

such as how the country is governed, the average amount of formal education each individual receives, and the country's overall competitiveness. But now a team of researchers from Harvard and MIT has discovered that a new measure based on a country's collective knowledge can account for the enormous income differences between the nations of the world better than any other factor.

The researchers, led by Ricardo Hausmann, director of Harvard's Center for International Development and former Minister of Planning for Venezuela, and Cesar A. Hidalgo, assistant professor at MIT's Media Laboratory and faculty associate at Harvard's Center for International Development, have published a book called *The Atlas of Economic Complexity*. Starting today, the book is free to download at <http://atlas.media.mit.edu>.

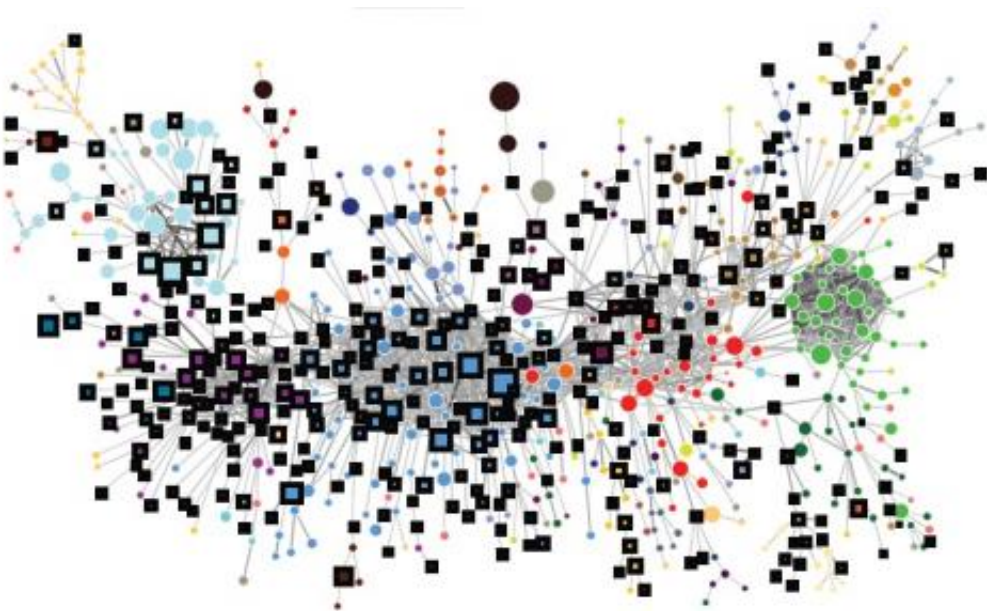
The authors plan to launch the book during an exclusive event at Harvard's Center for International Development on October 27th. Attendees will include chief economists of the World Bank and the Asian Development Bank, among other guests.

In the book, the authors show how the total amount of [knowledge](#) embedded in a country's economy can be measured by a factor they call "economic complexity." From this perspective, the more diverse and specialized jobs a country's citizens have, the greater the country's ability to produce complex products that few other countries can produce, making the country more prosperous.

"The total amount of knowledge embedded in a hunter-gatherer society is not very different from that which is embedded in each one of its members," the researchers write in their book. "The secret of modern societies is not that each person holds much more productive knowledge than those in a more traditional society. The secret to modernity is that we collectively use large volumes of knowledge, while each one of us

holds only a few bits of it. Society functions because its members form webs that allow them to specialize and share their knowledge with others.”

The researchers measured a nation’s collective knowledge in terms of the types of products it produces. Countries that produce lots of products that few other countries produce (such as medical imaging devices and jet engines) have more collective knowledge than countries that produce mainly ubiquitous products (such as cotton and soy).



This network shows the product space of the US. Image credit: The Atlas of Economic Complexity

“The amount of knowledge that is required to make a product can vary enormously from one good to the next,” the authors write. “Most modern products require more knowledge than what a single person can hold. Nobody in this world, not even the savviest geek nor the most

knowledgeable entrepreneur, knows how to make a computer. He has to rely on others who know about battery technology, liquid crystals, microprocessor design, software development, metallurgy, milling, lean manufacturing and human resource management, among many other skills. That is why the average worker in a rich country works in a firm that is much larger and more connected than firms in poor countries.”

But getting poorer countries to begin producing more complex products is not as simple as offering individuals a formal education in which they learn facts and figures - what the authors refer to as “explicit” knowledge. Instead, the most productive knowledge is the “tacit” kind (for example, how to run a business), which is much harder to teach. For this reason, countries tend to expand their production capabilities by moving from the products they already produce to others that require a similar set of embedded knowledge capabilities.

After measuring the Economic Complexity Index (ECI) of 128 countries by analyzing their products, the researchers found a strong relationship between ECI and income per capita, at least for countries that have limited natural resource exports. (Countries with, for example, large oil reserves tend to be wealthier than expected, since mining oil reserves depends more on geology than large amounts of knowledge.) For the 75 countries for which natural resources account for less than 10% of exports, the researchers found that economic complexity accounts for 75% of the variance in income per capita. After controlling for natural resource exports, economic complexity and natural resources explain 73% of the variance in per capita income across all countries.

Using this data, the researchers generated a ranking of the 128 countries in which Japan had the highest ECI, followed by Germany and Switzerland. The US was 13th.

The authors then predicted each country’s future economic growth by

comparing each country's ECI with its level of income (GDP per capita). If a country had a lower level of income than was expected for its level of complexity, the researchers predicted that the country would experience more growth in order to "catch up." In other countries, the level of income was higher than expected based on their level of complexity, suggesting that these countries would not experience strong future growth.

Based on this analysis, the top three countries with the highest expected growth were China, India, and Thailand. The US was 91st. As the researchers explained, complex economies tend to have few remaining opportunities because they already produce many complex products. Meanwhile, countries with an intermediate level of complexity differ largely in their potential for expanding to make more complex products.

The researchers hope that this ability to measure a country's prosperity and predict its future economic growth reveals some key areas that might be addressed and used to accelerate the process of [economic](#) development.

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