NET 2021 Power Round

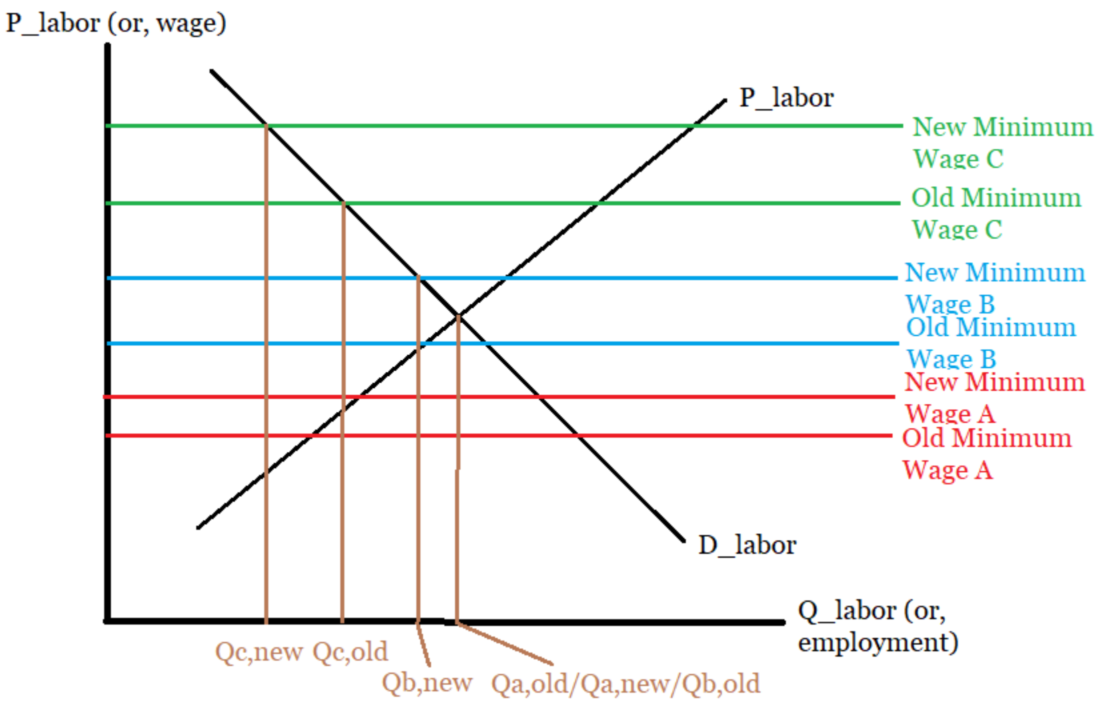
Wilson Division: Macroeconomics [ANSWER KEY]

April 2021

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

The redacted study is “Minimum Wages and Employment: A Case Study of the Fast-Food Industry in New Jersey and Pennsylvania” (1994) by David Card and Alan Krueger.

Part A An increase in the minimum wage serves as a price floor on the price of labor. If the new minimum wage is ineffective, we would expect no change in the quantity of labor in equilibrium. If it is effective, we would expect a decrease in the quantity of labor in equilibrium (see graph). However, the data shows an increase in the quantity of labor - quite an unintuitive result! Here is a graph showing three possible pairs of old/new minimum wages:

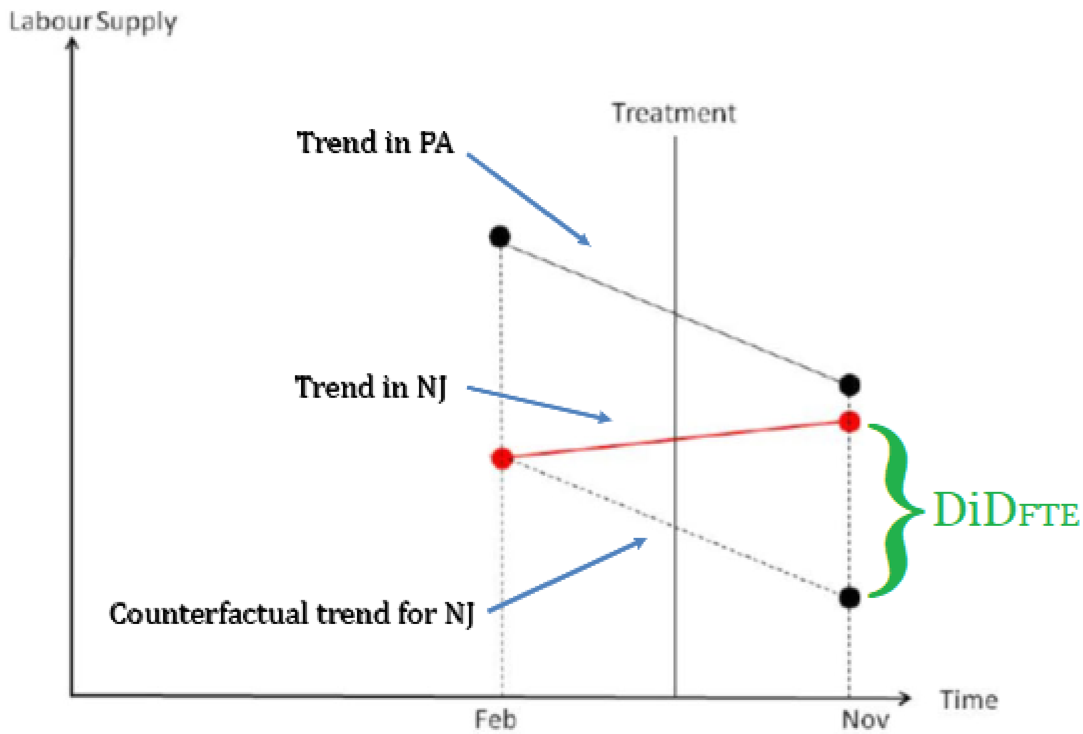


However, we cannot draw causal results from this data. For example, suppose that, in early 1992, a snowstorm knocked out power, causing restaurants to close down more often then usual. This would result in much lower labor quantities what we would normally expect relative to what happened later in the year, and this factor is unrelated to the minimum wage change. However, this is not the only correct answer - any reasonable cause of such a disparity is acceptable so long as it is unrelated to the minimum wage change.

1 point for identifying the expected change, 1 point for an accurate graph (doesn't necessarily need to be as extensive as this), 1 point for identifying the disjoint between theory and results, 2 points for a reasonable confounding factor and explanation.

Part B There are multiple valid responses to both parts of the question. We will give one for each: one reason parallel trends might be reasonable is that the restaurants surveyed are all geographically very close, so they are generally part of the same markets for fast food and for labor. One reason it might not be reasonable

is that the two groups of sample restaurants are subject to different labor regulations because they are in different states.
1.5 points for each, partial credit can given on a shaky but not altogether incorrect answer, no credit given for something flat wrong
Part C $DiD_{FTE} = (21.03 - 20.44) - (21.17 - 23.33) = 2.75$. Graphically:



This strengthens our assertions from part A. If the parallel trends assumption holds perfectly, then, without the minimum wage increase, FTE in New Jersey would have decreased by 2.16. However, with the minimum wage increase, FTE actually increased, as established in part A. This gives us a better causal estimate of the effect of minimum wage changes on employment.
1 point for calculation, 1 for graph, 2 for explanation
Part D
Again, there are many correct answers to this question: we will give 2. One reason is that, while Card/Krueger's study focused on fast food employment, Mato Grosso's labor force is largely focused on agriculture. We may expect that these two industries will react differently to minimum wage changes, so our results may not apply. Additionally, Card and Krueger's study was conducted in the United States - we are looking at policy recommendations for Brazil, which may have significantly different labor laws. These differences could affect how the market would react to a minimum wage change.
1.5 points for both, partial credit in the same way as B

Problem 2: Fiscal Policy with Inequality (10 points)

Part A In the short run, aggregate demand should shift uniformly *leftward*, so that output declines (a recessionary gap) as the price level falls (deflationary pressures).
One point is given for drawing the standard model. A second is given for identifying the demand shock.

Part B The government can either increase spending or decrease taxation.
The sole point is given for identifying both effects. Identifying one is sufficient for half credit.

Part C Poor consumers. Note that $u'(c) = \frac{1}{c}$ is decreasing in c, so standard first-year intuition gives that the poor consumers have a higher marginal utility to consumption and thus a higher MPC.

Part D G should be allocated to the poor individuals and 0 to the rich ones.
Both points are awarded for recognizing that to maximize stage 1 consumption it is sufficient to pick individuals with a higher MPC, which in this case are the poor individuals. Partial logic yields partial credit.

Part E Minimal. Rich individuals will save all of the stimulus and spend none of it (since they get more from interest), and thus it will not go through the expenditure multiplier in a classical sense.
The sole point is awarded for a justification to why stimulus to rich individuals will not have a multiplying effect.

Part F Given our argument in Part (B), a policymaker can either cut taxes or spend money. Our answers in Parts (C)-(E) indicate tax cuts for the rich are not effective (and neither is stimulus), so either stimulus for the poor or tax cuts for the poor are a sufficient answer.
Half a point is given for isolating that cash transfers for the poor are good. Another half point is given for correct logic.

Part G Answers may vary. One point is given for a valid criticism of each term.

Problem 3: Steady State Neoclassical Equilibrium (17 points)

Part A The argument is as follows. Fix any $z > 0$ and note

$$f(zK, zL) = A(zK)^{\alpha}(zL)^{1-\alpha} = Az^{\alpha}z^{1-\alpha}K^{\alpha}L^{1-\alpha} = z(AK^{\alpha}L^{1-\alpha}) = zf(K, L)$$

One point is awarded for setting a fixed $z > 0$ and plugging it in on one side. A second point is given for a completed solution.

Part B Fix a constant, nonzero amount of labor L and note by Part (A) that linear homogeneity gives

$$f(K, L) = \frac{1}{L}f\left(\frac{K}{L}, 1\right) = \frac{1}{L}f(k, 1)$$

This microfounds our argument; it is sufficient to divide through by L to obtain the per-worker production function. Thus,

$$f(k) = \frac{1}{L}AK^{\alpha}L^{1-\alpha} = AK^{\alpha}L^{-\alpha} = A\left(\frac{K}{L}\right)^{\alpha} = Ak^{\alpha}$$

Noting that $Y = f(K, L)$, we thus get $y = Ak^{\alpha}$.
One point is awarded for noting that the correct step is to divide the aggregate production function by L. A second point is awarded for deriving the functional form $y = Ak^{\alpha}$.

Part C Note that $i(k) = sy(k) = sAk^{\alpha}$, where $s \in (0, 1)$. Thus, both graphs should be strictly increasing, concave, and smooth. A graph resembling the graph of $y = x^{\frac{1}{2}}$ in shape is sufficient. The graph $i(k)$ should have similar curvature to, but be strictly lower than, $f(k)$. Both functions should have intercept $(0, 0)$.
One point is awarded for a graph of $f(k)$, and one for $i(k)$.

Part D Following the hint, we look for a value $k^* = k_{t+1} = k_t$ satisfying $k^* = (1-\delta)k^* + sf(k)$. Then

$$k^* - (1-\delta)k^* = sA(k^*)^{\alpha} \iff \delta k^* = sA(k^*)^{\alpha} \iff \delta(k^*)^{1-\alpha} = sA \iff k^* = \left(\frac{sA}{\delta}\right)^{\frac{1}{1-\alpha}}$$

which gives k^* as a function of s, A, and δ.
One point is awarded for a correct setup of the problem (e.g. the left hand side of the above work). A second point is given for successfully completing the algebra.

Part E This can be done using basic calculus. Noting our answer from Part (D), we have

$$\frac{\partial k^*}{\partial \delta} = \frac{1}{1-\alpha}\frac{-sA}{\delta^2}\left(\frac{sA}{\delta}\right)^{\frac{1}{1-\alpha}-1}$$

By inspection, all terms are positive except the $-sA$ argument, so the entire derivative is negative. Thus, k^* decreases as δ increases. The second argument. Consider the following:

$$\frac{\partial k^*}{\partial A} = \frac{1}{1-\alpha}\frac{s}{\delta}\left(\frac{sA}{\delta}\right)^{\frac{1}{1-\alpha}-1} \text{ and } \frac{\partial k^*}{\partial s} = \frac{1}{1-\alpha}\frac{A}{\delta}\left(\frac{sA}{\delta}\right)^{\frac{1}{1-\alpha}-1}$$

where upon inspection it is obvious these are all positive values, meaning k^* increases with both A and s.
One point is awarded for each comparative static. Formal arguments using calculus need not be used; reasoning using the monotone properties of the functions is sufficient.

Part F Following the hint, a graphical argument should be used. (An algebraic argument may receive full credit as well, but is somewhat more complicated). Plot the capital accumulation function $g(k) = (1-\delta)k + sAk^{\alpha}$ against the 45-degree line $h(k) = k$. Note that $g(k) = h(k)$ at the unique steady-state, k^*. If $0 < k < k^*$, then the concavity of $g(k)$ gives that $g(k) > h(k)$. But this is above the 45-degree line, so $k_{t+1} > k_t$. Analogous (but reflexive) logic occurs when $k_t > k^*$, with $k_{t+1} < k_t$. This implies that, regardless of the initial condition for capital, as $t \to \infty$, we should expect $\lim_{t\to\infty} k_t = k^*$; that is, the economy always converges to steady-state.

One point is given for any logical sufficient justification for why $k_{t+1} > k_t$ if $k_t < k^*$. One point is given for a sufficient justification for $k_{t+1} < k_t$ if $k_t > k^*$. Half a point is awarded if no work is shown but *both parts are attempted, and guessed correctly.* The last point is given for recognizing this implies convergence to the steady-state level of capital in the long-run.

Part G We will solve the bonus first, and then apply it to Part (G). Any answer that correctly attempts this simplification will achieve full credit.

First note that since $f(K, L)$ exhibits constant returns to scale, is $\mathscr{C}''(\mathbb{R})$, and strictly concave, we may apply much of the analysis in Parts (A-C), which did not rely on the specific functional form assumption we adopted. Thus,

$$k^* = (1-\delta)k^* + sf(k^*) \iff \delta k^* = sf(k^*)$$

Moreover, sine $c = (1-s)y$, we can rewrite steady-state consumption as $c^* = (1-s)f(k^*) = f(k^*) - sf(k^*)$. Thus, the objective function is but

$$\max_{k^* \in (0,\infty)} f(k^*) - sf(k^*) \iff \max_{k^* \in (0,\infty)} f(k^*) - \delta k^*$$

This induces the first order and second order conditions

$$f'(k^*) - \delta = 0 \text{ and } f''(k^*) < 0$$

Since $f(\cdot)$ is a concave function, $f''(k^*) < 0$ is always satisfied, meaning that $f'(k^*) = \delta$ satisfies this condition. This finishes our answer for the bonus.[1]

To finish our calculation in Part (G) for the desired value of k^*, we require the functional form assumption. Note that $f'(k^*) = \alpha A k^{\alpha-1}$, so we know that $\delta = \alpha A k^{\alpha-1}$. Further, we invert f' to get

$$\delta = \alpha A k^{\alpha-1} \implies k^{\alpha-1} = \frac{\delta}{\alpha A} \implies k^* = (\frac{\delta}{\alpha A})^{\frac{1}{\alpha-1}}$$

Now, to solve for the desired value of s^*, we plug $\delta = f'(k^*)$ into our answer for Part (D), resulting in

$$k^* = \left(\frac{sA}{\alpha A k^{\alpha-1}}\right)^{\frac{1}{1-\alpha}} = \left(\frac{s}{\alpha}\right)^{\frac{1}{1-\alpha}} k^* \iff 1 = \left(\frac{s}{\alpha}\right)^{\frac{1}{1-\alpha}} \iff s = \alpha$$

Which is the desired golden-rule savings rate. Thus, a central planner will always set the savings rate proportionate to the percentage of income that goes to capital in steady state (which is wonderfully intuitive!) Though notes this does explicitly assume a Cobb-Douglas structure on the production function.

In only Part (G) is attempted, (1) point is given for attempting the problem, (1) for finding the optimal k^*, and one for finding $s = \alpha$. One point is given for noting the irrelevance of the functional form and instead the stated assumptions in setting up the problem, and a second for finding $f'(k^*) = \delta$ as the condition.

[1] A complete solution will mention that this value is only guaranteed because $f \in \mathscr{C}''(\mathbb{R})$ and satisfies the *Inada conditions*, which we have omitted. Any solution which brings up the problem of existence will receive an additional bonus point.