THE ARKLEMS+LAND Database

MEASURING PRODUCTIVITY IN UNSTABLE AND NATURAL RESOURCES DEPENDENT ECONOMIES: ARGENTINA

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* Professor of Theory and Measurement of Economic Growth-University of Buenos Aires acorem@econ.uba.ar. This paper is an update and extension of a previous paper published by World Economics Journal. The research is based on recent update of ARKLEMS+LAND database for Argentina up to 2010-2011thanks of the support of CONICET. The author is the team leader of ARKLEMS+LAND project in coordination with WorldKLEMS and LAKLEMS projects. I would to thank to Dale Jorgenson and Fulbright Comission for giving me the chance to hold this research at Harvard University. Helpful comments has been received by Dale Jorgenson, Bart van Ark, Marcel Timmer, Paloma Anos, Norbert Fiess, Alberto Cavallo, Eduardo Cavallo, Herman Kamill, Fransisco Perez, Matilde Mas, Fransisco Perez, Daniel Heymann and Bernardo Kosacoff for the comments and suggestions. Partial results has been presented at IDB, IMF, University of Buenos Aires (ECON conferences 2011), and WorldKLEMS 2nd Meeting at Harvard Kennedy School.

Abstract

This paper measures the Source of Growth of Argentina through KLEMS methodology, taking advantage from a of ARKLEMS+LAND database series 3.0 preliminary version updated up to 2010. This database are based on the methodology presented in Coremberg (2009) (2001), including not only ICT and NonICT capital, Labor and Human Capital and Intermediate Inputs but also Natural Resource as Land and Subsoil Assets services contributions to GDP growth.

The paper presents mainly the contents and methodology of ARKLEMS +LAND series and some analytical results on the causes of TFP slowdown during different macroeconomic regimes of last two decades based on the disaggregation of short run from long run productivity effect.

Main findings showed that the Argentine economy could not take advantage in the long run from positive spillovers and complementarities from special inputs and dynamic sectors in every macroeconomic regime during the last two decades.

According to these diagnose, the paper presents a discussion about what kind of growth strategies could Argentina follow and the different scenarios that the country could attain after global financial collapse in order to achieve sustainable growth.

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SHORT BIO OF THE AUTHOR

Ariel Coremberg is a Professor of Economic Growth at University of Buenos Aires.

He holds a PhD in Economics from University of La Plata and a Master in Economics from University of Torcuato Di Tella.

At present, he is the coordinator and the leading researcher of the ARKLEMS+LAND project on KLEMS account of Argentina.

Dr Coremberg's research interests and extensive publications cover the areas of Macroeconomics, Economic Growth, Competitiveness, Development, Wealth and Financial Effects of Booms and Crises, and National Accounts.

He has published in several academic journals such as International Productivity Monitor, World Economics, as well as several books on National Balance Sheet and Wealth, Development, Education and Human Capital, Natural Resources, Capital Stock and Growth. He has been a consultant for the UN, IDB, World Bank, ECLAC, CAC, BsAs. Grain Exchange and Bs.As. Exchange Foundation.

1. ABOUT ARKLEMS+LAND PROJECT

ARKLEMS +LAND is a research project on the measurement, analyses and international comparisons of the sources of economic growth, productivity and competitiveness of the Argentinean economy at macro and industry level.

The methodology is based on KLEMS framework (Capital, Labor, Energy, Material and Service Inputs) developed by Pr. Dale Jorgenson (Harvard University), who leads the WORLDKLEMS Project together with Marcel Timmer (Groningen University) and Bart Van Ark (Conference Board and Groningen University).

The ARKLEMS + LAND project is organized by a team of Argentinean academics and researchers from University of Buenos Aires and CONICET, with more than twenty years of experience in KLEMS measurements of sources of growth, national accounts, and other issues in measurement and economic analyses. This project is audited by a prestigious academic committee.

The main outcome of ARKLEMS+LAND research, is a dynamic database on investment, capitalization, human capital, natural resources, the effect of ICT's, technological progress and productivity by industry, that allows the analysis and international comparison of Argentina growth's profile.

The research takes into account international experience on the measurement of economic growth profile and productivity: WORLDKLEMS, EUKLEMS, OECD, Instituto Valenciano de Investigaciones Económicas (IVIE), ASIA-KLEMS, LA-KLEMS, BEA, BLS, ERS-USDA, CSLS and recent economic literature on measurement of productivity and sources of growth.

Special features of Latin America and Argentina have been considered: Natural Resources (Agricultural Land and Subsoil assets), Public Infrastructure, Non Observed Economy (NOE), Informality and Segmentation in Labor Markets, Economic Cycle and Crisis effects on productivity performance, among others.

2. METHODOLOGY OF ARKLEMS DATABASE 3.0
(preliminary brief version)

2.1 Work packages

The methodology of ARKLEMS+LAND update is based on previous experience of the research team on KLEMS measurement, National Accounts and Input-Output Matrix in Argentina, taking into account the methodology and data sources cited in CEPAL (1991), PNUD-BIRF (1992), SNA Ar (1999), MIP97 Ar (2001), Coremberg (2002, 2008, 2009, 2010, 2011).

The project takes into account the research of Dale Jorgenson, EUKLEMS, IVIE, OECD and other institutions that establish the international standards of methodology, measurement, and analyses of Source of Growth and Productivity.

Special issues are taken into account, according to the characteristics of Argentina and of other developing countries: informal labor market, natural resources intensity and volatile behavior of GDP cycle.

In this version, the variables are measured according to the methodology that is briefly presented in this section[1].

All the components of growth are measured by Tornquist Index.

Output:

Tornquist volume index of gross value added and value of production by industry at producer prices by. In the future, the ARKLEMS will try to measure these variables at basic prices.

Capital services:

The approach of EUKLEMS (2007) (2009) based on the aggregation of capital assets by user costs at industry level is followed. The measurement includes more than 80 different types of assets at a very detailed level: from dwelling units, transport equipment, machinery, public and private non-residential construction, other agricultural assets as livestock and silos[2]. The update 3.0 version of Net Capital and Capital Services takes into account a revision of the previous version of database according to the Economic Census 2004 and partial results of Population Census 2010, and the updates of other registers. The estimation of ICT capital services followed a methodology detail in box 1 in order to secure international comparability of the series.

[1] A complete methodology report is presently being prepared by the ARKLEMS researchers. An exhaustive previous version is Coremberg (2009)
[2] This detail will be presented in future revisions of the database.

Box 1: Methodology of ICT services in Argentina

The estimation of the contribution of ICT to economic growth and especially to productivity growth involves important assumptions and methodological decisions. Solow (1987) has declared with a certain pessimism that "*the influence of computers is seen everywhere except in the productivity statistics?* [3]

The impact of technological progress incorporated in the ICT implies an improvement of quality not always captured by official price indexes, generating a potential underestimation of physical volume growth of this type of capital good and therefore negatively biasing its contribution to growth, hindering the intertemporal and international comparisons of investment and capitalization rates in ICT assets.

Some developed countries (United States, France, Canada, Germany), following the SNA93 recommendations have performed hedonic[4] adjustments to ICT prices, imputing changes in quality to physical volume indexes.

However, in several developing countries (and also in developed countries) no adjustments of this kind are performed to their statistics and their national accounts.[5]
For this reason, the economic measurement literature recommends the "price harmonization method" which consists in imputing the changes in ICT prices adjusted by quality from US official indexes to the economies under measurement, adjusted by changes in relative prices and exchange rate. This was the methodology adopted by EUKLEMS Project to obtain homogeneous measurement of productivity in Europe and in the United States. This project tried to attain the international harmonization in the measurement of ICT investment and stock.[6] [7]

In Argentina, the National Accounts use this price index but they specifically use the aggregate price index for imported capital goods, this is why, the ICT investment at constant prices is underestimated and also its contribution to growth. These goods have a negative trend in their prices which is greater than the average price of the rest of the capital goods.

In this paper, it was chosen to apply the "price harmonization method" by each ICT type imported to Argentina[8] allowing the intertemporal and international comparability

[3] Known as Solow Paradox
[4] And some equivalent cases like "matching models"
[5] Initially, because of the high cost that the construction of TIC hedonically adjusted prices index implies, given the need to maintain a continuos price statistics essentially heterogeneous, with frequent model and attributes changes.
[6] The International price and quantity statistics in Argentina, as well as in other countries which are net importers of ICTs, choose to adopt the so called International prices methodology (similar to the price harmonization method) which consists in the use of export price index of capital goods from the countries import origin (due to the lack of international homogeneous capital goods indexes) for all types, implying an hedonic adjustment of imported capital goods for the special case of ICT, if the suppliers use this kind of methodology.

[7] For an overview of this methodology see Wikof (1995), Colecchia and Schreyer (2001), Schreyer (2002), Mas and Quesada (2005), Van Ark and Timmer (2006) and EUKLEMS methodology in EUKLEMS (2007).
[8] This work considers as TIC asset the Computers, telecommunication equipment and software (own estimation).

of ICT investment and capitalization intensity and the quality adjustment of ICT contribution to the Argentinean economic growth.[9]

Natural Resources:

ARKLEMS+LAND includes a measurement of Agricultural Land and Subsoil Assets, taking into account the outstanding impact of these assets in Latin-America and their natural competitiveness advantage of natural resource intensive sectors.

According to Schreyer (2001), the exclusion of any input or factor that grew less than the other observerd measured inputs provoked a downward bias of measured TFP, as the author cited for the case of land in OECD countries, which is not considered a produced asset by the national accounts.

According to the ARKLEMS estimations, natural capital in Argentina grew less than the rest of inputs (land at moderate rate and subsoil assets at negative rate), so the measurement of natural capital services allows obtaining a measure TFP without this negative bias.

Box2: Estimation of Natural Resource Input in Argentina

The non-produced economic assets contribute with their services to the production process in those sectors intensive in their usage. The payments for the use of land are the rent of land (income due to resource ownership). In principle, the value of natural resources' productive services should be reflected in the price of those assets, since just like any other asset, the price should represent the present value of productive services that it provides. Likewise, not all the non-produced assets have market prices which enable their valuation. This could be the case of mineral deposits.

At International level, though there is no agreement at SNA93 level related to the methodology of valuation of non produced wealth and its productive services, there are several measurement experiences which should be taken into account when one tries to measure this type of assets for the Argentinean case. These methodologies involves taking market prices for the valuation of an asset or imputing expected net present value of the provided future services.

The valuation methodology of agricultural land used in the present work is the following: crop areas were valued for cereals, oil crops, industrial crops, fruits, vegetables and pastures. These were disaggregated in 136 different crops through the updating of official data. The prices correspond to marked prices quoted by the main sector real estate agencies with a database which disaggregates the country's total surface of agricultural land in approximately 150 counties classified according to location and size[10].

[9] As a result of these adjustments, Argentina presented an important dynamism in its TICS investment intensity, going from 12% in 1990 to 5% in 2006, though this level is lower than the levels presented by OECD countries such as USA (18.5%), UK (20.1%), Australia (13%), Portugal (11.5%) or even Spain (7%).

[10] This methodology permit to obtain the wealth value of land without recurring to apply net present value (NPV) assumptions. For a measurement of land following NPV at international level, see World Bank (2005), (2011).

The contribution of agricultural land to economic growth is given by the growth of planted land, weighted by the share of agriculture land rent in total Argentinean GDP. This rent was estimated using the rent/value ratio of agricultural land with the same disaggregation and source as the valuation of its wealth, taking into account OECD recommendations (2008)[11].

In the case of soil deposits, most of them do not have market prices. The Australian Bureau of Statistics as well as Statistics Canada and the World Bank (2005) recommend, in the absence of market prices, the valuation of resources by the expected net present value rents criterion, by extraction cost or by use cost.
In the Argentinean case, soil assets were valuated taking into account the existing oil and gas reserves and mineral deposits according to official data, through the constant income present value method suggested by the World Bank (2005), given that these assets do not have market prices, taking as discount rate or opportunity cost, the return of produced capital and the expected exhaustion time of the reserve, according to the reserve/ production ratio per type of asset.

The contribution of mineral reserves to economic growth, as in the case of agricultural land, results from the growth of reserves or deposits (according to official data) weighted by the share of mining rent in aggregated GDP. The rent of mining assets was calculated discounting the gains generated by the fixed assets in the mining sector (imputing the average rate of return to the sector's stock of capital estimations) of gross global operating surplus in the mining sector.[12]

Labor Input:

The unit measure is Hours worked, weighted by labor composition, according to the consistency and compilation of income generation accounts, based on Household Surveys, Employment Register and Population Census, adjusting number of workers and labor income by non observed economy effects (NOE).

Labor Composition Change:

The change in labor composition is captured by the Tornquist aggregation of hours worked by group: gender, experience, education, occupational categories and industry, following the experience of BLS, EUKLEMS and IVIE according to the original proposition by Dale Jorgenson[13].

Besides education and other personal characteristics of labor, this research includes occupational categories classification (registered employees, non-registered employees and self employed workers) of labor force allows analyzing the impact of informal labor, outstanding issue in Latinamerica, in the contribution of labor input to GDP and labor productivity growth. In this way, every other source of relative wages

[11] In fact, the user cost f agriculture and farming land is being estimated by the exogenous method known as "rental equivalent" OECD 2008.

[12] The results were made consistent comparing the resulting rent to the estimated resource value, resulting rent ratios (or user cost) of the resources for Argentina. (Equivalent to the sector's WAC rates according to experts in the mining and oil sector.

[13] Jorgenson, et.al. (2005), BLS (1993), Schwerdt and Turunen (2006), EUKLEMS (2007), Coremberg (2010a).

changes distinct from relative productivity of workers based on their skills (labor unions, regulations) could be captured in this measured and discount from residual TFP.

Total Factor Productivity:

As it is shown below, TFP is obtained as the difference between the Tornquist variation of valued added and the weighted contribution of every input. According to the issue of unstable economic cycle behavior of Argentina and other developing countries, ARKLEMS identifies pro cyclical factor utilization effects (labor intensity and capital utilization), ascribing them as short-run productivity gains.

The strict TFP version shown in the tables presents the residual TFP adjusted by factor utilization and quality change of labor input in the input side. The apparent TFP is the residual TFP without any adjustment of factor utilization and labor composition change.

2.2 Source of Economic Growth in Natural Resource and Unstable Economies

The exhaustive growth accounting which enables to identify a country's main sources of growth results in the following equation[14]:

$$\frac{d\ln Q}{dt} = \varepsilon_{K_{TIC}} \frac{d\ln KP_{TIC}}{dt} + \varepsilon_{K_{NTIC}} \frac{d\ln KP_{NTIC}}{dt} + \varepsilon_{K_{RN}} \frac{d\ln KP_{RN}}{dt} + \varepsilon_{L}\left(\frac{d\ln L^{Q}}{dt} + \frac{d\ln H}{dt}\right) + \frac{d\ln A^{S}}{dt} \quad (1)$$

were Q is GDP, KP are the services of productive capital[15], L^Q represents labor composition change[16], H represents employment (hours worked), A is total factor productivity (TPF) or strict Solow residual[17], ε_i represents product elasticity of each primary input and the sub index i: ICT, services of ICT capital, NICT, capital services of no ICT and RN, capital services of natural resources, L is labor input[18].;

Labor productivity dynamism is the weighted result of changes in capital intensity (capital services per hour worked), human capital and TFP:

$$\frac{d\ln Q}{dt} - \frac{d\ln H}{dt} = \sum \varepsilon_{K_i}\left(\frac{d\ln KP_i}{dt} - \frac{d\ln H}{dt}\right) + \varepsilon_{L}\frac{d\ln L^{Q}}{dt} + \frac{d\ln A^{S}}{dt} \quad (2)$$

[14] It is relevant to point out than no constant returns to scale in the production function are imposed. The only assumption made is that A represents an index of Hicks neutral TFP (Stiroh (2002)).
[15] The services of productive capital were estimated taking user costs by asset type as weights instead of asset prices following the usual methodology, presented in OECD(2001) (2008) and Coremberg (2008)
[16] Also called labor quality effect or human capital services by not only personal attributes but also adjusted by the jobs characteristics.
[17] This paper follows the methodology presented in Coremberg (2008) in order to identify strict TFP, positive movements of the production function sustainable in the long run, in the sense of including in the inputs, the effects of quality, composition and factor utilization. The discount of the effect of utilization enables to identify the cyclical gains in productivity that is not sustainable in the long run. See Bernanke & Parkinson (1990) and Basu, Fernald & Shapiro (2001). In any case, several apparent TFP paths are presented, where the factor contribution is alternatively adjusted by factor utilization and labor quality, being the strict TFP adjusted by both effects.
[18] In order to capture the composition and substitution effects, all the factor and the GDP are estimated according to the Tornqvist formula as it is usual in the measurement literature OECD (2001), EUKLEMS (2007).

$$\sum \varepsilon_{K_i} = \varepsilon_K$$

Given that ε are a non- observable variables, with the aim to do the growth accounting, as Solow has demonstrated (1957), one generally resorts to the Euler conditions assumptions of constant returns to scale and perfect competition. This makes the ε equivalent to the α, the share of factor remuneration in GDP, enabling to measure sources of growth approximating equation (1) through the following equation:

$$\frac{d\ln Q}{dt} = \bar{\alpha}_{K_{TIC}} \frac{d\ln KP_{TIC}}{dt} + \bar{\alpha}_{K_{NTIC}} \frac{d\ln KP_{NTIC}}{dt} + \bar{\alpha}_{K_{RN}} \frac{d\ln KP_{RN}}{dt} + \bar{\alpha}_L \left(\frac{d\ln L^Q}{dt} + \frac{d\ln H}{dt} \right) + \frac{d\ln A^S}{dt} \quad (3)^{19}$$

However, as it was mentioned before, the ε could be greater than 1 if for instance ICT, the Human Capital and the Natural Resources have an externality effect on growth, above their factor income[20].

On the other hand, independently of externalities, the problems in input measurement and capturing, as Abramovitz (1956) and Grilliches (1996) have pointed out, can cause biases in their contribution to growth, when they are not correctly adjusted by quality effects, biasing TFP[21].

The implementation of equation (3), using α as weights, as it is done in this paper and in all the non parametric literature, necessarily causes the capture of externalities in the measured TFP.

If the measured TPF would turn out to be reduced or negative, it could be an alternative symptom of two phenomena: the non existence or macroeconomic irrelevance of factor externalities, or its reduced utilization by the economy.

2.3 Industry Origins of Productivity Gains

The disaggregation of TFP at industry level is very important for the diagnosis of a country's economic growth profile. The productivity gains or losses at an aggregate level could be the result of a significant heterogeneity due to idiosyncratic differences in the characteristics of firms within sectors and to differences sectors that could be explained by productivity differentials.

According to the previous analysis, the economy's growth sustainability requires that a great share of the gains in productivity have their origin in what we have called strict or net TFP: continuous and permanent improvements in the production process organization, that is to say, that the economy takes advantage from the quality of inputs improvements, externalities, increasing returns, as well as optimal input and output reallocation across industries, instead of productivity gains originated in cyclical or temporary phenomena.

[19] An analogous procedure can be followed with equation 2 for the practical implementation of the measurement of labor productivity sources.

[20] For a more exhaustive discussion on the discrepancies between the ε and the α, see OECD (2001), Stiroh (2002), Coremberg (2008).

[21] As pointed out by Mankiw, Romer and Weil (1992) or Romer (1986) or Hulten and others (2005) for the case of human capital. Just like the way we will analyze in the following section; the lack of consideration of Human Capital as a capital asset, not measuring R&D as an asset and not measuring other intangible capital goods, results in the actual inclusion of their contribution in Solow's residual.

In this case, taking into account a broader definition for sustainable economic growth, it is necessary that production structure maintains the improvements in aggregate productivity of the economy.

In that sense, it is not only important that aggregate productivity gains are generated as a result of a more efficient resource allocation within every industry but also that aggregate productivity gains have their origin in the specialization of the economy in more dynamic and efficient sectors.

In broader sense, for sustaining long run growth, it is necessary that these sectors should generate significant externalities, increasing returns, complementarities, etc. to the rest of the economic sectors, with the capacity to maintain the living standards, profits and productivity continuously in the long run (dynamic efficiency).[22]

A consistent aggregation of TFP of different economic sectors is the methodology presented in Jorgenson, Gollop and Fraumeni (1987) and extended in Jorgenson, Ho, Samuels and Stiroh (2007). This methodology demonstrates that departing from the growth accounting equation (3) set out for each industry j, where in addition to the primary inputs, intermediate inputs are included:

$$\Delta \ln Y_j = \overline{\alpha}_{K,j} \Delta \ln K_j + \overline{\alpha}_{L,j} \Delta \ln L_j + \overline{\alpha}_{X,j} \Delta \ln X_j + \Delta \ln A_j$$

Y: output
X: Intermediate inputs
$\overline{\alpha}_{i,j}$: Geometric mean of input weights in output value

Aggregating by industry, it can be demonstrated that aggregate TFP results in:

$$\Delta A_T = \sum \frac{\overline{w}_j}{\overline{v}_{V,j}} \Delta A_{T,j}$$

This equation links the changes in industry TFP with aggregate TFP. The weight reflects the ratio between the shares of sector value added in GDP w_j and each industry's value added coefficient $v_{vj,}$ that in practice results in the so called Domar weights: the ratio between industry output and GDP, which are typically greater than 1[23].

In this way, the methodology shows the fact that improvements in sector TFP can be due to the sum of two factors: a direct effect on industry output and an indirect effect generated by the productive linkage when the output from one sector is sold to other industries. When the indirect effect is not taken into account, there could be a bias in the sector TFP contribution to aggregate TFP growth.

[22] See Timmer and Szirmai (2000), Ocampo (2008) and Pérez (2007).
[23]. Jorgenson, Gollop and Fraumeni (1987) and Jorgenson, Ho, Samuels and Stiroh (2007) present an extended version of the equation, where the terms "reallocation" are added. However, as in Jorgenson and Stiroh (2000) present for the US case, as well as in their estimation for Argentina, these terms were not significant.

3. ARGENTINA GROWTH PROFILE

This section analyzes the main results of the growth accounting according the suggested methodology. First, the main results for the aggregate accounting are presented.[24].

3.1 Introduction

In the last two decades, Argentina has experienced several structural changes in a context of strong economic instability and important modifications in the macroeconomic regime which had an impact in the sustainability of long run growth.

The structural reforms which were implemented at the beginning of the last decade[25], initially generated an apparent important rise in the productivity of the Argentinean economy, even when the adoption of convertibility exchange regime and the increase in foreign capital inflows caused a significant real appreciation of the domestic currency, generating a high deficit in the current account.

In fact, it was expected that a set of input and industry phenomena originated in the implemented economic regime, which continue at present, would generate sufficient productivity gains so as to maintain and sustain long run growth.

The increase in the quality of investment, especially through the incorporation of ICT assets in the production process, the improvement human capital, the rise in productivity of agricultural land and the greater dynamism of the service sector were one of the main fundamentals which would enable to maintain and improve the profitability and productivity of not only the tradable sectors (of which services are one of the main cost components) but also of the whole economy

However, the macroeconomic regime of the nineties did not achieve the expected results in terms of sustainability of growth.

The economic crisis which took place at the beginning of the 21st century showed the internal weakness of the Argentinean economy, caused by the inconsistency of the economic policy ("twin non-sustainable deficits).

It revealed an extensive growth path which until that time was based on short run factor accumulation and utilization rather than on permanent productivity gains in terms of improvements in the organization of the production process, which could take advantage of the improvements in the quality of inputs and could enhance the productivity gains in the tradable sectors, favoring not only sustainable growth but also sustainable external equilibrium.

[24] The periods which have been chosen for the analysis are the positive initial phases of the lasts two economic cycles of the Argentinean economy: 1990-1998: corresponds to the positive initial phase of the convertibility plan, after the 80's lost decade until the end of the Tequila effect), the recovery after the negative shock till 1998 when the slump period (1998-2002) began by the devaluation of brazilian real and 2002-20010 (last available year for the present economic cycle) the present macroeconomic inward development regime, 1998-2010: enables the comparison between the maximum level of GDP local (2010 is the last available data). The graphs showing the contributions also include an analysis of the 1990-2001 and 1990-2010 period which correspond to periods of market and convertibility economic reforms of the past decade and of the entire period being analyzed.

[25] Exchange rate convertibility regime and real appreciation of the domestic currency, external trade and financial openness, privatization, deregulation and concession of public services, etc.

The new economic policy regime inherited from the 2002 crisis based on high real exchange rate (also known as "competitive exchange rate") and the recovery of commodities' prices, especially of agricultural and farming goods, in whose production Argentina has a competitive advantage, enable the resurgence of economic growth.

One of the expected phenomena was that this new macroeconomic regime would be sustainable in the sense that it would not only generate important trade surplus but also it would sustain them as permanent productivity gains in the tradable sectors with a significant influence in the productivity of the whole economy.

The current reversion of the world's economy growth cycle and of international prices' trend casts doubt on whether the Argentinean structural productive profile is sustainable in the long run.

The main background research can be found in Coremberg (2008) and World Bank (2008) and the papers which have preceded it. One of the main conclusions of the above mentioned paper, based on aggregated growth accounting, is that Argentina had an extensive growth profile between 1990 and 2004 based on factor accumulation and on short run cyclical productivity gains which were unsustainable in subsequent periods, with insufficient generation of long run productivity gains (Strict Total Factor Productivity). However, in that paper, the role of ICT and natural resources is not studied, neither is the human capital explicitly incorporated and there is no analysis on the industry origin of productivity

This paper extends the analysis of sources of growth presented in Coremberg (2008) and Coremberg (2011), to the 1990-2010 period, gives more details on methodlogy and incorporates ICT, Human Capital, Natural Resources and industry origins of productivity gains to the identification of Argentina's economic growth profile. This is achieved thanks to the own estimation recently issued in Coremberg (2009b) of the capital stock, Labor Quality and TFP by asset type and industry, with special emphasis in the measurement methodology suggested for each source of growth[26].

This paper aims at identifying the changes in Argentina's growth profile through an exhaustive growth accounting analysis at industry and aggregated level. It takes into account the main recommendations from recent economic literature in terms of the analysis and the measurement of the main sources of growth.

One of the main findings of the suggested methodology is that in spite of the significant improvements in the quality of its factors and important productivity gains in tradable sectors, the whole economy has not profited from them, revealing a scarce magnitude of long run productivity gains. (Strict TFP)

In analytical terms, this paper tries to identify whether the potential existence of externalities from special inputs such as human capital and ICT as well as the productivity and efficiency dynamic effects from non tradable sectors in the past decade and tradable sectors and natural resources intensive industries in the present decade, have been able to sustain the economic growth in long run productivity gains.

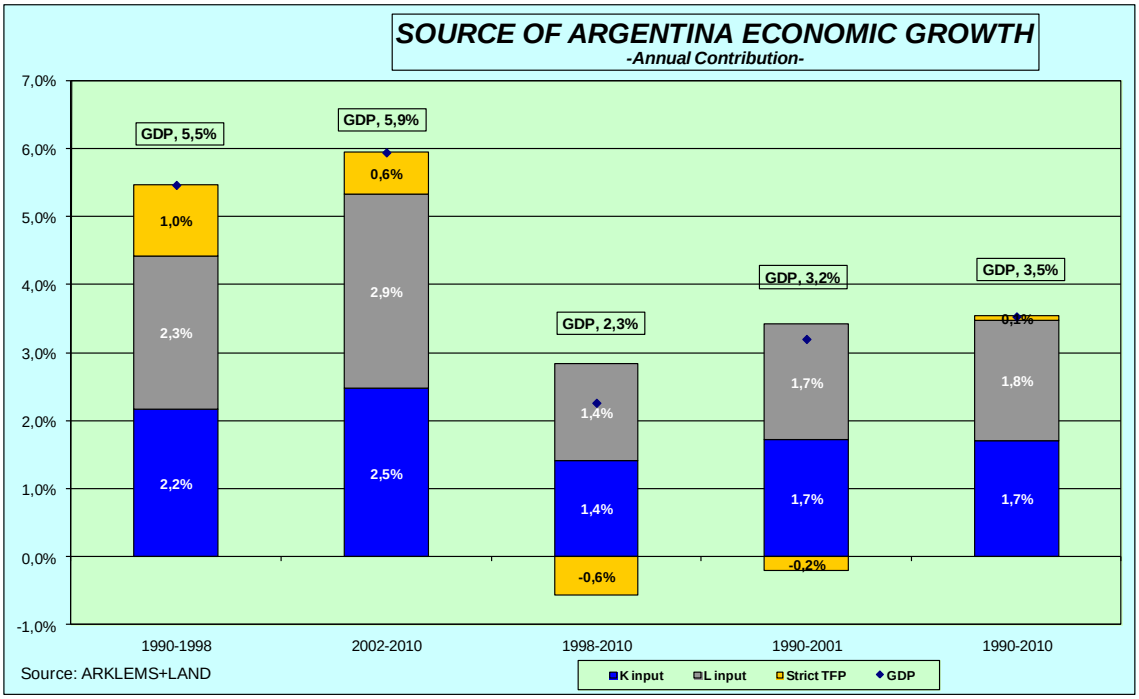
[26] At present, the author is updating own estimations of Argentina Source of Growth database up to to 2010 (ARKLEMS). As cited by the main international institutions and researchers, from 2007, private analysts estimate that CPI inflation has been considerably higher. The authorities have established a board of academic advisors to assess these issues. Private analysts are also of the view that real GDP growth has been significantly lower than the official reports since the last quarter of 2008.

3.2 Aggregate Source of Growth

Taking into account the aggregate methodology, economic growth profile in Argentina was an extensive type mostly driven by accumulation of factors.

As it is shown in the following figure, Argentina`s economic growth was driven by productive factor contribution for 1990-2010 periods and between cyclical peaks[27].

FIGURE 1



Both primary inputs explained equally this factorial contribution.

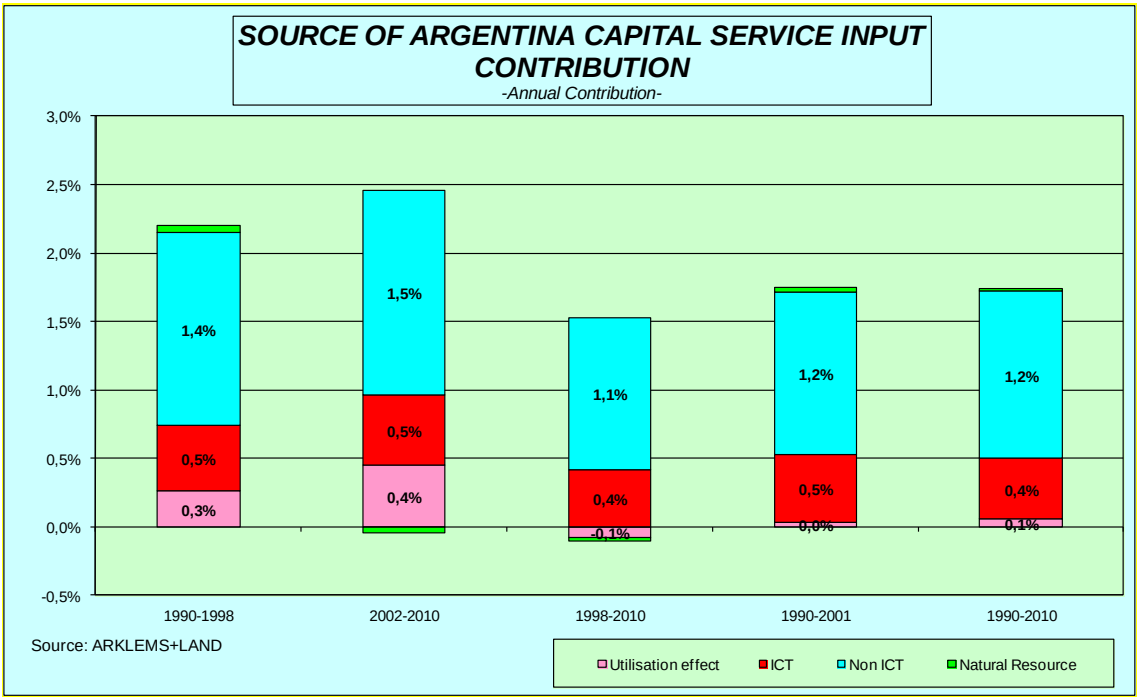
The extensive growth profile was confirmed by the strict TFP performance. Sustainable TFP (adjusted by input utilization and labor quality) has shown a negative trend during the same periods.

Strict TFP changes show a positive sign only during positive phases of economic cycle, but it halved during the present boom in comparison to the previous boom during the 1990's decade.

As it was explained above, the contribution of capital input was measured as capital services taking user costs by asset type as weights. This capital services contribution could be disaggregated in the contribution by assets type and utilization effects, as it is shown in the following figure:

[27] Capital input contribution to growth is given by the growth weighted sum of services provided by non ICT capital, TIC capital and natural resources and its utilization effect. The labor factor contribution to GDP growth results as a consequence of the growth in the amount of jobs, labor intensity (utilization effect) and labor composition effect.

FIGURE 2



Non ICT Capital was the main asset which contributed to the dynamic of capital services.

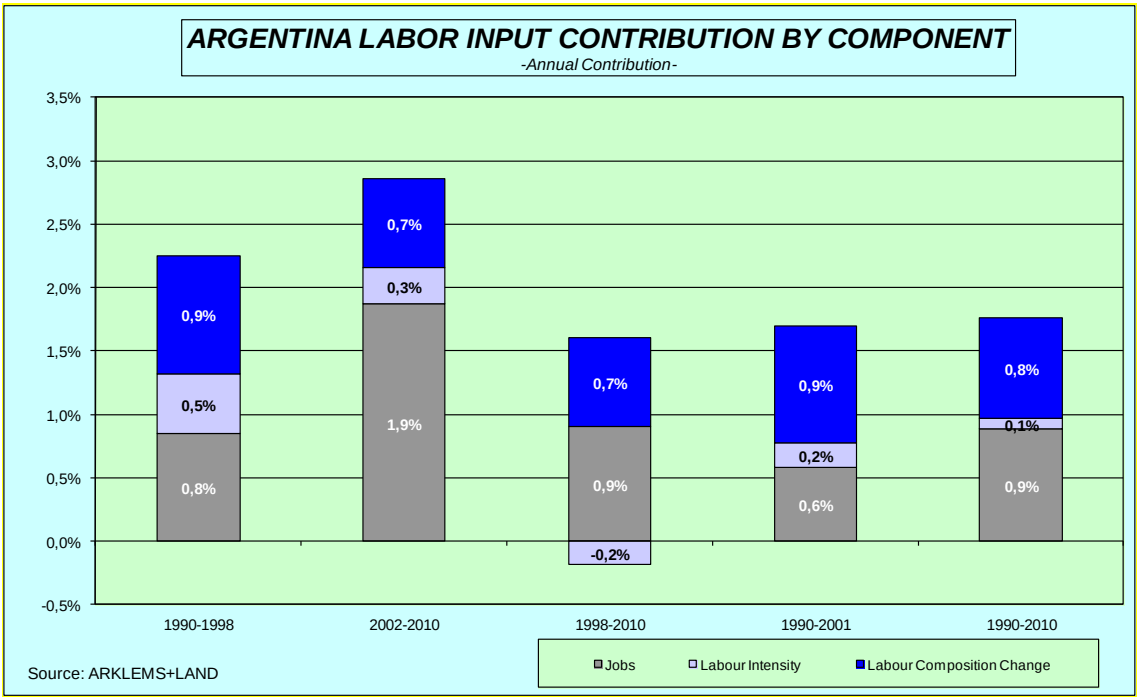
The utilization effect has a role during recovery and recession phases of economic cycle being more important during the more recent one (2002-2010), but not necessarily between cyclical peaks as it is shown in the previous figure.

ICT capital input contributed with 20% of GDP growth.

In addition, the greater user life (non-existent depreciation in the case of non-produced assets) and the real capital gains due to changes in asset prices (to a lesser extent) are the reasons explaining the substantial reduction in the importance of construction and natural resources in productive capital and inversely in the case of ICT productive services.

Labor input explained nearly half of the factor's contribution to GDP growth independent of the period, but its composition was very different by subperiods as it is revealed in the following figure:

FIGURE 3



Between GDP cyclical peaks, during Convertibility Period (1990-2001) and total period (1990-2010); labor input contribution was explained equally by labor quality and by net jobs creation[28].

But the performance of labor input and its composition were very different during the positive phases of GDP cycle under consideration.

Labor input utilization proxied by labor intensity has an important role only during the turning points of the economic cycle, being its contribution nearly equal between both positive phases.

Labor input contribution was higher during the post2002 crisis than at the beginning of the 1990's, mainly because net job creation was nearly the double of the previous decade. But, labor composition change during the post2002 period was less than the previous positive phase.

This difference is mainly due to the effect of labor hoarding and returns to skills behavior.

During the initial phase of the economic reforms implementation in the previous decade, net job creation substantially diminished causing an important increase in unemployment. Likewise, this phenomenon of the lower labor demand growth caused a significant change in the labor structure, which was orientated to retaining skilled workers (labor hoarding)[29].

At the same time, the returns to skills, education and experience, improved during the 1990's because of a skill-biased technology change effect. The latter was

[28]This paper follows Davis, Haltiwanger and Schuh (1997) concepts, Net job creation equal is the difference between jobs creation and job destruction.
[29] See Bernanke and Parkinson (1990).

due to increases in technological change embodied in the imported capital goods, which had an impact on human capital demand as a complementary input[30].

The subsequent recovery 2002-2010, was generated with a substantially higher real exchange rate and therefore with lower labor costs than in the previous decade, encouraging the increase in labor demand for less skilled workers, who had lost their jobs in the previous decade.

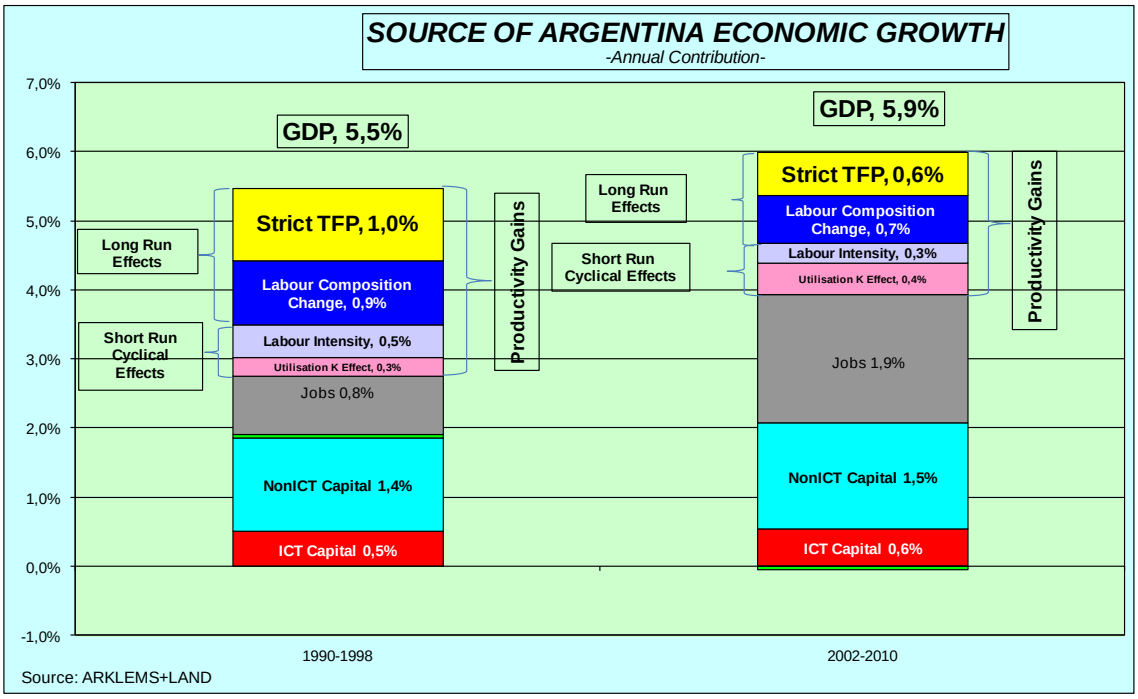
This phenomenon provoked a less dynamic labor composition change, even though the weight of registered employment began to increase after 2004.

Moreover, the positive labor composition effect during 1990's could be ascribed, as it is cited before, to a skill-biased technology change effect of the trade openness in favour of more educated workers but the reason of the positive effect during the current macroeconomic regime could be the moderate increase of wage gap in favour of formal labor force formalization of the labor force, more than wage gap in favor of educated workers.

The importance of the recovery effects on productivity and growth could be seen in the following figure where the growth profile between the last two positive phases of economic cycle is compared.

The following figure puts all inputs by type together allowing the analysis of GDP growth patterns: factor accumulation, input quality improvement, apparent productivity gains disaggregated by cyclical productivity gains and sustainable productivity gains (strict TFP):

FIGURE 4



[30] The analyses of these important phenomena exceed the space of this paper but it could be inferred that the important capital imports growth during the last decade could generate a skill biased technological change in the sense of Acemoglu (2002).

The comparison of economic growth performance the last recently recoveries during shows a moderate similar performance.

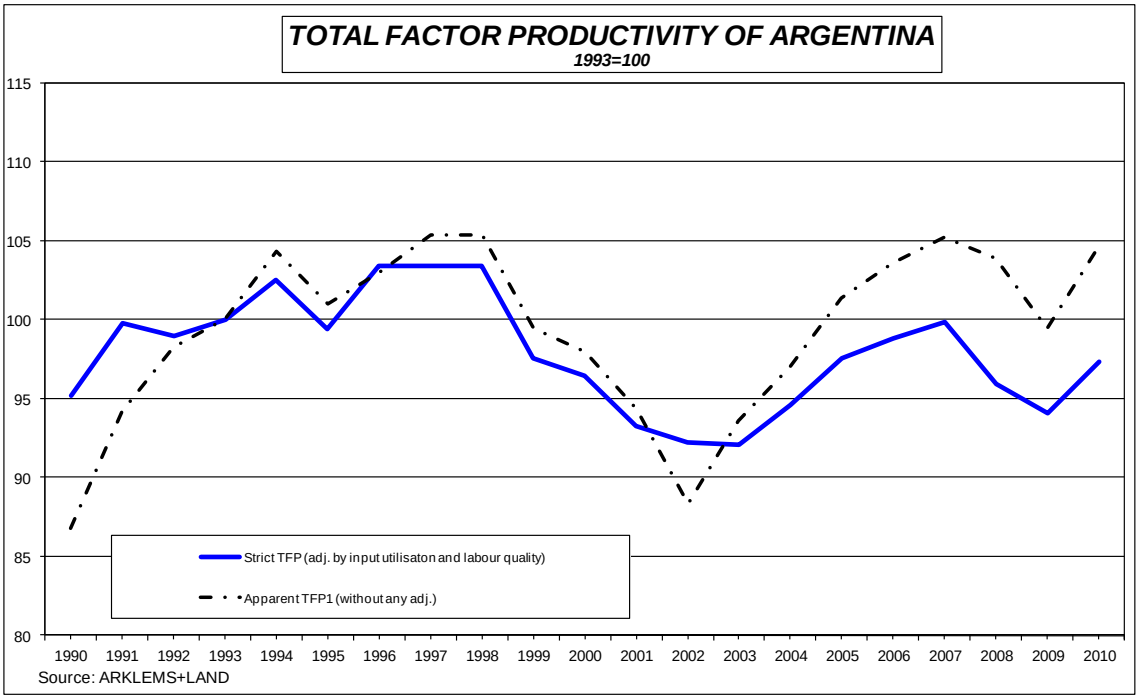
But, as it was shown before, between cyclical maxima, 1998-2010, the activity level grew at a moderate rate 2.3% per year, mainly explained by the contribution of primary inputs.

Economic growth has an extensive growth profile. It is almost explained by factors accumulation. Nearly half of the productivity performance is explained by short run phenomena as changes in utilization of inputs.

The net or strict TFP, once inputs are adjusted by factor utilization and labor composition, shows a positive but moderate growth during the recovery of the 1990's and at half rate during the present economic resurgence.

The significant cyclical contribution of factor utilization to GDP economic cycle can be verified in the TFP dynamic which is less pronounced if no adjustment by input utilization or labor composition is made, as the following graph shows:

FIGURE 5



In other words, apparent TFP gains were explained mostly by short run fluctuations during the recovery periods.

Sustainable long run productivity gains (strict TFP) explain only the rest, having a negative trend between cyclical peaks.

It is worth mentioning, that after the crisis the strict TFP is showing a lower trend than 1990's decade showing some kind of asymmetric and hysteresis effect of the 2002 crisis and post-political economy effect on the efficiency of the economy[31].

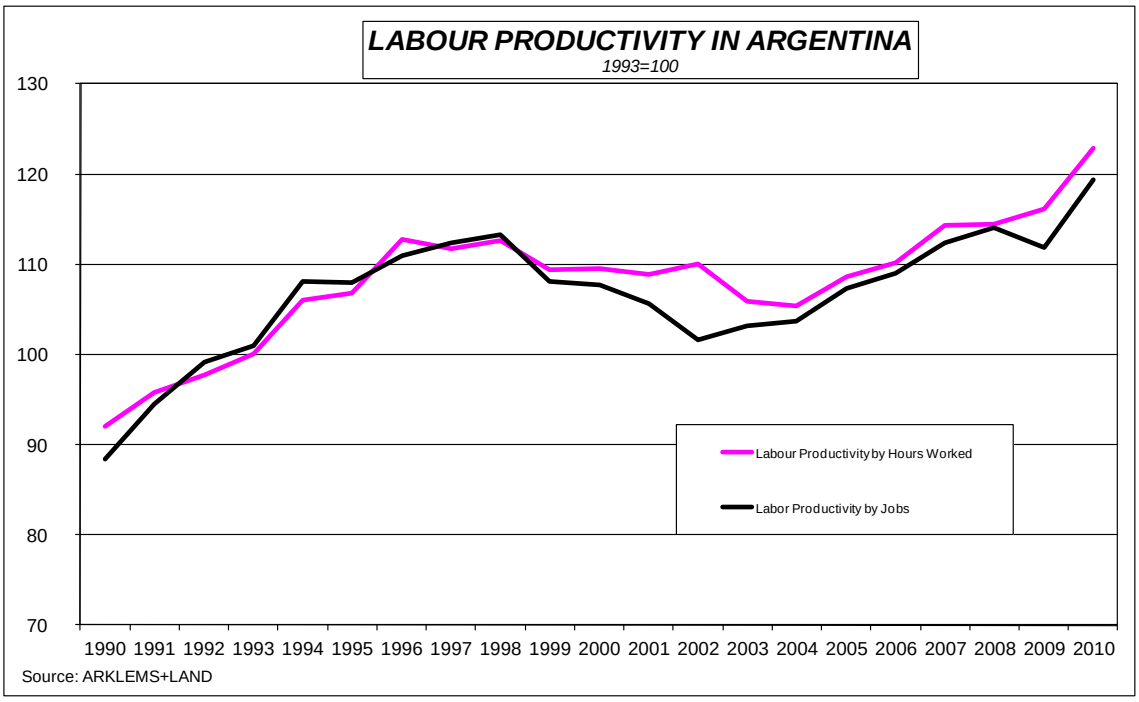
[31] See Gopinath and Neiman (2012)

3.3 Aggregate Source of Labor Productivity Growth

Now the objective is to analyze the main components of labor productivity growth during the period analyzed in this paper.

According to the following figure, labor productivity presents a positive trend in to the whole period (1% average annual growth) for both types of labor input, being the performance during the positive years of Convertibility the most dynamic subperiod.

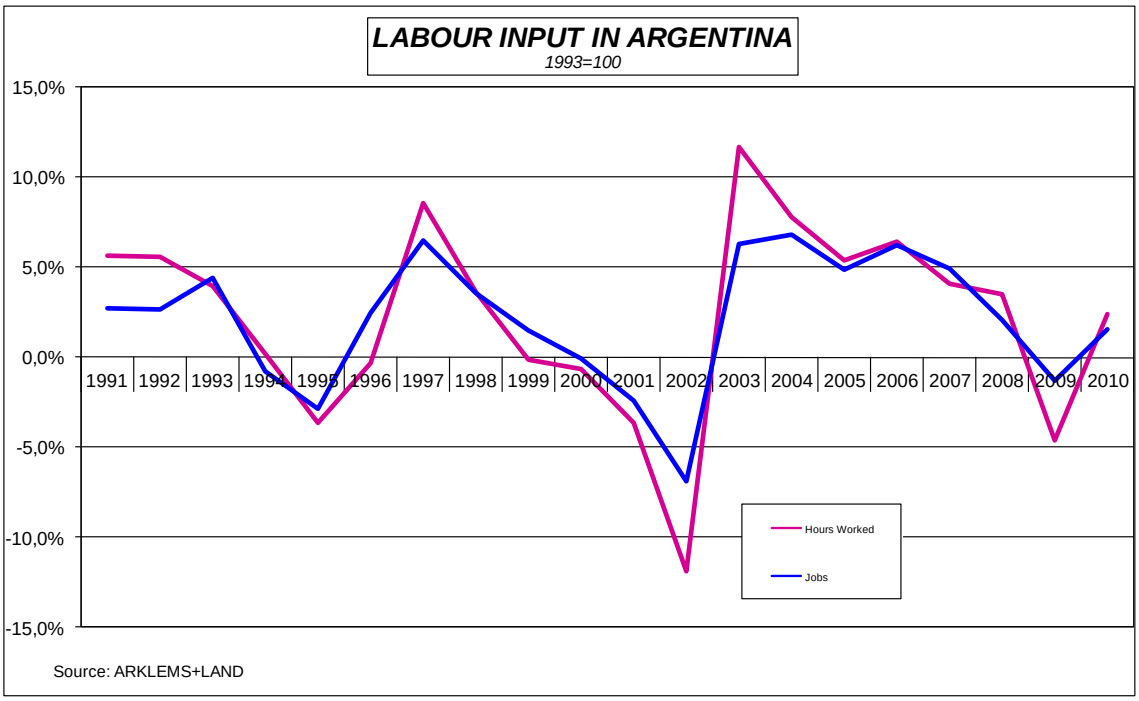
FIGURE 6



Both indicators of labor productivity exhibit procyclical behavior, but as one can expect the performance of hourly productivity has been more procyclical than the job indicator.

This effect is a consequence of usual procyclical labor intensity (hours/jobs) due to more flexibility of hours worked than in the jobs indicator. As it is shown in the following figure.

FIGURE 7

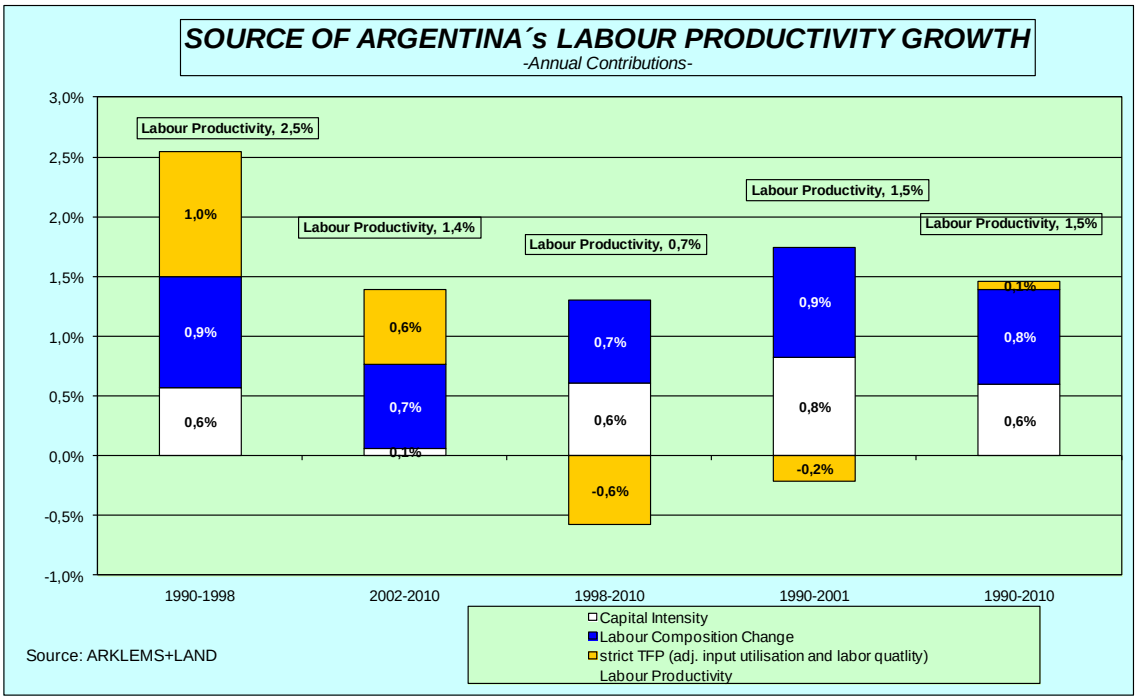


But what are the main drivers of labor productivity during the Convertibility Plan and “Competitive Exchange rate Regime”?

According to their main source, is labor productivity dynamics sustainable in the long run?

The main conclusions about the source of GDP growth repeat themselves for the labor productivity case.

FIGURE 8



Labor productivity grew at a very moderate rate between cyclical peaks; the negative trend of strict TFP was exactly compensated by the contribution of capital intensity. So the slowly labor productivity growth is almost explained by labor composition change.

Argentina generate improvement in the quality of labor and jobs but, there is a TFP slowdown at the same time. As it is analyzed by Azariadis and Drazen (1990), human capital could be wasted.

4. INDUSTRY ORIGIN OF ARGENTINA'S TFP SLOWDOWN

The previous section analyzed the key aggregate sources of growth and labor productivity performance of the Argentinean Economy from the productive factors point of view, in terms of quantity and quality improvements necessary to produce efficiency dynamics and sustainable long run economic growth.

The purpose of this section is to examine sectoral patterns of TFP growth through decomposition of the industry contributions.

This type of methodology allows analyzing two relevant issues in order to obtain some key policy lessons to improve strong productivity performance in Argentina after global financial collapse and sustain long run economic growth.

Which sectors are behind the TFP behavior and indirectly if any industry, incentive by the political economy or relative prices are generating spillovers on the rest of economy?

This section permits to obtain the diagnoses of the productivity slowdown in terms of the sectoral decomposition and type of efficiency of aggregate TFP dynamics during the period previous to global financial collapse necessary to extract some policy lessons to improve and sustain strong future economic growth in Argentina.

The methodology enables the analysis of industry origin of the strict TFP slowdown in the Argentinean economy presented in the previous section.

The studies of the sectoral dynamics of aggregate TFP growth permit to examine the role of the productivity of the main sectors in sustaining long run growth.

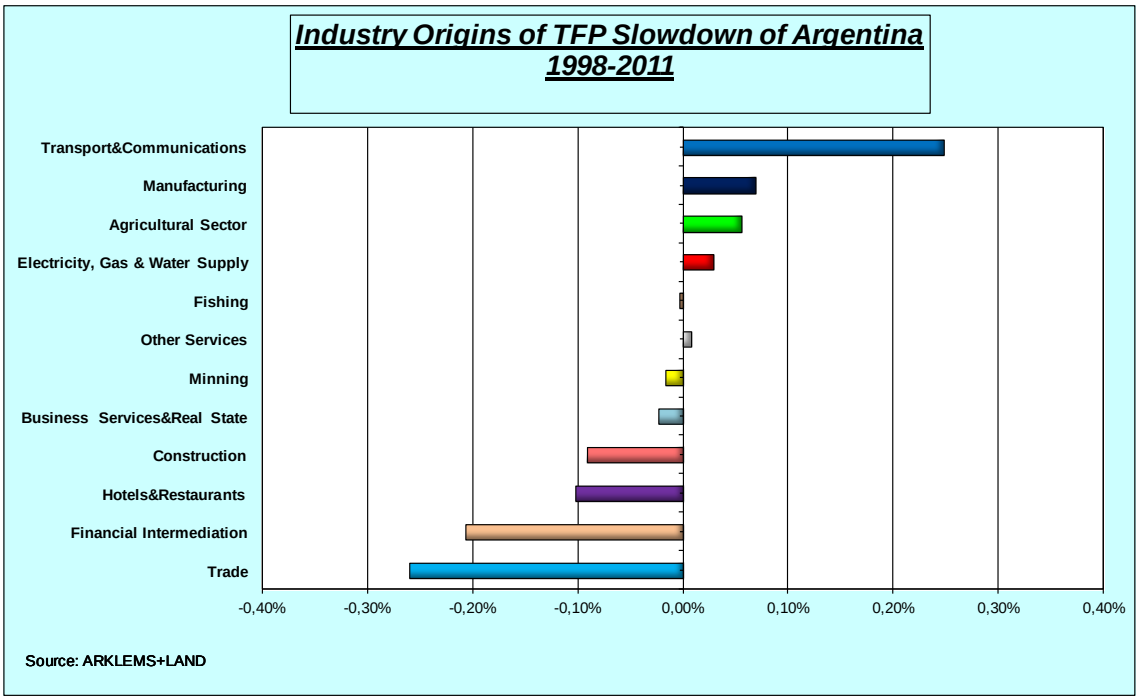
In this case, taking into account a broader definition, for economic growth to be sustainable, it is necessary that the production structure maintains the improvements in aggregate productivity of the economy.

In that sense, it is not only important that aggregate productivity gains are generated as a result of a more efficient resource allocation or improvements within sector productivity but also that aggregate productivity gains have their origin in the specialization of the economy in more dynamic and efficient sectors. These sectors should generate "efficient dynamic effects" in the sense of significant and relevant externalities, increasing returns, complementarities, etc. to the rest of the economic sectors, with the capacity to maintain the living standards, profits and productivity continuously in the long run[32].

As it is shown in the following figure, the aggregate TFP dynamism is originated in a great heterogeneity in industry TFP changes[33]:

[32] See Ocampo (2008) and Pérez (2007).
[33] Aggregate TFP in this section corresponds to the Domar aggregation of sector TFP adjusted by factor utilization. The small differences in its tendency (lower than half percentage point per year) in comparison to the analogous TFP calculated by aggregate accounting presented in the previous section, is due to the exclusion public administration, public education and public health sectors.

FIGURE 9



The negative trend in aggregate TFP between cyclical maxima is mainly due to the negative contribution of non-tradable sectors: private services (trade and financial intermediation, business services, hotels and restaurants) and construction. The positive dynamism of TFP in tradable sector together with transport and communication industry was not enough to generate TFP gains at an aggregate level.

Now the aggregate TFP slowdown could be explained by their industry origin. TFP gains (direct and indirectly through value chain) in manufacturing, transport and communication were not enough to encourage a greater dynamism in the rest of the sectors.

Certainly, apart from GDP cycle phases, the Argentinean economy does not take advantage from alleged efficiency dynamic industries or these sectors do not generate enough externalities, complementarities, increasing returns to the rest of the economy (in spite of real exchange incentives) so as to cause positive sustainable TFP gains.

4. CONCLUSIONS: Growth Strategies and Productivity Performance for Argentina after the global financial collapse

Since 1990, Argentina has shown an important GDP growth, but with high amplitude and volatile performance, following the typical unstable behavior and continuous change in economic policy regimes.

Labor productivity grew substantially, especially during the 1990`s decade, based on factor accumulation and utilization but also on input quality improvement, specially human capital formation and ICT intensity.

Tradable and non tradable sectors were the main industries that contributed to TFP performance in every recovery phase, following the signals of real exchange rate fluctuations. However, the incentives caused by the relative prices were not sufficient to compensate the latent uncertainty about the possible inconsistency of economic policy.

The new economic policy regime inherited from the 2002 crisis based on initial high real exchange rate (also known as “competitive exchange rate”) and the recovery of commodities’ prices, especially of agricultural and farming goods, in whose production Argentina has a competitive advantage, have enabled the resurgence of Argentinean economy.

One of the expected phenomena was that this new macroeconomic regime would be sustainable in the sense that it would not only generate important surpluses in external trade balance but also it would sustain them with permanent productivity gains in the tradable sectors with a significant influence in the productivity of the whole economy.

Despite the increase in factor quality, input accumulation and industries contribution, the performance of sustainable TFP was not very impressive.

TFP has shown a negative trend during the total period and also between cyclical peaks. Strict TFP has shown a positive but with a weak performance during the positive phase of GDP cycle.

As it is shown above, despite the significant TFP dynamism of tradable and natural resource intensive sectors before the recent global collapse, once the direct and indirect effects are taken into account, their contribution to aggregate TFP were not enough to compensate the negative performance of service sectors and to generate significant aggregate TFP gains.

Since 2002 crisis, the economic policy allowed the Argentinean economy to support external and fiscal balances (“twin surpluses) based on taxes on exports, taking advantage from the improvement in terms of trade and currency devaluation.

The ex-post performance of inflation, due to the boom of domestic demand and pressure from foreign inflation in commodities caused a posterior drop in real exchange rate, having a negative impact on competitiveness the Argentinean economy (partially compensated by the appreciation of euro and brazilian real currencies).

Moreover, the current reversion of the world economy cycle casts doubts on the sustainability of the economic growth profile of Argentina.

The present global economic crisis puts high level of uncertainty about sectoral growth strategies in developing countries.

The recent emergence of BRICH, and the role of agricultural and farm global suppliers like Argentina in the global valued added chain are being questioned.

One potential international scenario that Argentina could face in next future, could be an important recovery and growth acceleration of US and EU, that support the prospect of China future growth and then demands on agriculture Argentinean exports.

But it must take into account that one of the particular characteristics that caused many distributional conflicts in the Argentinean society is that exports are made out of land-intensive goods or “wage goods”.

At the same time, agricultural and farming sector played a substantial role in exports dynamic and fiscal revenues.

However, a devaluation of the domestic currency and improvement in agricultural commodities prices necessarily produces a drop in purchasing power of wages, causing the typical distributional conflicts in this type of economy (firstly analyzed by Díaz Alejandro (1963) and Braun and Joy (1968),) which constitute other channels through which a devaluation could have contractionary effects (Krugman and Taylor (1979).

So Price competitive advantage (as a result of devaluation or of terms of trade improvement) could be transitory if they are not support by strong productivity gains that allows increasing agricultural supply, moderating the needs to resort to devaluations and moderate distributional conflicts.

As it was analyzed before, to sustain economic growth of an economy intensive in natural resources, it is necessary to make a structural change or an upgrading towards more dynamic efficient sectors and higher value added in those intensive in non-produced resources.

This means a change towards industries which produce goods with more value added, greater dynamism of their productivity, complementary effects and externalities to other industries of the economy.

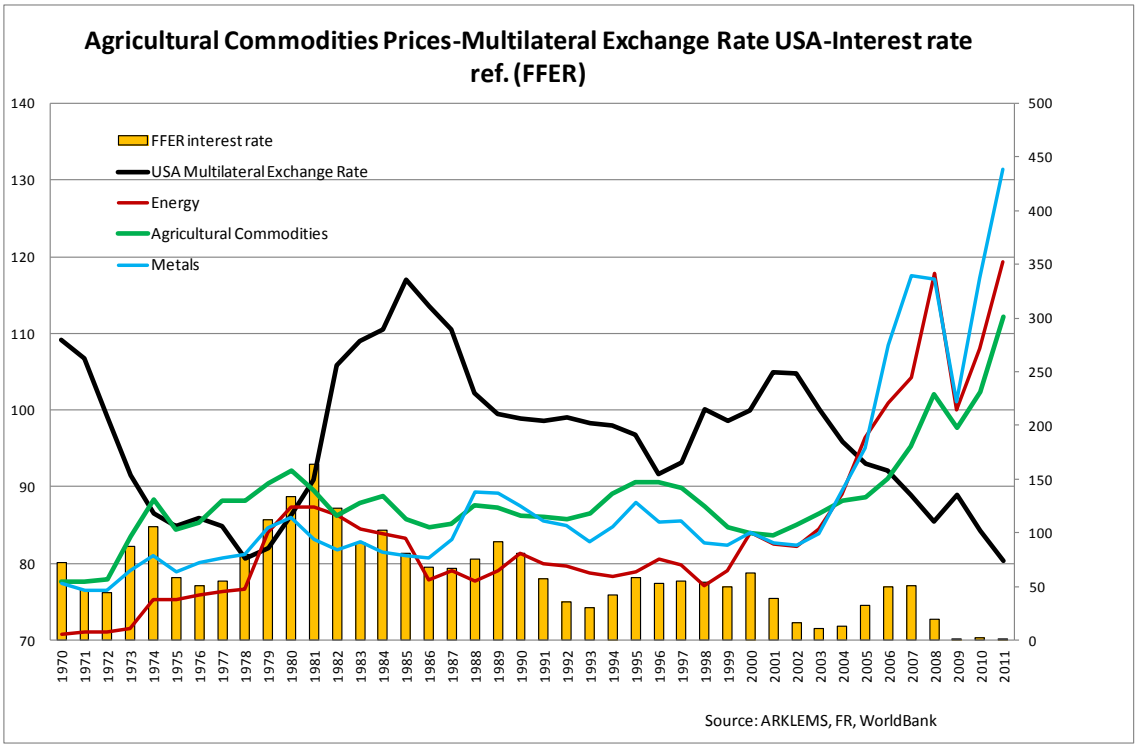
Another scenario that Argentina could show in the following years could be a recoupling of its growth profile to world economy cycle supposing a worsening of the current crisis in developed countries.

In that case, there is a risk of end of the so called financialization of commodities and the boom generated by terms of trade positive shocks.

According to the evidence, Argentina suffers a negative shock in her economy when there is a reversion of monetary policy and crisis in US, as it is shown by the following figure.

The macroeconomic crises of Argentina happened during the same period as US change to a more tight monetary policy: producing a hike in the reference interest rate, an appreciation of the dollar and as a consequence a drop in the agricultural commodity prices. Moreover, there would be a positive correlation between the current positive terms of trade that Argentina faces and the easing of monetary policy in US.

FIGURE 10



Additionally, if the crises in Europe and the sluggish recovery in US continues, there is a chance of a slowdown of GDP growth in the BRICH countries, mainly in China, that could negatively impact on Argentinean exports.

So in the case of reversion of the positive international conditions, Argentina could suffer a very important negative shock, with a high slump of commodities prices

In that case, one alternative (not the best welfare one, but feasible) is to adopt an international negotiations strategy and domestic policy to increase the supply of exports in spite of negative trend in external prices as Argentina did during the crisis of 1930.

But, in order to sustain future strong productivity gains, long run growth and welfare, the Argentinean economy needs to improve productivity in every sector.

Therefore, at the same time Argentine economy makes structural changes towards more dynamic efficient sectors, Argentina should accomplished a technological and human capital upgrading of natural resources intensive industries through significant within industry productivity gains with positive dynamic spillovers to the rest of the economy.

Once the sectoral upgrading has been achieved, more industries (intensive but above all those non-intensive in natural resources) could become exporters of goods with higher embodied technological progress and long run within efficiency gains.

The key variable to sustain this kind of policy is: productivity.

So, "putting relative prices right" or "peaking the leader" policies are not enough to support a growth strategy.

Needless to say that this kind of pro-productivity strategy, which must be conducted through country specific institutions and social safety nets, must be accompanied by macroeconomic stability and consistency in line with the incentives to promote investment and production in every kind of activity.

5. ARKLEMS SERIES 3.0 draft version

The following table presents the main series of ARKLEMS that have been used in this paper.

As it was described above, the series are a preliminary estimation of a complete revision of previous versions of ARKLEMS Source of Growth database for Argentina[34] that will take into account the contribution and analyses of the institutions that support this effort at more highly detail of industry level, and a new version of supply and use tables with the objective to disaggregate intermediate input in energy, material and service inputs.

[34] See Coremberg (2009)

Sources of Growth of Argentina

Volume Indices, 1993=100

	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001
VA Tornquist*	79,71	87,40	94,07	100,00	106,22	103,15	108,54	116,93	122,03	118,38	117,77	112,76
Capital Input	87,51	89,63	95,98	100,00	105,35	107,97	109,34	116,63	121,68	125,09	125,97	126,06
Capital Utilization Effect	94,51	96,79	100,14	100,00	100,46	99,69	96,97	98,88	98,31	97,53	96,34	95,19
KICT	78,55	78,33	87,24	100,00	114,33	122,62	137,87	164,83	198,31	232,58	270,34	292,09
KNICT	93,98	93,97	96,62	100,00	104,18	107,23	110,54	114,77	119,02	121,80	122,66	123,54
KNR	95,22	96,46	98,19	100,00	103,71	107,51	115,54	113,86	114,11	117,43	117,05	116,83
Labour Input	78,37	85,53	94,17	100,00	102,21	99,97	100,99	110,26	115,05	117,89	118,56	116,19
Labour Intensity Change	94,86	97,59	100,47	100,00	100,94	100,14	97,37	99,38	99,47	97,84	97,30	96,04
Jobs	94,09	96,68	95,75	100,00	99,23	96,40	98,78	105,22	108,96	110,60	110,50	107,87
Labour Composition Change	90,44	93,60	97,82	100,00	102,04	103,52	104,89	105,51	106,25	109,01	110,34	112,18
Apparent TFP**	86,74	94,16	98,22	100,00	104,30	101,02	103,02	105,33	105,38	99,45	97,99	94,32
Strict TFP***	95,19	99,76	98,96	100,00	102,53	99,39	103,44	103,37	103,39	97,56	96,44	93,23
Potential Aggregate Capital Services	92,49	92,50	95,85	100,00	104,89	108,30	112,64	117,92	123,70	128,16	130,62	132,27

Preliminary Estimates

Source: ARKLEMS + LAND DATABSE 3.0 1st preliminary estimation

* value added tornquist at producer prices, volume indices

** unadjusted

**Adjustment by input utilisation and labor composition

KICT: ICT Capital

KNOICT: Non ICT Capital

KNR: Natural Resources Capital

Sources of Growth of Argentina

Volume Indices, 1993=100

	2002	2003	2004	2005	2006	2007	2008	2009	2010
VA Tornquist*	100,58	108,53	116,44	126,28	136,15	146,99	152,29	147,37	159,65
Capital Input	115,61	122,28	124,82	129,37	135,73	146,14	159,92	160,73	170,43
Capital Utilization Effect	90,17	96,26	97,01	97,52	97,49	97,49	99,26	95,82	96,63
KICT	252,83	239,96	248,69	279,53	315,28	383,34	458,69	517,93	601,25
KNICT	121,12	120,64	122,35	126,51	131,51	140,13	150,01	156,06	164,83
KNR	114,05	112,79	111,06	103,81	109,48	113,91	115,70	112,13	107,26
Labour Input	102,85	114,57	123,99	133,20	144,46	153,26	161,92	157,53	163,71
Labour Intensity Change	91,24	96,19	97,08	97,58	97,72	96,91	98,26	94,99	95,80
Jobs	100,42	106,72	114,03	119,61	127,10	133,36	136,16	134,42	136,54
Labour Composition Change	112,66	112,31	112,82	115,09	117,44	119,80	122,37	124,70	126,57
Apparent TFP**	88,34	93,60	97,01	101,38	103,58	105,23	103,89	99,46	104,64
Strict TFP***	92,22	92,09	94,56	97,56	98,80	99,83	95,92	94,04	97,33
Potential Aggregate Capital Services	128,28	127,02	128,68	132,69	139,25	149,92	161,35	167,75	176,45

Preliminary Estimates

Source: ARKLEMS + LAND DATABSE 3.0 1st preliminary estimation

* value added tornquist at producer prices, volume indices

** unadjusted

**Adjustment by input utilisation and labor composition

KICT: ICT Capital

KNOICT: Non ICT Capital

KNR: Natural Resources Capital

Sources of Labour Productivity Growth of the Argentine Economy

Volume Indices, 1993=100

	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001
Labour Productivity	92,07	95,76	97,72	100,00	106,05	106,85	112,76	111,79	112,59	109,37	109,52	108,87
Capital Intensity	101,56	98,31	99,78	100,00	105,18	111,62	113,39	111,20	111,96	115,25	116,81	121,18
Capital Utilization Effect	94,51	96,79	100,14	100,00	100,46	99,69	96,97	98,88	98,31	97,53	96,34	95,19
KICT	91,77	86,49	91,11	100,00	113,22	125,35	140,43	153,93	176,89	205,31	237,55	264,80
KNICT	109,19	103,20	100,45	100,00	103,93	110,77	114,48	109,35	109,41	112,09	113,60	118,66
KNR	110,62	105,99	102,11	100,00	103,48	111,03	119,37	107,78	104,17	107,29	107,65	111,46
Labour Composition Change	90,44	93,60	97,82	100,00	102,04	103,52	104,89	105,51	106,25	109,01	110,34	112,18
Strict TFP***	95,19	99,76	98,96	100,00	102,53	99,39	103,44	103,37	103,39	97,56	96,44	93,23

Preliminary Estimates

Source: ARKLEMS + LAND DATABSE 3.0 1st preliminary estimation

**Adjustment by input utilisation and labor composition
KICT: ICT Capital
KNOICT: Non ICT Capital
KNR: Natural Resources Capital

Sources of Labour Productivity Growth of the Argentine Economy

Volume Indices, 1993=100

	2002	2003	2004	2005	2006	2007	2008	2009	2010
Labour Productivity	110,08	105,89	105,38	108,59	110,12	114,38	114,50	116,07	122,94
Capital Intensity	125,56	118,12	111,39	109,42	107,79	111,64	118,26	124,31	128,80
Capital Utilization Effect	90,17	96,26	97,01	97,52	97,49	97,49	99,26	95,82	96,63
KICT	260,16	217,76	209,25	222,69	235,65	272,26	311,76	364,34	409,97
KNICT	131,36	116,29	109,23	107,13	104,62	107,07	110,68	120,28	123,98
KNR	122,91	107,94	98,19	86,39	85,62	85,58	83,97	85,31	79,48
Labour Composition Change	112,66	112,31	112,82	115,09	117,44	119,80	122,37	124,70	126,57
Strict TFP***	92,22	92,09	94,56	97,56	98,80	99,83	95,92	94,04	97,33

Preliminary Estimates

Source: ARKLEMS + LAND DATABSE 3.0 1st preliminary estimation

**Adjustment by input utilisation and labor composition

KICT: ICT Capital

KNOICT: Non ICT Capital

KNR: Natural Resources Capital

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