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The 4 I's of Economic Growth

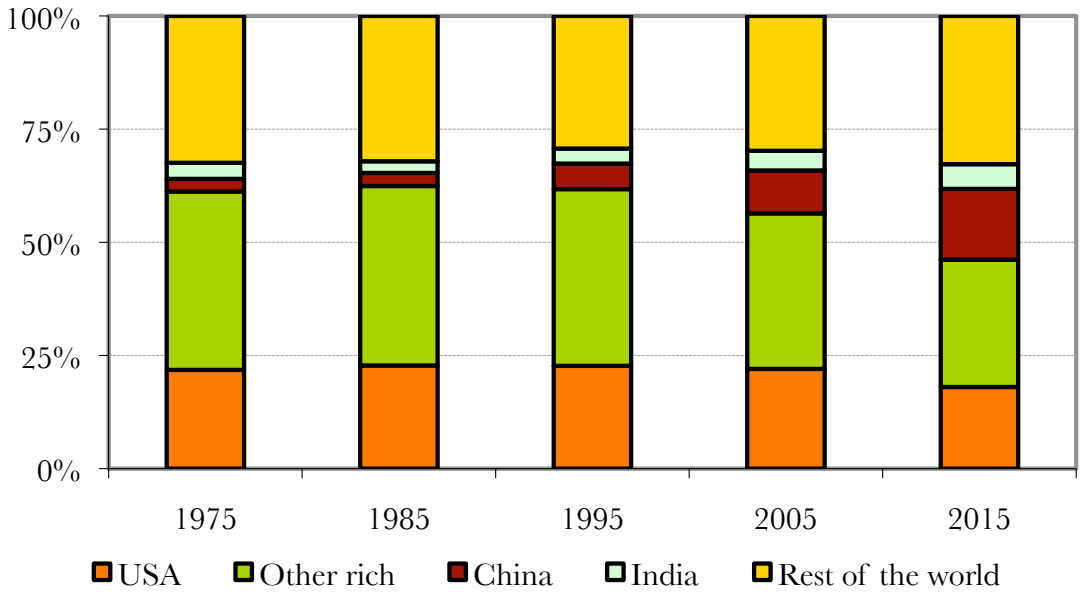
Antonio Fatás and Ilian Mihov

Introduction

Today the world economy is still dominated by rich countries. If we combine the total value of goods and services produced in 2007 in the rich countries and compare it to the value of world output, we will find that over 70% of the value is created in the high income OECD countries. Even if we adjust our calculations to eliminate the effect of differences in prices, so that a bowl of rice has the same price in the US and in China, the high-income countries' share in output remained above 50% in 2005. This share is quite impressive knowing that less than 15% of the world population lives in these countries. The skewness of production towards Western Europe and the US and more importantly the persistence of this distribution of incomes for more than 120 years has led analysts to talk about the Core of developed economies and the Periphery of developing countries. This is about to change.

The world economy undergoes a transformation that is unique from a historical point of view. We are getting to the point where for the first in the last 120 years the "Periphery" will produce more goods and services than the "Core". The shift of economic power can be compared only to the discovery of the New World and the subsequent rise of the United States as a key economic powerhouse. But as the Chairman of the Fed Ben Bernanke has pointed out, the inclusion of the US into the Core took centuries, while the recent shift in economic power started in the early 1980s and only twenty-five years later we already see a significant change in the world economic landscape.

Figure 1: Composition of world GDP by country and group
(Purchasing Power Parity)



This changing environment is surrounded with uncertainty: How fast will the process be? If large emerging markets such as China and India continue to grow at their current rates for the next ten years, while the advanced economies grow at 3%, then by 2015, world production will be dominated by emerging countries in terms of volumes of output. Will this scenario be realized, or more generally, can China and India sustain their recent high growth rate? What will be the consequence of this historical transformation on the rich economies of Western Europe and North America? To be able to answer these questions we need a robust understanding of the main drivers of economic growth. Our goal in this article is to present a usable framework that captures the essence of economic growth theory.

The Technological Frontier: Innovation

Over a long period of time, the increase in the economic well-being in the world can come only from innovation. Often we associate innovation with new technology or new products, but in reality a significant amount of innovation is also about new ways of producing the same old things, i.e. better management and better organization of production. We use the term innovation to signify both technological inventions and managerial or organizational innovations. In our discussion, it is useful to introduce the concept of the world technological frontier. A country whose production possibilities and organizational structure are located at this frontier uses the most advanced technology, the most advanced capital, the most skilled labor and implements best managerial practices to produce a variety of goods and services. In reality it is difficult to construct a measure of the world frontier but we can approximate its evolution by looking at those countries that enjoy the highest production per capita or per worker. In this sense, and as a simplification, we can start by using the US as a good proxy for the technological frontier. After all, the US has enjoyed levels of productivity above that of other countries for the last 100 years.

As an approximation to the technological frontier, on Figure 2 we plot GDP per capita in the United States from 1870 to 2007.[1] With a naked eye one can detect two large anomalies in the economic history of the US – the Great Depression from 1929 to 1933 and the Second World War from 1941 to 1945. The first event led to a drop in US income per capita by over 30%, while the mobilization of resources during the war implied an increase in output by over 40% relative to the pre-war years.

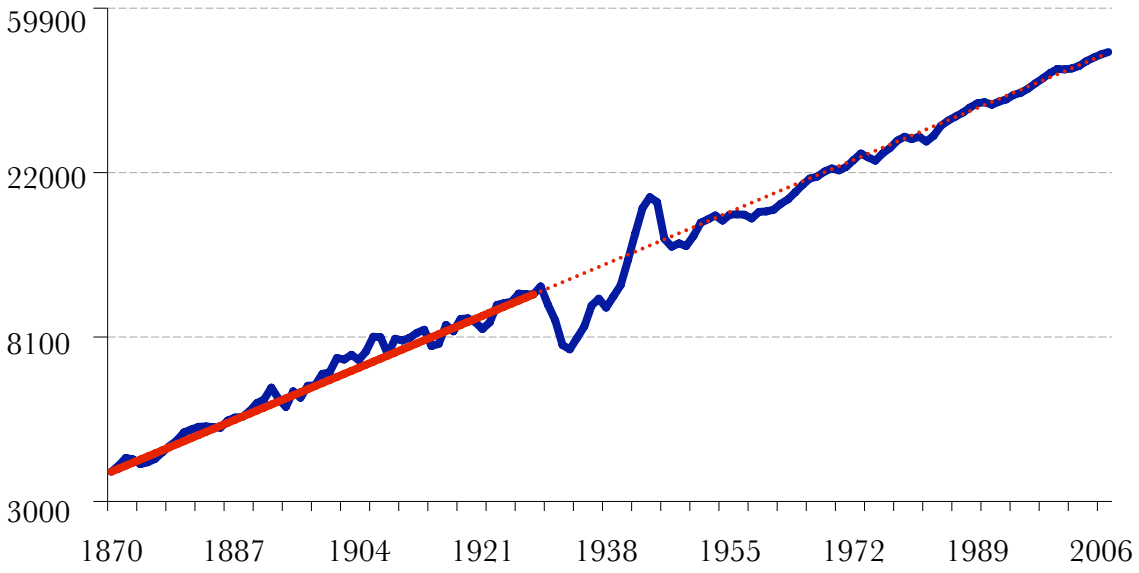
The truly amazing fact about the graph is that over these 135 years, the average growth rate in the US has been relatively constant. The straight line on the graph makes this

[1] We are ignoring some important distinctions in our analysis: income per capita is not the same as output per hour worked, which is a more appropriate measure of productivity. Even output per hour is only one of the many measures of productivity. It is possible that output per capita displays growth rates that are different from output per hour in the presence of demographic or labor market changes. However, over the long term these changes are minor compared with the speed of technological progress, which affects similarly output per hour and output per capita.

point clear.[2] Indeed, there are deviations from the straight line, but even after events such as the Great Depression and World War II, the US economy returns back to trend.

A simple exercise can help us understand the constancy in growth rates that we see in Figure 2. Let's go back in time and pretend that we have data only up to 1928 – right before the Great Depression and well before WWII. Let's try now to forecast output for 2007. The only data we have income per capita from 1870 to 1928.

Figure 2. US Real GDP per capita



To start the forecasting exercise, we can look at the past and see what a typical growth rate looked like in the decades before 1928. We could then add a theory to this and maybe argue that the U.S. market is reaching saturation, reaching diminishing returns to scale, the end of creativity and exhaustion of inventions (what else can be invented after electricity or the engine with internal combustion?) and predict that over time growth rates would decrease. Or maybe, we have a vision of a revolution in communications (telephone, telegraph) or transportation (automobiles, railroads, airline industry) and we forecast a faster growth rate ahead. But what if we ignore all of these "insights" and simply postulate that history will repeat itself and growth will continue at the same pace as before? What if we simply use data from 1870 to 1928 to forecast the level of GDP per capita in 2007? We fit the straight red line to the data from 1870 to 1928 and we extrapolate this trend, i.e. we continue to draw a dashed straight line from 1929 until 2007. In 2007 we read the value on the vertical axis – this is our projection of GDP per

[2] We are using a logarithmic scale in order to expose the constancy of the long-term growth rate. If a country grows with a constant growth rate, then on a logarithmic scale income per capita will appear a straight line. If the slope of the line is steeper, it means that the growth rate is higher.

capita. We would have predicted income per capita of $45,615, i.e. the economy would have grown by a factor of 4 from its 1928 level of about $9,000. How accurate is this prediction? Actual output per capita for the United States in 2007 is estimated to be $45,850. The forecast of GDP that we made in 1928 would have missed the actual number by only 0.5%! This is especially striking when we consider that in 1928 we did not include in our forecast the possibility of having a depression, a World War; no one knew at the time that there will be a sequence of oil-price shocks in the 1970s, a financial revolution in the 1980s, computers, internet, bio-technology…. We made our forecast by using a very limited amount of information and it turns out to be successful only because income per capita in the US over long horizons tends to grow at the average rate of 1.85% per year.

How can this be? Because growth in GDP per capita is mainly the result of technological innovation and investment, the stability of this growth rate indicates that technological progress in the US has been a very smooth process and one that has continued without pause over more than 130 years. Probably, the more precise statement is that the *adoption* of technological and organizational innovations has proceeded at the rate that implies a constant growth rate of the economy of 1.85% per year. Thus, even though there might be spurts of innovation, the adoption of new technologies proceeds at a relatively stable rate.

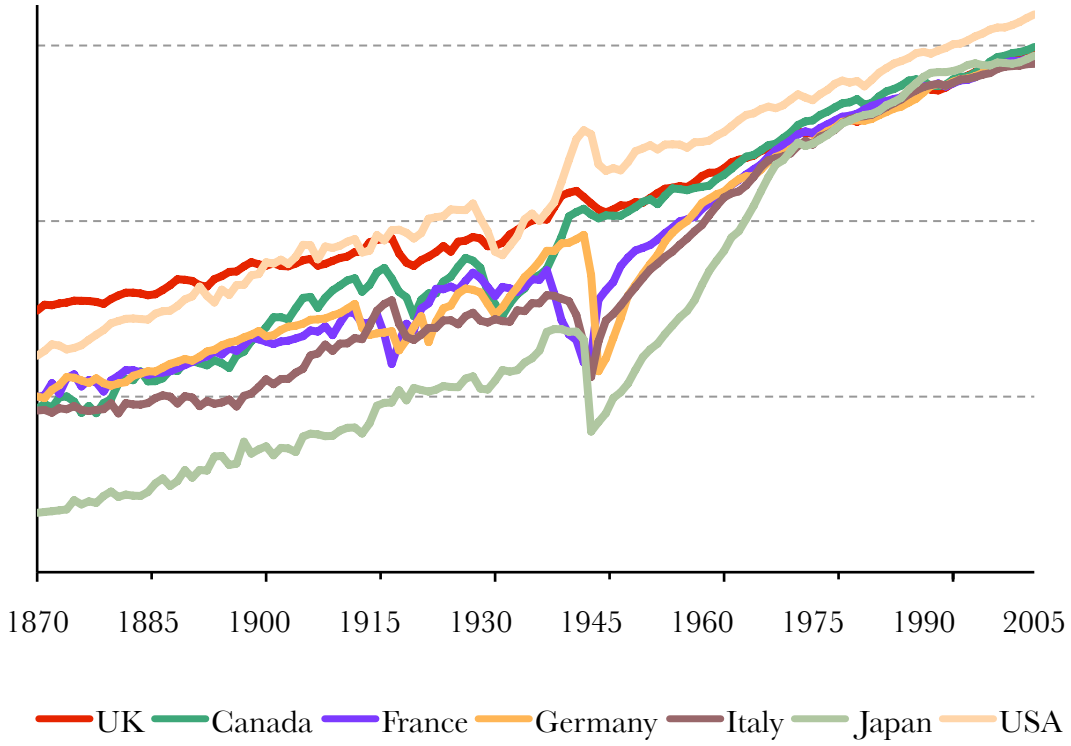
Of course, the fact that growth has been constant does not mean that it can be taken for granted, as technology and innovations are the results of efforts done by many corporations and research laboratories. Some of the technological revolutions we have seen in the last decades are the engine for that growth. The TV or the PC or the internet are all improvements without which we would not see any of the growth we have witnessed. But the fact that each of these revolutions is similar enough to the previous ones, without causing any substantial break in the trend is an important lesson. When each of them came to life they looked unique, technological progress seemed to be accelerating, we lived in periods that we have never seen before. That's how it felt, but the perception went beyond the reality.

As much as this is a very powerful statistical fact about the US economy, uncertainty remains about why the creation and adoption of new innovations is so stable. Is there a physical limit to our collective ability to generate new ideas? Or are we simply unable to absorb new technologies at a faster rate? Because we lack a solid theory of what drives this stable rate of technological progress we need to be careful extrapolating this trend into the future. Indeed, the recent period of globalization might have boosted permanently the growth of the world technological frontier. In the most recent twenty-five years of our sample, the growth rate has *accelerated* to about 2% per year. At the same time, our damage to the environment, climate change or the depletion of natural resources could one day bring an end to growth as we know it. Whether these effects will change the US long-term growth rate is, at this point, a matter of speculation, only time will tell.

Initial conditions

So far we presented the evolution of the US as an indication of how the world technological frontier has evolved. What happens in those countries that are away from the frontier?

Figure 3: Convergence to the technological frontier in the G-7 countries (GDP Per Capita, Purchasing Power Parity)



If Figure 3, we plot income per capita for the G-7 countries. We can now see more clearly why we have identified the US with the global technological frontier. With the exception of the first 30 years, the US has always had a higher rate of productivity than the other six countries. We can also see that for all these six countries growth has accelerated in the second half of the 20th century. We can also discern two very interesting facts, which are very clear after Second World War: (1) All countries seem to converge to a very similar level of GDP per capita. (2) The countries that were further away from the frontier have grown faster (their ascent to the world technological frontier is steeper). In other words, the further away a country is from the frontier, the higher growth rates can be. Once a country approaches the frontier, growth slows down and the steep rise moderates to the same growth rate as the US. The figure gives us yet another basic principle of growth: poor countries have the potential to catch up, i.e. to grow at rates that are much faster than the rich countries until they converge to the same income per capita. Once convergence occurs growth slows down.

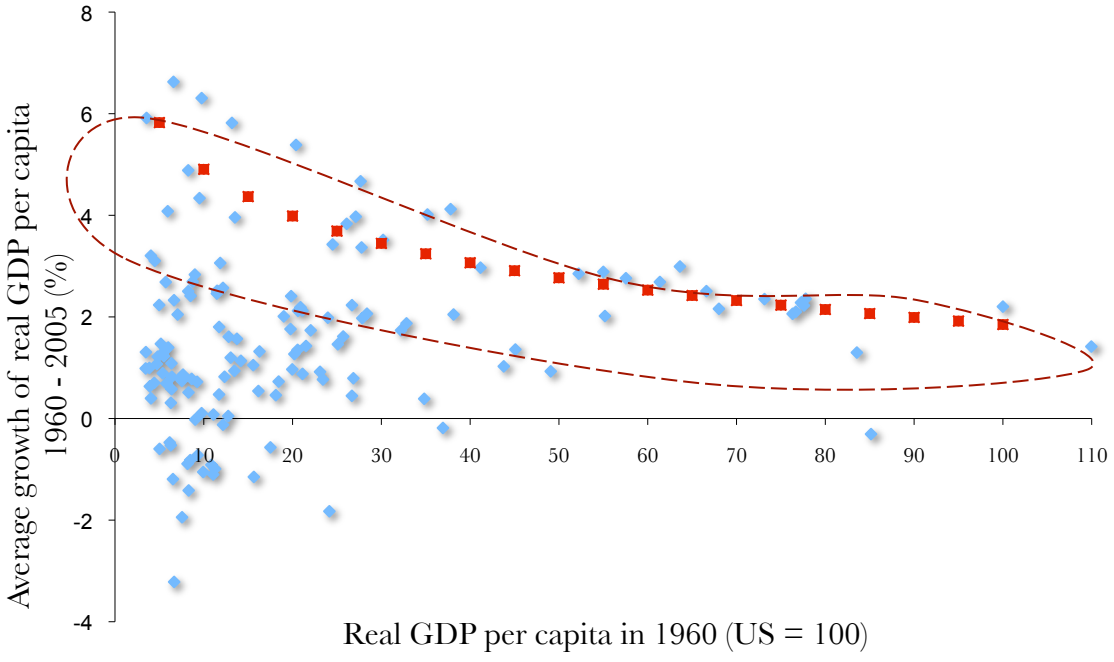
What is behind this process of convergence? The logic is rather simple – when a country is poor, it means that there is little production, hence there are few factories and labor is cheap. Building a new factory in such a country can be quite rewarding: if the product is easily tradable, then with low labor costs this firm can export to the rest of the world and earn higher rates of return on investment. Alternatively, we can think about the new factory as supplying for the local market a product that did not exist before. Again profits will be high because of the lack of competition. Companies can literally take a blueprint for a factory from the rich and more productive economy (e.g. how to produce cell phones) and build the factory in the poor country. If the country is poor then the possibilities for copying and importing knowledge are larger and hence growth rates can be higher. Once the poor country replicates the production facilities in the rich economy, there is no possibility for this fast "extensive" growth and growth rates slow down to be driven only by innovation.

An interesting question to ask is why this convergence did not happen earlier, during the period 1870-1945? For convergence to occur one needs an environment where technology and goods can flow freely between countries. A combination of a stable international political environment (at least among these countries), increases in trade and capital flows, the appearance of large multinational corporations, all of which is fostered by a reduction in the cost of transportation and communication are all behind the dramatic convergence that we see after the 1950s.

Investment

While the pattern of convergence is clear among G7 countries, as we look at other economies around the world we see that some countries converge faster, others do so at a much lower speed, a third group of countries do not converge because they grow at the same rate as the US, and yet a fourth group of economies diverge, i.e. they become poorer relative to the developed economies. We can detect these groups on Figure 4, where on the horizontal axis we measure initial conditions in 1960 (the distance to the frontier measured as income per capita in the country relative to income per capita in the US). On the vertical axis we have the average growth rates from 1960 to 2007. Each blue dot represents the growth rate and the initial conditions for a specific country. If convergence occurred on a massive scale, then we should see that countries that were initially poor (i.e. in the left corner of the graph) grew at higher rates in the subsequent 47 years. Let's assume that the speed at which poor countries converge to the rich ones is the same as the speed for the G-7 countries. The theoretical prediction from this pattern of growth is represented by the large red squares. For example, a country which has income per capita of about 20% of the US level (around $8,000) should grow by about 4% in income per capita terms. Instead of the nicely aligned downward-sloping scatterplot predicted by our theory, we see dots all over the chart. There is a group of countries that have converged over the past 47 years, and we have enclosed them within the dashed lines. However, the majority of the countries are not part of the convergence club. What determines this difference in performance?

Figure 4: Convergence plot – initial conditions vs. growth rates



Source: Maddison

Growth should come from increases in productivity or increases in inputs. If we imagine a country as a large factory (at the end that is what GDP measures, the production of all final goods and services that firms produce in a given country over a period of time), for output per worker to grow, we need a bigger factory, more machines, new technologies, new ways of organizing production, a more qualified labor force. All this comes from investment: in infrastructure, in human capital, in knowledge, in equipment. It must then be that countries that grow fast do so because of high investment rates. This is indeed the explanation for the patterns in Figure 4. As countries start with low levels of capital (and low productivity and GDP per capita) they have tremendous opportunities to invest and increase their capital stock and their knowledge in order to catch up with the rich countries. Countries like China, Korea, Japan and Singapore that have build up their physical capital at rates of 30-45% of GDP every year, have high growth rates of above 6%. It seems that to make a miracle, i.e. to have a country improve its welfare at a high speed, one needs that at least 25% of output be invested back in the economy (in China the rates of investment today are about 40%). These are astonishing numbers – they imply that out of $100 dollars of income on average $30 to $45 are put back in the economy in the form of new factories, new equipment, and new infrastructure. These are the success stories, we also see countries where investment rates are as low as 10% and instead of catching up to the developed countries, they become poorer over time.

When we talk about investment one should not immediately think about foreign investment (FDI). Sometimes, one hears the argument that China's speedy rise is driven by foreign direct investment (i.e. by foreigners building up the capital stock of the

country). In most cases around the world, including China, this statement is simply false. A small percentage of the Chinese gross investment in comes from abroad. The bulk of the new structures, equipment, factories are built from Chinese domestic savings. Needless to say, FDI plays a role in the growth process by transferring know-how but clearly it is not the main financing vehicle for investment.

Institutions

So far, it seems that there is an easy explanation of growth around the world and more importantly an easy prescription for growth. If a poor country wants to become rich, then its citizens and firms should just invest more. If the private sector cannot do this, then the government can step in and encourage or directly manage the necessary investment. There are at least three reasons why this rosy scenario does not materialize for all countries. The first one is rather mechanical: Investment today implies that individuals must be willing to save today, i.e. reduce their consumption. But reducing consumption is simply unappealing to many either because they are close to the level of subsistence so further cuts in consumption are physically impossible, or because they are happy with their current level of consumption and are not willing to trade it for uncertain future returns.

The second reason why the nice scenario does not materialize is because in most cases when governments try to substitute for the role of the private sector by taking up the investment challenge, they misdirect the funds and instead of building up useful productive capacity they build symbols of national pride that are of little practical use. Governments do have a role to play but it is more of a complement to the central role played by the private sector.

This leads us to the third and the most important reason for understanding why investment does not get materialized in poor countries. This reason is related to the institutional and regulatory environment of a country. In other words, let us think about why companies do not find attractive investing in countries with potentially many opportunities and what might look like as high returns. The answer has to do with the perceived rate of return to that investment and its risk. Return and risk are ultimately determined by a long list of factors that we put together under the label of institutions. We can think of legal institutions (the rule of law, property rights), political institutions (stability of policy, decision making), economic institutions (regulation, taxes, customs duties and procedures), social norms (that will determine how issues like income inequality will be resolved, which will affect policy variables such as tax rates), culture (entrepreneurial spirit, risk taking behavior, attitudes to work). In short, the *environment for doing business* matters and it matters a lot. This environment we call institutions.

In recent work, the World Bank has put together several databases that provide measures of institutional quality across countries. For example, a report aptly titled "Doing Business" records several key characteristics of the business environment for over 170 countries. What do they mean by business environment? Let us look at one simple

example: It only takes 2 procedures and about 2 days to start a business in Australia. In Brazil, there are 17 procedures and it will take you 152 days to establish a new company. Examples of other indicators are access to credit, observance of property rights, easiness of closing business, etc. There is a very strong correlation between regulation and institutions on the one hand and economic development on the other. Rich countries all have institutions of high quality while the opposite is true about poor countries. This measure of institutional quality provides countries and governments with clear guidelines on what to do to speed up reforms and growth. The goal for the government should be to set up the right environment for business rather than manage investment. Once the environment exists, once it is rewarding to save and a big chunk of the uncertainty about future payoffs is gone, individuals and firms start putting aside more money for investment and growth picks up.

The economics profession has isolated the key role of institutional quality for economic development only recently (the original work is by the Nobel Prize winner Douglas North in the 1970s and 1980s, but the massive research effort to isolate the role of institutions started in the mid-1990s). The big challenge is to implement institutional reforms. Some countries are better at doing this than others. What hinders change? Resistance from those who would be hurt by the reform. In the case of trade restrictions and tariffs, there is always a powerful lobby that wants to isolate the local market from foreign competition. Other regulations are difficult to change because there are bureaucrats that benefit from the complicated regulatory environment by asking for bribes in order to "help" their clients. These groups oppose change. Recently, it seems however that there is more pressure on governments to reform and indeed reform is taking place in many countries – in the same World Bank ranking of Doing Business, China jumped 15 places ahead in the ranking because of improvements in starting business regulation, obtaining credit, protection of investors and trade reforms. In principle, the change in institutions and economic growth are interrelated and possibly further institutional changes might come only after countries develop further. But although growth itself determines the willingness to change, it is still valid to say that in most of the poor countries there are still ample opportunities for improvements in the business environment.

The four I's of economic growth

It is time to summarize our arguments. Growth is a complex phenomenon that depends on many factors. But a quick look at a few stylized facts has shown us that:

- **Innovation** and Technology drive the technological frontier of the world. The progress in this frontier has been remarkably smooth over the last 130 years.
- For countries inside the frontier, there is potential to converge. **Initial conditions**, their level of development gives us an indication of how fast countries could grow.
- To converge, countries need to **invest**. Investment has to be understood broadly as building factories, buying equipment, improving education and healthcare, learning, etc.

- The **institutional environment** of different countries provides different incentives to investment. Those countries with institutions that favor investment display high investment rates and higher growth rates.

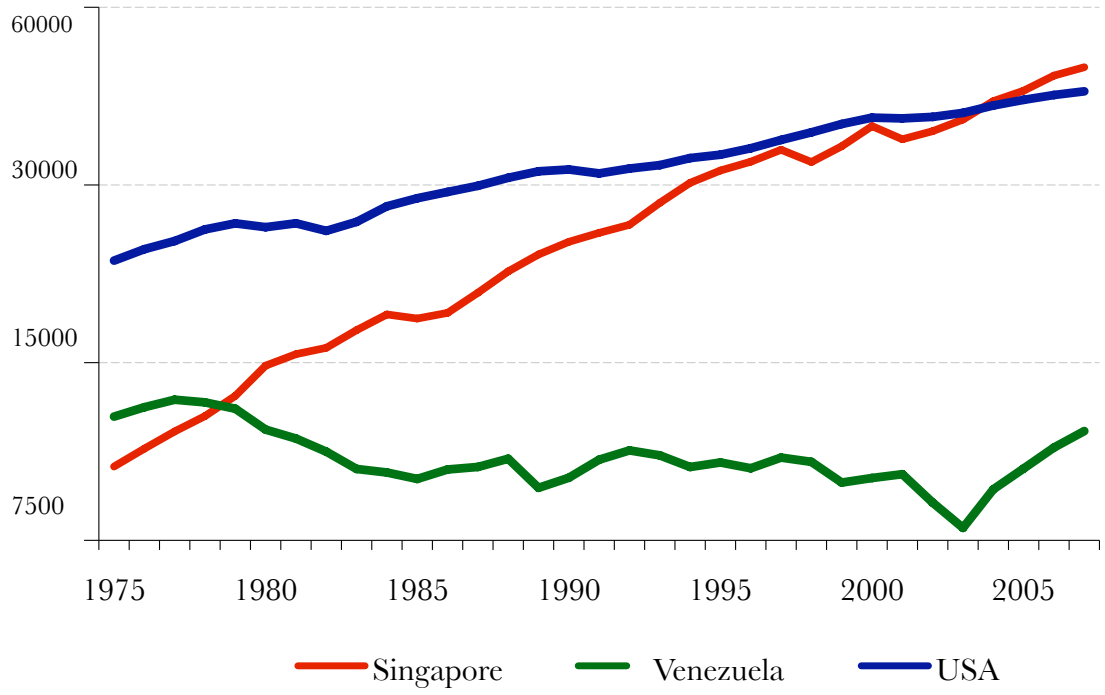
The 4 I's are summarized in the following table.

Innovation	The **incentives** to innovate (e.g. respect of intellectual property rights) will drive up the productivity growth in the country. This is the main force behind growth in the developed countries.	US, Japan, France, Germany
Initial conditions	Provides the potential for 'catching up'. Poor countries can grow faster when they set on a convergence path to the rich economies.	China today, Singapore in 80s
Investment	A key ingredient in the process of convergence is the building up of the capital stock. This requires high investment rates. Miracles are countries with investment of over 25% of GDP. In addition to physical investment, it is important to invest in human capital, efficiency, technology What drives investment: stability, institutions.	High growth (Korea) 35%; Steady state (US, Germany) – 18%
Institutions	The best way to ensure sound macroeconomic policies (i.e. stability) and political stability is to build institutions that create **incentives** for stability: Independent central bank, checks and balances, rule of law, transparency. These institutions facilitate business creation.	There is no country that has become rich with poor-quality institutions

One way to illustrate the four I's is to compare how Singapore and Venezuela developed in the past 30 years. They had similar distance to the technological frontier with income per capita in Venezuela at $7100 while Singapore slightly poorer at $6500. Despite its proximity to the largest market in the world, despite its oil resources, investment rates fluctuated between 15 and 19% and Venezuela stagnated. In the more recent years the economy has even declined and its current income is less than $6000 per person. While the rest of the world on average doubled their income per capita, people of Venezuela are poorer today than in 1975. Over the same period investment in Singapore was between 30 and 48% and the country quadrupled its income per person. The reason for the difference in performance is that the quality of institutions is very different. While Singapore has been continuously improving its business environment, Venezuela has seen a significant deterioration of its institutions and a sharp increase in political instability.

Out of 175 countries monitored by the World Bank, Venezuela is ranked as 164 in terms of its regulatory quality.

Figure 5: Singapore vs. Venezuela
GDP per Capita (Purchasing Power Parity)

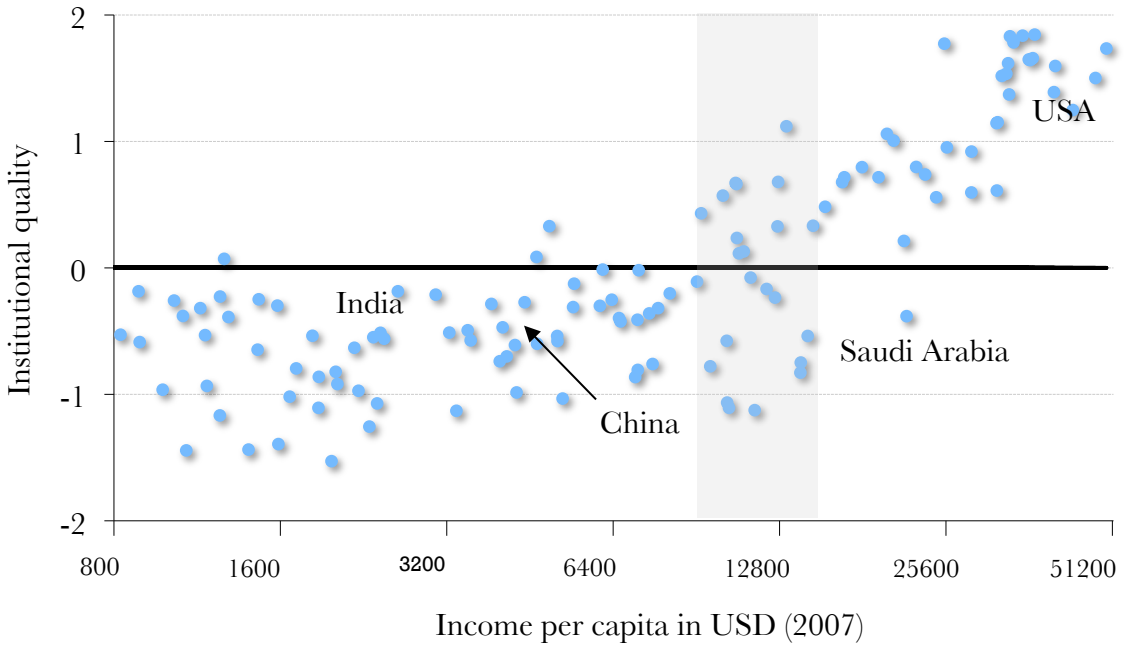


China and the growth of the Periphery

The article presents a framework, which allows us to connect economic theory to everyday questions asked by policy-makers, managers and individuals. Clearly we are leaving out some details that in some cases might be important, but the 4 I's do transmit the essence of economic growth theories. We can use this framework to ask questions that are key to understanding the current state of the global economy: How long will be China growing? With income per capita close to $5500 China is still far away from the world technological frontier. So growth in China will be driven not by invention of new products and new management methods that push world innovation, but rather by learning and imitating what advanced economies have already invented. History shows that recent growth rates of China are not extraordinary – the world has already observed the rise of Japan, Korea, Singapore and other Asian economies. What is different with China is not the speed of convergence but the size of the economy that is moving so fast. This is indeed new from a historical point of view.

If China follows the footsteps of the other Asian economies, then it seems that growth can continue for quite some time. But there are challenges. Probably the most important and fundamental reform is the improvement in the quality of institutions. In Figure 6, We have borrowed data from the World Bank to link institutional quality, which combines a measure of democracy, rule of law, corruption, regulatory quality, political stability and government efficiency on the vertical axis and income per capita in 2007 on the horizontal axis. Advanced economies – defined as GDP per capita above $13,000 -- all have good institutions. More generally, we can draw a vertical line at about $8,000 income per capita and separate the space into a 2x2 matrix. There is no country in the upper left cell – no poor country has good quality institutions and more importantly, there is no rich country with poor quality institutions (the lower right cell). There are three outliers in that box with income per capita below $13,000: Saudi Arabia, Russia and Argentina. While the first two of these became rich due to oil, the latter country is clearly not a good example to follow. One might even argue that the low quality of institutions is pulling Argentina back into the group of lower income countries (100 years ago Argentina was richer than most European countries and Canada; today Argentina has 1/3 of their income per capita). Judging from history, it is difficult to see how China can continue moving to the right, i.e. growing beyond the $8,000 mark without improving its institutions. To continue its rise, China has to reform.

Figure 6: Institutional Quality and Income



We now go back to the question we started with: how is the balance between core and periphery shifting and what should we expect in the decades ahead? In the last years, we have seen an increasing number of emerging markets adopting business-friendly institutions, joining the world economy and realizing the growth potential that our convergence theory predicted. As a result, their weight in their world economy keeps increasing. If institutional reform and globalization continues, this trend is here to stay. Should the rich countries be worried about their loss of status? If we ignore political issues or issues of national pride (which can be very important) and we focus on the economics of this shift of economic power, there is no reason for concern. The growth of poor countries does not come at the expense of growth in rich countries. One way to illustrate this point is to go back to the chart with the US income per capita. Despite all these changes, despite the fact that an increasing number of countries are getting very close to the income per capita levels of the US and many others are growing at much faster rates, we have not seen a significant change in the US growth rate. If any, we have observed a minor acceleration over the last two decades. The evidence so far suggests that the transformation of the Periphery in the recent years have benefited both poor and rich countries.