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15 Years of New Growth Economics: What Have We Learnt? (*)

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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 if important contributions. One of the main ones, perhaps the main one, is that it has shifted the research focus of macroeconomists. Between the time Lucas, Barro, Prescott and Sargent started 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 as everyone was doing research on business cycle theory. And, in this sense, the new growth theory was clearly a step in the wrong direction.

The new growth literature has had a similar impact on macroeconomic classrooms 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 want to highlight in this conference are the substantial ones: I want to discuss the most important 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 literature and the old one is that, this time around, growth economists have dealt with empirical issues in a much more serious way. This has led to the creation of a number of extremely useful data sets. Of course, at the top of the list we have the widely used data set constructed by Summers and Heston (1988, 1991), who constructed national account data for a large cross section of countries for a substantial period of time. 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 (and the reason was, perhaps, that they did not have the access to 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).)

(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 styled facts (like the Kaldor "facts") and show that the theory being proposed was consistent with one, two or perhaps several of these "facts". Some of these facts were quite "complex", and I do not mean this in the sense of being "complicated. I mean "complex" in the sense of "complex numbers". That is, they were half real and half imaginary. But whether the facts were true or not, they were related to the theories in a very loose way.

Today's research, on the other hand, tends to derive precise econometric specifications that are taken to the data. One of example of this can be found in the convergence literature. Barro and Sala-i-Martin (1992) derived an econometric equation that relates the growth of GDP per capita over some period to the initial level of GDP out of the Ramsey-Cass-Koopmans (Ramsey (1928), Cass (1975) and Koopmans (1965)) model of economic Growth. Mankiw, Romer and Weil (1992) derive a similar equation out of the Solow-Swan model ((Solow (1956) and Swan (1956)). For example, by linearizing the optimal neoclassical growth model or the Solow-Swan version of the same model, these researchers found that the growth of an economy should look like, $\gamma_{i,t,t+T} = \beta_0 - \beta \bullet \ln y_{it} + \beta \bullet \ln y_i^* + \varepsilon_{it}$

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 it 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[1]). In particular, if the production function is Cobb-Douglas with a capital share given by α then, the parameter β (which is also known as the speed of convergence) is given by $\beta = (1 - \alpha)(\delta + n)$,[2] where δ is the depreciation rate and n is the exogenous rate of population growth (notice that, when $\alpha=1$, which corresponds to the AK model, the speed of convergence is $\beta=0$).

My main point is that the modern literature took Eq. (1) as a serious prediction of growth theory and used it as a way to "test" the new models of endogenous growth (the AK models, which predict) against the old neoclassical models (which predict $\beta>0$.) At first, some researchers mistakenly took Equation (1) to predict that, if $\beta>0$ (that is, if the world is best

[1] 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).

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

described by the neoclassical model), then **poor countries should be growing faster than others.** This is known as the **convergence hypothesis.** And this is why people started running regressions of the type,

$$\gamma_{i,t,t+T} = \hat{b}_0 - \hat{b} \bullet \ln y_{it} + \omega_{it}$$

and tested whether the coefficient $\hat{b}$ was positive. Notice that if it was, then we would conclude that poor countries grow faster than rich ones so that there is **convergence across countries,** which was thought to be the prediction of the neoclassical model. If this coefficient was not significantly different from zero, then 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 which was "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. And the reason is that regressions like Eq. (2) implicitly assume that all the countries approach the same steady state. Notice that, if we take Eq. (1) and we make $y_i^* = y^*$, then this term gets absorbed by the constant $\hat{b}_0$ and disappears from the equation. The problem is that if the researchers assumes that countries converge to the same steady state and they don't, then Eq. (2) is misspecified and the errors term becomes $\omega_{it} = \varepsilon_{it} + \ln y_i^*$. If the steady states are 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 Equation (2)**.

Researchers proposed various solutions to this problem. One of them was to consider data sets for which the initial level of income was not correlated with the steady-state levels of income. This is why many researchers started using **regional** data sets (like states within the United States, prefectures within Europe or Regions within European countries).[3] Another solution was to use cross-country data but, instead of estimating the univariate regression like Eq.

[3] See Barro and Sala-i-Martin (1992, and 1998, chapter 11.)

(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 following the hints provided by the theory, researchers arrived at the exact opposite empirical conclusion: **the neoclassical model was not be rejected by the data. The AK model was**.

The reason for highlighting these results is not to emphasize the concept of convergence, or conditional convergence. The important point is that, for the first time, growth economists took the theory seriously to the data. And the theory told them exactly what kinds of regressions they should run and how to interpret the estimated coefficients. 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 main 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.[4] 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

A second reason for studying convergence has nothing to do with "testing theories": independently of what theories are more relevant, we are interested in knowing whether we live in a world in which poor people tend to improve more rapidly than rich people or in a world in which the rich get richer and the poor stay poor or even become poorer. In dealing with these questions, perhaps the concept of **conditional convergence** is not as interesting as the concept of **convergence** or **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 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**.

In recent times, this analysis has come under criticism from two fronts. The first one is the "Twin-Peaks" literature led by Danny Quah (1993, 1997). These researchers suggest that the "variance of the log of income" is too narrow a measure of the "distribution of world income" and they attempt to estimate the whole distribution. The main point is that, in 1960, the world distribution of income was uni-modal whereas, in the 1990s, the distribution has become bi-modal. Quah and associates then forecasted the evolution of this distribution and conclude that, in the lung run, the distribution will stay bi-modal, even though the lower mode will include a lot fewer countries than the upper mode. This conclusion, however, 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).

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

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

the policies or institutions under study are country-wide. But if we are interested in whether poor people's welfare is improving more rapidly than rich people's welfare, then the correct unit may be a "person" rather than a country. In this sense, the evolution of personal income in China is more important than the evolution of Lesotho's, and the reason is that China has a lot more people than Lesotho. 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 surprising 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 peaked in 1978. After this moment, the weighted variance declines over time, the main reason being that China, and with it, 20% of the world's population, has seen 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 (the unweighted analysis assumes that each person has the same income, and that all countries have the same population). Of course this analysis 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. Sala-i-Martin (2001) incorporates micro-evidence on the evolution of within-country inequality for 57 countries (with 80% of the world population) and shows that inequality during the last 20 years declines, even after accounting for the increases in within country inequality. In fact, within-country inequality is small and it does not move much over time relative to cross-country variance.

(E) Cross-Country Growth Regressions

Another important strand of the empirical literature is the one that follows Barro (1991)[5] in using data for a cross-section of countries and regressing the growth rate over some period on variables that reflect some potential determinants:

$$\gamma_{i,t,t+T} = \beta \bullet X_{it} + \omega_{it} ,$$

where X_{it} is a vector of variables that are 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 variables can be thought of proxying the steady-state, $\ln y_i^*$.

The cross-country regression literature is enormous: a large amount of papers have claimed to have found one or more variables that appear to be important determinants of growth, from human capital to investment in R&D, to policy variables such as inflation or the fiscal deficit, to the degree of openness 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.[6]

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) investment is strongly correlated with growth (although endogeneity issues arise), but is not nearly enough to explain growth fully. This means that we need to move beyond Solow-

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

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

Swan and Ramsey models that emphasize physical capital accumulation.

(iv) 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 not good for the economy).

(v) 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.

(vi) institutions (such as free markets) are important for growth.

(vii) more open economies tend to grow faster.

(ix) @more to come...@

(F) Cross-Country "Level of Income" and the Role of Institutions

@To be added (Geography and startling correlation between Y and latitude) @

(Hall and Jones (1999), Acemoglu, Johnson, and Robinson (2000), McArthur and Sachs (2001))

(2) Technology, Increasing Returns and Imperfect Competition

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

If the first main contribution of the economic growth literature is empirical, the second 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. In column 1 we show goods that are rival. Column 2 displays goods that are non-rival. Table 1 displays three rows ordered by the degree of excludability. Goods in the upper rows are more excludable than goods in the lower rows.

At the upper left corner we have cookies. A cookie is both rival and excludable. It is rival because if I eat this cookie, noone 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.

	Rival	**Non Rival**
More excludable	Cookies	Cable TV Signal
Intermediate Excludable		Sofware
Less Excudable	Fish in the Sea	Algebraic Formulas

The bottom row of column one has “fish in the sea”. The fish are rival because if I catch a fish, noone else can catch it. The fish are non-excludable because it is virtually impossible to prevent people from going to the see 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 pastures” which meant that everyone’s cows could go and pasture 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 gras was non-excludable. The result was, of course, that the city over-exploted the land and everyone ended up without grass, which was a tragedy.

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: 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 our monthly fee. At the bottom we have basic knowledge represented by "algebraic formulas": many people can add up at the same time so algebraic formulas are non-rival. These formulas are 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 can install the program that a friend or relative bought, and it is very hard to prevent this from happening. It is not fully excludable...but it is not fully non-excludable.

We should point out that whether a good is more or less excludable depends, no 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 owner of such good (the inventor) can charge for it. And if one can charge for it, then one can make money out of the invention, which increases the 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 that, 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,

$$F(\lambda \bullet K, \lambda \bullet L, A) = \lambda \bullet F(K, L, A),$$

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

Euler's theorem says that

$$Y_t = K \bullet F_K + L \bullet F_L$$

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

$$Y_t = R_t \bullet K_t + w_t \bullet L_t$$

in other words, once the firm has paid its inputs, there is no output left. Hence, the firm cannot devote resources to improve technology so, if one wants to argue that technological progress exists, it must be exogenous (in the sense that it cannot be induced by firms through a process of costy R&D).

Notice that since technology is non-rival, it must be produced once (and 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**. It follows that the average cost of producing technology is usually larger than the marginal cost. Hence, if firms engage in perfect price competition (a competition that leads to the equalization of prices with marginal costs), the producers of technology will always lose money. The implication is that in a perfectly competitive environment, no firm will engage in research. Put in another way, the best way to model technological progress is to **abandon** the **perfectly-competitive-pareto-optimal** world that is the foundation of neoclassical theory and allow for **imperfect competition**.

Romer (1990) introduced these concepts in a model in which innovation took the form of **new kinds 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.

The new growth models of technological progress have clarified some important issues when it comes to R&D policies. Perhaps most important one is that, despite that there are market failures (because of imperfect competition 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 **subsidize R&D**. 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 which means that prices tend to be above marginal cost and that the quantities bought 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 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: Following Newton's idea of "shoulders of giants", it can persuasively argued that the cost of R&D declines with the number of things that have already been invented. On the other hand, it can easily be argued also that easy inventions are made 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, there is reason to support **R&D subsidies**. 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.

As we mentioned, the schumpeterian approach brings in some additional distortions because current researchers tend to exert a negative effect on past researchers as they destroy their profits. 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. Of course government intervention is not required at all if the firm doing current research is the same firm that was doing research in the past. 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 this is the case, the inventing firm will tend to internalize the losses of current research on past researchers so no government intervention is called for.

The main point I want to highlight is that, even though 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.

(D) 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 do now.

(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 can also be observed in other fields such as Economic Geography (Krugman (1995), Matsuyama (1991) and Fujita, Krugman and Venables (1995), Macroeconomics, Trade Theory (Grossman and Helpman (1991), Industrial Organization (Aghion and Howitt (1992, 1998), Peretto (1998), Public Finance (Barro (1990), Barro and Sala-i-Martin (1992, 1998) , Econometrics (Quah (1993), Durlauf and Quah (1999), Sala-i-Martin, Doppelhoffer and Miller (2000), Economic History and Demography (Kremer (1993), Hansent Prescott (1998), Jones (1999), Lucas (1999), Galor and Weil (1998)).[7]

(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

[7] 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 get smaller-sized families, which allowed them to increase income per capita. This literature has made use of long term data (and I mean really long term data, going back 1 million b.c.). The insights from these historical analysis are perhaps another interesting contribution of the growth literature.

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)[8], political institutions (democracy, political freedom, political disruption, political stability), the health system (life expectancy is one of the variables most robustly correlated with growth), 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 get the same amount of output. Moreover, 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 with new and better technologies if an economy does not have the right institutions.

Even though 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 by 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 it. Although these are important questions being dealt currently in the literature, the answers are still not clear.

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

(5) Conclusions

Forthcoming@

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