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This document has been prepared by Claudio Aravena, Research Assistant of the Division of Economic Development, André Hofman, Director of CEPAL Review, both of the Economic Commission for Latin America and the Caribbean (ECLAC), Juan Fernández, and Matilde Mas, consultants of the same Division within the activities of the project LA KLEMS.

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Contents

Tables

Abstract

This paper develops a framework to analyze the potential of different variables to increase total factor productivity (TFP) growth in countries with poor productivity performance. It takes an industry level approach for a set of countries used as a benchmark. The information comes from the EU KLEMS and LA KLEMS databases. Once this influence is measured, the difference in the scores of each variable in four Latin American countries (Argentina, Brazil, Chile and Mexico) with respect to the benchmark is used to test their potential for increasing productivity growth. Results show that, the top priorities for these four countries are to improve the labour market, to reduce the share of self-employed people and to modernize the functioning of their economic systems. Our results also indicate that the intensification of investment in ICT and R&D activities is a key instrument for promoting growth. Public policies should also aim to encourage a higher endowment of Internet infrastructures and their use.

Introduction

Since the beginning of the Great Recession that began in 2007, the need to increase the growth rate of developed economies has been brought to light, with productivity gains essential to achieve this goal. However, studies show that this is not an easy task, given that Europe, in general, has a problem of slow productivity growth, particularly in services, when compared with the United States.[1] Latin American countries have not experienced the severity of the crisis since they have kept growing at a fast pace in terms of Gross Value Added (GVA) and employment creation during the period 2007-2011. However, with the exception of Chile, the other three analyzed Latin American countries (Argentina, Brazil, and Mexico) have experienced a very modest labour productivity growth, similar to the European Union countries but lower than in the United States, the world leader. Latin American countries have based their growth on the accumulation of factors of production (labour and capital) and at a much lesser extent through improving efficiency in the production process as measured by Total Factor Productivity (TFP) growth.

What can be done to improve the productivity of these economies? Which aspects should economic policy measures focus on? The paper proposes a methodology to evaluate how a set of selected variables have contributed to productivity growth. The usual strategy followed in the study of TFP growth determinants is to make econometric estimates of TFP growth (or level) as the dependent variable for the countries analyzed, and a set of independent variables thought to play a significant role. As TFP growth has proved to be very sluggish in three Latin American countries (the exception is Argentina), it does not seem advisable to rely only on the performance of these four countries. A better strategy would be to study the determinants of TFP growth within a broader set of countries with, in general, higher productivity growth. We take this alternative route by making use of the information provided by the EU KLEMS database.

To be specific, we will use the classification of 24 sectors of the market economy in 10 European countries (Austria, Denmark, Finland, France, Germany, Italy, Netherlands, Spain, Sweden and the United Kingdom) and the United States over the period 1998-2007 as benchmark to test the capacity of several variables to improve TFP growth. The analysis is carried out in two stages. Firstly, we make use

[1] See Timmer *et al.* (2010) and Mas and Steherer (eds.) (2012) for a review.

of a regression framework to estimate the main determinants of TFP growth for the benchmark countries. In the second stage we make use of the coefficients previously estimated to measure the impact that the selected variables would have on improving TFP growth in the four Latin American countries. The main contribution of this work is to provide a consistent framework for measuring the relative importance of different determinants of TFP growth, based on a large sample of countries and explicitly considering the sectorial dimension. The framework allows the distance of the two laggard countries to the benchmark to be computed and to propose measures for TPF improvement by means of computing TFP growth if these four countries converge to the levels observed in each variable. Results show that in four countries it is important to improve the functioning of the labor market; increase R&D and ICT investment; improve Internet infrastructures by increasing broadband access, as well as favor the use of new technologies by individuals.

The paper is organized as follows. Section II reviews the literature on measuring the determinants of productivity. Section III presents the patterns of growth in the four Latin American countries over the period 1998-2007. Section IV describes the methodological approach and definitions of variables. The influence of each variable is quantified in section V, while a simulation is carried out in section VI measuring how Argentina, Brazil, Chile, and Mexico TFP would be affected if the four countries converged either to the United States or to Europe an average in each determinant. Finally, the last section presents the main results.

I. Determinants of productivity: literature review

Isaksson (2007) provides a comprehensive literature review on TFP determinants based on macro, sectorial and micro studies. He summarizes the determinants of TFP in four groups. The first one includes variables related to the creation, transmission and absorption of knowledge. The creation of knowledge is related to R&D and ICT investment, while its transfer is related to trade and foreign direct investment (FDI).

The second group of determinants concerns factor supply and efficient allocation. The focus here is on human capital (e.g. schooling, health and training) and physical infrastructure (e.g. roads and electricity) rather than physical capital (machinery and equipment) since the latter is always included in the production function. Efficient allocation of resources is dealt with under two headings: namely, structural change (allocation of resources to the most productive sectors) and the financial system, since a good financial system is able to allocate savings to investments with the highest returns, and high-quality investment implies a higher probability of TFP growth.

The third group of determinants is related to institutions, integration and geography. Among institutions, a distinction is made between political (e.g. autocracy versus democracy) and economic institutions (e.g. property rights and regulations), whereas in the case of integration the focus is on trade (FDI is covered under "knowledge transmission"). Geography concentrates on the location of countries and, in particular, the effects of being located in the tropics or in Africa.

The final group is concerned with the role of competition, the social dimension and the environment for productivity growth. A long-held view argues that competition is the main determinant of productivity growth, while most recently it has been argued that environmental regulation deters it.

The great majority of papers reviewed by Isaksson (2007) are based on aggregated macro data for either individual or different sets of countries. Only a few of them rely on data disaggregated by industries as proposed here. Griffith, Redding and van Reenen (2004) use a panel of industries across 12 OECD countries. They accept the common view that R&D has two faces: the conventional role of stimulating innovation as well as enhancing technology transfer (absorptive capacity). Their theoretical rationale is based on models of endogenous innovation and growth (such as Romer (1990) and Aghion

and Howitt (1992)). They find R&D to be statistically and economically important in both technological catch-up and innovation. Cameron, Proudman and Redding (2005) analyse productivity growth in a panel of 14 UK manufacturing industries since 1970. They distinguish, as do Griffith *et al.* (2004), between innovation and technology transfer as a source of productivity growth for a country behind the technological frontier, led by the United States in all sectors. They also examine the role played by R&D, international trade and human capital. While R&D increases the rate of innovation, international trade enhances the speed of technology transfer. Human capital affects output through private rates of return, captured by the index of labour quality.

Timmer, Inklaar, O´Mahony and van Ark (2010, chapter 6) use a regression analysis to gauge statistically the importance of certain potential determinants of TFP growth, based on a technology gap model similar to Griffith *et al.* (2004). They also use relative levels of TFP but instead of assuming that the United States is the leader in all industries they consider that each individual industry —in the set of countries covered by the EU KLEMS database— is led by a specific country. Among the many possible TFP determinants, they focus on whether ICT use and the use of skilled labour generates externalities and whether regulatory barriers to entry hamper productivity growth. The ICT variable is defined as the share of capital compensation in gross output and skilled labour refers to university-educated workers. They do not find evidence of positive externalities in the use of ICT or evidence that a larger share of highly-skilled workers has an impact on TFP growth. Both results indicate that the impact of ICT and higher-educated workers is well captured in the growth accounting exercise.

In what follows we will take a similar route to that of Timmer *et al.* (2010), but instead of concentrating on the technological gap we will focus more on ICT and some institutional settings that are potentially important when explaining the poor performance of TFP in some countries.

II. Evolution of total factor productivity: Latin American countries vs. United States and Europe

The total factor productivity (TFP) figures comes both from the EU KLEMS and LA KLEMS databases, calculated making use of growth accounting methodology for each sector of the economy. In the calculation it is assumed that there is a production function in which the value added (*y*) of a sector *i* at a given moment in time *t* can be expressed as:

$$y_{it} = y_{it}(PK_{it}^{ICT}, PK_{it}^{Non-ICT}, HW_{it}, HK_{it}, TFP_{it}) \quad (1)$$

where PKICT and PKNon-ICT is productive ICT capital (hardware, software and communications) and Non-ICT (other assets), respectively. HW is hours worked and HK is a measure of the skills of the workforce or human capital. TFP measures the levels of efficiency in how factors of production are used, after deducting the impact of improvements in workers' skills and corrections in the measurement of different forms of capital. A detailed explanation on how TFP growth is computed in the EU KLEMS database can be found in Timmer et al. (2010, chapter 3).

As we can see from the data in table A.1, growth in labor productivity is considerably lower in Argentina, Brazil, and Mexico than in the United States. Especially worrisome is the slow pace followed by the first two countries. Only Chile stands out by its high labor productivity growth. While labor productivity grew by 1.36% in the whole of Europe, 2.02 in the United States, it was a mere 0.53% in Brazil and 0.61% in Argentina. In the benchmark, the United States and the European Union labor productivity growth was mainly based on TFP (0.84 and 0.45 in Europe, Germany and the in the United States and European Union, respectively) and also on capital deepening (1.02 percentage points (pp) in United States, and 0.78 in European Union). The disaggregation of the contribution of capital shows that ICT capital has played a greater role than other types of assets in the United States. Meanwhile, changes in the contribution of skilled labor were lower. In the four Latin American countries the pattern of productivity growth was somehow different. The most characteristic feature is the negative contribution of TFP in three out of four countries. TFP subtracted 0.32 percentage points in Brazil, 0.74 in Chile, and was even more negative in Mexico, -0.88 pp. Furthermore, the contribution of capital per hour worked was negative in two Latin American countries: Argentina (-0.65 pp) and Brazil (-0.30 pp) and very high in Chile (2.46 pp) and Mexico (2.26 pp). Finally, improvements in the composition of the workforce

play a major role in all Latin American countries with the exception of Mexico, for which the contribution was nil. Brazil stands out for a very high contribution of this variable (1.14 pp), and in both, Argentina (0.54 pp) and Chile (0.51 pp), it was clearly higher than in the United States (0.16 pp) and European Union (0.14 pp). This result is what it should be expected due to the relative laggard position of the Latin American countries with respect to the United States and European Union in labor qualification. For what we have seen, one fact stands out regarding how productivity has progressed in Latin American countries: the negative behavior of TFP during the period analyzed.[2]

Table A.2 shows the average annual growth of TFP by sector in the same period. We can see that the problem in TFP in Brazil is to be found in almost all sectors. The exceptions are Agriculture and Fishing; Electricity, gas and water and Financial Intermediation, while in Chile the largest negative rates of TFP growth correspond precisely to the last two: Electricity, gas and water, and Financial Intermediation, together with Manufactures. On the contrary, Chile´s Wholesale and retail trade, Hotels and Restaurants and Transport and Communication sectors have a relative high PTF growth rate.[3]

[2] Unfortunately, the disaggregation between ICT and non ICT capital in LA countries is not available yet, but for what can be seen a second fact would probably be the relative low contribution of ICT capital per hour worked as compared with United States and European Union.

[3] Information for Mexico it is not included since its sectoral disaggregation follows a different classification.

III. Policy variables to improve total factor productivity (TFP): methodology and definitions

This section examines the determinants of efficiency improvements (of TFP growth) from a large selection of potential explanatory variables. The analysis is performed in two stages. The first one, by means of a regression model, estimates the determinants of TFP using the maximum feasible level of industry disaggregation for 10 European countries and the United States. An alternative strategy would be to include the four Latin American countries in the TFP regression. However, since the level of industry disaggregation is much lower in these latter countries we do not have enough variability to perform this exercise. The second stage evaluates the potential of the variables found in the first stage to be most relevant in improving TFP in each of the two countries analyzed. In this second stage we calculate the distance between the values of each determinant in Argentina, Brazil, Chile or Mexico with respect to the benchmark. We use this difference and the coefficients estimated in the first stage to calculate the potential of each variable to increase TFP growth.

Therefore, the strategy we propose specifies a regression model where the dependent variable is the TFP growth of each sector of the market economy provided by the EU KLEMS and LA KLEMS databases. The explanatory variables for TFP growth that have been selected are the following.

Unit labour costs growth. Unit labour costs can be considered an indicator of the level of regional competitiveness. When labour costs grow at a higher pace than productivity —that is, when unit labour costs increase— it means a threat to the competitiveness of the economy if other costs are not reduced in compensation. Labour costs have been calculated with the information available in EU KLEMS and LA KLEMS.

Percentage of self-employees over total employment. This variable aims to capture the differences in labour markets in the economies. It is assumed that the more developed a labour market is, the greater proportion of employment is composed by employees earning wages (Kuznets, 1973). Furthermore, being an employee is assumed to be more secure than being self-employed. Hence a negative sign is expected in the estimation, as the higher the proportion of self-employment in an economy, the lower productivity gains. Data of self-employed and total employment is taken from the database LABORSTA elaborated by the International Labour Organization (ILO). When data is not available alternative data sources such as Eurostat and OECD have been used.

Investment in ICT. The calculation of TFP explicitly takes into account capital linked with new information technologies and communication. However, it is important to assess not only the rate at which it accumulates, but also the composition of aggregated capital. Thus, an additional variable is introduced: the percentage that ICT investment represents over total investment. The data is obtained from the EU and LA KLEMS database.

Related to ICT, two dummy variables are included which measure whether the sector is producing ICT or is an intensive user of ICT. Dahl, Kongsted and Sorensen (2011) use also a dummy variable for ICT-intensity but distinguishing between ICT-intensive and ICT-non intensive sectors instead of ICT-producers and ICT-intensive as we do here.

Spillover effects coming from physical and human capital. A high intensity in the use of these two factors of production can generate further effects than those coming from its direct use in each firm or sector (*spillover effects*). The generation of spillovers parts from the idea that the investment in physical or human capital by companies generates increases in its stock of knowledge. But, as well, this increase of the knowledge level is a public good that can be profitable for the rest of companies and sectors. That is to say, the increase of knowledge acquired, derivative of the installed capital stock, spills over to the rest of the economy. Therefore, these assumptions imply that productivity growth will not only come from the capitalization of each company or sector, but also from the capital stock (physical and human) aggregate of the economy (Romer 1986; Lucas 1988; Barro and Sala-i-Martin 2004, among others). Aggregated physical capital is taken from the STAN database (OECD) and from LA KLEMS for Latin American countries. The percentage of population with tertiary education over total population is used as an indicator of aggregated human capital. For most countries data is taken from the World Bank's World Development Indicators database and for some Latin American countries it is taken from national data sources (Argentina, Brazil and Chile).

Infrastructure and Internet use: Two variables that approximate the endowments of Internet infrastructure of firms and their use by individuals are included. Specifically, broadband Internet subscribers (as percentage of total population) are considered an indicator of the endowments in this type of infrastructure, and the percentage of individuals who use Internet as a variable that approximates the use of new technologies. Data is taken from the World Bank.

Expenditure on R&D: As it has already been mentioned R&D investment has been widely used as a determinant of TFP growth thanks to its capacity to stimulate innovation and also to enhance technology transfer. Aggregated expenditure on R&D as a percentage of total investment in each country is included in the estimation. Data is obtained from the World Development Indicators (The World Bank).

Effective exchange rates. Exchange rate depreciation would increase external demand and hence foster growth and employment creation if Marshall-Lerner conditions held. Additionally, a weaker real exchange rate can lead to a "growth surge" as workers move into traded goods industries with more "learning by doing" and exit non-traded sectors with slower productivity growth, which has a positive effect on TFP growth. However, on the contrary, appreciated real exchange rate may boost TFP if it implies higher competition in domestic markets by imports and force firms to improve their efficiency to export. Thus, at least in principle, the relationship between these two variables has to be settled empirically.

Regulatory variables in services: Mas (2012) stresses the importance of the services sector to explain the sluggish productivity growth in the European Union compared to a much higher rate in the United States. In order to capture the characteristics that hinder competition in various service sub-sectors, the three indicators on regulatory barriers included in the OECD database *Indicators of Product Market Regulation* (Nicoletti and Scarpeta, 2003) have been included. The indicators are constructed from questionnaires completed by national authorities in three separate years: 1998, 2003 and 2008. Given that only these three periods are available, the remaining sample years are interpolated. The indices are bounded between 0 and 6, the higher values meaning higher level of restrictions on competition. The indicators included are: (a) Sector specific administrative burdens (administrative burdens in road transport and retail distribution sectors); (b) Barrier to entry in network sectors (measures various kinds of entry barriers in network sectors —based on detailed data for seven network sectors—, as well as the degree of vertical integration in energy, rail transport and telecommunication

sector); and (c) Barrier to entry in services (measures barriers to entry in retail trade and professional services). Unfortunately, there is no information for the Latin American countries in the OECD database. Hence, although these three variables are included in the estimation, it is not possible to estimate the impact on TFP growth of the Latin American countries' convergence to the benchmark levels.

As we have seen in section II, a broader set of potential explanatory variables exists. Additional variables are not included due to lack of sufficient information for different countries and for sectorial breakdown. For example, infrastructure endowments are a variable which has a potential effect on TFP and should therefore be included in the estimates. However, capital stock in infrastructure is available solely for the Spanish economy. In relation to other variables that have been excluded, it should be mentioned that indicators cannot be obtained from *Labour Force Statistics* regarding the skills of company managers. Something similar occurs with variables on entrepreneurship. There are some studies that have included other variables among the determinants of TFP, such as foreign direct investment and the degree of openness. This paper does not include either for the following reasons. Although the OECD publishes data on sectorial foreign direct investment, the sectorial breakdown since 1998 is only available for investment flows, and is only available for *stock* for recent years. The relevant variable for productivity analysis should be accumulated investment stock, rather than just the investment made in a given year. The sectorial trade balance is not included either, as it is only available for those sectors that produce tradable goods, and is therefore not available for services.

IV. Determinants of productivity (TFP) in the benchmark countries

Table A.3 shows the results of the estimates. The dependent variable in all equations is TFP growth. The sample consists of all the countries included in the benchmark, that is the 10 European countries (Austria, Denmark, Finland, France, Germany, Italy, Netherlands, Spain, Sweden and the United Kingdom) and the United States. The equations are estimated using panel data techniques (random effects) in which the individual is defined by sector and country. The industry classification includes 24 sectors of the market economy. Regressions also include time and country dummy variables (country effects) in order to capture shocks and specific characteristics of countries, or years, not covered by other explanatory variables. The table includes several regressions in which additional variables are included sequentially as they do not have industry variability (only across countries and over time). In total, more than 1,300 observations are available, with R^2 around 0.66.

Column [1] indicates that there exist a negative relationship between unit labour cost growth and TFP. When labour costs increase at a faster rate than productivity —thus increasing unit labour costs— wages and prices experience an upward pressure with a loss of competitiveness. The rise in inflation reduces the real value of all fixed nominal incomes (salaries, pensions, unemployment benefits, nominal savings rates,…). If workers have enough power to translate the rise of inflation into higher wages, real wages will go up with negative effects on employment. Furthermore, the increase in unit labour costs would be detrimental for competitiveness since it would push up the price of our exports while reducing at the same time the price of imports.

The results also indicate that there is a negative relationship between the percentage of self-employees workers and TFP, as expected, and that the coefficient is always significant. Hence, the high level of self-employees in Latin American economies is an obstacle for TFP growth as it is often associated to more informal labour markets, and hence, less productive.

Columns [1] and [2] show the coefficients of the share of the investment in ICT on total investment, and of the dummy variables that measure if the sector is intensive in the production and/or the use of ICT. The coefficients of the dummy variables measure the differences in TFP growth that exist in average between the ICT producing (or users) and non-producing sectors (or non-users). The results show that ICT producing sectors grow systematically at a greater pace than the non-producing

ones. That is to say, ICT producing sectors have an advantage in terms of TFP that ranges between 1.6 and 1.1 pp. Nevertheless, evidence that the ICT intensive user sectors have greater productivity than non-intensive users is not obtained, since the coefficient is not significant.

The coefficient of the variable that measures the importance of the ICT investment on total investment is not significant, or only marginally. Apparently, this result contradicts the conclusions reached by abundant studies that find evidence in this sense (see Isaksson, 2007). This lack of significance of the coefficient is due to the high sample correlation between this variable and the dummy variables that measure if a sector is an intensive ICT user o producer. If these dummies are eliminated, the weight of the ICT investment is highly significant (equations [3] and [4]). Therefore, if the multicollinearlity problem between the variables is corrected, the results show that TFP growth is greater in those sectors in which the investment is more focused on this type of assets. In the rest of the equations of table 3, the weight of ICT investment is included solely, eliminating the two dummy variables.

The first set of variables that are included without industry variability are the physical and the human capital spillovers. Counterintuitively, the coefficient of physical capital spillover is negative and statistically significant, but it is due to a problem of multicollineality with the fixed effects. As long as physical capital is a stock variable with high inertia and the differences across sectors and countries are stable in the short time span considered, there seems to be a high correlation with the sector and country effects, which are constant. Columns [2] and [4] reestimate the model without the country effects and the coefficient becomes non-significant. Similarly, the human capital spillovers is only significant when the country dummy variables are included, but not when they are excluded. Hence, no evidence is found in the estimation in favour of the relevance of spillovers neither of physical or human capital. The R&D investment also shows a positive and significant sign, implying that an increase in R&D expenditure fosters TFP growth.

Equations [9] and [10] include the effective exchange rate. The coefficient positive and is only significant when the country dummies are dropped. Hence, evidence is found in favour of the hypothesis that appreciated exchanges rates foster productivity by means of the higher pressure to improve economic performance in the domestic market because exports are more costly and imports are cheaper. The following two estimations include variables related to the different regulatory barriers in services. Among the three variables included, only the third one (*Barriers to entry in services*) is significant.[4] The evidence therefore suggests that in a the context of the developed countries there are indeed barriers in the sectors of retail trade and professional services which mean that competition does not generate enough pressure on these sectors to improve their efficiency. This result is in line with Inklaar *et al.* (2008) who find that, in post and telecommunications, lower barriers are strongly related to higher TFP growth, while for other service sectors no evidence could be found. The last two sets of estimates include variables related to the endowments of Internet infrastructure of companies and their use by individuals. The coefficient of the indicator of Internet endowments is statistically significant whereas the extent of its use not.

The next step is to evaluate what is the most important determinant of those listed in table A.3. In order to do this, table A.4 shows the semi-elasticities of each of the variables calculated for the average sample value of each variable. Semi-elasticities are calculated given that the dependent variable is a rate of annual change (log difference) while the explanatory variables are expressed in levels, and so semi-elasticity seems more appropriate than elasticity.[5] The first ones measure the increase (percentage points) which would be observed in the dependent variable (TFP growth) if one of the explanatory variables increased by 1%. All the semi-elasticities are relatively stable[6] between equations. A 1% reduction in the

[4] The non-significance of the Specific administrative burdens and Barrier to entry in network sectors is not due to a possible problem in the high correlation between the three indicators of regulatory barriers. The estimates were repeated for each one separately. The only significant variable was the Barriers to entry in services variable (significant at 5% even with the country dummy).

[5] Although elasticities could be obtained from the estimated coefficients, these would have to be interpreted as the percentage increase in growth (therefore a concept of acceleration would be found) of TFP when an explanatory variable increases by 1%. This interpretation is less intuitive than semi-elasticity.

[6] Only semi-elasticities of statistically significant variables are mentioned.

percentage of self-employees would generate, on average for all estimates in which it appears, an increase of 0.4 percentage points in TFP. The importance of investment in ICT show similar semi-elasticities than the indicator of self-employment, although somewhat higher. TFP would increase 0.5 pp against a 1% increase by increasing ICT investment effort. However, the semi-elasticity with respect to the unit labour costs is much smaller, of only 0.07 pp.

The semi-elasticities of aggregate country variables are generally much higher. Consequently, if we consider the equations in which no country effects are included, a 1% increase in the proportion of Internet broadband connection users or R&D expenditure relative to total investment will generate an increase in TFP of 0.8 pp. But the higher elasticity correspond to the real exchange rate. A 1% increase of the effective exchange rate would increase TFP by 7.5 pp. Finally, according to estimates 1% reduction in the barriers to entry in services would generate an increase in TFP growth of 0.5 percentage points.

An idea of the impact of each variable on TFP growth is given by the semi-elasticities. These reflect the increase in TFP associated with a 1% change in each explanatory variable evaluated in the average value of distribution. However, if the potential of each explanatory variable is to be assessed, the range of variation must be taken into account. That is to say, it is possible that a determinant shows a very low semi-elasticity, but its range of variation is very high (much greater than the 1% taken as a reference in the semi-elasticity). In this case, the potential of the variable to improve TFP would be high. Conversely, there may be high semi-elasticity of some variables, but the 1% being quite a large variation of it according to the sample values. If the observed range of variation in the sample is taken into account, the impact on TFP would be reduced. The next section explicitly deals with the range of variability of each variable so as to measure its impact on TFP.

V. Policy variables to improve TFP growth in the large Latin American countries

In this section, the distance of each of the explanatory variables between each of the four Latin American countries (Argentina, Brazil, Chile and Mexico) in relation to the different benchmarks is evaluated over the average values over the period 1998-2007, so as to calculate its potential to accelerate TFP growth. Three different benchmarks are considered: the United States, the average of the 10 Europeans countries (Europe) and the aggregation of the United States and European countries.

The first variable shown in table A.5 is the proxy for the competitiveness of the economies. In the United States and in Europe unit labour costs grew at 0.4% and 0.1% respectively. In Latin American countries there were different profiles depending on the country. Unit labor costs grew faster in Brazil (6.3%) and Mexico (7.5%) than in the benchmarks, whereas in Chile (-0.1%), and especially in Argentina (-2.1) happened just the opposite. Table A.7 shows the average unit labour costs growth for the benchmarks and for each Latin American country breakdown by eight industries. Despite in the estimation a 24 industry disaggregation has been used, for Latin American countries only the breakdown in the eight sectors shown in table A.7 is available. Argentina stands out by the generalized decrease in unit labour costs in all industries, especially in *Mining and quarrying* (-7.4%) and *Agriculture, Hunting, Forestry and Fishing* (-3.3%). Just the opposite can be observed in Brazil and Mexico. Almost in all industries unit labour costs grew at higher rates than in the benchmarks. Chile shows a more moderate behaviour as unit labour costs grew in some sectors (*Electricity, gas and water supply*, *Construction* or *Mining and quarrying*) where in other decreased (*Wholesale, retail trade, hotels and restaurants, Transport, Storage and Communication or Manufacturing*).

In general, all Latin American countries stand out by its high share of self-employment. Whereas in Europe and in the United States the percentage of self-employees in total labour force is 16.7% and 8.3%, respectively, the percentage is 27,5% in Argentina, 28,3 in Chile, 34.5% in Mexico and a higher 48.0% in Brazil. By sectors (see table A.8) the higher differences with respect to the benchmarks are in *Manufacturing, Transport, storage and Communications, Construction* sector (Argentina y Brazil), *Wholesale, retail trade, hotels and restaurants* (Brazil and Chile) and *Agriculture, hunting, forestry and fishing* especially in Brazil and Mexico with respect to the United States.

Argentina, Chile, and particularly Mexico show particularly low weight of ICT investment in total investment compared with the United States (see table A.5). Whereas in the latter ICT represents 20.7% of total investment in Argentina the ratio is 12.9%, in Chile 5.5% and in Mexico only 4.2%. With respect to Europe the differences are lower, as the share of ICT investment is also lower (13.5%). Hence in Latin American countries the low proportion of investment devoted to ICT assets hampers TPF growth. On the contrary Brazil stands out by its high levels of investment in new technologies (35.6%). By sectors (see table 8) the greatest differences in Argentina, Chile and Mexico with respect the benchmark are observed in *Transport, storage and communications*, *Construction*, *Manufacturing*, *Financial institutions* and *Wholesale, retail trade, hotels and restaurants* (in Mexico).

Regarding the rest of the variables, those with no sectorial disaggregation, all countries share a same profile in comparison with the benchmark, although with different intensity. Firstly, these economies are characterized by a low intensity in their investment in R&D. In the United States R&D represents 13.7% of GDP something higher than in Europe (11.2). However, the Latin American country with higher ratio is Brazil with only 6.0%; Chile and Brazil hardly reach 2.5%, and Mexico is the country with the lowest level, 2%. Secondly, they are economies with a low penetration of the new technologies. Whereas in Europe and in the United States about half the population use internet, in Latin American countries the penetration of internet is lower. In Mexico, only 11.2% of the population uses Internet, in Argentina 12.4 and in Brazil 13.2. Chile is the Latin American economy with the highest level (21.9%), almost 10 percentage points more than the rest of countries. The same picture can be seen from the broadband Internet subscribers. In Europe and United States, the penetration is more than six times higher than in these other countries. Thirdly, in general the level of capitalization is lower, especially in terms of physical capital. In what respect human capital the only country with values substantially different from those of the benchmark is Brazil, in which only 7.2% of the population has higher education. Finally the effective exchange rate is quite different across countries. Argentina (175.6), and to a lower extent Mexico (111.2) have appreciated exchange rates, whereas Brazil and Chile show the opposite, depreciated real exchange rates.

After reviewing the position of the Latin American economies in relation to the benchmarks, we estimate how TFP growth in these two countries would be affected by the variation of each determinant from its actual value to placing it at the average values of each benchmark. The effect on TFP growth of variable *X* from the value of each country —Argentina, Brazil, Chile or Mexico— ($X_{Country}$) to each benchmark (*XBenchmark*) —the average of European countries, the United States or the average of the Europe and the United States— can be calculated as:

$$\text{Effect on TFP growth} = \beta_X \left(X_{Benchmark} - X_{Country} \right) \qquad [2]$$

where β_X is the estimated regression coefficient obtained in table A.3. The results of this exercise are shown in table A.9.[7]

Among the variables with industry disaggregation the greater influence comes from the unit labour costs. If the unit labour costs in Brazil and Mexico had grown at the same rate than in the United States, TFP growth would have increased by 4.4 pp. and 5.4 pp., respectively. Bearing in mind that TPF in these two countries were -0.3% and 0.9%, the effect is really important. On the contrary, the influence of convergence of unit labour to the benchmark's level is negative in Argentina and Chile. It does not necessarily imply a policy recommendation of increasing unit labour costs growth. This result has to be interpreted as follow. Given the fact that in these two economies unit labour costs growth has been slower than in the benchmarks, they have already benefited from the favourable evolution of this variables in the percentages shown in the table. As in Europe unit labour costs growth was lower in Europe than in the United States, the effect of the convergence to this benchmark is also lower. By sectors (table A.10) the improvement in TFP growth would be generalized, as almost in all sectors unit labour cost grew faster than in the benchmarks. Hence, the moderation of unit labour costs in those countries with higher increases would help to improve the efficiency of the economic system.

[7] Again, only the effects of statistically significant variables are described.

The percentage of self-employees have also an important role to improve productivity in Latin American countries. Considering the United States as benchmark, the convergence to its levels would increase TFP growth in Brazil by 2.2 pp, 1.5 pp in Mexico, and 1.1 pp in Argentina and Chile. Once again, the improvement of TFP would be greater in those sectors with more labour force self-employed, particularly in *Manufacturing*, *Construction* and *Wholesale, Retail Trade, Hotels and Restaurants* (see table A.11). Hence, the high presence of informal workers in labour market harms efficiency improvements in the four countries. The development of labour markets so that the proportion of employees increases is beneficial for those economies, although this is not an easy task. It depends crucially on the growth of firms' size, among many other factors.

In Argentina, Chile and Mexico the convergence of the investment in ICT assets to reach the values of each benchmark would yield an acceleration of TFP growth lower than the previous two variables. According to the estimates, if these countries reached the level of ICT investment of the United States, their increase in productivity would be of 0.2 pp, 0.3 and 0.4, respectively. The convergence to the European levels would have even lower effect, as the United States invest more in ICT assets than in Europe. In this case, the increase of TFP growth in Argentina would have been almost negligible, of only 0.1 pp in Chile, and of 0.2 pp in Mexico. In Brazil, the effect is negative given the high proportion of its investment in ICT, which is higher than in the two benchmarks. Table A.12 shows the effects of convergence to the benchmark at sector levels.

As mentioned earlier, productivity growth is between 1.6 and 1.1 pp higher in ICT producing industries than non-ICT producing industries. Therefore, if the weight of ICT activities is increased within the productive structure in these four countries, higher growth in aggregate productivity would be achieved via TFP growth, given that these industries usually have higher productivity.

In relation to the other variables, those with no sectorial variability, results show that the influence of investment in R&D is high in all countries. Increasing investment in R&D to the United States levels would generate productivity gains between 1.4 (Mexico) and 0.9 pp (Brazil). The extent of Internet use can help to improve the productivity of the Latin American countries. The assumption of convergence in the subscribers to broadband Internet to the United States and Europe averages would increase TFP by 0.5 and 0.6 percentage points. The convergence of the real exchange rate to the benchmark levels is positive for Brazil (between 3.5 and 2.6 pp. depending on the benchmark) and Chile (between 1.4 and 0.5). Finally, although not shown because of the lack of information for Latin American countries, the removal of barriers to entry in services would contribute also to the improvement of the efficiency of these four economies.

VI. Conclusions

The four large Latin American countries had a strong and sustained GDP growth in the years previous to the crisis. However, they do not share a common pattern of growth as the evolution of labor productivity has been very different in the period 1998-2007, with Chile (2.2%) growing at a rate four times higher than Brazil (0.5%). Furthermore, the sources of growth have also been very different. Whereas Argentina based its growth in TFP with a negative contribution of capital accumulation per worker, Brazil had a sluggish productivity growth as a consequence of a negative contribution of both TFP and capital. Chile had the strongest productivity growth thanks to its high capital accumulation. Mexico shares the same profile than Chile but with a lower labor productivity growth and a negative contribution of labour qualification.

Given the fact that in order to maintain a stable and sustainable pace of growth it is necessary for growth to be based on efficiency gains and not on the intensive use of capital and labour, three of the countries (Brazil, Chile and Mexico) share a common weakness. In the period 1998-2007 total factor productivity growth has been negative, that is, they have experienced some difficulties with efficiency improvements.

This paper develops a two-step framework to analyze the potential of different variables to increase total factor productivity (TFP) growth in Argentina, Brazil, Chile and Mexico. The two-step framework consist of the use of a multi-country industry level benchmark to quantify the effect of each potential determinant on TFP growth. Once this influence is measured, the difference in the scores of each variable in each of the four countries with respect to the benchmark is used to test their potential to increase productivity growth.

The results of this study indicate that ICT producing industries have average rates of TFP growth superior to other branches of activity. However, public authorities should not force a greater presence of ICT producing industries for which these four countries probably do not have competitive advantages.

For the four countries, the priority is threefold. On the one hand unit labour costs growth has to be reduced in Brazil and Mexico, as this variable has proved to have a great impact on TPF growth. Furthermore, all four countries have to improve the functioning of the labour market, reducing the share of self-employees in order to modernize the functioning of the economic system. Our results also indicate that

the intensification of investment in ICT and R&D activities is key, but this should not be undertaken indiscriminately. Investment in these assets has to gain weight within the structure of investment.

Public policy should also aim to encourage not only a higher endowment of Internet infrastructure, but also to promote the use of these technologies by the majority of the population. A factor that would also contribute to improve productivity growth in most European countries, is the reduction of the barriers to entry in service sectors, although its impact cannot be tested in Latin America for lack of data.

Bibliography

Aghion, Philippe and Peter Howitt (1992), "A Model of Growth through Creative Destruction", *Econometrica*, March, 323-351.

Cameron, Gavin, Proudman, James and Stephen Redding (2005), "Technological convergence, R&D, trade and productivity growth", *European Economic Review*, 49, 775-807.

Dahl, Christian M., Kongsted, Hans Christian and Anders Sorensen (2011), "ICT and Productivity Growth in the 1990´s: Panel Data Evidence on Europe", *Empirical Economics*, vol. 40(1), February, 141-164.

Griffith, Rachel, Redding, Stephen and John Van Reenen (2004), "Mapping the Two Faces of R&D: Productivity Growth in a Panel of OECD Industries", *The Review of Economics and Statistics*, 86(4), November, 883-895.

Inklaar, Robert, Timmer, Marcel and van Ark, Bart (2008), "Market Services Productivity Across Europe and the U.S.", *Economic Policy*, 23(53), 139-94.

Isaksson, Anders (2007), *Determinants of Total Factor Productivity: A literature Review*, United Nations Industrial Development Organization (UNIDO), July, 97 pgs.

Kuznets, Simon (1973), "Modern Economic Growth: Findings and Reflections" *American Economic Review*, 63, 3 (June), 247-258.

Mas, Matilde and Robert Stehrer (eds.) (2012), *Industrial Productivity in Europe: Growth and Crisis*, Edward Elgar.

Nicoletti, Giuseppe and Stefano Scarpetta (2003), Regulation, Productivity and Growth, *OECD Evidence*, The World Bank, January, 60 pages.

Romer, Paul (1990), "Endogenous Technological Change", *Journal of Political Economy*, 98:5, S71-S102.

Sala-i-Martín, Xavier (2002), "15 Years of New Growth Economics: What have we learnt?", Discussion Paper 0102-47, Columbia University, April.

Timmer, Marcel, Inklaar, Robert, O'Mahony, Mary and Bart van Ark (2010), *Economic Growth in Europe. A Comparative Industry Perspective*, Cambridge University Press, 292 pgs.

Vandenbussche, Jérôme, Aghion, Philippe and Costas Meghir (2006), "Growth, distance to the frontier and composition of human capital", *Journal of Economic Growth*, 11, 97-127.

Wölfl, Anita, Wanner, Isabelle, Kozluk Tomasz and Giuseppe Nicoletti (2009), "Ten years of product market reform in OECD countries–insights from a revised PRM indicator", *Economics Department Working Papers*, 695, OECD.

Annex

TABLE A.1
GROWTH ACCOUNTING: PRODUCTIVITY PER HOUR WORKED, 1998-2007
(Percentages)

	Productivity per hour worked	Contributions of the sources of growth				
		Changes in qualifications	Total capital per hour worked	ICT capital per hour worked	Non-ICT capital per hour worked	TFP
Argentina	0.61	0.54	-0.65	-	-	0.71
Brazil	0.53	1.14	-0.30	-	-	-0.32
Chile	2.23	0.70	2.46	-	-	-0.93
Mexico	1.37	0.88	1.41	-	-	-0.91
United States	2.02	0.16	1.02	0.56	0.45	0.84
Europe	1.36	0.14	0.78	0.37	0.41	0.45

Source: EU KLEMS (2011), LA KLEMS (2012) and authors' calculations.

TABLE A.2
ANNUAL GROWTH RATE OF PTF, 1998-2007
(Percentages)

	Argentina	Brazil	Chile	Mexico	United States	Europe
Total industries	0.71	-0.32	-0.93	-0.91	0.84	0.45
Agriculture and fishing	1.44	3.03	3.16	-1.64	2.87	1.17
Mining and quarrying	-1.73	-1.26	-3.08	-0.75	-2.77	-1.93
Manufacturing	0.87	-1.10	-0.54	-0.79	3.69	1.88
Electricity, gas and water supply	2.76	1.42	-5.54	-0.99	0.73	1.36
Construction	4.20	-1.15	0.64	-2.45	-4.34	-0.59
Wholesale and retail trade; hotels and restaurants	-0.86	-0.33	2.09	-4.60	1.81	0.48
Transport and communications	3.49	-2.99	0.68	2.26	2.79	1.76
Finance, insurance, real estate and business services	-1.64	1.34	-3.05	-4.00	0.35	-0.17
Community social and personal services	1.70	-0.50	-0.81	-2.45	-0.19	-0.27

Source: EU KLEMS (2011), LA KLEMS (2012) and own elaboration.

TABLE A.3
DETERMINANTS OF TFP GROWTH, 1998-2007

(Dependent variable: TFP growth)

	[1]	[2]	[3]	[4]	[5]	[6]	[7]	[8]	[9]	[10]	[11]	[12]	[13]	[14]	[15]	[16]
	With country effect	Without country effect	With country effect	Without country effect	With country effect	Without country effect	With country effect	Without country effect	With country effect	Without country effect	With country effect	Without country effect	With country effect	Without country effect	With country effect	Without country effect
Unit labor cost growth	-75.430 ***	-75.261 ***	-76.013 ***	-75.751 ***	-75.693 ***	-75.856 ***	-75.807 ***	-75.871 ***	-76.318 ***	-76.072 ***	-76.389 ***	-76.275 ***	-75.816 ***	-75.742 ***	-75.780 ***	-75.934 ***
	(1.605)	(1.609)	(1.602)	(1.603)	(1.595)	(1.602)	(1.604)	(1.598)	(1.602)	(1.597)	(1.603)	(1.612)	(1.613)	(1.603)	(1.602)	(1.600)
Percentage of self-employees	-4.266 **	-6.373 ***	-5.667 ***	-6.774 ***	-5.652 ***	-5.568 ***	-5.662 ***	-4.706 ***	-5.512 ***	-5.620 ***	-5.472 ***	-5.722 ***	-5.650 ***	-5.598 ***	-5.742 ***	-5.453 ***
	(1.805)	(1.628)	(1.679)	(1.562)	(1.680)	(1.633)	(1.679)	(1.519)	(1.679)	(1.495)	(1.679)	(1.618)	(1.680)	(1.546)	(1.681)	(1.498)
ICT user industry (dummy variable)	-0.018	-0.175														
	(0.267)	(0.272)														
ICT producing industry (dummy variable)	1.642 ***	1.185 **														
	(0.509)	(0.504)														
ICT investment / total investment	0.01	0.019 *	0.026 ***	0.033 ***	0.024 **	0.027 ***	0.026 ***	0.026 ***	0.026 ***	0.024 **	0.027 ***	0.031 ***	0,026 ***	0.028 ***	0.025 **	0.026 ***
	(0.012)	(0.011)	(0.010)	(0.010)	(0.010)	(0.010)	(0.010)	(0.009)	(0.010)	(0.010)	(0.010)	(0.010)	(0.010)	(0.010)	(0.010)	(0.010)
Capital stock per capita	-0.24 ***	-0.006	-0.246 ***	-0.011												
	(0.086)	(0.013)	(0.086)	(0.012)												
Percentage of population with higher education					0.38 ***	0.02										
					(0.094)	(0.019)										
R&D expenditure / total investment							0.14	0.11 ***								
							(0.138)	(0.030)								
Effective exchange rate									0.09 ***	0.06 ***						
									(0.024)	(0.016)						
Barrier to entry in services											-0.06	0.14				
											(0.803)	(0.158)				
Specific administrative burdens on road transport and retail trade sectors											1.14 ***	-0.17				
											(0.427)	(0.192)				
Barrier to entry in network sectors											-2.28 ***	-0.38 *				
											(0.539)	(0.226)				
Percentage of individuals that use Internet													0.00	0.01		
													(0.018)	(0.008)		
Broadband Internet subscribers per 100 inhabitants															0.07 **	0.07 ***
															(0.034)	(0.025)
Constant	16.86 ***	1.85 *	17.15 ***	2.14 **	-10.62 ***	0.58	-0.21	0.39	-8.59 ***	-4.60 ***	1.59	1.54 ***	0.11	0.35	-1.47 *	-0.56
	(6.011)	(1.115)	(6.025)	(1.069)	(2.668)	(0.661)	(0.518)	(0.411)	(2.313)	(1.705)	(3.158)	(0.595)	(1.038)	(0.659)	(0.878)	(0.730)
Observations	1348.00	1348.00	1348.00	1348.00	1348.00	1348.00	1348.00	1348.00	1348.00	1348.00	1348.00	1348.00	1348.00	1348.00	1348.00	1348.00
R2	0.67	0.66	0.67	0.65	0.67	0.65	0.67	0.66	0.67	0.66	0.67	0.66	0.67	0.66	0.67	0.66
Chi2	2611.73	2516.81	2574.82	2495.76	2598.12	2496.93	2554.40	2529.65	2592.64	2528.10	2621.45	2507.09	2551.71	2500.72	2562.79	2515.86

Source: Own elaboration.

Notes: * p<0.10, ** p<0.05, *** p<0.01. All estimations include individual random effects (sector and country) and temporal and country effects, except for equations [2] and [8], which do not include country effects. Standard errors are in brackets.

TABLE A.4
SEMIELASTICITIES OF TFP GROWTH, 1998-2007

(Values show the percentage points increase of TFP when each independent variable increases 1%)

	[1] With country effect		[2] Without country effect		[3] With country effect		[4] Without country effect		[5] With country effect		[6] Without country effect		[7] With country effect		[8] Without country effect		[11] With country effect		[12] Without country effect		[13] With country effect		[14] Without country effect		[15] With country effect		[16] Without country effect		[17] With country effect		[18] Without country effect	
Unit labor cost growth	0.077	***	0.077	***	0.078	***	0.077	***	0.077	***	0.078	***	0.077	***	0.078	***	0.078	***	0.078	***	0.078	***	0.078	***	0.077	***	0.077	***	0.077	***	0.078	***
	(0.002)		(0.002)		(0.002)		(0.002)		(0.002)		(0.002)		(0.002)		(0.002)		(0.002)		(0.002)		(0.002)		(0.002)		(0.002)		(0.002)		(0.002)		(0.002)	
Percentage of self-employees	-0.333	**	-0.497	***	-0.442	***	-0.529	***	-0.441	***	-0.435	***	-0.442	***	-0.367	***	-0.430	***	-0.439	***	-0.427	***	-0.447	***	-0.441	***	-0.437	***	-0.448	***	-0.426	***
	(0.141)		(0.127)		(0.131)		(0.122)		(0.131)		(0.127)		(0.131)		(0.119)		(0.131)		(0.117)		(0.131)		(0.126)		(0.131)		(0.121)		(0.131)		(0.117)	
ICT user industry (dummy variable)	-0.008		-0.074																													
	(0.113)		(0.115)																													
ICT producing industry (dummy variable)	0.172	***	0.124	**																												
	(0.053)		(0.053)																													
ICT investment / total investment	0.09		0.358	*	0.487	***	0.608	***	0.455	**	0.509	***	0.489	***	0.481	***	0.485	***	0.456	**	0.498	***	0.577	***	0.491	***	0.517	***	0.467	**	0.485	***
	(0.223)		(0.212)		(0.183)		(0.181)		(0.183)		(0.186)		(0.183)		(0.175)		(0.183)		(0.179)		(0.183)		(0.184)		(0.183)		(0.179)		(0.183)		(0.178)	
Capital stock per capita	-19.01	***	-0.437		-19.311	***	-0.873																									
	(6.748)		(0.990)		(6.767)		(0.963)																									
Percentage of population with higher education									10.32	***	0.61																					
									(2.549)		(0.529)																					
R&D expenditure / total investment													1.08		0.84	***																
													(1.103)		(0.241)																	
Effective exchange rate																	9.18	***	5.84	***												
																	(2.421)		(1.675)													
Barrier to entry in services																					-0.19		0.45									
																					(2.543)		(0.501)									
Specific administrative burdens on road transport and retail trade sectors																					1.58	***	-0.23									
																					(0.593)		(0.267)									
Barrier to entry in network sectors																					-4.90	***	-0.81	*								
																					(1.159)		(0.486)									
Percentage of individuals that use Internet																									-0.11		0.67					
																									(0.993)		(0.433)					
Broadband Internet subscribers per 100 inhabitants																													0.83	**	0.84	***
																													(0.419)		(0.303)	

Source: Own elaboration.

Notes: * p<0.10, ** p<0.05, *** p<0.01. All estimations include individual random effects (sector and country) and temporal and country effects, except for equations [2] and [8], which do not include country effects. Standard errors are in brackets.

TABLE A.5
AVERAGE VALUES OF TFP DETERMINANTS, TOTAL SECTORS, 1998-2007
(Percentages)

	United States	Europe	United States and Europe	Argentina	Brazil	Chile	Mexico
Growth of unit labor costs	0.39	0.06	0.09	-2.11	6.14	-0.05	7.53
Percentage of self-employees	10.57	17.44	16.82	23.96	33.34	21.95	25.13
ICT investment / total investment	20.73	13.47	14.13	13.08	35.57	8.21	4.48
Capital stock per capita (thousands of euros 2012 per inhabitant)	89.77	75.58	76.87	12.07	4.90	8.10	12.74
Percentage of population with higher education	49.80	24.94	27.20	28.07	7.19	21.43	21.20
R&D expenditure / total investment	13.73	11.24	11.47	2.49	5.95	2.59	1.96
Effective exchange rate	116.07	103.96	105.06	175.60	68.47	96.98	111.83
Percentage of individuals that use Internet	55.70	47.38	48.14	12.44	13.24	21.88	11.17
Broadband Internet subscribers per 100 inhabitants	9.79	9.60	9.61	1.58	1.12	2.51	1.04

Source: EU and LAT KLEMS, ILO, Eurostat, OECD, the World Bank, BIS, and own elaboration.

TABLE A.6
AVERAGE VALUES OF TFP DETERMINANTS, UNIT LABOUR COST GROWTH, 1998-2007
(Percentages)

		United States	Europe	United States and Europe	Argentina	Brazil	Chile	Mexico
AtB	Agriculture, hunting, forestry and fishing	-2.62	-0.05	-0.29	-3.33	0.65	-0.39	3.19
C	Mining and quarrying	-1.63	-1.21	-1.25	-7.37	15.93	1.05	9.38
D	Total manufacturing	-1.77	-0.51	-0.62	-2.46	4.86	-1.46	7.23
E	Electricity, gas and water supply	0.18	-1.47	-1.32	-0.04	0.01	3.54	9.17
F	Construction	3.80	0.96	1.22	-2.71	9.51	1.88	9.70
GH	Wholesale, retail trade hotels and restaurants	-0.38	0.00	-0.03	-1.15	6.71	-2.08	8.05
I	Transport and storage and communication	-1.64	-1.49	-1.50	-2.00	6.44	-1.18	6.50
JtK	Financial intermediation, real estate, renting and business activities	2.36	1.77	1.83	-0.88	4.94	1.78	8.30
Total private sectors		0.39	0.06	0.09	-2.11	6.14	-0.05	7.53

Source: EU and LA KLEMS databases.

TABLE A.7
AVERAGE VALUES OF TFP DETERMINANTS, SELF-EMPLOYEES, 1998-2007
(Percentages)

		United States	Europe	United States and Europe	Argentina	Brazil	Chile	Mexico
AtB	Agriculture, hunting, forestry and fishing	40.03	55.11	53.74	35.59	74.96	36.63	66.85
C	Mining and quarrying	2.02	5.44	5.13	5.88	14.18	7.35	6.39
D	Total manufacturing	2.12	7.24	6.78	24.24	22.53	18.87	23.51
E	Electricity, gas and water supply	0.00	4.59	4.18	1.88	1.44	2.07	0.87
F	Construction	20.11	21.79	21.64	47.92	49.75	25.44	28.38
GH	Wholesale, retail trade hotels and restaurants	4.53	19.49	18.13	-	46.13	37.92	-
I	Transport and storage and communication	6.12	10.60	10.20	21.51	34.52	30.98	23.59
JtK	Financial intermediation, real estate, renting and business activities	9.64	15.28	14.77	30.71	23.18	16.33	26.30
	Total private sectors	8.34	16.74	15.98	27.51	48.02	26.28	34.50

Source: ILO, Eurostat, OECD and own elaboration.

TABLE A.8
AVERAGE VALUES OF TFP DETERMINANTS, ICT INVESTMENT/TOTAL INVESTMENT, 1998-2007
(Percentages)

		United States	Europe	United States and Europe	Argentina	Brazil	Chile	Mexico
AtB	Agriculture, hunting, forestry and fishing	2.13	1.68	1.72	0.06	13.92	2.82	0.84
C	Mining and quarrying	4.94	5.55	5.50	1.99	39.68	3.48	0.37
D	Total manufacturing	29.16	17.62	18.67	11.25	32.06	5.60	4.00
E	Electricity, gas and water supply	11.47	8.00	8.32	18.20	30.52	3.64	6.81
F	Construction	25.84	11.60	12.90	12.99	18.13	20.39	3.72
GH	Wholesale, retail trade hotels and restaurants	22.55	21.11	21.24	27.39	32.11	19.12	9.68
I	Transport and storage and communication	48.34	21.48	23.92	9.11	33.29	5.92	7.09
JtK	Financial intermediation, real estate, renting and business activities	15.92	11.36	11.78	23.61	84.86	4.75	3.30
	Total private sectors	20.73	13.47	14.13	13.08	35.57	8.21	4.48

Source: EU and LA KLEMS databases.

TABLE A.9
ESTIMATED EFFECT OF THE CONVERGENCE OF EACH LATIN AMERICAN COUNTRY TO THE AVERAGE VALUES IN THE BENCHMARK IN EACH DETERMINANT

(Percentage points, only variables with significant coefficients are shown)

	Argentina			Brazil			Chile			Mexico		
	United States	Europe	United States and Europe	United States	Europe	United States and Europe	United States	Europe	United States and Europe	United States	Europe	United States and Europe
Growth of unit labor costs	-1.90	-1.65	-1.67	4.37	4.62	4.60	-0.34	-0.09	-0.11	5.42	5.67	5.65
Percentage of self-employees	0.75	0.37	0.40	1.28	0.89	0.93	0.64	0.25	0.29	0.82	0.43	0.47
ICT investment/total investment	0.20	0.01	0.03	-0.40	-0.59	-0.57	0.34	0.14	0.16	0.44	0.24	0.26
R&D expenditure/total investment	1.35	1.05	1.08	0.93	0.63	0.66	1.34	1.04	1.07	1.41	1.11	1.14
Effective exchange rate	-4.35	-5.23	-5.15	3.47	2.59	2.67	1.39	0.51	0.59	0.31	-0.57	-0.49
Percentage of individuals that use Internet	0.22	0.17	0.18	0.21	0.17	0.17	0.17	0.13	0.13	0.22	0.18	0.18
Broadband Internet subscribers per 100 inhabitants	0.56	0.55	0.55	0.59	0.58	0.58	0.49	0.48	0.48	0.60	0.58	0.58

Source: Own elaboration.

TABLE A.10
ESTIMATED EFFECT OF THE CONVERGENCE OF EACH LATIN AMERICAN COUNTRY TO THE AVERAGE VALUES IN THE BENCHMARK IN THE UNIT LABOUR COST GROWTH

(Percentage points)

		Argentina			Brazil			Chile			Mexico		
		United States	Europe	United States and Europe	United States	Europe	United States and Europe	United States	Europe	United States and Europe	United States	Europe	United States and Europe
AtB	Agriculture, hunting, forestry and fishing	-0.54	-2.49	-2.31	2.48	0.53	0.71	1.70	-0.25	-0.07	4.42	2.47	2.64
C	Mining and quarrying	-4.36	-4.68	-4.65	13.34	13.02	13.05	2.04	1.72	1.75	8.36	8.04	8.07
D	Total manufacturing	-0.52	-1.48	-1.39	5.04	4.08	4.17	0.23	-0.73	-0.64	6.83	5.88	5.96
E	Electricity, gas and water supply	-0.16	1.09	0.97	-0.13	1.12	1.01	2.55	3.80	3.69	6.83	8.08	7.96
F	Construction	-4.94	-2.79	-2.98	4.34	6.49	6.30	-1.46	0.70	0.50	4.48	6.64	6.44
GH	Wholesale, retail trade hotels and restaurants	-0.58	-0.87	-0.85	5.39	5.10	5.12	-1.29	-1.58	-1.56	6.40	6.11	6.14
I	Transport and storage and communication	-0.27	-0.39	-0.38	6.14	6.02	6.04	0.35	0.23	0.24	6.18	6.07	6.08
JtK	Financial intermediation, real estate, renting and business activities	-2.46	-2.02	-2.06	1.96	2.41	2.36	-0.44	0.00	-0.04	4.51	4.96	4.92
	Total private sectors	-1.90	-1.65	-1.67	4.37	4.62	4.60	-0.34	-0.09	-0.11	5.42	5.67	5.65

Source: Own elaboration.

TABLE A.11
ESTIMATED EFFECT OF THE CONVERGENCE OF EACH LATIN AMERICAN COUNTRY TO THE AVERAGE VALUES IN THE BENCHMARK IN THE PERCENTAGE OF SELF-EMPLOYEE

(Percentage points)

		Argentina			Brazil			Chile			Mexico		
		United States	Europe	United States and Europe	United States	Europe	United States and Europe	United States	Europe	United States and Europe	United States	Europe	United States and Europe
AtB	Agriculture, hunting, forestry and fishing	-0.25	-1.10	-1.02	1.97	1.12	1.19	-0.19	-1.04	-0.96	1.51	0.66	0.74
C	Mining and quarrying	0.22	0.02	0.04	0.68	0.49	0.51	0.30	0.11	0.12	0.25	0.05	0.07
D	Total manufacturing	1.25	0.96	0.98	1.15	0.86	0.89	0.94	0.65	0.68	1.20	0.92	0.94
E	Electricity, gas and water supply	0.11	-0.15	-0.13	0.08	-0.18	-0.15	0.12	-0.14	-0.12	0.05	-0.21	-0.19
F	Construction	1.57	1.47	1.48	1.67	1.57	1.58	0.30	0.21	0.21	0.47	0.37	0.38
GH	Wholesale, retail trade hotels and restaurants	-	-	-	2.34	1.50	1.58	1.88	1.04	1.11	-	-	-
I	Transport and storage and communication	0.87	0.61	0.64	1.60	1.35	1.37	1.40	1.15	1.17	0.98	0.73	0.75
JtK	Financial intermediation, real estate, renting and business activities	1.19	0.87	0.90	0.76	0.44	0.47	0.38	0.06	0.09	0.94	0.62	0.65
	Total private sectors	1.08	0.61	0.65	2.23	1.76	1.80	1.12	0.65	0.69	1.47	1.00	1.04

Source: Own elaboration.

TABLE A.12
ESTIMATED EFFECT OF THE CONVERGENCE OF EACH LATIN AMERICAN COUNTRY TO THE AVERAGE VALUES IN THE BENCHMARK IN THE P PERCENTAGE ICT INVESTMENT OVER TOTAL INVESTMENT

(Percentage points)

		Argentina			Brazil			Chile			Mexico		
		United States	Europe	United States and Europe	United States	Europe	United States and Europe	United States	Europe	United States and Europe	United States	Europe	United States and Europe
AtB	Agriculture, hunting, forestry and fishing	0.06	0.04	0.04	-0.32	-0.33	-0.33	-0.02	-0.03	-0.03	0.03	0.02	0.02
C	Mining and quarrying	0.08	0.10	0.09	-0.93	-0.91	-0.92	0.04	0.06	0.05	0.12	0.14	0.14
D	Total manufacturing	0.48	0.17	0.20	-0.08	-0.39	-0.36	0.63	0.32	0.35	0.67	0.36	0.39
E	Electricity, gas and water supply	-0.18	-0.27	-0.26	-0.51	-0.60	-0.59	0.21	0.12	0.13	0.12	0.03	0.04
F	Construction	0.34	-0.04	0.00	0.21	-0.17	-0.14	0.15	-0.24	-0.20	0.59	0.21	0.25
GH	Wholesale, retail trade hotels and restaurants	-0.13	-0.17	-0.16	-0.26	-0.29	-0.29	0.09	0.05	0.06	0.34	0.31	0.31
I	Transport and storage and communication	1.05	0.33	0.40	0.40	-0.32	-0.25	1.14	0.42	0.48	1.11	0.39	0.45
JtK	Financial intermediation, real estate, renting and business activities	-0.21	-0.33	-0.32	-1.85	-1.97	-1.96	0.30	0.18	0.19	0.34	0.22	0.23
	Total private sectors	0.20	0.01	0.03	-0.40	-0.59	-0.57	0.34	0.14	0.16	0.44	0.25	0.26

Source: Own elaboration.

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