Department of Economics University of Maryland

Economics 325

Intermediate Macroeconomic Analysis

Problem Set 1 – Suggested Solutions

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Instructions: Written (typed is strongly preferred, but not required) solutions must be submitted no later than 2:00pm on the date listed above.

You must submit your own independently-written solutions. You are permitted (in fact, encouraged) to work in groups to think through issues and ideas, but you must submit your own independently-written solutions. **Under no circumstances will multiple verbatim identical solutions be considered acceptable.**

Your solutions, which likely require some combination of mathematical derivations, economic reasoning, graphical analysis, and pure logic, should be **clearly, logically, and thoroughly presented;** they should not leave the reader (i.e., your TAs and I) guessing about what you actually meant. Your method of argument(s) and approach to problems is as important as, if not more important than, your "final answer." Throughout, your analysis should be based on the frameworks, concepts, and methods developed in class.

There are a total of three problems, each with multiple subparts.

Problem 1: Consumption, Savings, and Borrowing Constraints (45 points). In this problem, you will **formally** study how borrowing constraints might affect the representative consumer's optimization problem. To keep things tractable, you will numerically study optimal choices when there are no borrowing constraints at all; and then you will study optimal choices when there are borrowing constraints that affect the consumer's optimal decisions (i.e., all of the analysis is Lagrangian analysis).

The representative consumer's lifetime utility function is $\ln c_1 + \ln c_2$, in which there is no discounting (of future utility) at all. There is also no government at all, hence taxes and government spending are always zero.

Numerical values for required items are: $y_1 = 5$, $y_2 = 15$, $a_0 = 5$, $r = 0.05$, $a_2 = 0$ (this last is as usual); furthermore, suppose this is a purely real economy (i.e., there is never any inflation).

For the first parts of the question, suppose there is no borrowing constraint at all.

a. **(4 points)** Set up a **sequential** Lagrange optimization problem consistent with the above facts.

Solution: The sequential Lagrangian is

$$\ln c_1 + \ln c_2 + \lambda_1 \left[y_1 + (1+r)a_0 - c_1 - a_1 \right] + \lambda_2 \left[y_2 + (1+r)a_1 - c_2 \right]$$

with standard notation (in particular, λ_1 is the multiplier on the period-1 budget constraint, and λ_2 is the multiplier on the period-2 budget constraint). Note a **lifetime** Lagrangian received **zero** credit here (even though you may have solved it correctly in the next parts of the question – if so, you were awarded full credit in subsequent parts).

b. **(10 points)** Based on the Lagrange optimization problem you constructed in part a, solve for the numerical values of optimal choices of period-1 consumption and period-2 consumption.

Solution: Based on the sequential Lagrange above, the first-order conditions on c_1, c_2, and a_1 are, respectively,

$$\frac{1}{c_1} - \lambda_1 = 0$$

$$\frac{1}{c_2} - \lambda_2 = 0$$

$$-\lambda_1 + \lambda_2(1+r) = 0$$

As usual, take the third first-order condition (on a_1) to solve for either of the two multipliers. Then take this expression and use it to substitute into one of the other two first-order conditions. Substituting this into the other first-order condition gives the standard consumption-savings optimality condition, $\frac{1/c_1}{1/c_2} = 1+r$, or, rearranged, $\frac{c_2}{c_1} = 1+r$. Rearranged even further, we have that $c_2 = (1+r)c_1$ at the optimal choice. In terms of the numerical values above, this equation says that that $c_2 = (1+0.05)c_1$.

This is one equation in two variables. The other equation needed is the **lifetime** budget constraint (which, note, is not the budget constraint, in the **sequential** Lagrangian above – but that's fine, it's a true statement, nonetheless). The lifetime budget constraint (LBC) of the consumer is the usual

$$c_1 + \frac{c_2}{1+r} = y_1 + \frac{y_2}{1+r} + (1+r)a_0,$$

which, when inserting the given numerical values, is $c_1 + \frac{(1+0.05)c_1}{1+0.05} = 5 + \frac{15}{1+0.05} + (1+0.05)5$ (in writing this expression, the second term on the left-hand side brings the result of the consumption-savings condition in). Solving for the optimal choice of period-1 consumption, $2c_1 = 24.5357$, or $c_1 = 12.2679$. Hence, based on the consumption-savings optimality condition, $c_2 = (1+0.05)c_1 = 12.8813$.

c. **(4 points)** What is the consumer's asset position at the end of period 1? And, related, is period-1 savings of the consumer positive, negative, or zero? Briefly explain the economics.

Solution: Based on the solution in part b, period-1 savings is

$$\begin{aligned} s_1 &= a_1 - a_0 \\ &= y_1 + ra_0 - c_1 \\ &= 5 + (0.05)5 - 12.2679 \\ &= -7.0179 \end{aligned}$$

Given the initial asset holdings a_0 = 5, this implies a_1 = -2.0179. The consumer is in debt at the end of period one. And the reason is simply that he wants to consume more in period one than his total resources (which is his period-one income y_1 **and** his gross asset income $(1+r)a_0$ = (1+0.05)*5.

For the remainder of the question, suppose there is a borrowing constraint. In particular, suppose the consumer can borrow zero during period one. For possible use in the Lagrangian below, write this term as

$$... + \mu \cdot (\text{zero borrowing})$$

where the ellipsis indicate things that come before the borrowing constraint, and $\mu > 0$ (the Greek letter "mu") is the Lagrange multiplier on the borrowing constraint**.**

d. **(4 points)** Starting from the sequential Lagrange you constructed in part a, what is now the Lagrange optimization problem? If there are no other terms in the problem, briefly explain why not. If there are other terms in the problem, briefly explain their economic content.

Solution: There are a few different ways to construct the "zero borrowing" constraint. The most straightforward is to suppose that period-one consumption **cannot** be larger than period-one resources: that is, simply the period-one budget constraint, $c_1 = y_1 + (1+r)a_0$. Note that this is a **different** constraint than either the period-one budget constraint or the period-two budget constraint – it simply asserts that the individual cannot borrow during period one.

Hence, the sequential "Lagrangian" is

$$\ln c_1 + \ln c_2 + \lambda_1 \left[y_1 + (1+r)a_0 - c_1 - a_1 \right] + \lambda_2 \left[y_2 + (1+r)a_1 - c_2 \right] + \mu \left(y_1 + (1+r)a_0 - c_1 \right),$$

which is technically fine (even though there is more to say about this "Lagrangian" in the next parts below).

e. **(10 points)** Starting from the Lagrange optimization problem you constructed in part d, solve for the optimal choices of period-1 consumption and period-2 consumption.

Solution: In principle, the "Lagrangian" set up in part d cannot be solved as usual (i.e., the "usual" first-order conditions cannot in principle be computed). However, one can reason their way through the problem.

There are two possible cases. First, suppose that the no borrowing constraint does **not** bind (i.e., $\mu = 0$). In this case, we would solve the same exact problem as in parts b and c, and get the same answer. However, there we concluded that the consumer's asset position was **negative.** Hence, the no borrowing constraint must have bound, hence this is a contradiction.

Thus, the borrowing constraint **does** bind (i.e., $\mu > 0$). In this case, we can go straight to the borrowing constraint, which tells us that period-one consumption must be

$c_1 = y_1 + (1+r)a_0 = 5 + (1+0.05)\cdot 5 = 10.25$. This implies that the asset position at the end of period one is exactly $a_1 = 0$.

Then, in period two, the consumer begins with zero assets (and hence zero asset income), and simply has $c_2 = y_2 = 15$ (given that we have that $a_2 = 0$ at the end of his planning horizon).

f. **(4 points)** At the optimal choice computed in part e, what is the numerical value of the Lagrange multiplier on the borrowing constraint (i.e., of μ)?

Solution: Now, based on the logically computed solutions found (for c_1 and c_2) in part e, set things up to compute the numerical value of the no-borrowing constraint (this was the hardest part of the problem). Specifically, the first-order conditions on c_1, c_2, and a_1 are, respectively,

$$\frac{1}{c_1} - \lambda_1 - \mu = 0$$

$$\frac{1}{c_2} - \lambda_2 = 0$$

$$-\lambda_1 + (1+r)\lambda_2 = 0$$

Note that the multiplier μ appears in the first-order condition for c_1, which is a key observation.

As before, take the third first-order condition (on a_1) to solve for either of the two multipliers. Then take this expression and use it to substitute into one of the other two first-order conditions – let's focus in particular on the first-order condition for c_1.

The difference, as noted above, compared to the above set of substitutions (in part b in particular) is that the multiplier mu appears explicitly in the first-order condition on c1. The substitution of mu into the first-order condition on c_1 gives

$$\mu = \frac{1}{c_1} - (1+r)\lambda_2 .$$

The difference with a standard condition is that $\mu = 0$ if there is no borrowing constraint; whereas here, we have μ appear. Proceeding, substitute λ_2 into this expression, which gives

$$\mu = \frac{1}{c_1} - (1+r)\frac{1}{c_2} .$$

Rearranging this expression so it looks like the "usual" consumption-savings optimality condition,

$$\frac{c_2}{c_1} = (1+r) + \mu c_2$$

This clearly looks different than the standard consumption-savings optimality condition; but if $\mu = 0$, this would simple be exactly that condition.

Taking the **part e** logically-computed values of c_1 and c_2, this equation (when solved for μ) gives

$$\begin{aligned}\mu &= \frac{1}{c_1} - (1+r)\frac{1}{c_2} \\ &= \frac{1}{10.25} - (1+0.05)\frac{1}{15} \\ &= 0.0276\end{aligned}$$

which obviously is larger than zero.

g. **(4 points)** What is the numerical value of the consumer's asset position at the end of period 1? And, related, is period-1 savings of the consumer positive, negative, or zero? Are these answers different from, or identical to, your answers in part c? Briefly explain the economics.

Solution: The answer for this appeared (incidentally) in part e: the consumer's asset position at the end of period one is exactly $a_1 = 0$. In turn (and also computed there) was the fact that the individual **does** dissave (negative savings) in period one – simply not as much as he could originally (he now dissaves less because of the no-borrowing constraint).

h. **(5 points)** Under which scenario (no borrowing constraint, or a borrowing constraint that exists) is the individual's lifetime utility maximized? Briefly explain the economics.

Solution: Compute the two utility levels (which do not mean anything per se – they simply allow us to make a comparison).

In the first (no borrowing constraint at all) case, his lifetime utility was

$$\ln c_1 + \ln c_2 = 12.2679 + 12.8813 = 5.0628.$$

In the second (borrowing constraint) case, his lifetime utility was

$$\ln c_1 + \ln c_2 = 10.25 + 15 = 5.0353.$$

Clearly, he is worse off under the borrowing restriction. Note that there is **no** cardinal sense of utility here – all the measure allows us to say is he is worse off under the no borrowing restriction.

Also note that what matters is **the (sum of the) natural log of consumption,** not consumption itself. Because the natural log function is nonlinear, it is **not** the case that the individual is better off just because the sum of the consumption values is higher in the latter case – a good example of utility versus consumption directly.

Problem 2: Taxation Dynamics in the Two-Period Model (24 points). Suppose the government is considering how to balance its two-period (i.e., its lifetime) budget constraint. No matter what, it must be the case that $b_2 = 0$ (i.e., just like the representative consumer, the government cannot end its existence in debt, nor will it, due to some unnamed lifetime utility function, end with strictly positive assets).

For the analysis of this problem, consider four successively simplifying assumptions:

1. Consider **ONLY** the optimality conditions of the consumer sector during the two periods (i.e., do not consider any of the budget constraints at all).

2. More precisely, take the results of other models (in particular, consumption-labor and consumption-savings) as given. In particular, the consumption-labor optimality conditions are $\frac{u_l(c_1,l_1)}{u_c(c_1,l_1)} = (1-t_1)w_1$ and $\frac{u_l(c_2,l_2)}{u_c(c_2,l_2)} = (1-t_2)w_2$. And the consumption-savings optimality condition is $\frac{u_{c_1}(c_1,c_2)}{u_{c_2}(c_1,c_2)} = 1+r$.

3. All of the taxes that appear in the three equations above are at play, but there are **NO** other types of non-lump-sum taxes that can be implemented.

4. Prices in both labor markets (i.e., $w_1 > 0$ and $w_2 > 0$) and in the financial market (i.e., $r > 0$) are unchanging as various fiscal policy choices are considered.

Suppose that government spending is constant (and strictly positive) in each of periods one and two (of course, the practical policy discussions are also about government spending). Thus, you can think of the government debating only how to change its collection of **BOTH** lump-sum taxes $T_1 > 0$ and $T_2 > 0$, **AND** of non-lump-sum labor income taxes $t_1 > 0$ and $t_2 > 0$, **AND** (by implication) bond holdings b_1 between period one and period two.

a. **(4 points)** Construct the single two-period (i.e., lifetime) government budget constraint starting from the two period-by-period (i.e., period one and period two) budget constraints. Show any important steps, and briefly explain the economics.

Solution: The period-one and period-two budget constraints of the government are

$$g_1 + b_1 - b_0 = t_1 + rb_0 + \text{non-lump-sump}_1$$
$$g_2 + b_2 - b_1 = t_2 + rb_1 + \text{non-lump-sump}_2$$

in which the terms "non-lump-sum" stand for total taxes collected via something besides lump-sum taxes. Combining these two budget constraints (and, as usual, setting $b_2 = 0$) gives

$$g_1 + \frac{g_2}{1+r} = t_1 + \frac{t_2}{1+r} + \text{non-lump-sum}_1 + \frac{\text{non-lump-sum}_2}{1+r} + (1+r)b_0$$

The interpretation of the government lifetime budget constraint (GLBC) is as usual, but the terms on the right-hand side (the tax collection terms) are slightly more general. In this problem, there are both lump-sum taxes (in periods one and two), as well as non-lump-sum taxes (in periods one and two). Of course, these **four** tax terms can be combined into the standard **two** tax terms if one wants, but it would have to be clearly indicated that this **new** tax term is not necessarily lump-sum.

It is very instructive to continue with the GLBC presented above.

For the rest of the problems, it is also instructive to introduce a utility function for consumers: suppose it is ln c_1 + ln l_1 + ln c_2 + ln l_2 (it doesn't matter if it's this precise function or not; what is needed is strictly increasing and strictly concave utility generally). For this function, the marginal utility functions are also easy to compute: $u_c(c_1,l_1) = 1/c_1, u_l(c_1,l_1) = 1/l_1, u_c(c_2,l_2) = 1/c_2, u_l(c_2,l_2) = 1/l_2$**.**

Hence these can be used in setting up the consumption-leisure conditions presented above.

The solution to the *pair* of equations just mentioned AND (importantly) the GLBC will define the utility to the consumer of each particular taxation approach below. To make things simple (and because what matters is *differences* in utility, *not* utility itself), let's choose some very simple numbers for the problem: suppose $w_1 = w_2 = 1$, $r = 0.1$, $g_1 = 3$, $g_2 = 3.3$. Importantly, the b_0 term is left unspecified for now.

Substituting (slowly) all of these numerical values into the consolidated GLBC,

$$3 + \frac{3.3}{1+0.1} = t_1 + \frac{t_2}{1+0.1} + \text{non-lump-sum}_1 + \frac{\text{non-lump-sum}_2}{1+0.1} + (1+0.05)\cdot b_0$$

or, simplified a bit,

$$6 = t_1 + \frac{t_2}{1+0.1} + \text{non-lump-sum}_1 + \frac{\text{non-lump-sum}_2}{1+0.1} + 1.05\cdot b_0 .$$

Until the last part of the question (part f), the precise numerical values of the lump-sum taxes also don't matter – so let's make an assumption regarding these as well: lump-sum taxes are $t_1 = 2$ and $t_2 = 2.2$. The GLBC then reads

$$6 = 2 + \frac{2.2}{1+0.1} + \text{non-lump-sum}_1 + \frac{\text{non-lump-sum}_2}{1+0.1} + 1.05\cdot b_0$$

or, simplifying even further,

$$6 = 4 + \text{non-lump-sum}_1 + \frac{\text{non-lump-sum}_2}{1+0.1} + 1.05 \cdot b_0,$$

or

$$2 = \text{non-lump-sum}_1 + \frac{\text{non-lump-sum}_2}{1+0.1} + 1.05 \cdot b_0 .$$

Finally, in the rest of what follows, let's abbreviate the non-lump-sum taxes as "non" (for both periods one, non_1, and two, non_2).

b. **(4 points)** Suppose the government proposes to collect very low labor income taxes in period one, and much higher labor income taxes in period two. From the perspective of the very beginning of period one, **briefly (in no more than three sentences)** show/discuss whether this proposal is optimal (i.e., enhances **consumers' lifetime utility**) or not? **Briefly discuss (among your three sentences) the economic intuition.**

Solution: This proposal is **not** optimal from the consumers' perspective. Given the above assumptions, suppose that the government proposes to collect $non_1 = 0.01$ and $non_2 = 0.11$ (once again, the precise numerical values also don't matter, but this illustrates the idea of the question). The calculations below show that this combination cannot maximize consumers' utility, because **(and this is the crucial issue)** it does not satisfy "consumption smoothing" (i.e., it does not satisfy equality of consumption in all periods).

Given the very large amount of questions this issue raised, let's compute this in detail. The following calculations (which now also includes the pair of consumption-leisure optimality conditions) at the start of the calculation,

$$\frac{1/l_1}{1/c_1} = (1-0.01)\cdot 1$$

$$\frac{1/l_2}{1/c_2} = (1-0.11)\cdot 1$$

$$2 = 0.01 + \frac{0.11}{1+0.1} + 1.05 \cdot b_0$$

Proceeding slowly, we can rewrite the first two equations, and simply compute the bottom equation, as

$$\frac{c_1}{l_1} = (1-0.01)\cdot 1$$
$$\frac{c_2}{l_2} = (1-0.11)\cdot 1$$
$$2 = 0.11 + 1.05\cdot b_0$$

or even more concisely,

$$\frac{c_1}{l_1} = 0.99$$
$$\frac{c_2}{l_2} = 0.89$$
$$2 = 0.11 + 1.05\cdot b_0$$

or even **more** concisely,

$$c_1 = 0.99\cdot l_1$$
$$c_2 = 0.89\cdot l_2 \qquad .$$
$$2 = 0.11 + 1.05\cdot b_0$$

The first two expressions allow us to write lifetime utility as

$$\ln(0.99\cdot l_1) + \ln(l_1) + \ln(0.89\cdot l_2) + \ln(l_2)$$

This is one equation in the two unknowns, l_1 and l_2. The other equation of the original triple helps resolve the system – that is, b_0 was unspecified, so now let's set it appropriately to make sure the third equation (the GLBC) is satisfied.

Now we can examine the equation above: $\ln(0.99\cdot l_1) + \ln(l_1) + \ln(0.89\cdot l_2) + \ln(l_2)$ does **not** satisfy "consumption smoothing" (or, technically, "leisure smoothing" – but we can invert the leisure terms to write things in terms of consumption instead, because there is a one-to-one mapping in each period), hence is **not** the optimal choice.

c. **(4 points)** Suppose the government proposes to collect very high labor income taxes in period one, and much lower labor income taxes in period two. From the perspective of the very beginning of period one, **briefly (in no more than three sentences)** show/discuss whether this proposal is optimal (i.e., enhances **consumers' lifetime utility**) or not? **Briefly discuss (among your three sentences) the economic intuition.**

Solution: This proposal is also **not** optimal from the consumers' perspective. Having followed all of the mathematics/economics from above, this part is simple: just invert the numbers for taxes. The same exact conclusion holds: this number is not optimal, either.

d. **(4 points)** Suppose the government proposes to bring the two labor income tax rates into exact equality. In terms of consumer lifetime utility, is this solution a better solution, a worse solution, or is it impossible to determine? Show any key steps. Also briefly explain the economics of why it is better or worse, or, if it is impossible to determine, explain the economics of why.

Solution: However, equal tax rates, given that non-lump-sum taxes are being used, are the **best** possible option. To see this, from the GLBC, keep b_0 fixed at what it was above (i.e., in parts b and c). The non-lump-sum taxes must sum to 0.11, also as above. But now suppose the government sets taxes equally in the two periods: 5.5 percent in period one, and 5.5 percent in period two. With this setting

$$\frac{c_1}{l_1} = (1-0.055)\cdot 1$$

$$\frac{c_2}{l_2} = (1-0.055)\cdot 1$$

$$2 = 0.11 + 1.05\cdot b_0$$

Calculating exactly as above, we end up with the statements

$$c_1 = 0.95\cdot l_1$$

$$c_2 = 0.95\cdot l_2$$

$$2 = 0.11 + 1.05\cdot b_0$$

In terms of lifetime utility of the consumer, it's computed as

$$\ln(0.95\cdot l_1) + \ln(l_1) + \ln(0.95\cdot l_2) + \ln(l_2)$$

The consumer's lifetime utility is as high as it can be, given the set of lump-sum taxes being used. That is, "consumption smoothing" is being satisfied, a basic goal of consumers with strictly increasing (and strictly concave) utility; this is a basic goal of consumers with this class of preferences.

e. **(4 points)** Given your assessment of the tax system in part d, consider the following: suppose the government collected more of its total tax revenue via lump-sum taxes, T_1 and T_2, which leaves less total taxation to collect via labor income taxes. If the two labor income tax rates are still left exactly equal to each other (but at a lower rate), is consumer lifetime utility **even** better off, **even** worse off, or is it impossible to determine? As above, show any key steps. Also briefly explain the economics of why it is better or worse, or, if it is impossible to determine, explain the economics of why.

Solution: This part is simpler. Assuming that the tax rates are left equal in each of the two periods, **now** if lump-sum taxes are raised, the two tax rates can **each be lowered** (i.e., by the same amount), so that total lifetime utility would be even higher.

f. **(4 points)** For this part only, suppose labor income tax rates can be set (either one of them, or both of them simultaneously) to **negative** values (i.e., $t_1 < 0$ and $t_2 < 0$). Noting the results of parts d and e, what if lump-sum taxes are set so high that the government can set both t_1 and t_2 each to strictly negative (and still equal) values. Is consumer lifetime utility **EVEN** better off, **EVEN** worse off, or is it impossible to determine? As above, show any key steps. Also briefly explain the economics of why it is better or worse, or, if it is impossible to determine, explain the economics of why.

Solution: Given the last two parts of the problem, this assessment makes sense (at least strictly from the point of view of the government). It is the same economics as in part e, except now carried to an even more extreme level. (Whether it can actually be implemented is another issue, due to solvency issues of the **consumer.** But that is another question entirely.)

Problem 3: Unemployment, Labor Markets, and Inequality (31 points). Consider the static (i.e., Chapter 2) model of consumption and labor hours (aka, leisure), modified a bit by taking account of, qualitatively, a matching process between unemployed individuals (i.e., those that would like to be working, but for some reason are not) with firms. As in Chapter 2, suppose there are 168 hours total for each individual.

Formally, one can **only** suppose that an individual makes a "consumption-labor hours decision" **if** he has a job. If an individual does not have a job, our analysis simply leaves his labor-income life outside the model (note well this statement). Doing so makes it easier to keep all analysis, loosely speaking, within the realm of the "representative agent" view. **However,** in this problem, you will look somewhat outside the strict representative-agent view, as noted above.

Suppose all of the people (which we will leave unnumbered) in the economy would like a job. Having a job means an individual **must** choose to work 40 hours, and there is no other choice possible. However, not everyone has a job – those that do not have a job can only work zero hours.

There are no numerical values in this problem; all analysis is qualitative, but can be (as you will read below) somewhat mathematical.

a. **(5 points)** If we are considering only those individuals that are employed, how many **hours** does the average individual work? Briefly, and clearly, explain.

Solution: Given the information above, any individual who is employed works 40 hours per week, no more and no less. This is thus the average number of hours worked.

b. **(7 points)** Consider two different scenarios, labeled scenario #1 and scenario #2. In the different scenarios, the number of individuals who work are different. Thus, the number of individuals who are **not** working are also different under the two scenarios. **Suppose we do not want to consider everyone (employed and unemployed) in both scenarios as consuming the consumption goods of the consumption-labor model**. That is, we want to consider **only** the employed individuals as consuming equal quantities of those goods, and **hence** ignore the other individuals. Is this possible to do? If so, how, both mathematically and conceptually? If not, why not, both mathematically and conceptually? Briefly, and clearly, explain.

Solution: This is also straightforward, given the information above and in this particular question. Indeed, based on the information in this particular question and the basic principles of Chapter 2, all each individual does is consume $c = (1-t)W/P$ units of goods. If we're concerned with only the averages, then the answer is the same in both scenario #1 and scenario #2. If we're also concerned with how many total goods are being consumed, then we would also multiply by the number of employed individuals in each case. In either case, this is straightforward to do.

c. **(7 points)** Consider two different scenarios, labeled scenario #1 and scenario #2. In the different scenarios, the number of individuals who work are different. Thus, the number of individuals who are **not** working are also different under the two scenarios. **Suppose we do want to consider everyone (employed and unemployed) in both scenarios as consuming the consumption goods of the consumption-labor model.** That is, we want to consider **both** the employed and unemployed individuals as consuming an equal quantity of those goods, and **hence not** ignore the other individuals. Is this possible to do? If so, how, mathematically and conceptually? If not, why not, both mathematically and conceptually? Briefly, and clearly, explain.

Solution: This problem is in some sense much harder, but in some sense also much easier. There are many possible solutions that had to be (at least somewhat) mathematically oriented – but there are many possible solutions that are simply wrong.

The basic question you're asked is that the employeds' and unemployeds' consumption is set equal to each other. Suppose there are *N* employed individuals and (1-*N*) unemployed individuals (the numbers are arbitrary, and note that there is no need for time indices here because we're thinking in the pure static model). The employed individuals earn *w* dollars per hour, taxed at the rate *t*. The unemployed individuals need to get some "earnings," which, for some concreteness, let's think of the government literally giving part of the tax receipts raised from the employed individuals to the unemployed individuals:

$$\bar{c} = N \cdot (1-t)w + \text{Transfer} \cdot (1-N)$$

In a very real sense, this expression is it – give the unemployed individuals (of which there are a total number (1-*N*)) some resources so that they can go enjoy consumption.

Then, depending on what you/one thought regarding the level of Transfers (an important **political** question), we could go even further. But from the point of view of "pure" economic analysis, this analysis (or something that is like it), is as far as we can go.

d. **(6 points)** Start from the scenario outlined in part c. Politicians notice if the level of average consumption per person (**regardless** of employment status) varies. Name three distinct things that would encourage politicians to try to boost programs that would enhance employment. **(Note: we will ONLY read the first two sentences of each of your three responses (which must be of reasonable length) of any response you write. So be BRIEF.)**

Solution: Three things (of many different things) are:

1.
2.

3.

e. **(6 points)** Start from the scenario outlined in part c. Politicians notice if the level of consumption per person (**regardless** of employment status) varies. Name three distinct things that would encourage politicians to try to boost programs that would enhance firms' rights to demand labor as they see fit. **(Note: we will ONLY read the first two sentences of each of your three responses (which must be of reasonable length) of any response you write. So be BRIEF.)**

Solution: Three things (of many different things) are:

1.
2.
3.