

Long-Run Growth Forecasting

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The importance of long-run growth analysis

Forecasts are usually made to help and guide decision making. Good forecasts are preconditions for good, informed decisions. These decisions may vary from a financial market bet on interest rate changes to the policy decision on how to structure a country's pension system. Ideally, decision-makers should be as well prepared as possible for the future, which would allow them to act appropriately. To detect challenges and opportunities in a timely manner decision-makers require a good forecasting framework. Given the role governments, companies and individuals play, knowledge about the drivers and linkages that determine the future will allow these players to actually shape the future themselves.

1.1 Frequent forecast failures

Unfortunately, history is full of examples of poor predictions and therefore poor decisions. In the early 1990s, the USA was seen by many as a sclerotic economy destined for anemic economic growth with high unemployment and to be overtaken by Japan within a few years. As we know today, these predictions could not have been more wrong. Growth of US gross domestic product (GDP) averaged 3.3% per year between 1992 and 2005. Asset markets in the US surged as they became increasingly confident that the future would be much brighter than assumed in the early 1990s.

By contrast, Japan in the early 1990s was seen as a role model. In the event, a decade of economic stagnation, falling asset prices and banking sector problems followed and made many forecasters look incompetent. Germany is another case where trend GDP growth has been overestimated significantly for the past 10 years. From about 2% in 1995 the consensus forecast for trend growth was revised down to around 1% by 2005. Actual growth over the years 2001-05 was just 0.7%. Year after year, growth expectations of investors and companies had to be revised downwards. Had investors known already in the mid-1990s just how low Germany's growth potential was, some investment

plans would have turned out quite differently: production capacities would not have been expanded as much and investors would have avoided companies with a large exposure to German domestic demand.

Forecast errors are not confined to developed markets. The frequent crises in emerging markets over the past two decades tended to be even more severe and surprising. For example, the 1997 crisis in emerging Asia caught many investors by surprise - who wished they had been better able to anticipate the difficulties. Even worse, after retreating from Asia during the crisis, many companies were surprised by the rapid rebound of countries like Korea and Malaysia - and wished they had had a framework to tell them to stay engaged in these countries.

This anecdotal evidence is supported by more formal analysis. The forecasts in the International Monetary Fund's semi-annual World Economic Outlook (WEO) displayed a tendency to systematically overpredict real GDP growth as Timmerman (2006) shows. Between 1991 and 2003, the next-year forecasts in the September WEOs for France, Germany, Italy and Japan were on average a full percentage point too high. This bias points to a significant overestimation of trend growth. Indeed, one of Timmerman's recommendations on how to address these forecast errors is to have "more frequent reviews of estimates of potential output growth" (op. cit. p. 9). This would entail a more thorough modeling of trend growth using elements of growth theory.

The IMF is not alone in having made these systematic forecast errors. They are also visible in the European Central Bank's (ECB) staff forecasts for the euro area and in consensus forecasts. For the year 2003 the staff forecast for GDP started out at 2.5% - way above the final outcome of 0.5%. Forecasts for 2002, 2004 and 2005 were also too high by between 0.4 and 2.1 percentage points. The consensus according to the ECB's Survey of Professional Forecasters did not fare much better. In the first quarter of 2001 the five-year ahead GDP forecast was 2.7%, while growth over 2001-05 actually averaged just 1.4%.

Repeated small differences in growth rates can lead to large differences in outcomes many years down the road. A growth rate of per capita GDP of 1.5% does not look all that different from a growth rate of 2%. But over 20 years, this translates into a 10% difference in income levels - not a negligible amount.

These persistent and large forecast errors indicate that economists do not yet have the appropriate theories, data and/or statistical tools to adequately model the developments of national economies. Unfortunately, the task at hand is really enormous: Lucas (1988, p. 13) observed that "The growth rate of an entire economy is not an easy thing to move around. Economic growth, being a summary measure of the activities of an entire society, necessarily depends, in some way, on everything that goes on in a society."

In trying to help reduce forecast errors in the future, this study makes three contributions. First, it provides an assessment of the main existing theories of economic growth and proposes an augmented Kaldor model as the most

reasonable synthesis. It is the first work to derive hypotheses of pair-wise cointegration among the key variables in growth models. Second, this study applies modern non-stationary panel estimation techniques to test these hypotheses for 40 countries for the period from 1971 to 2003. And third, it presents long-run growth forecasts for the years 2006-20. A forecast competition will show that forecasts based on the theories outlined here can outperform consensus forecasts and simple time-series models.

The time horizon is the medium to long run of 5 to 20 years. In economics the term “growth” already refers to the long-run development of an economy, the evolution of its potential or trend output. However, since the media and financial markets frequently use “growth” when referring to changes in GDP over shorter periods of a year or even a quarter (which are the combined result of trend and cyclical factors), this study uses the term “long-run growth” to avoid any uncertainty regarding the time horizon.

While the ultimate goal of this study is to derive a set of forecasts, the path to these forecasts is at least as important. A forecaster has to understand the assumptions made, the limits of theories, the datasets used and has to cross-check the insights with real world experience. Unfortunately, the theoretical and empirical growth literature has not yet produced a consensus on some of the most important questions: How important is the accumulation of physical capital for GDP growth? Is investment exogenous or endogenous? Should population growth be treated as exogenous? Does an increase in education lead to higher output? What is the best econometric technique to try to answer these questions?

1.2 Strong demand - but little supply

Demand for substantiated long-term growth forecasts is high following the surprises and forecast errors made in the past. Growth forecasts are used in many areas in business and financial markets and by governments.

Businesses require forecasts for economic growth for their budgeting, strategic planning and for the analysis of business cases. Since many corporate investments, such as a new chemical plant, have investment horizons of 10 to 15 years they also require GDP forecasts over a similar horizon. The need for a neutral forecast is particularly strong here because individual business units have a genuine interest in presenting high forecasts, which may steer the allocation of resources to their unit. If budgets, strategic plans and selected business cases are based on wrong assumptions, losses for the whole company may ensue. If production and inventories are too high relative to actual demand in the future, then prices may need to be set below initial plans to clear inventory. Just-in-time production may ease some of these difficulties, but production capacities nevertheless have to be aligned with expected demand.

Financial markets make heavy use of long-run GDP forecasts in many ways. For example, many pricing models are based on the economy's underlying growth trend: Government bond yields are often priced on the sum of expected real GDP growth and inflation. And these bond yields are themselves the benchmark against which other assets (equities, real estate) are priced. Fund managers try to outperform their peers by comparing the growth forecast that the market is pricing in at the moment with their own, possibly model-based, forecast for long-run growth. They would prefer to invest in markets that few others see as promising today but that will show their strength in the near future.

When assessing the risk of overheating of an economy, the current growth rate of GDP is compared to the rate of potential GDP growth. Business cycle analysis usually starts from trend growth and then adds or subtracts from it depending on the current state of policy variables and exogenous developments (e. g. oil, exchange rate). But most of these analyses use past trends as a starting point. If trend growth is on a downward trajectory, this may lead to a series of downward revisions of growth forecasts and upward revisions of inflation forecasts - as seen in Europe and especially in Germany since 2001.

Furthermore, policy-makers are interested in specific advice on how to strengthen their countries' growth performance - or how to prepare for geopolitical changes resulting from diverging economic outcomes. A systematic analytical framework and a set of conditional forecasts for growth would make their tasks easier.

Long-run growth forecasts are also important for international organizations like the World Bank or the International Monetary Fund. A stabilization program and the associated recommendations may look quite different depending on the economy's underlying growth potential. It turns out that the IMF's medium-term growth projections have a tendency to err on the high side. As Batista and Zalduendo (2004) emphasize, this "over-optimism may lead to complacency regarding the adequacy of growth-oriented structural reforms pursued by a country."

In addition, national fiscal authorities require solid forecasts for trend GDP growth to estimate future tax revenue and pension liabilities. Wrong estimates of revenue and expenditure may lead policy-makers to cut tax rates and expand welfare spending. The result would be unexpectedly high fiscal deficits - as seen in many European countries since 2001. Around the turn of the millennium, many European governments used GDP forecasts that turned out to be too high because they were too optimistic both on the cyclical and on the trend development of GDP. This meant that budget deficits turned out much higher than expected and led to major political upheaval inside the European Union because several countries did not comply with the Stability and Growth Pact.

Likewise, central banks need a good grasp of the growth rate of potential GDP over the medium term. If a central bank overestimates the trend growth rate, it may supply too much liquidity and end up with unexpectedly high in-

flation. For example, in 1999 and 2000 the European Central Bank came under pressure to revise its reference value for the expansion of M3 money supply upwards because strong current GDP growth had led many financial market analysts to revise upward their forecasts of the euro area's potential GDP growth. In the event, the ECB correctly opted for maintaining its assumption of potential GDP growth at 2 to 2.5% - possibly because it has superior capabilities in modeling the economy's potential GDP. Similarly, central bank reaction functions such as the Taylor rule require a 'normal' or natural real interest rate as an important input. Often, this natural rate is derived from the economy's long-run growth potential.

A stronger focus on forecasting in growth economics may also have positive effects on the development of economic theory. When trying to apply principles of economic theory to build a forecast model, the usefulness of these principles is put to a test. This study is partly about what economists can learn when applying the ideas of growth theory in a real-world forecasting context. The theoretical model outlined in chapter 2 and the discussion of the individual variables in chapters 4 to 9 benefited strongly from having to be useful for forecasting.

While demand is strong, there is a scarcity of substantiated long-run growth forecasts. Some models used by central banks and international organizations just extrapolate the past trend of GDP growth or of labor productivity into the future using simple statistical tools like the Hodrick-Prescott filter. Academic research into economic growth shies away from exploring the forecasting performance of growth models and focuses mostly on explaining the past. The Handbook of Economic Growth published in 2005 does not include a chapter on forecasting in its two volumes with a total of 1998 pages.

Private institutions either make ad-hoc assumptions on future growth or generate models that may not deliver what they claim to do. The "Growth Competitiveness Index" (GCI) developed by the World Economic Forum (WEF) claims to "evaluate the potential for the world's economies to attain sustained economic growth over the medium and long term"¹ and receives a lot of media attention every autumn partly because it is one of just a few models in the face of the strong demand. Unfortunately, there is a slight negative correlation between the 2001 GCI ranking and actual GDP growth over 2001-05. This forecasting weakness has some tradition: In the early 1990s, the WEF produced a joint ranking with the Institute for Management Development (IMD). The 1993 version saw Japan and Germany ranked at numbers 2 and 5 - just ahead of a decade of very weak growth. By contrast, Finland and Korea ranked 25th and 28th in 1993 - just ahead of a decade of very strong growth. Therefore, the GCI or the IMD index does not seem to be a good predictor of economies' future growth prospects. Neither fills the gap between high demand and low supply of long-run growth models.

¹ See Blanke et al. (2003), p. 3.

International organizations such as the IMF and the World Bank maintain a set of models to forecast long-run GDP growth for a large number of countries. However, these models and their forecasts are not usually available to the public. Exceptions are working papers, for example those by Batista and Zalduendo (2004) and Ianchovichina and Kacker (2005). Wherever possible, I will compare my models and insights with those from these forecasters. Recently, private-sector institutions such as banks and consultancies added their own models. Chapter 13 will discuss these contributions as well.

1.3 Plan of work

This study is about forecasting long-run GDP growth both per capita and in total. It will derive forecasts for average annual GDP growth for the period 2006 to 2020 for 40 economies around the world based on models with annual frequencies using the most current data available. The forecast horizon of 2020 is motivated by the average investment period of large projects initiated by companies or governments.

In addition, to allow some out-of-sample testing of the model, I will use data until 1995 to derive forecasts for average annual per capita GDP growth over the period 1996 to 2005 (and data until 2000 for forecasts over 2001 to 2005). In principle, it would be possible to calculate and evaluate estimates for each year over the forecast horizon. However, the model does not aim at explaining the business cycle. Evaluating annual observations either of growth rates or of GDP levels is likely to produce much larger absolute forecast errors than evaluating the averages. A five-year horizon should be long enough to average out business cycle disturbances. Indeed, in most countries, the span from 2000 to 2005 seems to be close to a peak-to-peak period. The model forecasts will be evaluated against a set of alternatives in chapter 13.

On the way to these forecasts I will evaluate the different theoretical models, discuss the individual drivers of economic growth and decide on the most appropriate econometric technique.

1.3.1 Choosing a sensible theoretical model

Economics carries the stamp of the "dismal science" partly because of the gloomy predictions of Thomas Malthus in 1798 that population would grow faster than food supply, dooming mankind to unending poverty and hardship. Ricardo and Marx drew similarly gloomy conclusions. By contrast, the history of the past 200 years shows that economies can create tremendous riches and move far away from poverty. The reason is substantial technological progress, which economists continue to struggle to explain. While this shows that the models of Malthus and Ricardo were clearly misspecified, there is still no consensus on the drivers of economic growth even today.

A crucial challenge in model building is to distinguish between correlation and causality. Many variables are likely to be correlated with economic growth, but not all of them have a causal link. My strategy is to combine the information from historical country experiences (e.g. Landes [1999]) and careful econometric analysis to build a model that uses variables that are as exogenous and as causal for economic growth as possible. Judgments, assumptions and compromises will have to be made. This is in line with the view of Brock and Durlauf (2001), who believe that historical and qualitative studies play a crucial role in the development of credible statistical analyses.

There is no single best way to conduct empirical analysis in the social sciences. However, it is crucial to understand the advantages and disadvantages of the different approaches in order to find the most suitable framework. The approach in this study is what Colander (2000, p. 137) calls modern economics or the economics of the model, i.e. "the study of the economy and economic policies through empirically testable models." Colander also quotes Keynes as defining the task at hand: "Economics is the science of thinking in terms of models joined by the art of choosing models which are relevant to the contemporary world." However, there is less and less *art* in economics because modern applied policy models must be specified in a way that can be directly empirically tested.

Since the focus is on growth rates rather than levels of GDP, I will leave aside constant factors that affect mainly the level of economic activity such as climate, religion, a colonial past, settler mortality, being landlocked etc.² This significantly reduces the realm of possible theoretical models. Furthermore, the focus has to be on developments that are reasonably predictable. This relegates many important developments to the sidelines. For example, a depreciation of the exchange rate, an unusually expansionary monetary or fiscal policy, a drop in energy prices or a change of government may all lead to a significant acceleration in GDP growth for several years. Indeed, Hausmann, Pritchett and Rodrik (2005) find that events like these explain most of the accelerations of GDP growth over time. In this study they will be excluded from the analysis because they are either highly unpredictable (e. g. exchange rate moves) or because they will eventually be followed by a reversal of policy (e. g. short-term monetary and fiscal shocks). A change of government may have a short-run confidence-boosting effect which already anticipates measures that will have a visible impact on drivers of growth in the long run. My analysis focuses on these long-term effects of policy changes.

When assessing the theoretical growth literature, chapter 2 will gather the most useful elements from different theories. The neoclassical model contributes the importance of diminishing returns to factors. New growth models

² Parts of the literature claim that these factors also permanently affect the growth rates of GDP. However, this would imply a centuries-long divergence of income levels, which does not appear to be observed outside Africa, i. e. in the countries considered here.

add human capital and barriers to technology adoption. Evolutionary models emphasize the importance of complementarities. My synthesis builds on Kaldor's technical progress function and augments it with insights from the other models. Chapter 2 also explains why the production function should be used with considerable care in growth models and why many endogenous models with their scale effects are not helpful for building a model of the real world. Chapters 4 to 9 look at some of the most important drivers of growth in more detail. Each chapter focuses on the theoretical rationale and the best available data for measuring each driver.

1.3.2 Choosing the best econometric technique

The survey of growth theories will show that no consensus is available on how to best model long-term economic growth. This implies that empirical analysis has to help with selecting an appropriate model. Solow (1987, 2001 add-on) suggests that an "alternative strategy might be to begin with unprejudiced empirical study of the determinants of the speed of technological innovation..."

In general, my approach will be rather pragmatic, in line with Romer (1994c, p. 20): "If we set our standards for what constitutes relevant evidence too high and pose out tests too narrowly, we will indeed end up with too little data. We can thereby enshrine the economic orthodoxy and make it invulnerable to challenge."

Temple (2000, p. 202) rightly points out that "the litmus test for the cross-country growth literature will come when we find out how useful our current models are in predicting the variation in growth rates, not for existing data, but for periods beyond the usual samples." What holds for cross-country models applies equally to time-series and panel models: Forecast performance may be an important indication for a model's validity. On the other hand, the theory of forecasting sketched in chapter 10 shows that a sound theoretical basis is not a necessary condition for good forecasts.

With these difficulties in mind, chapter 11 includes an evaluation of the different empirical growth models and assess their strengths and weaknesses. Cross-country regressions will be dismissed as not flexible enough for modeling the complex process of long-run economic growth - even though these models are still widely used today. Panel models are more appropriate, but initial attempts did not take into account the non-stationarity of the underlying data.

I will propose a two-stage approach, which first analyzes the long-run linkages between the levels of the key variables (panel cointegration). The second stage is the modeling of growth rates of GDP, taking into account the information gained in the first stage. Chapter 12 will present the estimation results. Finally, chapter 13 conducts two forecast competitions and presents forecasts for GDP growth over 2006 to 2020.