NET 2021 Power Round

Wilson Division: Macroeconomics

April 2021

Instructions

This is the **macroeconomics portion** of the Wilson division of the 2021 Northwestern Economics Tournament Power Round. There are three questions of *unequal* weight, accounting for a weighted *half* your score for the Power Round. You are encouraged to work together on these questions. Answer each question as clearly and succinctly as possible. You may write on a blank sheet of paper where you *clearly indicate* where your answer to each part is. If you are unsure of your answer, take your best guess: there is no penalty for incorrect answers. It is recommended you spend approximately an hour on this portion. Remember, we do *not* share your answers or scores with Northwestern admissions, nor do we keep them for ourselves. You are not expected to know how to answer each question on the exam; rather, this test is designed to assess your economic and formal reasoning skills. Have fun, and good luck!

Problem 1: Difference-in-Differences in Labor Markets (15 points)

The following question is adapted from a particularly foundational economic paper. You may ignore issues of statistical significance.

On April 1 of [YEAR], USA State B's minimum wage increased from $4.25 to $5.05 per hour. In neighboring USA State A, no such change occurred. Before and after this minimum wage change, economists surveyed 410 fast-food restaurants in these two states, measuring metrics involving employment, meal prices, and operating hours. One particularly important statistic that they calculated was a measure of labor quantity called *Full-Time Employment*, or *FTE*. For a firm, FTE is equal to the number of full-time employees and managers times 1 plus the number of part-time employees times 1/2. Here are the average FTEs for fast-food restaurants in these regions in February and November:

	State A	State B
February	23.33	20.44
November	21.17	21.03

Part A (5) Ignoring State A for a moment, what do you think about these data points for State B? Based on the minimum wage change, are they what you would have expected? In 1-2 sentences and a graph, explain why or why not. Assuming that this was the only major economic policy instituted by State B's congress during this time, suggest one possible confounding factor that would make you hesitant to draw strong conclusions from these two data points alone.

As any statistician would tell you, correlation does not equal causation! But what if we want to derive an estimate of a causal effect? One important concept in establishing such a relationship is the *counterfactual*. This is "what would have happened if policy change X had not really occurred". In this case, the counterfactual in our minimum wage experiment is "the average FTE in State B in November if the minimum wage had stayed the same".

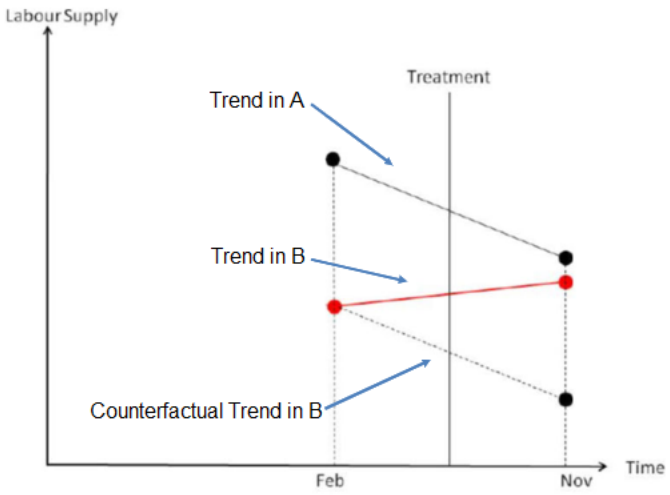
However, since we don't have access to a time machine (yet), we cannot observe the true counterfactual. One assumption we use to simulate a counterfactual is the *parallel trends assumption*. Assigning one observational group as the "treatment group" and another observational group as the "control group", this assumption states that, regardless of any differences in outcomes before the treatment, the two groups are similar enough that, if the treatment had not occurred, we would have expected these outcomes to change over time in the same way.

Part B (3) Using State B restaurants as a treatment group and State A restaurants as a control group, assess the parallel trends assumption in FTE. Give 1 reason why it might be reasonable, and 1 reason why it might not be. (HINT: Another way of saying this is: "if the minimum wage increase had not happened, the 'counterfactual trend in B' shown on the graph on the next page is a reasonable guess as to what the average FTE would've been in State B in November")

Suppose that we are sufficiently convinced that the parallel trends assumption holds in this case. Now, we can solve for the causal effect size of this policy change with the *difference-in-differences* (DiD) method. The DiD estimator is the difference in the outcome in the treatment group before and after the treatment date minus the difference in the outcome in the control group before and after the treatment date. In mathematical terms, this is:

$$DiD_Y = (Y_{after,treatment} - Y_{before,treatment}) - (Y_{after,control} - Y_{before,control})$$

Part C (4) Using the data on page 1, find DiD_{FTE} for the minimum wage experiment. Once you've done so, mark it on the graph on the next page (which is not to scale). Does this result strengthen or weaken your assertions in part A? Explain why in 1-2 sentences.



When it was published, ths paper made a huge splash in the social science community because of how it contradicted our typical economic intuition (which you probably cited in your answer to part A). However, as economists, we must always consider *external validity*. This is the extent to which we can apply the results of our studies in other contexts.

Part D (3) Suppose that, next week, you are hired as a policy analyst serving the state of Mato Grosso, a largely agricultural region in western Brazil. Give two specific reasons why you might hesitate to directly apply the results of this study to your policy recommendations.

Problem 2: Fiscal Policy with Inequality (10 points)

In this problem, we consider an economy with two types of consumers: poor and rich. We will consider the comparative effects of two different short-run growth policies in a Keynesian framework.

Consider the following stylized (closed) economy. There exist a continuum of consumers with identical utility functions but different endowments: some proportion $\theta > \frac{1}{2}$ of them are *poor*, with endowment $c_0 = e_L$ and another proportion $(1-\theta) < \frac{1}{2}$ are *rich*, such that $e_L < e_H$, with endowment $c_0 = e_H$. All consumers have identical utility functions $u(c) = \ln(c)$.

Part A (2) Assume at time $t = 0$ that the macroeconomy is in steady-state, but that suddenly a shock occurs which decreases aggregate demand substantially (e.g. lockdowns due to a pandemic). Using the standard Aggregate Demand/Aggregate Supply model from AP Macroeconomics, graph the effect of this shock in the short-run.

Part B (1) It is well known that in the long-run, the economy will revert back to its steady-state output, but with a different price level. However, this usually takes a long time. If a government wishes to exert countercyclical Keynesian policy, what fiscal policy can it pursue? (There are two answers; give both).

Part C (1) Do the poor or rich individuals have a higher marginal propensity to consume? Justify your answer.

Part D (2) Assume the total amount of expenditure the government can spend is some constant G, which it can divide between spending for the poor or spending (tax cuts) for the rich. After initial consumption, the multiplier is the same regardless of if poor or rich people were the original recipients of the government stimulus. Thus, maximizing the aggregate expenditure multiplier is equivalent to maximizing the stage 1 quantity of consumption for fixed G. If the government wishes to maximize its expenditure multiplier, how much money should the government give the poor individuals? The rich? (Assume there are sufficient consumers that the stimulus does not change any individual's MPC).

Part E (1) Assume that the return on capital, r is such that $u'(e_H) < r$ (that is, the marginal utility of consuming e_H is smaller than the return on capital r). What is the effect of a tax cut for the rich individuals in terms of fiscal stimulus?

Part F (1) If you are a policymaker who believes in this model, what type of stimulus are you likely to advocate for? Be specific.

Part G (2) Using economic intuition and arguments, identify two shortcomings of this model, and explain how those shortcomings would lead to (potentially) incorrect conclusions in the context of fiscal policy.

Problem 3: Steady State Neoclassical Equilibrium (17 points)

In this problem, we consider a simplified version of the Neoclassical model and investigate its steady state equilibrium.

Part A (2) Assume that firms in some country take as inputs capital K and labor L and produce an aggregate output good $Y = f(K, L)$ such that $f(K, L) = AK^{\alpha}L^{1-\alpha}$ for some $0 < \alpha < 1$. Show that f displays *constant returns to scale*: that is, for any positive constant z, $f(zK, zL) = zf(K, L)$.

Part B (2) Let $k = \frac{K}{L}$ be per-capita capital in the economy. Find the per-worker production function equivalent of $f(K, L)$. That is, what is the functional relationship between k and y, where $y = \frac{Y}{L}$? (Hint: treat L as a constant and use Part (A)).

Part C (2) Assume that each year, some constant proportion of output is invested $i = sy$ and the rest is consumed, so that $c = (1 - s)y$, where $0 < s < 1$. Using the functional form you derived in Part (B), graph $i(k)$ and $f(k)$ on the same space, with k on the x-axis and i, f on the y-axis.

Part D (2) Assume now that each year, some proportion of capital δ depreciates. Then if k_t is the stock of capital at time t, $k_{t+1} = (1 - \delta)k_t + i_t$. Define the *steady-state level of capital*, k^*, to be the value of k_t such that $k_{t+1} = k_t$. Find k^* in terms of the parameters s, A, and δ. (Hint: substitute $y = f(k)$ into $i = sf(k)$).

Part E (3) What happens to k^* when δ increases? When A increases? When s increases?

Part F (3) Fix k^* from Part (D). If $k_t < k^*$, is $k_{t+1} < k_t$ or $k_{t+1} > k_t$? What if $k_t > k^*$? Conjecture as to what this implies for the economy-wide stock of capital in the long run. (Hint: Use a graphical argument, plotting k_{t+1} against k_t).

Part G (3) Recall that $f(K, L)$ is a Cobb-Douglas production function. At steady state, we have that $k^* = (1 - \delta)k^* + sf(k^*)$, with a steady-state level of consumption $c^* = (1 - s)y$. Find the *Golden Rule Level of Capital*, k^* that maximizes steady-state consumption. Moreover, find the golden rule savings rate, s^*, that achieves this value.

Bonus (2) Assume now that $f(K, L)$ is some arbitrary function that exhibits constant returns to scale, is twice differentiable, and is concave in k. If investment is linear in output, (that is, $i = sy$ for some constant y), what is the optimal value of k more generally?