Using physics to make better GDP estimates

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A team of Italian physicists has used economic complexity theory to produce five-year gross domestic product (GDP) estimates for several countries around the world. In their paper published in the journal *Nature Physics*, Andrea Tacchella, D. Mazzilli and Luciano Pietronero describe how they applied the theory to economic forecasting and how well it has worked thus far.

Currently, economists use a variety of models to produce GDP estimates, which are often used by law and policy makers to inform

decisions about future events. Such models typically require a host of variable inputs and are quite complex. In sharp contrast, the estimates made by the Italian team used just two variables: current GDP and another they describe as "economic fitness."

The researchers calculated a number for a given country's economic fitness using physics principles applied to export products. Such factors as diversification and the complexity of the products were taken into account, offering a means of gauging the relative strength of a given economy. The idea was to rate a country's economic strength—the wider the range of products being exported and the more complex they were, the more likely GDP was likely to grow—and used that to forecast future prosperity.

The team reports that they have been running their models for approximately six years—long enough for them to see how well their estimates matched actual GDP numbers over time. They report that their estimates were on average 25 percent more accurate than were those made by the International Monetary Fund. They report also that their models accurately predicted the booming Chinese economy in 2015 when more traditional models suggested the country was headed for a slowdown.

The researchers explain that the field of economic complexity involves studying the behavior of economies over time and the factors that cause them to change. Doing so includes using tools such as those that have been developed to measure turbulence in fluids and traffic jams. The philosophy of such research, they explain, revolves around the idea that complex systems with a large number of elements that interact in non-linear ways tend to have emergent properties. Learning to understand such properties, they further note, can offer insights into relationships such as the one between exports and GDP trends.

More information: A. Tacchella et al. A dynamical systems approach to gross domestic product forecasting, *Nature Physics* (2018). DOI: 10.1038/s41567-018-0204-y

Abstract

Models developed for gross domestic product (GDP) growth forecasting tend to be extremely complex, relying on a large number of variables and parameters. Such complexity is not always to the benefit of the accuracy of the forecast. Economic complexity constitutes a framework that builds on methods developed for the study of complex systems to construct approaches that are less demanding than standard macroeconomic ones in terms of data requirements, but whose accuracy remains to be systematically benchmarked. Here we develop a forecasting scheme that is shown to outperform the accuracy of the five-year forecast issued by the International Monetary Fund (IMF) by more than 25% on the available data. The model is based on effectively representing economic growth as a two-dimensional dynamical system, defined by GDP per capita and 'fitness', a variable computed using only publicly available product-level export data. We show that forecasting errors produced by the method are generally predictable and are also uncorrelated to IMF errors, suggesting that our method is extracting information that is complementary to standard approaches. We believe that our findings are of a very general nature and we plan to extend our validations on larger datasets in future works.

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