The Fourth Industrial Revolution and the Future of Work in Argentina

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About CIPPEC

(Center for the Implementation of Public Policies Promoting Equity and Growth) is a non-profit, impartial independent organization that produces knowledge and offers recommendations to design and implement better public policies. Its mission is to propose policies pursuing development, equity and the strengthening of democracy.

Its policies also aim to anticipate future dilemmas through applied research, open dialogues and supporting governance.

"The best way to predict the future is to invent it"

Alan Kay

The Fourth Industrial Revolution and the Future of Work in Argentina[1]

I. On the verge of a new technological revolution

The world is undergoing a significant transformation with few precedents in history. Taking advantage of previous improvements in Information and Communication Technologies (ICTs), a set of new technologies (artificial intelligence –AI-, internet of things –IoT-, smart sensors, 3D impression), seems to be changing the way we produce, consume, trade, and of course, the way we work (Schwab, 2016).

In this new technological revolution, known as "The fourth industrial revolution" (4IR), production processes are changing due to the emergence of digital economy – i.e. goods which are made of bits rather than atoms- and its merge with the already known physic and biological worlds. Under the 4IR a new order is emerging with reconfigurations in at least three axes: humans vs. machines; production of goods vs. value creation through services; and finally, elites vs. crowds as knowledge generators. In all these cases the latter factor is displacing the former factor, threatening the status quo: machines are increasingly substituting humans not only in ordinary tasks but also in more complex cognitive activities, the digital economy acquires dynamism in comparison to traditional manufacturing, and information and knowledge is increasingly generated in a collaborative manner (McAfee and Brynjolfsson, 2017).

Three aspects of this structural change allow us to understand the magnitude of future challenges. First, technology's pace of change seems to be faster than in former technological revolutions like the steam machine at the end of XVIII century, the electricity at the end of XIX century, and the ICT revolution the past decade (see Skilton and Hovsepian, 2018). Second, the revolution has just started and most of these technologies were rarely known a decade ago (Winblad, 2017). Third, this group of technologies are general-purpose technologies (GPT) which means that they are widely used, they have a lot of applications in different sectors, and they generate large spillover effects to the rest of the economy (Bresnahan and Trajtenberg, 1996).

How will the 4IR affect labor markets? Will machines recreate completely the cognitive activity of humans, as Norbert Wiener believed seven decades ago at the beginning of Artificial Intelligence? Or is there still a place for humans in the production process?

1 The authors want to thank Lucía Ribichini, Juan Delich, Alejo Sorrentino, Patricio Larroulet, Caterina Brest López, and Pablo Carreras Mayer for their collaboration in the organization of the TFG's workshop and in the preparation of this document.

The answers to these questions are hard to come by. On the one hand, there is a lot of uncertainty. Because of its incipient nature, the speed of change, and their multiple and wide applications, it is difficult to know the 4IR's impact on economic and employment patterns in the medium and long run. On the other hand, history shows that technological revolutions are periods of economic divergence, where some countries were able to fully absorb the new inventions and technologies while other lagged behind. Thus, if history serves as a guide, the impact of technology on the future of work is likely to diverge across countries. Demographics, factor endowments, gender and informality gaps, and the existence (or not) of key complementarity factors will all shape the race between technology and skills, making it highly idiosyncratic.

II. Likely impacts on labor markets: the global narrative

We can organise the global discussions about future of work in the 4IR by taking into account three main topics.

The first one refers to the relation between automation and employment. As well as in former technological revolutions, in the 4IR the idea that we are facing the obsolescence of a great part of the workforce is widespread (Mokyr et. al., 2015). Therefore, some analysts think that "technological unemployment", that worried Keynes back in the 1930s, could well be a reality in the near future, especially if we analyse the main features of the 4IR. Most importantly, goods traded are mostly of a digital nature, meaning that once a good is developed, to produce more units of it has no additional cost. The possibility to make perfect copies simultaneously and at near-zero marginal cost has substantial consequences on labour markets as it threatens traditional productive processes associated with standardized production based on extensive use of labour in routine tasks (Rifkin, 2015). So, the first question that arises here is: To what extent automation could result in job losses?

The second point to think about future of work concerns labour conditions. On one hand, technological change boosts the group of firms that lead the innovation process, which are now the major producers of digital assets (e.g. Google, Amazon, Facebook and Apple). Hence, a switch in income distribution that benefits new capital forms at the expense of payments to traditional capital and labour is to be expected (Autor et. al., 2015; Autor et. al., 2017). Complementarily, as a large proportion of new technologies are labour saving, the immediate effect is a shrink in real wages. On the other hand, technological change also threatens other aspects of traditional labour contracts such as social security benefits and the stability and length of job contracts (Dregryse, 2016). The expected rise in the demand of independent workers and short-term labour contracts –a reality known as gig economy- sets the need to redefine 20th century labour institutions (Sundararajan, 2016). Then, the second doubt we face is: Which is the future of real wages and traditional labour relations?

Last but not least, we have to pay attention to the evolution of inequality and income gaps in labour markets. Technological change is not usually neutral in terms of skills demand (Acemoglu, 2002). Instead, it tends to favour workers who have skills complementary to new technology, which improves their productivity. It is difficult to identify the specific skills that will lead the 4IR, but it is clear that

they will tend to be biased towards three broad groupings: general cognitive knowledge, specific knowledge associated to new technologies, and socio-emotional skills. Then again, profits from technological change will be unequally distributed among workers according to their skill profiles, with the subsequent negative effects on wages of workers with outdated skills (McAfee and Brynjolfsson, 2014). At the same time, new technologies have the potential to mitigate income gaps and inequalities in several disadvantaged labour market sectors. For instance, women and young people might benefit from digital innovations that enable them to bridge the gap leapfrogging strategies (World Bank, 2016). The last question then is: Will 4IR technologies increase or reduce actual gaps in the labour market?

In this uncertain context, a global narrative regarding how will these new technologies shape future labour markets is reaching consensus (See IMF, 2018 and Blit et.al, 2018).

According to it, the widespread adoption of cheaper and more intelligent machines and the proliferation of new forms of capital (mostly of an intangible nature) will indeed disrupt labour markets through two mechanisms. First, new employment opportunities will be created among the tasks that complement and increase the power of these technologies. These comprehend both entire sectors –as software- and specific activities throughout all sectors –like design and commercialization-. Both employment and relative wages should increase in these economic activities. Second, new technologies will threaten jobs that involve tasks that became obsolete as a result of the adoption of cheap technology. This will impact on entire sectors and jobs along the economy. Both the level of employment and relative wages related to this kind of jobs are expected to fall. Trajtemberg (2018) distinguished between these two forces associated with the new GPT as those which "enhance human capabilities" on the one hand, and those which "substitute human capabilities", on the other.

It is still difficult to know specifically which jobs will disappear thanks to the 4IR (ILO, 2017). We cannot either anticipate its general impact on employment and welfare. Nonetheless, the narrative goes, historical evidence suggests that in the long-term the positive effect is greater than the negative one. Therefore, in the long run both employment and real wages are expected to grow due to technological change. Excess of workers in jobs where GPT is expected to replace human tasks could be absorbed by an increased labour demand in activities where GPT makes humans more productive. Even if this transformation seems to go beyond previous revolutions, threatening high skilled workers, its impact should be similar to earlier disruptions. Therefore no big job losses are expected, but working hours might decline leaving more time available for the consumption of leisure. Indeed, nothing different from former technological revolutions (Fogel, 2004).

Where deep changes are expected is in labour relations. Work in the future will be framed around more flexible frameworks, and employer-employee relations will tend to be more sporadic. That is why 20th Century labour institutions (unemployment insurance, minimum wage, social protection) should be substantially modified; otherwise they will be useless.

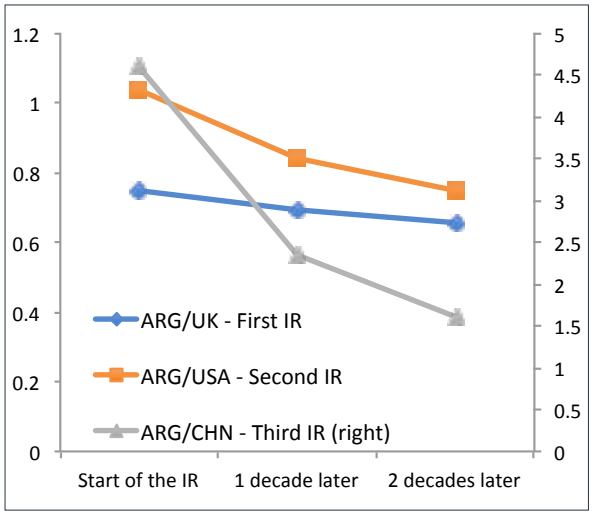
Summing up, according to this narrative, negative impacts of digital transformation on labour markets will be temporary - except for traditional labour institutions obsolescence. A new equilibrium will be eventually attained, based on a full absorption of new technologies and the complete acquisition of the relevant skills. Meanwhile, as it happened during former revolutions, there will be a race between technology and skills, that is, between the adoption of new technologies and the reskilling of the workforce (Goldin and Katz, 2008)[2]. In these race frictions between supply and demand of labour will appear, and this may reflect in rising income inequality and increased political tensions.

2 In the World Development Report 2019 (World Bank), this race is define as "automation vs. innovation", the first one reducing jobs and the second generating them. See World Bank (2018)

Finally, the global consensus has something to say about public policies. What can we do to seize the opportunities offered by the 4IR and minimize its costs? Public policy can make a difference by investing in labour force reskilling. It is therefore necessary to redesign the compulsory education curricula, reform systems of technical and vocational education and training (TVET) and develop schemes for life-long learning. It is also important to implement policies to address the problem of widening income gaps and other technology-induced inequalities. Taxing robots, online platforms and big data owners, and implementing a universal basic income are the most cited examples of this kind of policies (Van Parijs and Vanderborght, 2017).

III. Building a narrative for Argentina

From a developing country's point of view, this narrative presents some pitfalls. Particularly, it doesn't seem to fit the way that former global technological revolutions and economic development interacted in the past. History shows that times when GPTs emerged were also periods of large increases in income, productivity and welfare gaps between countries, with the consequent emergence of winners and losers at the global level (Pritchett, 1997). What is it that losers share? As Douglass North stated in his Nobel Lecture: "Societies that get "stuck" embody belief systems and institutions that fail to confront and solve new problems of societal complexity". In our case, the inability to seize the benefits of the 4IR is related to low levels of absorption of the new ideas and technologies, both by firms and workers. The evidence of the relative performance of Argentina in past technological revolutions supports this hypothesis: we tended to lag behind (Figure 1).



Graph 1. Argentinean GDP per capita relative to the most dynamic country in each industrial revolution.
Source: The Conference Board

Would it be different this time? Should we get on the wave of "technologic anxiety" that the developed world is experiencing nowadays? Or should we first ask to what extent are we –firms and workers in developing countries- prepared to adopt new technologies associated with the 4IR in the first place? Who will win in each case? Who will lose? There are so many questions to be addressed that it is difficult to find a simple answer.

Therefore, a first step to start building an answer is to contextualize technological change. That is, to build a narrative about the 4IR and jobs incorporating the main characteristics of the argentine economy[3]. To achieve this, CIPPEC performed a foresight exercise on the future of work in Argentina under a 10-year time horizon (2030).

3 The idea of adjusting the global narrative about future of work to the developing countries contexts could be found also in ILO (2017), AfDB et al. (2018) and Schlogl & Sumner (2018).

Foresight exercises in a nutshell

What is a foresight exercise? A foresight exercise is an outside-the-box thinking tool which is used when a region, nation or organization finds itself facing a future challenge whose characteristics are not defined clearly. The rationale for each individual foresight exercise may therefore differ. Thus, the objectives of these kinds of exercises are wide, and its usefulness is large for different sectors and organizations:

• Informing and discussing policy-making so that decisions taken by key actors in the commissioning body are more aware of longer-term developments and how these are liable to interact with current policy decisions.

• Building networks that bring together people from different sectors and institutions involved with shaping the future of a particular topic. The foresight exercise is key to help them better understand the challenges and opportunities that they are liable to confront, and the strategies and objectives that they should pursue.

• Developing capabilities throughout a region or organisation and encourage a "foresight culture". The aim is that people with a variety of backgrounds should be able to define and embark in their own foresight activities and to create their own networks.

• Building strategic visions and creating a shared sense of commitment among foresight participants.

Often a foresight exercise will be stimulated by the need to take a particular decision and to face a variety of daily and particular issues such as:

• Formulating long-term national and regional programmes.

• Setting research priorities, matching investment opportunities to produce new knowledge with social and market requirements.

• Planning major public spending programmes with long-term implications (e.g. infrastructure, education or heath).

• Defining the strategy of a company, industry or public sector.

• Coping with transition in the economic or political system.

• Improving long-term competitiveness within a certain territory.

• Dealing with changes in the socio-economic framework (new markets, new legislation, etc.)

The foresight exercises constitute a collective, interdisciplinary and systematic reasoning process that seeks to develop a vision or narrative understood as possible future scenarios that we can reach (or avoid) through current activities (Georghiou, 2008). It is neither the objective to predict the future nor to reveal it as if it was predetermined. The aim is to help build the future through better knowledge of prevailing tendencies and other potential drivers of change (Figure 1). The exercise assumed that upcoming changes will not be incremental but of a disruptive nature, opening opportunities and representing threatens that are not easy to identify from a diagnostic based on the current state of affairs.

How to assess how the future will be given all the uncertainties involved? The future may be clouded with uncertainty, but signals of future developments can be identified and analysed. These are manifestations of change that can already be identified and projected reasonably well into the future.

Obviously, there are many ways to develop a foresight exercise. Foresight usually draws on both quantitative and qualitative approaches as they provide distinctive inputs to the analysis of the problems being dealt with. Our exercise was based on a qualitative method, because they are often employed when key trends or developments are hard to capture using simplified indicators, or when such data is not available. In addition, various forms of

Figure 1. The lemma underlying our exercise: to help build the future through better knowledge. Taken from "Back to the Future Part III".

creative thinking are encouraged by creativity methods. Thus, in this specific case, qualitative characteristics prevail, although quantitative data was required to determine, or rate, topics to be considered in more detail.

Our exercise

CIPPEC carried out a foresight exercise of this sort for a joint project with collaborators from India and South Africa financed by the EMSD. Trends and disruptions were analysed and a set of four scenarios were developed. These scenarios represent alternative "pictures" of how our medium-term future may look like. They were developed in a systematic and analytical fashion, devising several stages to guide the though process. Implications for jobs and skills and associated required policies were afterwards drawn from this analysis.

During the workshop, men and women from the business community, labour unions and civil society together with academics of different areas (history, economics, education, political sciences, among others) thought about possible and different future scenarios in Argentina, discussing about what kind of actions should be necessary in order to achieve the best possible world in the near future. See Appendixes 1 and 2 for a detail of the workshop participants, the groups they participated in, and a short bio of each member.

Why to perform this activity? As we mentioned before, a global narrative about technological change and the future of work is emerging. It states that technological innovation will be pervasive across the world, and the impacts on labour markets will be deep but largely transitory. Will the future of work look the same everywhere? On the one hand, evidence points to developing countries lagging behind in terms of technological diffusion and the re-skilling of their current and future workers. This could exacerbate development gaps with respect to advanced countries as has happened after previous technological revolutions. On the other, structural factors that are country-specific —such as demographics, factor endowments, and gender gaps— may cause new technologies to have different impacts on labour markets.

The exercise comprised three steps or stages. In the first one, the main tendencies and factors of change likely to affect Argentina and the world in the next ten years were analysed. During the second stage, four different scenarios about how will the world be in terms of growth and employment were created in a collective fashion. Finally, based on previous analysis on tendencies and scenarios, the participants proposed and discussed public policies and actions that must be conducted to reach the best possible future.

In the first phase we discussed key global tendencies that would likely affect labour markets in the future. These are changes that occur slowly but once they are fully unveiled they have deep long-term impacts on the economy. The macro-trends analysed were: changes in the technological frontier, demographic transitions, changes in geopolitics (e.g. the rise of Asia), cli-

Pictures 2a and 2b. Participants discussing macro-tendencies and its likely impacts during the first exercise.

mate change, and resource depletion[4]. These trends took into account evidence-based developments that allow for a relatively confident assessment of their future states.

With this in mind we defined alternative scenarios –or possible futures- subject to the evolution of two main trends: (a) the adoption and diffusion of new technologies by firms, and (b) the acquisition of 4IR-related skills by workers[5]. In a nutshell, our own race between technology and education[6].

To simplify the analysis, in both cases we considered two possible developments, a "positive" one and a "negative" one[7]. A positive performance in terms of technology adoption and diffusion by firms implies an accelerated adoption of new technologies associated with the 4IR, while a negative scenario involves a poor diffusion of these technologies throughout the economy. On the other hand, a successful acquisition of skills by workers means a full and generalized re-skilling of the population that enables the workforce to perform newly and non-automated tasks, while the negative scenario implies partial re-skilling of workers. The conjunction of these two possible paths results in four alternatives worlds, which we will comment in the next section.

Finally, having discussed the different possible scenarios that Argentina could face, participants proposed possible ways to act in order to achieve the best economic and social situation in the near future. Policy ideas –to be mentioned and described below- were based on the necessity of adapting present institutions to the coming world but bearing in mind that technology's impact and the future of work might not look the same everywhere.

4 The macro-tendencies mentioned here are similar to those ones described in foresight studies with the same time horizon. See for example UKCes (2014), DIB(2016) and PwC(2017).

5 WEF (2018), in its foresight exercise about future of work in 2030 highlights three main factors for the scenario building, two of them similar to those took into account in our exercise: technologic change rate and skills and knowledge evolution. The third factor was talents mobility.

6 Scenarios are based on key factors, i.e. factors that have a significant influence on the issue examined and its future development. The concept of key factors is used to reduce complexity by examining a large number of parameters (actors, challenges, trends, etc.) and then selecting those which are the most relevant. This process often begins with environmental scanning, in which numerous parameters determining trends in the environment are identified, systematised, and classified –as was done in the first stage-. The choice of key variables was based on three attributes: potential impact, its uncertain evolution, and the public policy ability to shape them. This was also useful to do a comparison with the global narrative discussed above.

7 For more details see Appendix 4.

IV. Results

The Megatrends

As mentioned above, the first exercise of our activity consisted in discussing key trends that would likely impact on labour markets. From this analysis some relevant conclusions emerged regarding opportunities and challenges for Argentina (for more details see Appendix 4):

• **Global technological change:** new technologies associated with artificial intelligence (AI), machine learning and Big Data will modify consumption, production, and intermediation patterns worldwide, resulting in an increasing role of machines in activities previously reserved for humans. In the next ten years the change will be greater in consumption than in production where many technologies are still in an experimental phase-. Jobs in manufacturing sectors with low and medium productivity are those most threatened by automation. The largest chunk of new opportunities will appear –basically in services- as open-code technologies are generalized and their large spill-over effects are spread through the system (as a result of network effects). Data will be a keystone, being the main input for the operability of the economy. Exchanges will occur mainly through digital platforms, most of them exclusively dedicated to business-to-business (B2B) exchanges. New forms of intangible capital associated with digitalization –like reputational capital- will play a central role in monitoring enterprises and maybe citizens too.

• **Demographic trends:** in developed countries population ageing and relative scarcity of working-age population will encourage technological innovation and put pressure on social institutions. In developing countries more advanced in the demographic transition, like China and Brazil, similar pressures are to be expected, and the incentives for automation will rise as a consequence. Meanwhile, countries lagging in this transition –as India, Indonesia and Nigeria- will experience the demographic bonus, which is why a growth model based on low wages could be a good option for them.

• **Changes in global power:** developing countries will take a central role in terms of global growth. China will be the neuralgic trade and finance centre, while India and other emerging countries will be relevant too. Income convergence in Asia together with demographic changes, will lead to a strong expansion of the global middle class –recreating the path followed in the last years-. Protectionism and nationalism could be a response from countries that lose their position and benefits.

• **Climate change and non-renewable resources:** the main negative effects of climate change will be felt in the long term. In spite of this, some tendencies will become effective in the next decade. Climate events like droughts or heavy rainy seasons could be more frequent. Furthermore, the global economy will move gradually to a de-carbonization of its activities, directing its efforts to the achievement of a more sustainable energy matrix based on renewable sources.

These trends are related to each other. As we mentioned above, one of the main forces behind automation is demography. Developed countries are investing in new technologies in order to diminish the costs of productive processes in a context of an increasing labour scarcity (Acemoglu and Restrepo, 2018). Likewise, climate change effects will depend critically on technological innovation that allows, for example, capturing the carbon dioxide from the atmosphere (Wagner and Weitzman, 2015). The use of non renewable resources will be bound by population growth but also by the grade of urbanization and new green energy technologies available. Despite these connections, what we know is that these trends are in good measure exogenous to business decisions, workers skills and the public policies that could be taken in Argentina.

Argentina 2030: four alternative futures

After reflecting upon the key trends and their implications, the participants thought about different possible scenarios that Argentina could face in the next years.

Figure 2 shows four different worlds in terms of 4IR technology adoption and diffusion by firms on the one hand and the acquisition of knowledge and skills by workers, in the other. It is important to remember that we are not making predictions here. What we are doing is a brainstorming exercise to think about main factors involved in the structural change ahead of us and discuss alternative public policies that could be carried out. The characteristics of each scenario are depicted in terms based on overall economic growth and the way it is achieved (sectorial heterogeneity, social cohesion, etc.)

How will the argentine economy be in 2030 in each scenario?

We start with the "high adoption and diffusion of technologies – high re-skilling" scenario, which we named **The Pink World**, in clear reference to a positive shift from the status quo. In this scenario firms completely acquire new digital technologies so that productive processes of different sectors and types of firms are executed through wireless connections that coordinate machines, software and data (Industrial Internet of Things – IIoT). The nature of the firm shifts to a more flexible and decentralized structure, with a major role deployed by digital platforms as trading systems. The substantial technological change noticed in firms redirects the labour demand to more complex tasks with further cognitive content. In the similar way, a deep change in the stock of skills of workers takes place, involving massive reforms in the formal learning systems to new and the proliferation of more dynamic and flexible mechanisms (like Massive Online Open Courses or MOOC). Actually, in this scenario Argentina keeps up with the global narrative: the race between technologies and skills is very dynamic, ends rapidly and tied[8].

In the pink world the Argentinean economy grows at high rates converging to the standards of life of developed countries. Sectors with static comparative advantages –associated with the use of land- fully exploit the benefits of the revolution in biotechnology, which allow them to growth at high rates. Sector with dynamic comparative advantages, such as Knowledge-Intensive Services (KIS) and extractive industries (basically non-conventional oil and gas, also experience high growth rates. The manufacturing sector lags behind relative to the former sectors but improves its performance regarding argentine's recent history. Particularly, numerous niche markets emerge taking advantage of the complementarities between the digital world and the new skills acquired by workers. The economy in this scenario is highly integrated to the world, and GDP and exports diversification allow it to interact with other regions and at the same time to obtain the international reserves that the country needs to make growth sustainable.

In terms of social cohesion, the Pink World shows a positive performance, allowed by the improvement of learning systems and the capacity of their workers to perform a re-skilling that goes hand in hand with the evolution of technology. This joint evolution explains why workers are able to move from low-productivity jobs to medium or high-productivity ones. Poverty is lower than in recent history but structural problems persist. Income inequality – which is currently high in relation to developed regions-, could rise depending on the degree of matching between the supply and demand of skills.

The second possible scenario, named **Mild Dutch Disease**, is one of lagged adoption of technologies but a better readjustment of skills. In this future the economy meets some opportunities derived from the interaction between high skilled workers and less sophisticated technologies. Nevertheless,

8 A more detailed description can be found in Appendix 5.

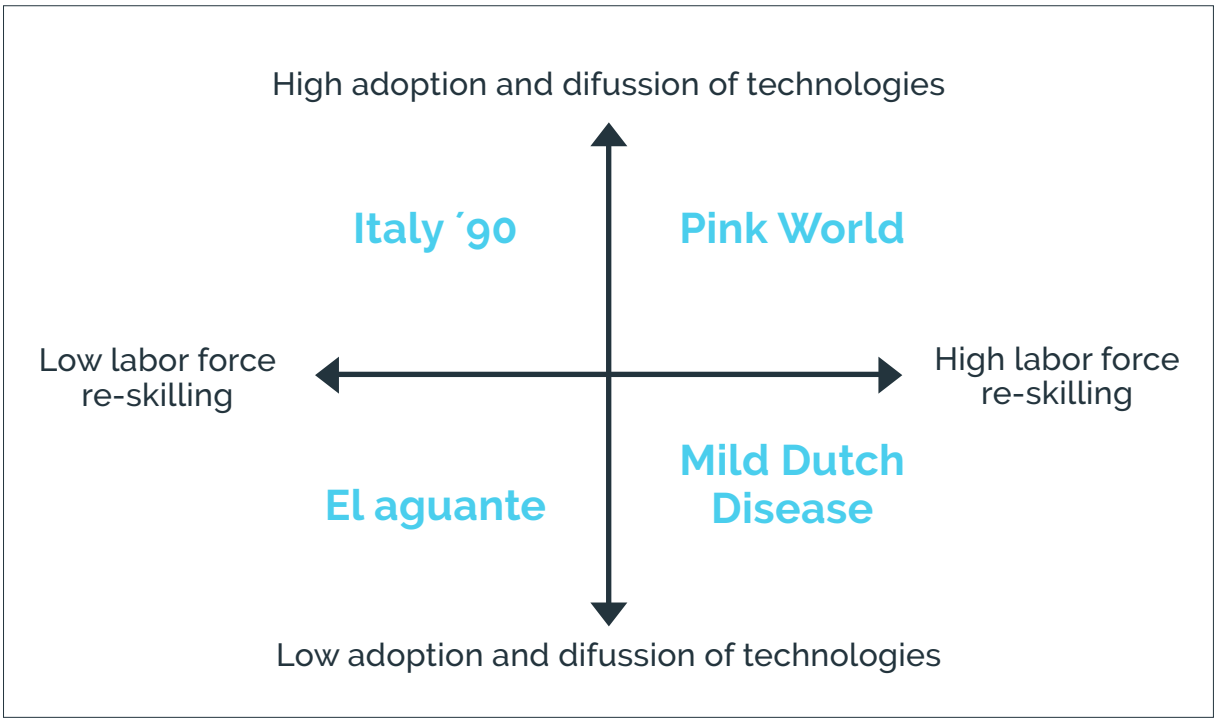


Figure 2. The four worlds for Argentina in 2030 (i)
Source: authors' elaboration

the technological delay in AI and smart technologies results in an 4.0 Industry which is severely underdeveloped: leapfrogging opportunities in manufacturing and services industries are not be sufficient for the economy to bridge the gap with the developed countries. Again, primary sectors will lead, growing faster than the rest of the economy and representing the main connection with the rest of the world. But growth rates are less impressive than in the Pink World because technological absorption in lower. By being late-adopters of frontier technologies, primary sectors remain relatively isolated form the rest of the economy, having a low impact on total employment (that's the reason of the scenario's name)[9]. International reserves scarcity is a structural problem that remains active in this scenario. Industrial sectors will have some protection against external competition –what could be behind the lags in technology adoption-, and this allows them to maintain the level of employment relatively stable.

In the Mild Dutch Disease social cohesion is higher than in recent history given that the huge investment in education acts as an inclusive force, and poverty drops to relatively lower rates. However, difficulties to use the new skills of the labour force in an out-dated productive process works as a an obstacle that makes very difficult to turn these very skills into productivity gains.

The third possible world combines low acquisition of technologies by firms, with a poor improvement in workers skills. This world was named El Aguante, because of society being in permanent conflict as a consequence of (necessary) redistribution of the losses that the technology lag entails. It represents a stark opposite to the Pink World described above. What we could expect here is little economic growth and a widening gap in the life standards compared with developed countries. Nonetheless, as in the Mild Dutch Disease future, comparative advantage

9 With Dutch Disease we are making reference to a poor productive and export diversification. The name is based on the macroeconomic effects of the discovery of gas fields in the North Sea on Netherland at the end of the 1960s.

Picture 4. Rocky's fights are a good analogy to represent the economic volatility and the social conflicts arising in the scenario "El Aguante".

Picture 5. As in Italy 1990 World Cup, in the "Italy 1990" future Argentina must exploit the few opportunities it has in order to achieve a better economic and social situation.

sectors are relatively dynamic but leapfrogging opportunities remain subdued. A large number of non-tradable, low-productivity sectors –construction for example- might employ low-skilled workers, even though their capacity to reach a sustainable expansion depends exclusively on the available level of international reserves. Climate conditions will condition the potential expansion of the economy. As a consequence, during "bad times" (draughts, negative terms of trade shocks, trade wars at a global level) necessary adjustments are economic and politically hurting. Indeed, this future is about an economy with little economic growth and high macroeconomic volatility, both firms and workers are unable to make long run bets, such as buying new machines or acquiring human capital. In this context policies are also dominated by short-term considerations.

In the world of El Aguante social cohesion is low and redistributive conflicts are frequent. One of the reasons is job insecurity: low-income sectors will depend on compensatory public policies like cash-transfer programmes and subsidies on food and energy. A second reason could be the high macroeconomic volatility, which in an economy with small and fragile safety nets would trigger recurrent income conflicts. Lastly, greatest social tensions could arise from a declining trust in the political system.

The fourth scenario corresponds to "high technology adoption – low skills development". This future is called **Italy 90**, as a reference to Argentina's football team that participated in the World Cup in Italy in 1990. The team included an exceptional player as Diego Maradona –the greatest of all times according to many people- and other ten much less skilled.

In this world the economy grows at the same pace than other emerging countries, but with a high degree of heterogeneity between sectors. Those with static comparative advantage lead growth – with the KIS as a second source of growth. The rest of the economy grows at a slower pace but experiences huge productivity gains as a result of a fast automation process. As this structural change is basically labour saving, it entails negative effects on income distribution[10].

10 The name of this scenario also makes reference to what happened in the early 1990s in Argentina, when a

Opportunities to create employment complementary to new technology are limited, as high skilled labor remains scarce. Put it in another way, in this world technology won the race against education. Some business opportunities for unskilled workers come out due to digital platforms improvements, but it does not have a large effect on aggregate wealth and wellbeing.

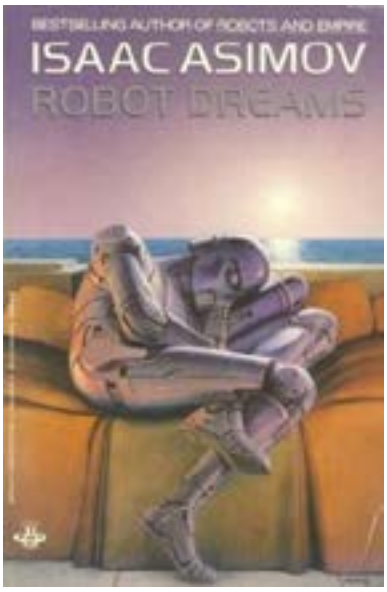
Social cohesion in the Italy 1990 scenario is threatened by a high rate of structural poverty, a deterioration in working conditions of workers in manufacturing and low-productivity services, and a wider disparity between labour income and capital income. Automation may also increase the distributive conflict and threaten the stability of the political system.

The evolution of these two main trends -newtechnologies acquisition, and skills and knowledge evolution both in firms and workers- will have impacts not only on the performance of the economy but on labour markets too. How would employment levels, informality, labour relationships and real wage evolve in each of these worlds?[11]

In **The Pink World,** automation is high on routine tasks, which include manual jobs that are well remunerated today. What can we say about the level of employment? Employment shifts from manufacturing industry to services, causing an increasing *servification* of the economy. The skills training system -throughout the different education institutions that comprise it- has curriculums adapted to new economic needs and enables workers to move from sectors where machines substitute humans to those where human labour is complementary. In some circumstances re-adjustment costs are prohibitive and some sort of temporary safety net will be needed to cover left-behind workers. Working hours will be lower but in most occasions they will be distributed along the day and without a specific workplace.

In The Pink World real wages rise due to large productivity gains. Despite the massive use of digital platforms, informality in low and medium productivity sectors (what we could call "traditional informality") persists. Besides, a new kind of informality related to the gig economy arises, which concentrates around medium and high-income workers. The gig economy and the use of online platforms improve labour conditions in manual tasks that humans still do. Labour institutions must evolve following changes in labour markets such as a deep reconfiguration of the firm (e.g. "office jobs" are no longer the norm in this future). Workers will be holders of their own labor benefits, dealing with labour insurance and pension saving mechanisms. Because of this decentralization of the benefits, market forces will prevail displacing public policy-, while labour unions will see their role reduced.

Income inequality in the Pink World remains large as the dynamics of automation certainly entails winners and losers. Nevertheless, it will occur alongside with a decline of poverty and rising wages. Younger cohorts are rapidly integrated



Picture 6. As in several stories of Isaac Asimov, in the Pink World highly complex cognitive tasks could now be performed by robots and machines incorporating AI.

similar dynamic of large productive reconversion with negative effects on unemployment rates took place.

11 See more details in Appendix 6.

while older cohorts who are "analogue natives" might face problems to match their skills with the new demands. The gender gap is likely to persist due to the replacement of tasks where there is a bias towards men (manufacturing industry) by others equally biased (STEM activities).

In the **Mild Dutch Disease** world, adoption and diffusion of technologies is slow, which results in a low pace of automation in the production process. Jobs that entail routine tasks still exists due to effective protection coming from (i) the low and slow adoption of new technologies itself, and (ii) increased trade barriers (consequence of protectionist policies). In the service sector, digital trade and the use of platforms take increasing importance so that there is new business opportunities associated with the sharing economy. But this change is not as generalized as to affect aggregate productivity. Technological unemployment is not present in this world, while job mobility across sectors is low showing the little dynamism of the economy at a microeconomic level.

In this future real wages remain stagnant, particularly in terms of tradable goods (food, household appliances, etc.). Basic technologies enable the development of trade and cooperation platforms, which leads to a shift in labour market's organization towards more flexible structures with numerous independent workers. Informality in the most technologically lagged sectors is the same as in the recent past, while it rises a bit among workers in the fourth and fifth quintile of income. Social benefits come from platforms and, in second place, through public policies, even though these benefits are limited to a small segment of the population.

Income gaps are relatively reduced in this world, as a consequence of heavy investment in human capital. Nonetheless, in this world low demand of high skilled workers is the norm. A mismatch biased to low skills prevails in the labour market, and the high skilled workers are unable to obtain a substantial skill (or education) premium. A large portion of workers' skills is not used in the productive process, and it is the skill profile required in available jobs opportunities –and not the workers' stocks of skills- which lags behind.

Picture 7. Robots and machines have already begun to replace humans in routine tasks. (This picture was taken in a pizza-shop from Pakistan; Source: El comercio, Peru)

In **El Aguante** both technology adoption and skills fall behind as compared to the rest of the world. The low rate of automation implies that several routine tasks that have already disappeared in other parts of the world in Argentina are still carried out by humans. As a result, technological unemployment is not a problem, but may remain hidden under the form of poor working conditions and low productivity.

As in the Mild Dutch Disease future, real wages are low in terms of tradeable goods, but in El Aguante volatility is higher, following the recurrent pattern of the business cycle of deep expansions and contractions. Traditional labour institutions prevail, as well as high informality in precarious sectors.

Labour income inequality decreases in this future as a consequence of the low level of innovation. Nevertheless, the small group of the population that obtains the new skills set and is connected to the world will achieve extra benefits. The gender gap also remains high as sectors traditionally biased to the male gender predominate.

Finally, in **Italy 1990** the huge transformation in the productive system results in a rise of structural unemployment. In this future the problem of technological unemployment does appear, as digital adoption is not followed by a re-skilling of workers that enables them to

move towards non-automated sectors. Service sectors with little value added will expand, absorbing workers that leave the manufacturing sector, but this will ultimately prove insufficient to maintain unemployment in one-digit levels. Labour informality remains high in low productivity sectors and rises in high productivity sectors as well.

What happens with inequality in Italy **1990** World? The labour share in income is smaller than in recent history as a result of labour saving technologies that bias income distribution in favour of traditional and new forms of capital. Income inequality could also get worse due to a wide range of skills that become obsolete after the technological transformation.

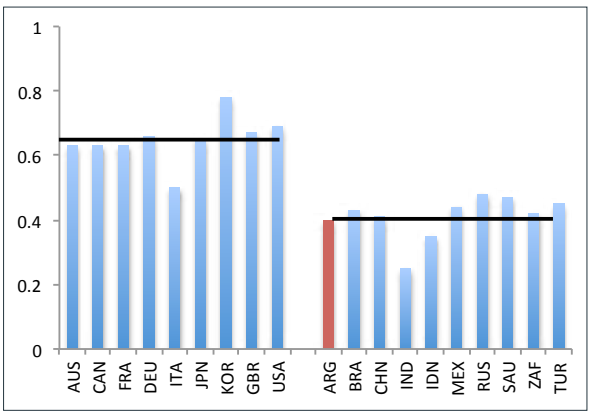
Toward a hopeful future: is the status quo enough?

Which of these alternative worlds is more desirable? The scenarios with little technology adoption (The Mild Dutch Disease and El Aguante) are futures with poor economic growth whose productivity tends to diverge when compared to developed countries. Italy 90 could represent a future of high growth but also one of large inequalities. Particularly, the economy's inability to relocate workers who are replaced by machines could lead to a pattern of non-inclusive growth. Given this, from the four possible worlds, the one with high technology adoption and complete re-skilling seems the most preferable. Note also that this future matches the one that prevails in the global narrative over the long run.

Is Argentina heading in this direction?Consider first the adoption and diffusion of technologies. How is our current performance with digitalization? From a panoramic sight, recent developments give us some optimism. Greater economic integration promoted by smaller transport and communication costs, more open trade and the emergence of global value chains could all facilitate firm's access to new technologies (IMF, 2018). Besides, the new technologies are easier to use and adapt to different contexts, as they are more open and collaborative in nature. Thus, leapfrogging strategies seem to be easier to perform than during former technological revolutions. As a result, not only the average time between an invention and its application as a technology has been reduced, but also the discrepancy of lags in adoption across countries (Eden and Nguyen, 2016). In Argentina, for example, the use of the telegraph was effective three decades after its deployment in the United States, while the Internet was incorporated with only a three-year lag (Comin and Hobijn, 2010).

The outlook changes if, instead of looking at the adoption of a new technology, we consider available data about its actual diffusion rate. By doing so, we obtain a completely different picture: technology gaps between leaders and followers are wider in the current GPT than in the case of the steam engine, electricity or the ICTs (Comin and Mestieri, 2017). **Picture 3** confirms this hypothesis. It presents the Digital Adoption Index by firms, created by the World Bank (2016) and applied to G20 countries[12]. Note that the diffusion of digital technologies in Argentina is lower than in countries that lead the digital transformation, like Japan, Germany and United States. The status quo situates Argentina in one of the south quadrants (i.e. low technological absorption).

12 While this index is an aproximate measure of 4IR technologies difussion, it could offer a general picture of the divergent trends in each country. Similar results for Argentina can be found in Dutz et al. (2018)

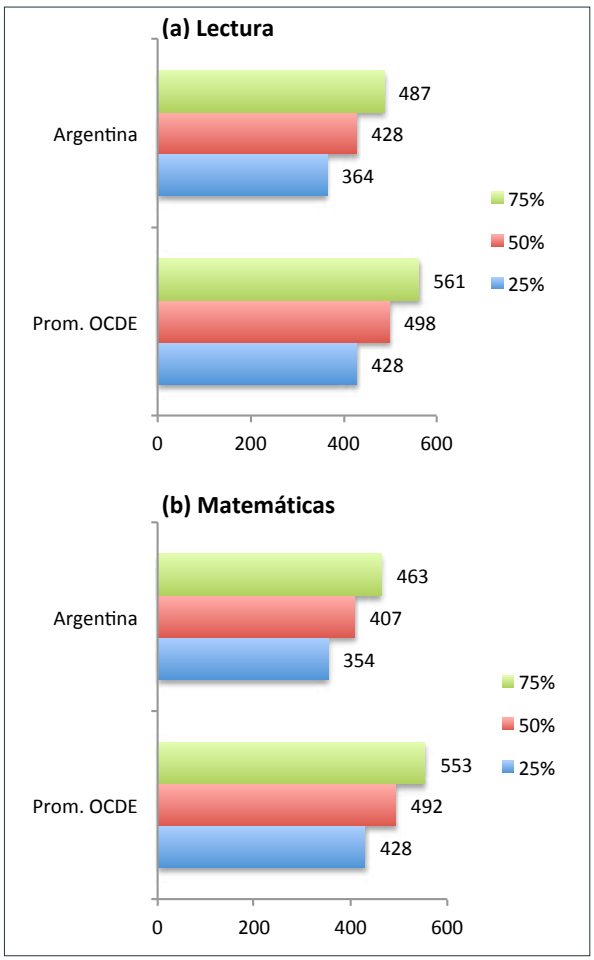


Picture 3. Graph 2. Digital adoption in G20 countries
Source: World Bank (2016) [13]

Consider now workers' skills. Unfortunately, Argentina does not take part in standardized surveys about skills and knowledge of workers (PIAC OCDE and STEP –World Bank-). That is why we have to approximate to skills and knowledge state through educational performance.

Over the last 50 years skills development in Argentina and much of the world has changed drastically. First, a rise in the amount of years dedicated to education occurred. If in 1980 United States was five years ahead of Argentina in average years of education, now this difference has been reduced to three years. Secondly, public expenditure in education has been rising faster than GDP: a greater quantity of resources has been guided to human capital investment.

However, neither schooling nor public investment in education measures accurately the evolution of knowledge. When we analyse statistics about learning capabilities, the outlook is again quite different: Argentina fails to achieve basic learning objectives. According to the Programme for International Student Assessment (PISA) implemented by OECD, the average results in Argentina are significantly worse than those achieved by developed countries (see Picture 4). The starting point for Argentina in terms of skills adoption would be on the west quadrants of Picture 1.



Graph 3. Educational performance by percentile - Argentina vs OECD
Source: OECD (2016)

Summing up, our analysis shows that the starting point for Argentina is a world far from the global narrative: the southwest scenario. Beyond the heterogeneities, as a country Argentina is in El Aguante World, with low adoption and diffusion of technologies and problems to readapt knowledge and skills. This diagnostic also explains what could happen if public policies and private sector's behaviour does not change: the status quo will mean that we obtain a country that is unable to catch the wave of the 4IR.

13 Digital adoption in firms is a simple average of four normalized indexes: percentage of firms with websites, number of secure servers, download speed and 3G coverage in the country.

Final: policy guidelines to break the status quo and take advantage of the Fourth Industrial Revolution

The 4IR just started. As happened with GPT in the past, it will take time until it meets its potential. A window of opportunity is open both for developed and developing countries: there is still time to adapt policies and institutions for the foreseeable future. From our prospective exercise for 2030 emerges that there is a long and winding road ahead for Argentina. The Status quo is not a feasible option if we want to make the most of this opportunity. Several policy guidelines are derived from previous discussion.

The first policy guideline refers to the rate of technological change. Argentina needs to foster the adoption and diffusion of 4IR technologies. For this to happen, a broad and modern industrial policy programme has to be set in motion. Argentina's most dynamic sectors are near the technological frontier, but this is not the case in manufacturing and low-productivity services.

Even though there is much that we do not know about the scope of actual technological change, we could learn from what other countries are doing and adapt it to our own needs. Taking as a starting point the National Academy of Science and Engineering (ACATECH) recommendations, the German government began its programme "4.0 Industry" in 2013, and was then followed by several other countries: "China 2025"plan in the Asian giant, the "Advanced Manufacturing" in the United States, the "Nouvelle France Industrielle" in France, "Smart Industry" in Sweden, among many others.

What are these industrial 4.0 programmes all about? A common point is the goal of reorganizing the industry's structure, by shifting to more flexible, integrated and connected production systems. Therefore, a key issue is to invest in innovation associated with creation and adoption of digital technologies crucial for the productive system conversion (Big Data analytics, robotics, IIOT, etc). A second characteristic is that they share a final common goal: to improve competitiveness, in such a way that it is reflected on the export pattern of the country. Third, these programmes share their focus on the impacts on labour markets and the idea that human capital accumulation has to move alongside intangible capital accumulation related to the 4IR. A last common feature refers to the identified need of upgrading the supply of digital and IT-related infrastructure.

What does this mean in terms of specific policies for Argentina? Even without implementing a systematic programme as the ones aforementioned, we list below several policies that could be carried out by the public sector and which we think are essential to foster productive and technological (re)conversion:

• Develop a diagnostic about the use and diffusion of 4IR related technologies in each sector, distinguishing by firm size, kind of capital, business models, etc.

• Promote R&D investment, focusing on the potential of technological institutes associated with the productive ecosystem (INTA and INTI).

• Facilitate private sector's risk-taking in projects related with 4IR technologies, developing new and enhancing currently available financial instruments.

• Involve the public sector in risky projects through public procurement schemes that strengthen innovative start-ups.

• Target policy efforts on more lagged sectors of the entrepreneurial ecosystem, from SMEs to informal sectors –larger in Argentina than in developed countries-, in order to detect leapfrogging opportunities that could make the difference.

• Encourage investment in basic digital infrastructure.

A second general guideline is related to skills and knowledge training programmes. Available evidence shows that enhancing socio-emotional and cognitive skills is a necessary condition for the 4IR, even when other complex skills will be needed in specific sectors. Flexibility and adaptability capacities will also be crucial, and these are possible only if expertise is acquired throughout life (lifelong learning) rather than during a specific phase or period. As a consequence, current and future workers reskilling will be a tough ordeal since it involves numerous learning stages, from early infancy to professional training.

Ideally, in this dynamic context the best option would be to set up a specific public agency that tries to anticipate labour challenges. There, the mix of data about labour markets and prediction models could work as a policy guide to design and implement education policies and incentive mechanisms that encourage professional training inside companies.

If the creation of an agency of this kind was not possible, there are several specific policies that can make the difference.

• A comprehensive diagnostic about the state of knowledge and workers' skills is needed.

• Early childhood learning should be encouraged. At that time brain structure is settled, and is a key period to develop basic cognitive and socio-emotional skills.

• Even though basic education coverage has been broadened, a higher quality education is necessary to acquire better and more advanced skills and knowledge.

• Higher education should be adapted to facilitate the transition to the labour market. Learning mechanisms and professional training systems should be enhanced.

• Training systems within firms should be updated on a regular basis to cope with rapid technological change.

It is necessary also to rethink protection schemes, particularly those institutions that regulate labour relationships. Traditional schemes should be reformed, towards more flexible arrangements that could be complemented within a global safety net. Here the status quo does not work either: high informality rates in Argentina hinder the effective protection of workers' rights. Labour conditions are far from those of a "formal, long term job" that is prevalent in developed countries.

These policy recommendations may seem ambitious, not only from the starting point of Argentina but also taking into account that Argentina and other emerging countries find it hard to reform and adapt their policy schemes and institutions to sudden changes (remember North's words above). However, 4IR entails a window of opportunity but the benefits are not automatic. Instead, it needs a drastic change in the way firms, workers and the government behave. We hope this time to be different.

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Appendix 1

GROUP	PARTICIPANTS	PROFILE	SCENARIO
Yellow	Jorge Katz Marcela Browne Roxana Mauricio Santiago Ceria Roberto Russell	University of Chile C20 UBA – IIEP Medallia Argentina UTDT	Pink World
Pink	Pablo Gerchunoff Rafael Rofman Silvia Naishtat Marta Pujadas	CONICET World Bank Clarín UOCRA	El Aguante
Green	Daniel Heymann Natalia Herger Alejandro Garibotti Gabriel Kessler Monica Tepfer	UBA – IIEP PEET - UBA B20 CONICET UOCRA	Italy 90
Blue	Fernando Peirano Ivan Matovich Maria Ines Berniell Pablo Elverdin Nicolás Cherny	UBA CIPPEC CEDLAS Grupo CEO CONICET	Mild Dutch Disease

Appendix 2: members of Argentina's TFG

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Investigadora asociada al CEDLAS, Universidad Nacional de La Plata y profesora de Estadística II en dicha institución. Ha realizado presentaciones en conferencias y seminarios y publicado numerosos artículos de investigación. Es especialista en Economía laboral, Economía de la educación y Economía del desarrollo. Es Licenciada en Economía de la Universidad Nacional de Córdoba, Magister en Economía y Finanzas y Doctora en Economía del CEMFI.

Marcela Browne

Coordinadora local del Grupo de Trabajo de Educación, Empleo e Inclusión del C20 Argentina, por la fundación SES. Se desempeñó como consultora externa y participó en el diseño metodológico, coordinación del trabajo de campo y análisis preliminar de un estudio cualitativo en el marco del proyecto Ventanas de Oportunidades para los Jóvenes, iniciativa concebida e instrumentada por Fundación SES con apoyo de International Youth Foundation y Walmart Foundation. También prestó su colaboración en proyectos del Centro de Innovación Social de la Universidad de San Andrés.

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Se desempeña como Vicepresidente de Ingeniería y Director de Medallia Argentina desde 2016. Antes fue socio de Hexacta SA, y Jefe de Metodología, Estándares y Operaciones en Banco Río. Es Docente en el programa de posgrado de la UCA y Profesor asociado de la Facultad de Ciencias Exactas y Naturales de la UBA, donde dicta un curso de Ingeniería de Software. Miembro del Consejo Asesor de Ingeniería de Software (CEIS). Es Licenciado en Análisis de Sistemas de la Universidad de Buenos Aires y Master of Software Engineering de la Universidad Carnegie Mellon.

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Investigador Adjunto del CONICET. Fue Director del Programa de Instituciones Políticas de CIPPEC. Especialista en política comparada, economía política e instituciones políticas. Ha publicado numerosos artículos en revistas internacionales, libros y capítulos de libros sobre estas temáticas. Es Licenciado en Ciencia Política de la Universidad de Buenos Aires, Master en Gobierno del Instituto Ortega y Gasset y la Universidad Complutense de Madrid, y Doctor en Ciencias Sociales de FLACSO.

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Es miembro del Grupo CEO y Coordinador de estrategia y contenidos del Grupo de Países Productores del Sur (GPS). También es consultor externo del International Food Policy Research Institute (IFPRI) y asesor de la Cámara de Maquinaria Agrícola en Argentina. Sus áreas de investigación incluyen temáticas de economía, comercio, seguridad alimentaria y política agroindustrial; sobre los que ha publicado numerosos papers y artículos en los últimos años. Previamente, fue Director de Integración Sectorial y Política Industrial y Coordinador General del programa de promoción de exportaciones del Ministerio de Industria. Es Licenciado en Economía graduado en la Universidad de Buenos Aires.

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Historiador económico, profesor plenario e investigador de la Universidad Torcuato Di Tella. Es además investigador principal del CONICET, Profesor Honorario de la Facultad de Ciencias Económicas (UBA), becario de la Fundación Simón Guggenheim y miembro de número de la Academia Nacional de Ciencias Económicas. Se especializa en la historia de la política económica argentina y en historia del desarrollo económico argentino. Sus trabajos han sido publicados en diversas revistas científicas y compilaciones y ha escrito varios libros (solo o en colaboración). Se desempeña como docente invitado en la Universidad Alcalá de Henares, en el Instituto Universitario Ortega y Gasset y en la Universidad de la República en Montevideo. Ha sido consultor de organismos internacionales como el Banco Mundial y la CEPAL en temas de historia económica y la reforma del sector público. Fue asesor y Jefe de Gabinete de Asesores del Ministro de Economía.

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Editora del Diario Clarín -sección Economía- desde 1994-. Es miembro de la Academia Nacional de Periodismo, fue nominada en dos oportunidades al Martín Fierro por su labor periodística en radio, y es ganadora de múltiples premios entre los que destacan el Konex por su labor en la prensa gráfica (2007) y el Buenos Aires Herald (2004). Como periodista especializada en temas económicos ha elaborado numerosos artículos para revistas de divulgación y ha publicado libros en conjunto con otros especialistas entre los que se destacan Argentina Innovadora, escrito junto con María Eugenia Estenssoro. Es ingeniera agrónoma de la Universidad Católica Argentina.

Fernando Peirano

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Marta Pujadas

Se desempeña como Directora del Área Jurídica de la UOCRA y Red Social. Es integrante del equipo jurídico CGT RA y de la Red de Derechos Humanos y Sindicales y Equipo Jurídico Continental de la Central Sindical de trabajadoras y trabadores de las Américas. Presidenta del Comité Regional de Mujeres de América Latina y el Caribe de la Internacional de la Construcción y del Consejo Sindical de Asesoramiento Técnico (COSATE) de la Conferencia Interamericana de Ministros de Trabajo de la OEA. Es abogada de la Universidad de Buenos Aires, Master en Prevención y Protección de Riesgos Laborales (Universidad de Alcalá) y egresada del Curso de Expertos Latinoamericanos en Relaciones Laborales Universidad de Bologna-Castilla La Mancha y O.I.T (Turín).

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Líder de Programa del Banco Mundial para la Educación, la Salud, la Protección Social, el Empleo y la Pobreza, para Argentina, Paraguay y Uruguay. Ha trabajado en temas de desarrollo humano, protección social y pensiones en varios países de América Latina, a nivel regional y en países de Europa Central. Anteriormente, fue Jefe de Estudios de la Superintendencia de AFJP en Argentina, y Asesor en temas previsionales del Ministro de Economía y del Secretario de Seguridad Social en Argentina. Se desempeñó como docente en las universidades de California, Universidad de Buenos Aires, la Universidad Nacional de Córdoba, la Universidad Nacional de Luján, la Universidad Nacional Autónoma de Honduras, la Universidad Torcuato di Tella, y la New York University (NYU). Es Licenciado en Economía (UBA), cursó la Maestría en Demografía Social de la Universidad Nacional de Luján y Doctor en Demografía de la Universidad de California en Berkeley.

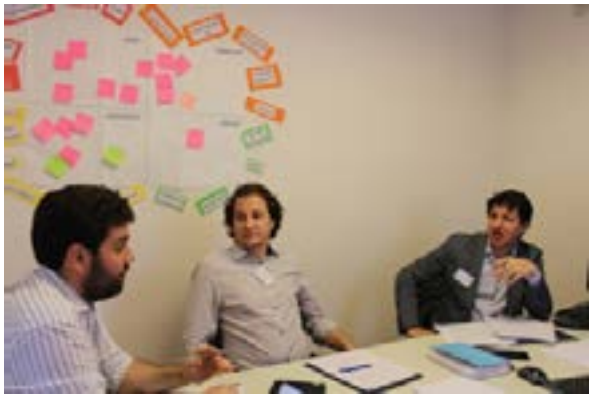
Roberto Russell

Profesor Plenario y Director de la Maestría y el Doctorado en Estudios Internacionales de la Universidad Torcuato Di Tella. Presidente de la Fundación Grupo Vidanta. Ex-Director Académico del Instituto del Servicio Exterior de la Nación. Ha sido consultor e investigador en temas de educación universitaria y de relaciones internacionales (PNUD, UNESCO, CEPAL, OEA, IRELA, Ministerio de Educación de Chile, Ministerio de Relaciones Exteriores, CONEAU y CONICET Argentina). Se desempeñó como profesor de Relaciones Internacionales y Política Exterior Argentina en la UBA, en UDESA y en FLACSO. Fue Research Scholar, Programa Fulbright (SAIS) y Profesor/Investigador Visitante en las Universidades Johns Hopkins, Georgetown, Londres, Beijing, Salamanca y en los Institutos Ortega y Gasset e IRELA (España). Ha publicado numerosos libros y artículos en revistas especializadas sobre Teoría de las Relaciones Internacionales, Relaciones Internacionales de América Latina y Política Exterior Argentina. En 2006 fue galardonado con el Premio Konex (Humanidades – Ciencias Políticas). Es abogado de la Universidad de Buenos Aires, Licenciado en Relaciones Internacionales de la Universidad del Salvador, Master en Ciencias Sociales con Mención en Ciencia Política de FLACSO, y Doctor en Relaciones Internacionales de la School of Advanced International Studies (SAIS), Johns Hopkins University.

Mónica Tepfer

Es abogada en el área jurídica de la UOCRA y forma parte de la Secretaría de Relaciones Internacionales CGT RA. Titular de comité en Internacional de trabajadores de la construcción y la madera (ICM). Participó como joven líder en el IV Congreso Mundial de la ICM, el cual se celebró recientemente en Durban ICC, Sudáfrica.

Appendix 3: Photos from the workshop



Appendix 4

MEGA-TRENDS			
Technological Global Change	**Demographic Change**	**Shifts in Global Economic Power**	**Climate Change and Natural Resources**
Fast advance in technological innovation	*Changes in size, distribution and age of population*	*Power shifting between developed and developing countries*	*Long-term effects and changes in the energy matrix*
Artificial Inteligence (AI), machine learning and Big Data will modify consumption and production patterns -digital platforms, process improvements, etc-. This will result in productivity gains and time saving, allowing people to focus on new activities that improve life standards and reduce social tension.	In developed countries, the shortage of human workforce in rapidly-ageing economies will put pressure on social institutions, what will drive the need for technological innovation. In those developing countries that are one step further in the demographic tranisition -Brazil or China- similar pressures will arise, and consequently so will the automation incentives. For those countries that are experiencing the demographic bonus, the growth model based on low wages could be a feasible option.	Developing countries, particularly China, will assume a central role in terms of global growth, becoming the main center of trade and finance. Income convergence of asian countries to the life standards of developed countries will lead to a great expansion of middle class. Protectionism and nationalism could be a response of some countries in retaliation for their economic losses.	"Wether main negative effects of climate change will be noticed in the long term, climate events as droughts or floodswill be more frequent in the near future. Furthermore, the global economy will gradually shift to a descarbonization of its activities, modifing the energy matrix in favour of renewable sources."

MAIN TENDENCIES FOR THE FORESIGHT EXERCISE	
Technology adoption and difussion	**Workers skills adjustment**
Firms capacity to introduce frontier technology into the productive process	*Re-skilling and adoption of new demanded skills*
Country's success in the next years in terms of technology acqusition will depend on the occurrence or not of a wider use of technologies associated with the 4IR, opposite to a partial and less diffused adoption of these technologies that widens the gap between the life standards of the country and that of the developed world.	A good performance imply a complete and generalized adoption of skills and knowledge by workers, so that they could move on to non-automatable tasks. Older workers will need to learn new skills in order to remain in their jobs. Re-skilling will become the norm.

Appendix 5

SCENARIO	EVOLUTION OF MAIN TENDENCIES	ECONOMIC GROWTH	SECTORIAL DYNAMIC	Social Cohesion	
				Poverty	Inequality
Pink world	High adoption of technology, successful re-skilling	Rapid economic growth, converging to the life standards of developed countries.	Sectors associated with agriculture lead the growth by taking advantage of biotech-nological revolution. KIS and extractive industries follow the growing trend. Market niches emerge as sup-pliers of complemen-tarities between the digital world and the new skills demanded.	Poverty is lower than currently, although structural poverty remains.	Improvements in education and skills learning enable low-productivity workers to switch tasks, moving on to sectors with middle and high productivity, what allow to narrow the income gap among sectors. Nevertheless, inequality could rise if skills mismatching takes place.
Mild Dutch Disease	Low technology adoption, better re-skilling	Moderate growth enabled by the adaptation of workers to the new world and the incorporation of skills in a context of lagged technology adoption.	Primary sectors lead the growth and represent the main conection with the rest of the world	Poverty remains in levels below the currently ones.	Huge investment in education works as an inclusive force.
El Aguante	Low technology adoption and scarcy re-skilling	Modest growth and deterioration of the standard of living relative to developed countries. It is an economy with low average growth and high macroeconomic volatility.	Sectors with comparative advantages (agriculture) are the most dynamic and connected with the world; non-tradable sectors, like construction, could work as employers of non-qualified workforce, even thoughits expansion will depend on foreig currency stocks.	Poverty rate will raise, although its evolution could be disrupted by external shocks that impact on the economy.	Social cohesion is low and distibutive conflicts frecquents. That is a consequence of large labour informality, high macroeconomic volatility and the deterioration of the political system.
Italy 90	High technology diffusion with poor re-skilling	The economy grows at a similiar rate to those ones in emerging countries, but with great internal disparities.	Sectors with comparative advantages lead, with KIS in a second place, while throughout the economy are productivity gains associated with a process of heavy automation that push human labour out of the market.	Wider income gaps and lowest income participation of labour.	Wider income gaps and lowest income participation of labour.

Appendix 6

SCENARIO	EVOLUTION OF MAIN TENDENCIES	LABOUR MARKET CHARACTERISTICS		
		Automation, unemployment and realocation	Job Conditions	Labour Market Inequalities
Pink world	High adoption of technology, successful re-skilling	Routine tasks are automated, and technology adoption affect both manufactures and services. Displaced workers are re-trained and then reincorparated to the labour market	Real wages raise and traditional labour institutions shift to more flexible systems associated to the on-demand economy.	Income inequalities are larger, because of the high dynamism of the economy. Nevertheless, real wages rise and younger people are rapidly inserted into the market. Gender gap persists.
Mild Dutch Disease	Low technology adoption, better re-skilling	Low automation, little employment creation and limited intersectorial movility.	Real wages are stagnant -particularly in terms of tradable goods-. Sharing economy increases but that is not seen in labour conditions improvements.	Income inequalities are marginal but because of the general bad conditions: overqualification, informality, etc. Women and youths join the market through digital platforms.
El Aguante	Low technology adoption and scarcy re-skilling	Low automation. Hidden technological unemployment in traditional low-productivity sectors. High volatile unemployment rate.	Real wages get stagnant and suffer fluctuations and cycles. Traditional labour institutions persist as well as informality.	Income gaps are narrow and few workers that perform a successful re-skilling experience the benefits of the 4IR.
Italy 90	High technology diffusion with poor re-skilling	The 4IR is noticed in labour saving technologies. Technological unemployment appears.	Income participation of workers are significantly reduced, and a widening income gap arise between high-skilled and low-skilled workers.	Wider income gaps and lowest income participation of labour.

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