

Econ 270: Growth, the Empirical Evidence

We now begin this course's examination of long run macroeconomic conditions, a field known as economic growth. Before beginning, consider the following two examples as motivation:

1. Regardless of whether either country is in recession or expansion, living standards in the United States and other wealthy nations are stunningly higher than Burundi and other poor nations. This is not a short term result. By the end of this course you should be able to provide a good answer as to why such differences across countries persist in the long run.

2. Economic growth also attempts to explain differences over time. For example, why are living standards, in spite of the recent recession, so much higher in the United States in 2011 than in 1776?

Chapter 3 of Jones provides a useful descriptions of some basic facts regarding economic growth. Because this material is descriptive and straightforward, there is little to gain by going through it in class in detail. This material is, however, fair game on quizzes and the final exam. As you read this material, note the following:

1. For most of human history, there has been little to no growth. Until the past few centuries, most people lived near subsistence levels. Growth is thus a recent event.

2. A one percent change in annual growth may seem small, but over time, this can lead to dramatic differences in the level of output.

Empirical Growth

Before developing theoretical models to explain long run differences in economic performance, we will take a look at the empirical evidence on which factors matter. Robert Barro of Harvard is a top macroeconomist. Much of the following discussion tracks his paper. Although it is only one paper in a long literature, its results are a reasonable representative of the field. Different data or methodologies may, of course, affect the results:

Barro, R. 2003. "Determinants of Economic Growth in a Panel of Countries." *Annals of Economics and Finance*, 4, 231-274.

Keep in mind that Barro's focus is explaining long-run performance. The omission of variables that are thought to mainly affect the short-run (*e.g.* money) is thus deliberate. We will examine the empirical evidence behind business cycles later in the term.

Barro uses a panel of countries, meaning that his data include different countries over different years. He begins by describing his data from 1965-1995. Among 113 countries, the average annual per capita real growth rate is 1.5%. The lowest rate is the Democratic Republic of Congo at -3.6%, while the highest is South Korea at 6.9%. This is a massive difference. Congo's GDP (in 1995 dollars) falls from \$959 to \$321 between 1965 and 1995, a two-thirds decline. South Korea's increases from \$1754 to \$13,773, almost an 8 fold increase.

We now discuss the factors that Barro finds to have a significant effect on growth.

1. The initial level of GDP. Barro includes the log of initial GDP. He finds that if a country starts off with a higher level of GDP, then it exhibits slower GDP growth. This suggests that real per capita GDP has a tendency to converge over time. Specifically, all else equal, 2.3% of a GDP gap between countries will disappear each year. Thus if the United States is \$1000 richer than Canada in 2012, we expect that this gap will be reduced by \$23 by 2013.

This result makes sense. Poorer countries are likely to initially have more obstacles to growth and thus have more opportunities to improve their performance by eliminating these obstacles. Consider China and India, two of the recently fastest growing large economies in the world. Until about 1980, China was a closed communistic economy that eliminated incentives for investment and labor, and remained desperately poor. Around that time China began a transition to a market economy and opened its markets to trade and investment. As a result, China has flirted with growth rates near 10% (although these have recently slowed). India, while not a communist country, was also subject to corruption and closed markets. It has also experienced rapid growth since eliminating these barriers. Such low hanging fruit is not available for advanced economies like the United States or Western Europe, their growth relies substantially on technological progress. It is unlikely that the U.S. could achieve a 10% growth rate (unless it is a temporary result of emerging from a very severe recession), nor is it likely that China will be able to maintain its current growth rate once it becomes a middle income economy.

2. Education. Barro finds that increasing male upper level schooling by 1.3 years increases growth by 0.5% per year. This is sensible result; education increases the productivity of the labor force. Surprisingly, Barro finds that there is no similar effect for female educational attainment.

The latter result for female education illustrates why it is important to think about the economic mechanisms behind econometric results, as opposed to blindly accepting them. There

is no apparent reason why female education would affect growth much differently than male education. Barro himself is suspicious of this result. He notes that his measure of education is based on years attained and does not reflect the quality of the underlying education. He speculates that his data on female education may therefore be missing this key differentiation. He notes that quality adjusted data are not readily available.

3. Life expectancy. Barro finds that as life expectancy increases, so does growth. Most likely, this result occurs because better life expectancy results from better general health and a healthier workforce is more productive.

4. Fertility. If the average woman has an additional .54 children in her lifetime then growth is reduced by 0.7%. Higher fertility is thus bad for growth. Newborns, of course, do not contribute to economic activity but do increase the population. They can, in fact, turn a dashing college professor into a babbling sleep deprived idiot overnight. It is thus unsurprising that they reduce per capita GDP. Also, higher fertility reduces the labor force participation rate.

I try to emphasize in my courses that welfare does not equal GDP. This result provides a good example. Accepting this result as inviolate *arguendo*, I propose banning childbirth because such a result would be good for GDP growth. Excluding angry loners, few would support a policy resulting in the extinction of the human race in spite of any beneficial effect on GDP.

5. Government consumption. This measure does not include government expenditures on defense or education. Barro finds that reducing government expenditures by 4.7% of GDP increases growth by 0.3%.

There are competing intuitions that may explain this result. We consider two. First, recall the recent discussion on efficiency in macroeconomics. Efficiency requires that the government effectively provide only public goods. If the average government is spending more than this amount, then reduction in government spending may boost productivity and output. Second, perhaps efficiency requires both more government spending and less output. In this case, reducing spending would increase GDP, but this is not desirable.

It is not obvious whether government spending is inefficiently high or inefficiently low. On one hand, civil engineers often note that the U.S. is underinvesting in infrastructure. A stark example of this argument is the April 2007 disaster in Minneapolis where a section of a bridge fell into the Mississippi River, killing 13 people. On the other hand, there is concern that special interests (*a.k.a.* pork barrel spending) spend too much on road construction in some

areas. It may be the case that spending is inefficiently low in some locales, and inefficiently high in others.

6. Rule of law. The concept of the rule of law includes property rights. Few would buy a home if there is considerable risk that the government or another citizen will be able to steal it. There is little incentive to innovate if an entrepreneur cannot be confident that he will be able to profit from the results. The rule of law thus includes the risk of governmental expropriation, an effective police force, and proper access to courts. It is therefore unsurprising that Barro finds that the rule of law is good for economic growth.

7. Democracy. Barro includes both democracy and democracy-squared. The former coefficient is positive while the latter is negative. For values close to zero, representing totalitarian states, the former term is more important. More democracy is good for growth. For values closer to one, however, the latter term is more important. This suggests that too much democracy may be bad for growth and that an intermediate value of democracy maximizes growth.

Both the rule of law and democracy are measured using indexes. These indexes are admittedly, subjective measures.

8. Openness. Barro defines openness as the ratio of the sum of imports and exports to GDP. He finds that openness is good for growth. This is also unsurprising. Recall the concept of comparative advantage, the basic justification for free trade, from Econ 101. A closed economy is unable to exploit comparative advantage and thus must produce some goods inefficiently. An open economy, however, is better able to specialize. More surprisingly, Barro finds that the magnitude of this effect is very small. Increasing openness by one standard deviation increases the growth rate by 0.008%.

There is, however, an additional intuition for this result. When a company produces in a foreign country, it is able to learn new productive methods from the foreign business environment. Likewise, foreign companies may be able to observe and integrate aspects of the alien company's productive process. These opportunities do not exist in closed economies.

9. Terms of trade. Suppose that a country is an oil exporter and the price of oil increases. We expect that they will see increased growth. Barro confirms this intuition.

10. Investment. Recall that investment refers to the creation of new capital. Because capital is an input, more capital should increase output. Barro finds that increasing investment

by 7.8% of GDP increases GDP growth by 0.4%. For the U.S., investment is usually between 15-20% of GDP.

11. Inflation. Most models of the business cycle (which we will study in a few weeks) predict that the rate of inflation does not affect the long run. Barro, however, finds that increasing inflation by 0.33% reduces growth by 0.007%. For countries with stable prices (like the United States), this is not a significant result.¹ For very high levels of inflation, however, this result may be important.

Statistically, countries with high inflation also have volatile inflation. It is thus not possible to identify the individual effects of higher inflation vs. less predictable inflation. Barro's result likely originates with the latter. Producers do not like risk, including inflation risk. One way to reduce this risk is to reduce production, thus reducing growth.

The previous lists includes the variables with the most significant effects. Barro's paper also reports variables with smaller effects (*e.g.* ethnic fragmentation, whether the country is landlocked, civil liberties), but we do not have time to go through them all.

Another variable of interest, especially recent, is the debt to GDP ratio. Currently, for the United States, this ratio is about 70% of GDP, and this figure will surely increase in the next several years. You may have heard news about this ratio exceeding 100%, but that requires that we include debt that the government owes to itself. Economically, this should be excluded. A recent paper by Carmen Reinhart and Kenneth Rogoff, "Growth in a Time of Debt,"² attempts to quantify the effects of higher debt. They find that debt to GDP ratios of 60% cause moderate reductions in growth and that levels of 90% find major reductions in growth. This paper has had a major influence in the policy debate regarding large public debt levels.

In 2013, however, another paper by Thomas Herndon, Michael Ash and Robert Pollin discovered important errors in Reinhart and Rogoff (2010).³ These include Microsoft Excel errors and possibly bias in choosing which countries were included in the dataset. This paper concludes that after fixing these issues, Reinhart and Rogoff greatly exaggerate the effects of debt. Notably, the original Reinhart and Rogoff paper was not subject to serious peer review.

¹For students who have taken econometrics, it may be useful to note the difference between statistical and economic significance. The former implies that we can say with a high level of confidence that inflation does affect growth; the effect is different than zero. Economic significance, however, implies that the magnitude of the effect is large enough to care about. These notes are concerned with economic significance.

²*American Economic Review, Papers and Proceedings*, January 2010.

³See "Does High Public Debt Consistently Stifle Economic Growth? A Critique of Reinhart and Rogoff," available at <http://www.peri.umass.edu/236/hash/31e2ff374b6377b2ddec04deaa6388b1/publication/566>.