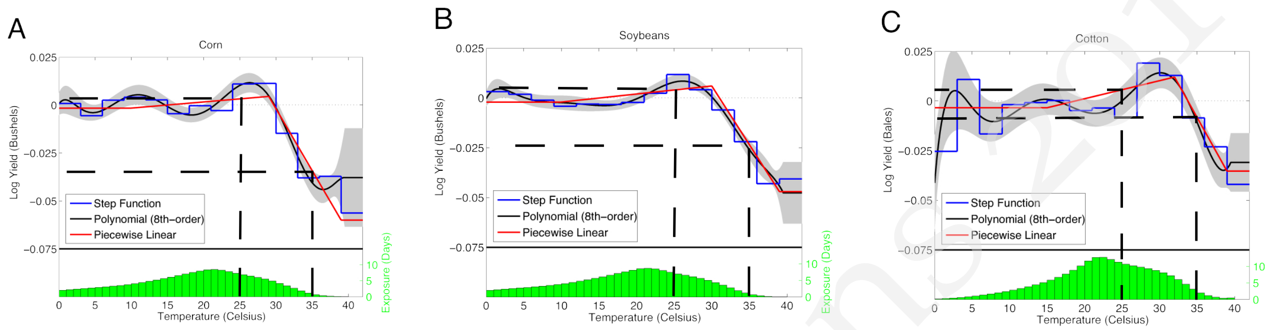
EC1340-Fall 2019
Problem Set 4 solutions

(Updated 25 September 2019)

Matt Turner

1. Following are the figures from Schlenker and Roberts, where I've drawn in dashed black vertical and horizontal lines to illustrate changes in yield at 25 and 35 degrees C.



By eyeball, we have

Temp	corn	soy	cotton
25	0.005	0.005	0.005
35	-0.03	-0.023	-0.005
change	-0.035	-0.028	-0.010

That is, the factor by which corn yields change is $\ln(x) = -0.035$ so $x \sim 1 - 0.035$, the factor by which soy yields change is $\ln(x) = -0.028$ so $x \sim 1 - 0.028$ and cotton it's about 1 -0.1. Thus, this hypothetical change in climate leads to about a 3.5% decrease in corn yields, a 2.8% decrease in soy and a 1% decrease in cotton.

What does this suggest to you about the ability of crop substitution to compensate for changes in climate?

2. We have three data points; $(y,x) = \{(1,1),(4,2),(2,3)\}$. Our dummy variable D is 1 for $x > 3/2$ and 0 otherwise.

(a) We want to perform the regression, $y = A_0 + A_1 D + \epsilon$ using OLS.

Our errors are,

$$\begin{aligned}\epsilon_1 &= (1 - A_0)\\ \epsilon_2 &= (4 - A_0 - A_1)\\ \epsilon_3 &= (2 - A_0 - A_1)\end{aligned}$$

To find OLS coeffcientts, solve

$$\min_{A_0,A_1} (1 - A_0 - A_1)^2 + (4 - A_0 - A_1)^2 + (2 - A_0 - A_1)^2$$

To solve, differentiate with respect to each of A_0 and A_1.

Our first first order condition is

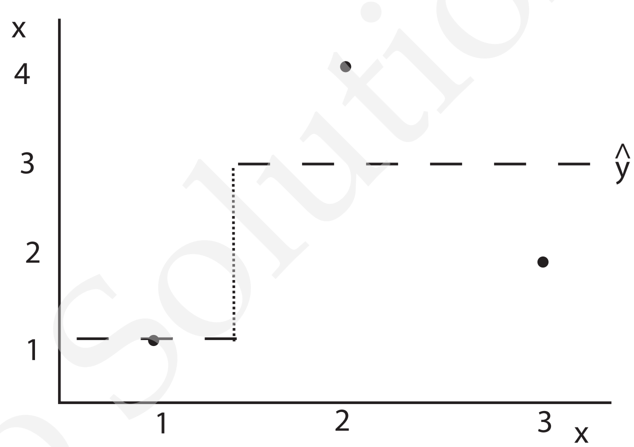
$$
\begin{aligned}
0 &= \frac{\partial(.)}{\partial A_0} \\
&= 2(1 - A_0)(-1) + (4 - A_0 - A_1) + 2(2 - A_0 - A_1)(-1) \\
&= (1 - A_0) + (4 - A_0 - A_1) + (2 - A_0 - A_1)
\end{aligned}
$$

Our second first order condition is

$$
\begin{aligned}
0 &= \frac{\partial(.)}{\partial A_1} \\
&= 2(4 - A_0 - A_1)(-1) + 2(2 - A_0 - A_1)(-1) \\
&= (4 - A_0 - A_1) + (2 - A_0 - A_1)
\end{aligned}
$$

Solving these two equations for A_0 and A_1 we get $A_0 = 1$ and $A_1 = 2$.

(b) Your graph should look about like this:



(c) In general, dummy variables lead to regression lines that are step functions and measure the mean difference between observations where it is "on" and the observations where it is "off". In this example, A_1 is difference in y between the first observation and the mean of the second and third.

3. From table 2, we have that $g_{it} = g_i - 0.95T_{it} - 0.35T_{it-1}$ for a poor country. With $g_i = 0$, this becomes $g_{it} = -0.95T_{it} - 0.35T_{it-1}$. For a rich country, we have $g_{it} = -0.2T_{it} + 0.05T_{it-1}$.

   GDP develops according to $\frac{Y_{it+1}}{L_{it+1}} = (1 + g_{it})\frac{Y_{it}}{L_{it}}$ With $L_{it} = 1$, this becomes $Y_{it+1} = (1 + g_{it})Y_{it}$.

   In fact, this isn't quite right. Because all of the estimations in the paper treat g as a percentage, in order to get the path of GDP correct, we need to divide by 100. So, the development of GDP should really be $Y_{it+1} = (1 + \frac{g_{it}}{100})Y_{it}$.

   All together, we have,

	poor		rich	
T	1+g	Y	1+g	Y
0	.	1	.	1
0	1	1	1	1
1	0.9905	0.9905	1.002	1.0025
1	0.987	0.9776	1.0025	1.0045
1	0.987	0.9649	1.0025	1.0070
1	0.987	0.9523	1.0025	1.0095

   This answers (a) and (b).

   (c) From the table, growth is -1.3% for a poor country, and this growth rate is constant after the second period of a permanent temperature change of 1 degree.

   (d) Nordhaus, Mendelsohn and Shaw concluded that 5 Fahrenheit, which is about 3 Celsius of warming, together with associated change in rainfall would give between a 0 and 6% change in the level of agricultural productivity. Dividing by 3, this means that on degree of warming gives between a 0 and 2% decrease in output. In the context of the Dell, Jones and Olken analysis, this would correspond to a one-time decrease in g of 2%. DJO find a growth effect. You see in the table above, that this effect compounds over time, so that unlike the level effect in NMS, this cannot be erased by a few years of growth. Thus, the effect that DJO estimate is much bigger than the effect that NMS find.