15 Years of New Growth Economics:

What Have We Learnt? (*)

By

Xavier Sala-i-Martin, Columbia University and Universitat Pompeu Fabra

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Abstract: This paper evaluates the empirical and theoretical contributions of the Economic Growth Literature since the publication of Paul Romer's seminal paper in 1986.

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Paul Romer's paper "*Increasing Returns and Long Run Growth*" is now 15 years old. This pathbreaking contribution led to a resurgence in research on Economic Growth. The new literature has made a number of important contributions. One of the main ones, perhaps the main one, is that it has shifted the research focus of macroeconomists. From the time Lucas, Barro, Prescott and Sargent led the **rational expectations** revolution until Romer, Barro and Lucas started the new literature on economic growth, macroeconomists devoted virtually zero effort to the study of long-run issues and they were all doing research on business cycle theory. And, in this sense, the new growth theory represented a step in the right direction.

The new growth literature has had a similar impact on macroeconomics classes and textbooks. Up until 1986, most macroeconomics classes and most macroeconomic textbooks either relegated economic growth to play a marginal role or they neglected it altogether. Things are very different now. Modern undergraduate textbooks devote more than a third of their space to economic growth and most macroeconomic classes (graduate and undergraduate) devote a substantial amount of time to this important subject. The impact of these two changes on the training of new young economists is very important, and this should be viewed as another contribution of the new economic growth literature.

But the contributions I wish to highlight in this conference are the substantial ones: I want to discuss the most significant ways in which the new economic growth literature has expanded our understanding of economics.

(1) The Empirical Touch

(A) The Construction of New Data Sets

One of the key differences between the current and old literature is that, this time around, growth economists have dealt with empirical issues much more seriously. This has led to the creation of a number of extremely useful data sets. Of course, the Summers and Heston data set tops the list. Summers and Heston (1988, 1991) constructed national accounts data for a large cross-section of countries for a substantial period of time (for some countries, the data starts in 1950, for most countries it starts in 1960). The usefulness of this data set is that, in principle, the data is adjusted for differences in purchasing power across countries, which allows for strict comparability of levels of GDP at a point in time. Even though some researchers have complained about the quality of this data set, overall, this has been one of the main contributions of this literature because it has allowed researchers to confront their theories with actual data. This was not true the last time growth economics was a popular area of research in the 1960s (the reason being, perhaps, that they did not have access to the data that we have today).

But the Summers-Heston data set is not the only data set which has been created recently. Barro and Lee (1993), for example, have also constructed a large number of variables, mainly related to education and human capital. This was especially important because the first generation of endogenous growth theories emphasized the role of human capital as the main (or at least one of the main) engines of growth. Other data sets constructed recently include social and political variables which are especially useful for one of the most recent lines of research which emphasizes institutions (see for example, Knack and Keefer (1995) or Deininger and Squire (1996) and others.)

(B) Better Relation Between Theory and Empirics

A second important innovation of the new growth literature is that it has tied empirical studies closer to the predictions of economic theory. The neoclassical literature of the 1960s linked theory and evidence by simply “mentioning” a bunch of stylized facts (such the Kaldor “facts” [1]) and showed that the theory being proposed was consistent with one, two or perhaps several of these “facts”.

Today’s research, on the other hand, tends to derive more precise econometric specifications and these relationships are taken to the data. The best example can be found in the convergence literature. Barro and Sala-i-Martin (1992) use the Ramsey-Cass-Koopmans (Ramsey (1928), Cass (1975) and Koopmans (1965)) growth model to derive an econometric equation that relates the growth of GDP per capita to the initial level of GDP. Mankiw, Romer and Weil (1992) derive a similar equation from the Solow-Swan model ((Solow (1956) and Swan (1956)). These researchers derived a relationship of the form:

$$\gamma_{i,t,t+T} = \beta_0 - \beta \cdot \ln y_{it} + \beta \cdot \ln y_i^{*} + \epsilon_{it} \qquad \textbf{(1)}$$

where $\gamma_{i,t,t+T}$ is the growth rate of per capita GDP for country i between time t and time t+T, y_{it} is per capita GDP for country i at time t and y_i^{*} is the steady-state value of per capita GDP for country i. The term ϵ_{it} is an error term. The coefficient is positive if the production function is neoclassical, and is zero if the production function is linear in capital (which was usually the case in the first generation one-sector models of endogenous growth, also known as “AK” models[2]). In particular, if the production function is Cobb-Douglas with a capital share given by O then, the parameter O (also

[1] Some of these facts did not really come from careful empirical analysis, but were quoted and used as if they were widely proved empirical facts.

[2] Paul Romer’s seminal paper (Romer (1986)), is an example of an AK model. See also Rebelo (1987), Jones and Manuelli (1990) and Barro (1990).

known as the speed of convergence) is given by $\beta = (1-\alpha)(\delta+n)$,[3] where O is the depreciation rate and *n* is the exogenous rate of population growth (notice that, when O=*1* , which corresponds to the AK model, the speed of convergence is O=*0*).

My main point is that the modern literature took Eq. (1) as a serious prediction of the theory and used it as a way to "test" the new models of endogenous growth (the AK models, which predict $\beta=0$) against the old neoclassical models (which predict O>*0*.) Initially, some researchers mistakenly took Eq. (1) to suggest that neoclassical theory predicted **absolute convergence**. That is, if O>*0* (that is, if the world is best described by the neoclassical model), then **poor countries should be growing faster than others.** And this is why people started running regressions of the type,

$$\gamma_{i,t,t+T} = \hat{b}_0 - \hat{b}\cdot \ln y_{it} + \omega_{it} \qquad \textbf{(2)}$$

and tested whether the coefficient $\hat{b}$ was positive. Notice that if $\hat{b}>0$, then poor countries grow faster than rich ones so that there is **convergence across countries**. On the other hand, if $\hat{b}=0$, then there is no relation between the growth rate and the level of income so the neoclassical model was rejected in favor of the AK model of endogenous growth. The main empirical results found were that the estimated $\hat{b}$ was not significantly different from zero. This was thought to be "good news" for the new theories of endogenous growth and "bad news" for the neoclassical model.

Very soon, however, researchers realized that this conclusion was erroneous. The reason being

[3] The derivation of this equation assumes constant savings rates a la Solow-Swan.

that regressions of the form of Eq. (2) implicitly assume that all the countries approach the same steady state or, at least, that the steady-state is not correlated with the level of income. Notice that, if we take Eq. (1) and we make $y_i^* = y^*$, then this term gets absorbed by the constant $\hat{b}_0$ in Eq. (2) and disappears from the regression. The problem is that, if researchers assume that countries converge to the same steady state and they don't, then Eq. (2) is misspecified and the errors term becomes $\omega_{it} = \epsilon_{it} + \ln y_i^*$. If the steady state is correlated with the initial level of income, then the error term is correlated with the explanatory variable, so the estimated coefficient is biased towards zero. In other words, the early finding that there was no positive association between growth and the initial level of income could be a **statistical artifact resulting from the misspecification of Eq. (2)**.

Researchers proposed various solutions to this problem. One of them was to consider data where the initial level of income was not correlated with the steady-state level of income. This is why many researchers started using **regional** data sets (like states within the United States, prefectures within Japan or regions within European, Latin American and other Asian countries).[4]

Another solution was to use cross-country data but, instead of estimating the univariate regression like Eq. (2), estimate a multivariate regression where, on top of the initial level of income, the researcher would also hold constant proxies for the steady state. This came to be known as **conditional convergence.** Further research showed that the conditional convergence hypothesis was one of the strongest and most robust empirical regularities found in the data. Hence, by taking the theory seriously, researchers arrived at the exact opposite empirical conclusion: **the neoclassical model was not rejected by the data. The AK model was**.

The reason for highlighting these results is not to emphasize the concepts of convergence, or conditional convergence. The important point is that, the new growth economists took the theory

[4] See Barro and Sala-i-Martin (1992, and 1998, chapters 10, 11 and 12).

seriously when they took it to the data. And this was a substantial improvement over the previous round of economic growth research.

(C) The Neoclassical Model is Not Bad, but there are Other Models Consistent with Convergence

The results from the convergence literature are interesting for a variety of reasons. The key result was, as we already mentioned, that conditional convergence was a strong empirical regularity so that the data are consistent with the neoclassical theory based on diminishing returns. And this was the initial and more widespread interpretation. Similarly, these empirical results also meant that the simple closed-economy, one-sector model of endogenous growth (the AK model) was easily rejected by the data. However, more sophisticated models of endogenous growth that display transitional dynamics were also consistent with the convergence evidence.[5] For example, the **two-sector models of endogenous** of Uzawa (1965) and Lucas (1988) were later shown to be consistent with this evidence. It was also shown that AK models of **technological diffusion** (where the A flows slowly from rich countries to poor countries) tend to make similar predictions.

(D) Other Findings from the Convergence Literature

The first reason for studying convergence is to test theories. A second reason is that we are interested in knowing whether we live in a world where poor the standard of living of the poor tend to improve more rapidly than that of the rich or in a world where the rich get richer and the poor become poorer. In dealing with these questions, perhaps the concept of **conditional convergence** is not as interesting as the concept of **absolute convergence**. Another interesting concept is that of σ-convergence, which looks at the **level of inequality across countries** (measured, for example, as the variance of the log

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[5] See Barro and Sala-i-Martin (1998), chapters 6 and 8.

of GDP per person) and checks whether this level increases over time. The key result here is that **inequality across countries tends to increase over time.** [6]

In recent times, this analysis has come under criticism from two fronts. The first is the "Twin-Peaks" literature led by Danny Quah (1996, 1997). These researchers are interested in the evolution of the distribution of the world distribution of income and the variance is only one aspect of this distribution. Quah noticed that, in 1960, the world distribution of income was uni-modal whereas, in the 1990s, the distribution became bi-modal. He then used Markov transitional matrices to estimate the probabilities that countries improve their position in the world distribution. Using these matrices, he then forecasted the evolution of this distribution over time. His conclusion was that, in the long run, the distribution will remain bi-modal, although the lower mode will include a lot fewer countries than the upper mode.

Even though Quah's papers triggered a large body of research, his conclusion does not appear to be very robust. Jones (1997) and Kremer, Onatski and Stock (2001) have recently shown that a lot of these results depend crucially on whether the data set includes oil-producers (for example, the exclusion of Trinidad and Tobago or Venezuela from the sample changes the prediction of a bi-modal steady state distribution to a uni-modal distribution; the reason is that these are two examples of countries that were relatively rich but have become poor so if they are excluded from the sample, the probability of "failure" -that is, the probability of a country moving down in the distribution- lowers substantially).

The second line of criticism comes from researchers that claim that the unit of analysis should not be a **country**. Countries are useful units if we want to "test" theories because many of the policies or institutions considered by the theories are country-wide. But if we are interested in whether poor people's standard of living improves more rapidly than rich people's, then the correct unit may be a "person" rather than a country. In this sense, the evolution of per capita income in China is more

[6] This led Lance Pritchet to write a paper called "Divergence Big Time". The title is self-explanatory.

important than the evolution of Lesotho's because China has a lot more people. In fact, China has almost twice as many citizens as all African countries combined, even though Africa has around 35 independent states. In this sense, a better measure of the evolution of personal inequality is the **population-weighted** variance of the log of income per capita (as opposed to the simple variance of the log of income per capita, which gives the same weight to all countries, regardless of population). The striking result is that the weighted variance does NOT increase monotonically over time. As shown by Schultz (1998) and Dowrick and Akmal (2001), the weighted variance increases for most of the 60s and 70s but it peaks in 1978. After that, the weighted variance declines, rooted in the fact that China, with 20% of the world's population, has experienced large increases in per capita income. This effect was reinforced in the 1990s when India (with another billion inhabitants) started its process of rapid growth.

The population weighted-variance analysis assumes that each person within a country has the same level of income but that some countries have more people than others. [7] Of course this ignores the fact that inequality within countries may increase over time. In particular, it has been claimed that inequality within China and India has increased tremendously between 1980 and today, which may more than offset the process of convergence of the income per capita of these two countries to the income per capita of the United States.

(E) Cross-Country Growth Regressions

Another important line of research in the empirical literature follows Barro (1991)[8] and uses cross-country regressions to find the empirical determinants of the growth rate of an economy:

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[7] Notice that the unweighted analysis assumes that each person has the same income, and that all countries have the same population.

[8] For surveys of the literature, see Durlauf and Quah (2000) and Temple (1999).

$$\gamma_{i,t,t+T} = \beta \cdot X_{it} + \omega_{it} \,, \qquad \textbf{(3)}$$

where X_{it} is a vector of variables that is thought to reflect determinants of long-term growth. Notice that, in the context of the theory that predicts Eq. (1), if one of the variables in the vector *X* reflects the initial level of income, then the rest of the variables can be thought of proxying the steady-state, $\ln y_i^*$.

The cross-country regression literature is enormous: a large number of papers have claimed to have found one or more variables that are partially correlated with the growth rate: from human capital to investment in R&D, to policy variables such as inflation or the fiscal deficit, to the degree of openness, financial variables or measures of political instability. In fact, the number of variables claimed to be correlated with growth is so large that the question arises as to which of these variables is actually robust.[9]

Some important lessons from this literature are:

(i) There is no simple determinant of growth.

(ii) The initial level of income is the most important and robust variable (so conditional convergence is the most robust empirical fact in the data)

(iii) The size of the government does not appear to matter much. What is important is the "quality of government" (governments that produce hyperinflations, distortions in foreign exchange markets, extreme deficits, inefficient bureaucracies, etc., are governments that are detrimental to an

[9] See the work of Levine and Renelt (1992) and, more recently, Sala-i-Martin, Doppelhoffer and Miller(2001) for some analysis of robustness in cross-country growth regressions.

economy).

(iv) The relation between most measures of human capital and growth is weak. Some measures of health, however, (such as life expectancy) are robustly correlated with growth.

(v) Institutions (such as free markets, property rights and the rule of law) are important for growth.

(vi) More open economies tend to grow faster.

(2) Technology, Increasing Returns and Imperfect Competition

(A) Clarifying the Nature of Technology: The Importance of Non-Rivalry

If the one important set of contributions of the economic growth literature is empirical, the another one is theoretical: the endogeneization of technological progress. The main physical characteristic of technology is that it is a "**non-rival**" good. This means that the same formula, the same blueprint may be used by many users simultaneously. This concept should be distinguished from that of "**non-excludability**". A good is excludable if its utilization can be prevented.

Romer (1993) provides an interesting table that helps clarifies the issues. Table 1 has two columns. Column 1 shows goods that are rival. Column 2 displays goods that are non-rival. The three rows ordered by the degree of excludability. Goods in the upper rows are more excludable than goods in the lower rows.[10]

At the upper left corner we have cookies. A cookie is both rival and excludable. It is rival because if I eat this cookie, no one else can eat it at the same time. It is excludable, because the owner of the cookie can prevent me from using it unless I pay for it.

[10] The concept of **rivalry** is a discrete or 0-1 concept (goods can either be used by more than one user or they cannot). The concept of excludability is more continuous.

	Rival	**Non-Rival**
More excludable	Cookies	Cable TV Signal
Intermediate Excludable		Sofware
Less Excudable	Fish in the Sea	Pythagoras Theorem

The bottom row of column one has "fish in the sea". The fish are rival because if I catch a fish, no one else can catch it. The fish are non-excludable because it is virtually impossible to prevent people from going out to the sea to catch fish. The goods in this box (rival and non-excludable) are famous. They are called goods subject to the "tragedy of the commons" (the name comes from the medieval cities: the land that surrounded the cities was "common land" for pastures which meant that everyone's cows could go and pasture in them. The grass that a person's cow ate could not be eaten by other cows -so it was rival. Yet the law of the land allowed everyone's cows to pasture, so the grass was non-excludable. The result was, of course, that the city over-exploited the land and everyone ended up without grass, which was a tragedy. Hence, the name.

These goods are important and interesting, but they are not the goods that we want to discuss here. We are interested in the second column: the non-rival goods. At the top box we have "cable TV signal". HBO is non-rival in the sense that many people can watch HBO simultaneously. However, it is excludable because the owners can prevent us from seeing HBO if we don't pay the monthly fee. At the bottom we have basic knowledge represented by the Pythagoras Theorem: many people can use it at the same time so it is a non-rival piece of knowledge. This formula is also non-excludable since it is impossible for anyone to prevent its use.

In the middle box we have technological goods that are non-rival and partially excludable. For example, computer software. Many people can use Microsoft Word at the same time so the codes that make this popular program are clearly non-rival. In principle, people cannot use the program unless they pay a fee to Microsoft. In practice, however, people install the program that a friend or relative bought, and it is very hard to prevent this from happening. It is not fully excludable. This is why we put it in the intermediate row.

We should point out that whether a good is more or less excludable depends not only on its physical nature but also on the legal system. The economic historian and Nobel Prize winner, Douglas North argued that the industrial revolution occurred in England and it occurred in the 1760s precisely because it was then and there that the institutions were created that protected intellectual property rights. Notice that intellectual property rights are a way to move technological goods "up" in the excludability ladder in column 2. And when there are institutions that make goods excludable, then the inventor can charge and make money for it, which provides incentives to do research.

(B) Modeling Technological Progress: Increasing Returns and Imperfect Competition in General Equilibrium Models of Growth

The old neoclassical literature already pointed out that the long-run growth rate of the economy was determined by the growth rate of technology. The problem was that it was impossible to model technological progress within a neoclassical framework in which perfectly-competitive price-taking firms had access to production functions with constant returns to scale in capital and labor. The argument goes as follows. Since technology is non-rival, a replication argument suggests that a firm should be able to double its size by simply replicating itself: creating a new plant with exactly the same inputs. Notice that, in order to do so, the firm would need to double capital and labor, but it could use the same technology in both places. This means that the concept of constant returns to scale should apply to capital and labor only. That is,

$$F(\lambda \cdot K, \lambda \cdot L, A) = \lambda \cdot F(K, L, A), \qquad (4)$$

where A is the level of technology, K is capital and L is labor.

Euler's theorem says that

$$Y_t = K \cdot F_K + L \cdot F_L \tag{5}$$

Perfectly competitive neoclassical firms pay rental prices that are equal to marginal products. Thus,

$$Y_t = R_t \cdot K_t + w_t \cdot L_t \tag{6}$$

In other words, once the firm has paid its inputs, the total output is exhausted. Hence, it cannot devote resources to improve technology. It follows that if technological progress exists, it must be exogenous to the model in the sense that R&D cannot be "induced and financed" by neoclassical firms.

Notice that since technology is non-rival, it must be produced only once (once it is produced, many people can use it over and over). This suggests that there is a large fixed cost in its production (the R&D cost), which leads to the notion of **increasing returns**. The average cost of producing technology is always larger than the marginal cost. Hence, under perfect price competition (a competition that leads to the equalization of prices with marginal costs), the producers of technology who pay the fixed R&D costs will always lose money. The implication is that in a perfectly competitive environment, no firm will engage in research. Put another way, if we want to model technological progress endogenously, we need to **abandon** the **perfectly-competitive-pareto-optimal** world that is the foundation of neoclassical theory and allow for **imperfect competition**.[11] And this is another

[11] The path-breaking paper of Romer (1986) went around the problem using an alternative trick: he assumed that firms did not engage in purposefully financed R&D. Instead, knowledge was generated as a side product of investment. This line of research, however, was quickly abandoned.

contribution of the literature: unlike the neoclassical researchers of the 1960s, today's economists deal with models that are not Pareto optimal.

Romer (1990) introduced these concepts in a Dixit and Stiglitz (1977) model in which innovation took the form of **new varieties of products**. Aghion and Howitt (1992, 1998) extended the theory to a **Schumpeterian** framework in which firms devote R&D resources to improve the quality of existing products. The **quality ladder framework** differs from the **product variety** framework in that the improvement of the quality of a product tends to make the previous generation of products obsolete. This leads to the schumpeterian notion of "**creative destruction**" by which firms create new ideas in order to destroy the profits of the firms that had the old ideas (Schumpeter (1942)).

The new growth models of technological progress have clarified some important issues when it comes to R&D policies. Perhaps the most important one being that, despite market failures (because of imperfect competition, externalities, and increasing returns), it is not at all obvious whether the government should intervene, what this potential intervention should look like and, in particular, whether it should introduce **R&D subsidies**. This is important because there is a widespread popular notion that countries tend to underinvest in technology and that the government should do something about it. The models of R&D highlight a number of distortions, but it is not clear that the best way to deal with them is to subsidize R&D. For example, the one distortion that is common across models is the one that arises from imperfect competition: prices tend to be above marginal cost and the quantity of ideas generated tend to be below optimal. The optimal policy to offset this distortion, however, is not an R&D subsidy but a subsidy to the purchases of the overpriced goods.

A second distortion may arise from the **externalities** within the structure of R&D costs. If the invention of a new product affects the cost of invention of the new generation of products, then there is a role for market intervention. The problem is that it is not clear whether a new invention increases or decreases the cost of future inventions: it can persuasively argued that the cost of R&D declines with the number of things that have already been invented (this follows Newton's idea of "shoulders of giants"). On the other hand, it can also be argued also that easy inventions are pursued first, which suggests that the R&D costs increase with the number of inventions. Notice that if the cost declines, then firms doing R&D tend not to internalize all the benefits of their inventions (in particular, they do not take into account the fact that future researchers will benefit by the decline in R&D costs) so there tends to be underinvestment in R&D. In this case, the correct policy is an **R&D subsidy**. Notice, however, that if the costs increase with the number of inventions, then current researchers exert a negative externality on future researchers so they tend to overinvest and the required policy becomes an **R&D tax** rather than an R&D subsidy.

The Schumpeterian approach brings in some additional distortions because current researchers tend to exert a negative effect on past researchers through the process of **creative destruction**. These effects tend to call for taxes on R&D (rather than R&D subsidies) as current researchers tend to perform too much, not too little, R&D. Finally, we should point out that **government intervention is not required at all** if the firm doing current research is the technological leader. For example, Intel owns the Pentium II and performs research to create the Pentium III and then the Pentium IV, thereby destroying the profits generated by its past investments. When the new inventor is also the technological leader, the inventor will tend to internalize the losses of current research on past researchers so no government intervention is called for.

The main point I wish to highlight is that, although the new generation of growth models are based on strong departures from the old pareto-optimal neoclassical world, it is not obvious that they call for strong government intervention and, when they do, it is not obvious that the intervention recommended coincides with the popular view that R&D needs to be subsidized.

(C) Markets for Vaccines

An influential idea which has come out of the economic growth literature is Michael Kremer’s recommendation of a market for vaccines to help solve the new African pandemics of AIDS and malaria (Kremer (2000)). Kremer emphasizes that the best way to provide incentives for R&D in diseases that affect mainly the poor is not the financing of public research. The best solution is the creation of a fund with public money (donated by rich governments and rich private philanthropists -like Bill Gates). This fund would not be used to finance research directly but to purchase vaccines from the inventor. The price paid, of course, would be above marginal cost, which would provide incentives for pharmaceutical companies to devote resources to investigate and develop vaccines that cure malaria and AIDS, which is something they do not currently do.

(3) Merging Economic Literatures

Another important contribution of the new economic growth literature is that it has exerted some influence on other economic literatures and, in turn, it has benefitted from them. One of the most prominent examples of this symbiosis is the interaction with the new development literature which, traditionally, was mostly institutional and centered around economic planning. Growth economists who, as mentioned earlier, used to rely almost uniquely on pareto-optimal-complete-market-perfectly-competitive neoclassical models, now systematically abandon their traditional paradigms without being ashamed and they discuss the role of institutions without thinking they are doing second-rate research. At the same time, development economists have learned and have found it valuable to incorporate general equilibrium and macroeconomic features to their traditional models.

This kind of cross-discipline interaction with growth economics can also be observed in other fields such as Economic Geography (Krugman (1991), Matsuyama (1991) and Fujita, Krugman and Venables (1995)), Macroeconomics and Trade Theory (Grossman and Helpman (1991), Industrial Organization (Aghion and Howitt (1992, 1998), Peretto (1998)), Public Finance (Barro (1990), Barro and Sala-i-Martin (1998)) , Econometrics (Quah (1993), Durlauf and Quah (2000), Sala-i-Martin, Doppelhoffer and Miller (2000)), Economic History and Demography (Kremer (1993), Hansent and

Prescott (1998), Jones (1999), Lucas (1999), Galor and Weil (1998)).[12]

(4) Institutions

Another important lesson we have learned from the new economic growth literature is that "institutions" are important empirically and that they can be modeled. By "institutions" I mean various aspects of law enforcement (property rights, the rule of law, legal systems, peace), the functioning of markets (market structures, competition policy, openness to foreign markets, capital and technology), inequality and social conflicts (the relation between inequality and growth has been widely studied)[13], political institutions (democracy, political freedom, political disruption, political stability), the health system (as previously stated, life expectancy is one of the variables most robustly correlated with growth), financial institutions (like an efficient banking system or a good stock market) as well as government institutions (the size of bureaucracy and red tape, government corruption).

Institutions affect the "efficiency" of an economy much in the same way as technology does: an economy with bad institutions is more inefficient in the sense that it takes more inputs to produce the same amount of output. In addition, bad institutions lower incentives to invest (in physical and human capital as well as technology) and to work and produce.

But, despite their similar effects on the economy, the promotion or introduction of good institutions differs substantially from the promotion of new technologies. In fact, it is hard to come up

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[12] Following the influential paper by Kremer (1993), a number of researchers have attempted to model the "history of the world" over the last million years with a single model that explains the millenia-long periods of stagnation, the industrial revolution and the subsequent increase in the rate of economic growth and the demographic transition that led families to become of smaller size, which allowed them to increase income per capita. This literature has made use of long term data (and I mean really long term data, dating back to 1 million b.c.). The insights from these historical analysis are perhaps another interesting contribution of the growth literature.

[13] See Aghion et al. (1999), Barro (1999) and Perotti (1996).

with new and better technologies if an economy does not have the right institutions.

Although the new economic growth literature has quantified the importance of having the right institutions, it is still at its early stages when it comes to understanding how to promote them in practice. For example, the empirical "level of income" literature mentioned above has demonstrated that the "institutions" left behind in the colonies directly affect the level of income enjoyed by the country one half century later: colonies in which the colonizers introduced institutions that helped them live a better life in the colony, tend to have more income today than colonies in which colonizers introduce predatory institutions. This seems to be a robust empirical phenomenon. However, it is not clear what the lessons are for the future. In other words, can we undo the harm done by the "colonial predators" and, if so, what can we do and how can we do so. Although these are important questions currently being dealt with in the literature, the answers are still unclear.

Indeed, we are still in the early stages when it comes to incorporating institutions to our growth theories. Empirically, it is becoming increasingly clear that institutions are an important determinant of growth.[14]

(5) Conclusions

The recent economic growth literature has produced a number of important insights both at the theoretical and empirical levels. This paper has analyzed some of the most salient. Although this might be seen as pessimistic, let me finish with a confession of ignorance: we have learned a lot about growth in the last few years. However, we still do not seem to understand why Africa turned to have such dismal growth performance. The welfare of close to 700 million citizens of a whole continent has deteriorated dramatically since independence and the main reason is that the countries in which these people live have failed to grow. Understanding the underlying reasons for this gargantuan failure is the most important question the economics profession faces as we enter the new century.

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[14] The recent of work of Hall and Jones (1999), Acemoglu, D. S. Johnson and J. Robinson (2000) and MacArthur and Sachs (2001) are excellent examples of this.

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