000} = 0.62 \]

\[ \frac{560}{2000} = 0.28 \]

\[ \frac{700}{2000} = 0.1 \]
e) We now consider expansionary fiscal policy as in an increase in \( G \). In particular, \( G \) rises from 200 to 300. We are assuming the government spending multiplier is zero so that GDP is unaffected and remains at 2000. Click Here for Barro (a very noteworthy economist) arguing that government spending multipliers are likely to be zero! (Classical for sure!) Resolve for the new market clearing interest rate and the associated levels of savings and investment.

\[
Y = C + I + G \\
S = I \\
2000 = 400 + 0.5(Y - T) - 600Y + 600 - 400Y + 300 \\
2000 = 400 + 900 - 1000Y + 900 \\
1000Y = 2000 \\
Y = 2 \text{ (2000)}
\]

Add this development to your diagram and label as point B.

\[
I = 600 - 400Y \\
= 600 - 400 \cdot 0.2 \\
= 520
\]

f) (10 points total - 5 for discussion, 5 for graph) What has happened to the level of desired investment and why? Support your argument by drawing a user cost – MPK\( f \) diagram showing the movement from A to B. What is this phenomenon referred to? Click Here for a huge hint!

When \( Y \) increase, UC will increase and \( K^* \) will decrease. Furthermore, the investment will decrease.

According to crowding out, when government spending increase, interest rate increase, then the level of MPK\( f (AS, A) \) desired investment will decrease.

g) What has happened to the level of desired consumption and why? Be specific and be sure to refer to the substitution effect in your answer!

When \( Y \) increase from 10\% to 20\%, the level of desired consumption decrease from $1,240 to $1,180, and the investment also decrease from $560 to $520. According to Substitution effect, when interest rate increase, people are willing to substitute current consumption towards future consumption.