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Economists have long recognized that possessing natural resources does not guarantee economic success. Nigeria, which has abundant oil and natural gas reserves, remains mired in poverty, while Hong Kong, which has virtually no natural resources, is one of the wealthiest places on earth. What's more puzzling is why certain policy distortions — ranging from price instability to high tax rates — often don't appear to affect growth as much as economic theory says they should.

Growth theory has come a long way. How much further can it go?

BY DOUG CAMPBELL

Wouldn't it be great if there was a recipe for growth? Not personal growth, as in conquering one's fears of, say, public speaking. Economic growth is what we're talking about. It is hard to overstate the potential usefulness of a formula that governments could follow to ensure good health and riches for their citizens: Sift together two parts savings, three parts capital investment, and one heaping part of incentives for innovation. Bake for two generations and *voilà*: a fully developed, fast-growing country.

As it happens, such a recipe exists. In fact, there are many different varieties. We will discuss all of these in more detail later, but in brief (and at the risk of oversimplifying), there are two main contenders. First is the "neoclassical theory of growth," in which economic output depends on quantities of capital mixed with labor force efficiency. Then we have the "new growth theory," in which continual technological innovation has been built into the model itself, instead of being treated as an "exogenous" factor largely outside anybody's control.

There is some disagreement over which one of these theories most closely describes the real world — or whether either comes close to doing so. Moreover, it's been 20 years since the last big advance in growth theory, with many recent contributions calling attention to its weaknesses.

This gives rise to the question: Is growth theory stunted? To be sure, you could ask the same about many topics in economics. But growth is probably the biggest economic question of them all: Why do some countries prosper while others stagnate? For many economists, finding an answer to that question is the main reason they became economists in the first place.

Flying Solow

A current economics textbook will tell you that growth is produced by reshuffling resources in ways that make those resources more valuable. Although it might seem intuitive that a nation with an abundance of natural resources, like oil, would prosper while those deficient in such resources would stagnate, this is not the case. Consider the small island of Japan, for example, whose growth rate in the

past 50 years caught up with the natural resource-rich United States and whose citizens now are about as wealthy. By organizing resources ranging from physical to intellectual capital and combining them with some sort of capital investment, growth can happen in otherwise naturally inhospitable environments. The trick is to hit upon the right combination of resources, especially for developing countries whose economies can't seem to right themselves.

Growth theory began to take off around the mid-20th century. In his recent book, *Knowledge and the Wealth of Nations*, David Warsh describes how Robert Solow woke up the economics profession to a novel theory of growth. In two papers, 1956's "A Contribution to the Theory of Economic Growth," and its 1957 follow-up, "Technical Change and the Aggregate Production Function," Solow zeroed in on the notion that technical change, more so than capital investment or savings, was at the heart of economic growth. That is because technical change was found to be the key in increasing productivity; nothing else had that effect in the long run. "Here was the answer to

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DEVELOPMENT

the question of why the economy kept climbing the mountain of diminishing returns,” Warsh wrote. “It had relatively little to do with labor or capital accumulation. ‘Technical progress ... was creating the new wealth.’”

At its simplest, the Solow model says that, yes, investments in capital and labor *can* spur growth. But these gains are transitory because of diminishing returns — the problem that, after awhile, productivity doesn’t improve as much with the addition of, say, the same type of computer. The only thing that propels growth over the long haul is technological change — be it in creating a more powerful antibiotic or in building a smaller memory chip.

It was a useful theory. With the Solow model, one could pose questions and view the results. Should public policy provide incentives so that people save 2 percent more of their income each year? The model predicts what the long-range, overall impact of economic output would be from this policy prescription.

Soon enough, Solow’s basic model was modified into a neoclassical theory. Among other tweaks, the most important extension from the Solow model was that savings moved to the inside; with Solow, savings — like technological change — had been treated as exogenous. (To economists, “exogenous” means a factor that is injected from a model’s outside. By contrast, “endogenous” refers to variables that are determined from things happening inside the model.)

The exogenous nature of the Solow and neoclassical models remained their big flaw. By treating technological change as exogenous, the models say the very driver of economic growth is not an internal component in the model; it is something injected more or less arbitrarily from the outside. Though policy could affect the growth rate during the transition period, eventually policy is ineffective as nations reach their long-run (or steady state) growth rate. Additionally, the neoclassical model assumes that technological skill is the same in all countries, which obviously doesn’t fit with the real-world experience.

Bennett McCallum, an economist at Carnegie Mellon University and a visiting scholar with the Richmond Fed, summed up the neoclassical model’s failings in a 1996 paper: “It fails to explain even the most basic facts of actual growth behavior,” McCallum wrote. “The model itself suggests either the same growth rate for all economies or, depending on one’s interpretation, different values about which it has nothing to say.”

Thus, in the neoclassical models, policy is impotent in influencing growth once nations reach their steady state. Likewise, the model’s main components — capital and labor — didn’t explain long-run growth either. It is all about randomly given technical change. As a guide for policymakers, its powers are limited.

So the largest hole remained the same: How do you encourage technological change? More precisely, how do

you get technological change inside a growth model?

New Growth Theory

It wasn’t until the mid-1980s, and more formally, 1990, that growth theory got its next big boost. First, there was the series of famous lectures by Robert Lucas, the Nobel Prize-winning economist who brought rational expectations theory into mainstream economics. In his lectures, later published as “On the Mechanics of Economic Development,” Lucas refocused discussion on the importance of human capital accumulation in spurring growth. Then it was a former student of his, Paul Romer, now at Stanford University, who moved the debate forward. Romer is credited with pioneering what became known as endogenous growth theory, though many others have contributed. It is called the endogenous growth model because Romer succeeded in placing technological change on the model’s inside.

The key to growth in the endogenous growth model is that it captures the “externalities” of investments in human capital. These are the byproducts of knowledge, where people not only get trained to use, say, a new computer, but also figure out a new, more efficient way to build a computer. These externalities may at first manifest themselves within individuals and their firms. But because ideas are “non-rival,” or can be used by anybody, they eventually spill out into the wider economy.

This research and development function — this factory for new ideas — is embedded in the new growth model. Ideas are both produced and consumed. This way, the problem of diminishing returns to capital investment is overcome. As defined in the new growth theory, capital investment is directed in large part to human capital, whose ideas have the power to keep economies growing through constant innovation.

Thus, in the endogenous growth model, policy matters because you can go about creating incentives for investments in human capital and research and development. This can be done via subsidies for education, tax rates, and, certainly, beefing up intellectual property rights.

When Romer's work came out, there were protests from many economists that they understood the importance of ideas and technical change all along. But what Romer and the new growth model made possible was a framework in which one could think about how policy affects long-run growth. In an interview, Romer says, "The history of economics shows us that formal mathematical models, rather than just verbal intuitions, sharpen our understanding and our thinking."

In a way, the basic new growth model that Romer built is like the part of the neoclassical model that happens when an economy is in transition, before it gets to the steady state. The transitional period just never ends. The beauty of the endogenous growth model is that, theoretically, it seems to replicate real-world experience: Different rates of saving and accompanying investments in capital *can* produce different incomes (or economic outputs). Additionally, these resulting different rates of income are unrelated to differences in returns to capital. That means that countries with low incomes wouldn't necessarily be those which would be expected to have higher growth rates, and hence, be more attractive to capital investments from foreigners — just as we see in the world.

Or is it? When economists have looked to the real world for support of both neoclassical and endogenous growth theory, they have often been disappointed.

Real-World Comparisons

One way economists figure out whether their models actually work is by taking them to the data and performing statistical regressions. They use growth rates as the dependent variable and regress them against, say, monetary policy. Then they look for robustness, or whether there is a strong relationship between growth and monetary policy across countries. Such testing on growth theory began shortly after the new class of models was introduced. Among the leading empirical researchers have been teams like Robert Barro and Xavier Sala-i-Martin.

The results haven't been as encouraging as was first hoped. Even in 2006, it is hard to find strong empirical evidence of long-run growth rates being affected by individual policies. For example: Growth theory would single out high-inflation countries as likely to experience slow growth. But cross-country regressions do not find a strong link between high inflation and lowered economic prosperity, despite the fairly intuitive connection and relative consensus among economists that policymakers ought to be trying to lower inflation in order to spur growth.

How can this be? Cross-country growth regressions suffer several inherent problems. Among them, the variables that economists must use to stand in for things like tax rates and political stability are often crude. This makes it difficult to identify which variables are most important for creating the right conditions for growth.

William Easterly, a former World Bank economist now at New York University, surveyed empirical growth studies, including many of his own, for a 2005 book chapter. These studies *have* found links between policy and growth, with the most widely studied policies, including fiscal policy,

inflation, exchange rate management, and trade. But Easterly questions the strength of those links.

Tax rates have been the leading policy investigated, "yet the literature has generally failed to find a link between income or output taxes and economic growth," Easterly wrote. For example, studies in the 1990s seemed to show that tax rates were not associated with changes in growth rates. That is, countries with really high tax rates weren't necessarily growing any slower than countries with lower rates — precisely the opposite of what endogenous growth theory predicts.

To be sure, Easterly concludes that there is "some statistical association between national economic policies and growth," meaning that growth theory sometimes provides predictions in line with the data. But he adds that these associations are not very robust. To Easterly, this puzzle is attributable to the difference in trying to grow something and trying to destroy something. A nation's history and institutions are things that policy is largely powerless to overcome. "Countries that pursue destructive policies like high inflation, high black-market premium, chronically high budget deficits, and other signs of macroeconomic instability are plausible candidates to miss out on growth," he says. "However, it doesn't follow that one can create growth with relative macroeconomic stability."

Different economists have different views about how big of a problem is the mismatch between data and theory. Do such mismatches render growth theory useless? Rodolfo Manuelli, a University of Wisconsin economist who was one of the original modelers of new growth theory, grants that simple versions of the endogenous growth model aren't supported by the data. But he believes that has more to do with the "ad hoc" nature of empirical work and the scarcity of reliable data than any broad weakness in new growth theory.

Likewise, Manuelli (as others have pointed out as well) thinks that translating between the model and

the real world is difficult. Where the model might predict market distortions that affect human capital accumulation can account for cross-country differences in growth rates, it's not clear what those distortions are in the real world. Are they tax rates? Are they corrupt governments? "I don't think it's been established that the theory is a clear success," Manuelli says in an interview. "At the same time, I don't think that the existing empirical work shows that it's a failure."

Ross Levine, a Brown University economist, is one of growth literature's leading empirical researchers. His work finds a strong relationship between the depth of a nation's financial sector and its growth rate. But as far as ties between individual policies and growth go, the financial sector seems to be an exception. "It's not so much that policies don't matter," Levine says in an interview. "It's that policies tend to come as a group."

In this view, the underlying principle of endogenous growth theory still holds. Of course, high inflation is going to hurt growth. Empirical studies fail to single out inflation as the problem because inflation is probably just one of a host of related policy problems, from corrupt government to high government spending relative to output.

Moreover, a solid understanding of growth requires more than a simple observation of how some countries have done it. A case study of Taiwan might be useful in illustrating how a small country with relatively little in the way of natural resources has provided high standards of living for its citizens. But it's not clear how much Taiwan's success can tell us about the failures that many sub-Saharan African countries, for instance, have had in their quest for growth. The interaction of political forces across countries deeply complicates the search for identifying the relative importance of technology, savings, and institutions, among many other variables. Theory can help in that search, especially in understanding the recent experiences

of developed nations like Taiwan. But modeling the highly distorted economies of less-developed nations is another matter.

Romer Redux

Although he no longer works on growth models, Paul Romer still closely follows the literature. The failure of some empirical studies to support endogenous growth theory doesn't bother him for a couple of reasons. First, it's important to distinguish between "growth" and "development." If one defines "growth" as applying to the rate of growth of the GDP per capital over time for already developed nations such as the United States or European nations, it is impossible to discount the importance of knowledge and ideas, Romer says. Granted, he says, for lesser-developed countries the debate is open, as the "development" literature is unclear about the importance of the ideas in helping lesser-developed countries close the gap with developed countries.

"In development theory, there's an open debate about how important thinking about ideas is for understanding the catch-up process," Romer says. "Why do some countries catch up and others do not? I think this is where people say the [endogenous] theory doesn't make sense."

The theory "doesn't make sense" in that for underdeveloped nations, creating incentives for nurturing new ideas must be viewed at the bottom of its priority list. More urgent would have to be creating political stability as well as political accountability, enforcement of property rights, and support for a free market. In the case of sub-Saharan nations of Africa, few would argue that it's a lack of ideas — rather than a lack of a well-functioning market system — that is holding back countries from catching up with the rest of the world.

On the other hand, Romer points to China as a more complicated case. In China, there is a fast-growing manufacturing economy, fueled by

direct foreign investment. And yet the nation still lacks a fundamentally sound market economy. "There's no way to understand the Chinese experience without understanding their success in taking knowledge from the rest of the world and putting it to use in their borders," Romer says. "So theories of how ideas get transmitted and put to use are central to understanding the China case."

Above all, Romer is wary of rejecting endogenous growth theory out of hand based on the failure of empirical studies to validate all of its versions and all of its predictions. An example: Endogenous growth theory teaches that in a world where countries don't interact (don't trade with each other or communicate at all), the largest economies should grow fastest. A test of that assumption would find that it's not true. But the problem isn't so much the theory, Romer says, as the assumption that was used to test the theory. "That's not the same as saying that knowledge and ideas are unimportant in the process," he says. "It just means some of the particular functional forms that people have used to try to capture the effects of knowledge are wrong."

Refinements

Pierre Sarte, an economist at the Richmond Fed, has written several papers on growth theory. His most recent article aims to explain a certain case when endogenous growth theory and data seemingly contradict each other. It is a useful example of how the relationship between growth theory and empirical studies ought to be viewed with some skepticism.

The data seem to show that countries with higher average ratios of government spending, or average tax rates, to output are associated with higher growth rates. On its face, this finding is completely at odds with what endogenous growth models say should happen — that high tax burdens should trigger lower growth rates. Sarte and co-author Wenli Li noted first that because marginal tax rates are not easily observable,

empirical studies substitute for these rates with tax shares in income (or the ratio of government spending to GDP). They attacked this problem by building a model that more closely resembled the real world. The authors used progressive tax rates (where most endogenous growth models have relied on flat rates) and “heterogeneous agents” (to represent people of different incomes).

Li and Sarte show that — because of a Laffer curve-type effect — some people have lowered incentives to accumulate human and physical capital in environments with highly distortionary tax codes. This in turn lowers their income, and thus may cause the overall tax shares in income to decrease. At the same time, an environment with a highly distortionary tax code is associated with lowered growth in the model. So the end result is that a distortionary tax code is associated with *both* lowered growth rates and lowered tax shares in income simultaneously. It follows that, when plotted together, the relationship between tax shares in income and growth in the model will appear to be positive, just as in the data. But the fact remains that this in no way implies that taxes don’t have a distortionary effect.

The overarching conclusion Sarte draws is that using tax revenue as a share of output (the average tax rate) is a poor stand-in for the marginal tax rate. In other words, the empirical

findings may be sending the wrong signals because they’re not using the right measures. “What the paper points out more generally is to be careful about interpreting the data,” Sarte says.

At the same time, Sarte sees a wider problem for growth theory. Taxes or other measures that economists typically use in empirical studies don’t convey the breadth and depth of distortionary policies that are in fact at the heart of slow or negative growth rates in developing countries. Similarly, Sarte agrees with the likes of Easterly and Manuelli in seeing deficits in the ability of models to account for things like property rights or a corrupt legal system. “I find it very difficult to believe that highly distortionary policies have no effect on long-run growth prospects,” Sarte says. “You don’t see that in the data simply because it’s very difficult to measure the relevant distortions.”

The Verdict

So we return to the question: Is growth theory stunted? The apparent failure of empirical growth literature to validate theory doesn’t bother economists like Manuelli, who see distinct roles for theory versus statistical regressions (as well as distinct cases where neoclassical theory works just fine, and others where endogenous growth models are more insightful).

The most valuable contribution of pure theory is to answer “what if” policy questions that the data, being based on past policy, cannot address. By necessity, theory simplifies reality into a mathematical model. “We are sort of in an in-between region right now,” Manuelli says. “My hunch is that, in some time, newer, better versions [of growth theory] will come closer to encompassing all the complexity of actual economies.”

To Levine, there is likewise no need for alarm. Though empirical work hasn’t found clear links between individual policies and growth, that may not be the point. He sees endogenous growth literature’s focus on asking why countries choose groups of policies that don’t lead to rapid growth.

Even if he’s wrong about the precise direction of growth literature, Levine is confident that there will be another Solow and Romer-like innovation before long. “The question is too big and too central to economists,” Levine says. “With the new growth theory, there were some new insight, there was a lot of new data and this confluence of ideas and data caused a lot of action in trying to examine the links between policy and growth. We learned a lot, and now people are starting to ask the question, ‘Why would countries choose different types of policies that don’t lead to growth?’ Maybe that will lead us to the next step.” **RF**

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