

Why do some countries' economies grow faster?

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Where do you make your academic home if your PhD is in physics, you did a postdoc at Harvard's Kennedy School of Government, and you're researching macroeconomic theories that defy the conventional wisdom in the field? The MIT Media Lab, naturally.

That, at least, is the unusual career path taken by César Hidalgo, one of two new assistant professors to join the Media Lab last fall. Hidalgo says that one of his heroes is Francis Bacon, the 16th-century English statesman, philosopher, lawyer and essayist generally credited with inventing the scientific method, and it's the breadth of Bacon's intellectual appetite that Hidalgo finds inspiring. In his PhD thesis, Hidalgo applied mathematical tools largely derived from statistical [physics](#) to problems in economics and urban planning and to the analysis of cell-phone networks; in other work, he's used similar tools to study gene expression and disease epidemiology.

But in recent years, Hidalgo has been concentrating on development economics. And as might be expected from someone trained as a physicist, his approach to the subject is unorthodox.

The standard theoretical framework for development economics was established more than 50 years ago by the MIT economist Robert Solow, who developed a mathematical model that predicts countries' [economic](#) growth on the basis of labor and capital (the tools of production); subsequent work expanded the model to include factors such as land and human capital (expert knowledge). The model proved highly influential,

ultimately earning Solow the 1987 Nobel Prize in economics.

Nonetheless, Hidalgo argues, by lumping together a huge variety of resources under the general heading “capital,” it can obscure distinctions that are crucial to an accurate understanding of countries’ economies. In a series of papers cowritten with Ricardo Hausmann, director of the Center for International Development at Harvard’s Kennedy School of Government, Hidalgo has argued that, indeed, the best predictor of a country’s future economic health is not the magnitude but the diversity of its production capacity.

Ins and outs

Economists think of production in terms of inputs and outputs. The outputs are the goods that a country produces. The inputs are everything that’s required to produce those goods. In 19th-century America, lumber was an example of a product with relatively few inputs. Exporting it required little more than the manpower and tools to chop down trees and haul them to shipping ports. Twentieth-century digital-signal-processing chips, on the other hand, are products that require a lot of inputs: the ability to extract and purify exotic materials like gallium arsenide, computer-aided design software to produce circuit layouts, and the chemicals and vacuum chambers required for the deposition of different layers of material, among other things.

Hidalgo and Hausmann argue that the diversity of a country’s production capacity, and thus the true strength of its economy, depends on the diversity of both its outputs and its inputs. Two countries could export the same number of products — they could have the same diversity of outputs — but if one exports only garments, it’s likely to have many fewer inputs than a country that exports a mix of garments and other light manufacturing, agricultural products, electronics and cultural goods. And the country with more inputs, the researchers claim, will

adapt better to a changing world economy.

It's an intuitively plausible claim, but getting a quantitative handle on it is difficult. Diversity of outputs is easy enough to measure: Economists have developed some standard schemes for classifying products that have borne up well in empirical studies. But almost anything could count as an input: not just natural resources or factories but, say, a good public-transportation system that makes the labor market more efficient, or intellectual-property laws that reward entrepreneurship.

That's where Hidalgo's mathematical tools come in. Rather than try to exhaustively categorize inputs — probably an impossible task — Hidalgo simply assumes that products that require a lot of inputs are scarcer than those that don't: More countries export lumber than export digital-signal-processing chips. By analyzing both the diversity of a country's products and the number of other countries capable of producing the same products, Hidalgo is able to quantitatively assess the diversity of the country's inputs.

Cash value

Hidalgo and Hausmann have found that GDP correlates pretty well with diversity of outputs, but it correlates much better with diversity of inputs. And the cases where the correlation breaks down could actually be more interesting than the cases where it holds, because they could indicate economies poised for growth. In 1970, for instance, the Korean economy had much greater diversity of inputs, according to Hidalgo's measure, than the Peruvian economy; but Peru had twice Korea's GDP per capita. Over the next 30 years, the relative diversity of inputs in the two countries' economies stayed more or less the same, but by 2003, Korea had four times Peru's GDP per capita.

Moreover, Hidalgo points out, Korea's surge is impossible to explain

using the standard factors of production. “In 1970, Peruvian workers were working with four times the capital per worker, and they were working with two and a half times the land per worker, and they had the same level of education as Korean workers,” Hidalgo says.

“All economists drank the Solow model with their mother’s milk,” says Ugo Panizza, head of the Debt and Finance Analysis Unit at the United Nations Conference on Trade and Development. “It’s so engrained in our thinking.” In 2007, Hidalgo, Hausmann, and colleagues at both the Kennedy School and Notre Dame (where Hidalgo did his PhD) published a paper in *Science* outlining their view of development economics. Among mainstream economists, “There was not much attention and a lot of skepticism,” Panizza says. “When something so new comes, the first reaction is sort of defensive: Why should I throw away what I’ve learned so far, which seemed to have worked fairly well?”

But the tide seems to be turning. Panizza says that at a recent conference sponsored by the Latin American Economic Association (of which, admittedly, Hausmann is the president), several economists from some of the best-respected academic economics departments in the United States discussed ways of incorporating Hausmann and Hidalgo’s work into their own models.

Panizza says that Hausmann and Hidalgo’s work is so new that it’s too soon to assess the accuracy of the mathematical models that they’ve proposed. But even if those models are later superseded by others, Panizza says, they’ve helped open up a new direction of economic research that looks very promising. “It will change the way in which people think about these issues,” Panizza says.

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