Econ 115: Problem Set 1: Big "What-If?"s

Spring 2017

Due March 20, 2017

Problem 1: Big "What-If?": Population Growth without the Demographic Transition

Take "subsistence" to be annual labor productivity of $1,000 per worker year. At that level of income, human populations are stable. If average incomes worldwide are 20% above subsistence, global population grows at 0.2% per year—and at an additional 0.2% for each additional 20%-points that average incomes rise further until incomes reach $3,000 per worker year. In our world, once incomes rise above $3,000 per worker per year population growth falls off: women become rich enough and literate enough and children healthy enough to create a freer society, and while most women want to have one or two or even three children, relatively few with many options want to have many more than that.

But suppose that were not the case: suppose that at "subsistence" incomes equal to $1,000 per worker per year, human populations are stable, and that global population grows at 0.2% per year faster for each 20%-points global average incomes rise above subsistence.

A. At what level of average global incomes would population growth be 1%/year? 2%/year? 3%/year? 4%/year?

B. If global incomes averaged $4,000 per worker per year, how long would it take world population to double?

C. The global population today is 7.5 billion. If global incomes averaged $4,000 per worker per year *and could be maintained at that level*, how long would it take before world population would exceed 100 billion?

D. Today 40% of the world's population—3 billion people—are farmers or their families, and they grow enough calories and nutrients to feed 30 billion people at a minimal level of calories. But we are already farming essentially all of the world's productive land area and are rapidly exhausting our marine food resources as well. Suppose that if the number of farmers were to increase beyond the current level each additional 3 billion people as farmers and in farm families would be only two-thirds as productive at raising food as the previous 3 billion. How large would the farmer and farm family proportion of a world population of 100 billion need to be in order to keep everybody fed?

Problem 2: Big "What-If?": American Immigration

The U.S. population in 1800 had 2.5 million workers. In 1900 it had 40 million.

A. If there had been no net immigration into the United States after 1800, and if the worker population had grown by natural increase at 2.18%/year, what would the U.S. labor force have been in 1900?

B. The extra U.S. workers as of 1900 coming from immigration over the previous century—migrants, and children of migrants, and children of children of migrants, were deployed about 1/6 to agriculture, 1/3 to services, and 1/2 to manufacturing. Given that the actual labor force in 1900 was 1/3 deployed to each sector, what would the deployment of the U.S. labor force have looked like in 1900 without immigrants if the deployment of the descendants of the 1800 population did not shift in the absence of immigration.

C. The descendants of the 1800 population would not all have remained in their actual occupations in the absence of immigrants—there would have been considerable adjustment. But suppose that they had. In the history we know, America produced 25% and Britain produced 20% of world manufactured goods in 1900. Suppose that in our non-immigrant "what-if?" American manufacturing production had shrunk in proportion to the shrinkage in manufacturing workers, and that 2/3 of that shrunk manufacturing production had been located instead in Britain (with the rest going to other European countries). What would the shares of America and Britain in global manufacturing have been in that "what-if?"

Problem 3: Big "What-If"?: Long-Run Global Growth

Before printing, before the commercial revolution, before the industrial revolution, before modern economic growth, the ongoing processes of invention and innovation were such that the growth rate over the period of the next doubling of world economic product was proportional to the level of annual world economic production at the start of that period. Basically, two heads were better than one and twice as much economic activity was twice as good in terms of giving people good new ideas about technology and organization.

Back then the rate of innovation and invention was very slow: in an era in which the initial level of annual world economic product were $10 billion, the average growth rate over the next doubling would be 0.005%/year..

A. As of the year zero, annual world economic product was $100 billion. What was the average growth rate of annual world economic product over the period to the next doubling?

B. At what date was that first doubling from $100 billion accomplished?

C. What was annual world economic product when that that first doubling from $100 billion was accomplished?

D. How long would the next doubling have taken to take place?

E. By what date would that second doubling from $100 billion—the doubling from $200 billion to $400 billion in annual world economic product—have taken place?

F. Current annual world economic product is $115 trillion. How long would it have taken—without printing, without the commercial revolution, without the industrial revolution, without modern economic growth—for the world economy to reach 1% of our level of total production?

Problem 4: Big "What-If"?: The Business Cycle and Inequality

One of the perennial theories about why business cycles—or, rather, nonfarm business cycles—were bigger back before World War II than they were in the post-WWII Age of Social Democracy is that higher income inequality made economies more vulnerable to shocks.

Take our standard Keynesian income-expenditure model:

$$Y = \mu(c_0 + I_0 + NX) - \mu I_r r + \mu G$$

where:

- Y is the level of demand—spending—income—production
- μ is the multiplier
- c_0 is the degree of consumer confidence
- I_0 is the "animal spirits" of businesses—the optimism or pessimism and hence willingness or unwillingness of their investment committees to spend money expanding capacity
- NX is net exports, determined by foreigners' relative desire to spend dollars they earn on our exports as opposed to saving and investing them inside the United States
- I_r is the sensitivity of investment spending to changes in the interest rate
- r is the real interest rate, influenced but not controlled by the central bank
- G is government purchases

And where the value of the multiplier μ is determined by:

$$\mu = 1/(1-c_y)$$

where:

- c_y is the fraction of an increase or decrease in *current* income by which households will expand or contract their spending on consumer goods and services when their *current* income changes

Start with an economy about the size of the U.S. economy in 1925, setting:

- $c_0 = 13\ 1/3$
- $c_y = 2/3$
- $I_0 = 20$
- $NX = 0$
- $I_r = 2$
- $r = 5$
- $G = 10$

A. With these parameter values, what is the value of the multiplier μ?

B. With these parameter values, what is the value of production Y?

C. Suppose business animal spirits were to fall by 5. What would happen to Y?

Now return business animal spirits to their original value of 20. Suppose that greater income inequality makes it much more difficult for most households to save and build up their wealth in the form of stocks of financial assets that they can sell to raise money. It thus becomes much more difficult for them to buffer changes in their income—when their income falls, they *have* to cut back spending by more because they have no option. Instead of being equal to 2/3, now:

$$c_y = 4/5$$

but because households think that their permanent income is the same, c_0 also shifts to keep consumption spending the same when the economy is at its full employment Y = 100:

$$c_0 = 0$$

D. With these parameter values, what is the value of the multiplier μ?

E. With these parameter values, what is the value of production Y?

F. Suppose business animal spirits were to fall by 5. What would happen to Y?

G. Explain, intuitively, as best you can, why in this model the economy is more unstable—incurs a larger depression when hit with the same shock to business confidence—with higher income inequality:

Problem 5: Big "What-If?" American Industrialization

Real production per worker in real inflation-adjusted values in the United States today is about $100,000 per year; in 1900 it was about $12,000 per year, in 1800 it was about $3,000 per year. The U.S. population in 1800 had 2.5 million workers. In 1900 it had 40 million. Today it has 160 million. As of 1800 the United States's economic structure had not yet begun to shift substantially away from the British colonial pattern to the "Hamiltonian" manufacturing- and technology-heavy pattern.

In 1900 America produced about $160 billion in manufactured goods in a year, $160 billion in agricultural goods, and $160 billion in services, spending about 1/3 of work time in each of those three sectors. If the United States had remained part of the British Empire in the 19th century, manufacturing development would have been suppressed. The example of Australia suggests that only $80 billion of manufactured goods would have been produced, half of the manufacturing workers would have been displaced, and those workers displaced out of manufacturing would have gone to work in agriculture.

Measuring agricultural output in calories (or equivalents), the total production of the United States agricultural sector in 1900 was some 80 trillion calories per year, with 1 calorie-equivalent selling for 0.2 cents—500 calories to the dollar.

A. Suppose that in our "what if" scenario the extra workers displaced out of manufacturing into agriculture were half as productive when crowded onto the land as the average worker in agriculture in actual history. How much in value and calories-equivalent of agricultural goods would they have produced?

B. Americans would have been unable to eat the extra agricultural products produced. They would have exported them in order to buy manufactured goods from Europe. Suppose that the maximum willingness to pay by Europeans for extra American agricultural goods were 0.1 cent per calorie-equivalent. And suppose that demand were perfectly elastic in that Americans could sell as much in extra agricultural goods to Europeans as they wanted at that price. What would Americans have then earned from their extra agricultural exports?

C. How well-off would Americans have then been in this “what-if” scenario?

Problem 6: Big "What-If?": The Great Depression

U.S. nominal GDP was $100 billion in 1929. The multiplier μ was 3. By 1933 an extra 25% of the non-farm labor force were unemployed relative to normal times, with the non-farm labor force being two-thirds of total employment.

A. By how much higher was the total unemployment rate—that is, including farmers in the base—in 1933 than it had been in 1929?

B. Remember Okun's Law: when the unemployment rate goes up by 1%-point, production falls relative to the economy's potential by 2%. Assume that production was equal to potential in 1929. By how much, then, was production below potential in 1933?

C. Suppose that Herbert Hoover had wanted to stop the Great Depression in its tracks and restore full-employment by embarking on a large-scale government spending program. About how much would he have had to spend?

D. Actual federal government spending in 1929 was $4 billion. What would Hoover have had to do to the size of the federal government in order to accomplish such a program?

E. Total—federal plus state and local—government spending in 1929 was $11 billion. What would Hoover have had to do to the size of the total government in order to accomplish such a program?