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Artificial Intelligence and the labor market

Is this time different?

Thinking about indicators to measure the impact of Artificial Intelligence on the world of work involves learning about what workers do

By Thiago Meireles[1]

Whenever a new technology becomes increasingly integrated into productive and economic processes, questions arise about its impact on humanity. The current protagonist is AI, which has become increasingly close to everyday life with recent technological advances related to the computational capacity for processing large databases. For some years now, it has no longer been uncommon for services accessed on electronic devices to use data collection and machine learning algorithms to produce optimized and personalized results for end users. More visibly, these processes have begun to influence routine choices, such as daily routes; the next song, podcast, movie, or series on streaming applications; and the offer of products or services based on one's browsing in search engines and social media. Although slightly less visible, applications in fields such as medicine, public health, and education already exist as well. Despite how natural this introduction or the lower visibility of some tools may seem, the debate about their impacts has crossed different fields, such as the future of democracy, ethics, economics, and, more specifically, the future of work.

The launch of ChatGPT 3.5 and the consequent explosion of users at the end of 2022 popularized some of the concerns that were previously restricted to a small number of researchers. The model's ability to produce cohesive, coherent, and well-written texts impressed the general public, despite factual errors and hallucinations, generating anxiety about professional adaptation due to the fear of replacement

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Photo: Personal archive

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by new technology. In addition to the rapid development of ChatGPT itself and other Large Language Models (LLM), with all the investment and announcements of technology giants in the development of their solutions, other applications of generative AI have also become popular. For the average Brazilian user, Meta's recent provision of Llama on its social networks and WhatsApp brings technology closer to users who were not previously interested in the tool. Regardless of the technical aspects of LLM and the limitations in their applications, the advances compared to more traditional Natural Language Processing (NLP) models are clear.

It is important to understand that many of the fears stem from the possibility of AI establishing itself as a General Purpose Technology (GPT)[2], i.e., a technology with potential for widespread use across the economy. Although several GPT coexist over time, there is an association between economic incentives to develop specific technologies and economic growth. The expectation is that AI will spread, generating widespread productivity gains as it evolves. Most GPT do not offer definitive solutions but rather present new opportunities, ultimately acting as facilitating technologies (Bresnahan & Trajtenberg, 1995). In this sense, new GPT always pose challenges from the point of view of public policies and the same question emerges: Is this time different?

To respond satisfactorily, it is first necessary to build a broader analytical framework considering public policies and, specifically, the potential impacts of AI on the labor market. It is also important to draw parallels and establish differences with other transformations observed over time to understand whether the expansion of AI use is very different from past processes. Based on this, it will be possible to elaborate more detailed hypotheses about potential outcomes, speculating on the challenges in terms of public policies for the near or even long-term future. Particularly, the concern is related to the future of work and, more specifically, the elimination or creation of occupations and jobs. It is necessary to understand whether AI has the potential to generate mass unemployment, alter the quality and remunerate of jobs, and produce diffuse or concentrated gains. In summary, the question, again, is whether it will be different this time.

Although the fear caused by automation processes has been a constant over time (Hanson, 2001), in addition to potential replacements, new technologies generate complementarities. Acemoglu and Restrepo (2020) argued that many of the important advances in the history of technology are related to automation processes that lead to new automation processes. An example was the pursuit of the automation of weaving and spinning in the early stages of the Industrial Revolution, which was subsequently directed to other industries. Specifically regarding AI, Nilsson (1984) anticipated the perspective that computing and robotics would begin to complement human work and eventually become intelligent to the point of replacing this work — at a lower cost and with higher quality and efficiency.

Even though many voices are warning about the replacement of work by AI, it is challenging to estimate the real impact it has already had and will have on different strata in different labor markets. Based on other processes, such as

[2] The "GPT" in ChatGPT, which stands for "Generative Pre-trained Transformer," is unrelated to "GPT" in the context of General Purpose Technology.

factory automation and the mechanization of agriculture, it is hypothesized that layoffs due to AI will be concentrated locally and temporally (Agrawal et al., 2019). However, the whole technological innovation process of this magnitude and the question "Is this time different?" are associated with what Mokyr et al. (2015) call "technological anxiety." The authors argued that technological development does not mean the end of work, but that it can change its characteristics in the future. However, the negative effects of automation processes can be overestimated by technological anxiety (Antón et al., 2020).

The question "Is this time different?" is associated with the speed and impact of the most recent technological innovations being greater than those of other historical moments, even though the impacts of technological productivity have contributed to a rise in the standard of living over time (Autor, 2015; Autor & Salomons, 2018; Mokyr et al., 2015). Directly, even if processes of great technological innovation in the past have not led to the "end of work," technological anxiety leads to the question of whether ongoing innovations will produce a different result.

Organizational structures, both social and work-related, are essential to understanding how technological changes have affected how work is carried out and how rapidly some recent transformations have occurred. It is also important to highlight that these processes occur in different ways, even when their socioeconomic aspects are similar, so these structures are central to understanding why they occur in different rhythms and forms. In other words, context matters.

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Another point is to establish an analytical framework to think about the impact of AI on different occupations, despite the challenges posed by the increasingly accelerated pace of innovation. To deal with these difficulties, Fernández-Macías and Bisello (2020) presented a taxonomy that organizes tasks according to the content of the work, also associating the methods (such as work organization) and tools (technologies) applied. While not ignoring the importance of other processes, such as robotization, digitization, and platforming of work, Tolan et al. (2021) sought to develop an instrument to measure the potential replacement of work by AI based on this taxonomy. The construction of an AI index to measure the risks faced by different occupations was based on the inclusion of cognitive tasks, unlike studies on other processes of replacing work with new technologies that included only routine tasks. The proposal for the development of the index is composed of three layers to track the speed of these innovations in occupations, which are: (a) tasks; (b) cognitive skills; and (c) development of AI research. From an empirical point of view, it is worth noting that there are no major differences regarding the potential impact of AI when compared to other indices that sought to measure it, such as those of Brynjolfsson et al. (2018) and Webb (2019).

The common aspect of studies aiming to measure the impacts of AI on the world of work is the understanding of what workers do in their occupations. That is, it is important to understand the tasks that certain occupations perform to identify the intensity with which new AI technologies can replace, complement, or transform the work these professionals carry out, regardless of the proposed methodology. In this sense, four elements would be necessary to classify tasks: The analysis of their content; an approach that combines the task content based on the type of work; the analysis of the type of transformation resulting from the process of transformation; and the identification of required skills. In this

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way, on the one hand, physical, manual, and social tasks would be differentiated and, on the other, the methods, forms of work organization to carry out the tasks, and the tools or types of technologies employed would also be differentiated. This would lead to a clearer framework for understanding what is and is not amenable to automation based on the use of AI.

This concern is also present in studies in Brazil which, at least partially, address approaches that seek to incorporate the composition of occupations, and not just tasks in isolation, to estimate the possible impacts of innovations. On the one hand, studies have been developed based on the content of occupations, especially their cognitive aspects, using data from O*Net[3] (Kubota & Maciente, 2019; Maciente, 2016; Maciente et al., 2019). On the other, there are those who seek to understand the impacts in a context that considers the processes of work computerization by observing the O*Net job zones, also based on the composition of occupations and their cognitive aspects (Albuquerque et al., 2019). Although these studies incorporate the discussion of cognitive aspects and skills in occupations in automation processes at work, they still do not include the changes related to the expansion of the use of AI.

The incorporation of AI-related elements in labor market analysis is still quite difficult despite the inclusion of those related to other automation, robotization, and platforming processes. In addition to understanding the tasks and the cognitive skills needed to perform them in a given context, the rapid advancement in technology poses even more challenges. By mapping the cognitive skills needed to perform a few dozen generic tasks and mapping how AI research has developed tools that can perform those tasks, as well as the way occupations combine those tasks, Tolan et al. (2021) presented an alternative with a synthetic index of the impact of AI on occupations.

In a doctoral research study (Meireles, 2022), this index for a twelve-year series of the Annual List of Social Information (RAIS) was incorporated to identify the vulnerability of occupations in Brazil in a disaggregated way. The study aimed to determine which occupations would be the most vulnerable and the level of threat faced by those with the largest mass of formal workers during the period. It is worth mentioning the influence of economic aspects of the Brazilian context, such as low labor productivity combined with its lower cost, in addition to inequality in labor income, which could lead to a lower correlation between the impact of AI and the formal labor market. In other words, the impact would be concentrated at the top of the distribution in occupations that demand greater schooling and specialization, reduced in the number of links, and contrary to the idea of end-of-work.

Among the main limitations of the study, two are noteworthy. The first is the lack of a methodology to predict which occupations would cease to exist or arise as a result of the development of AI. The second and greater limitation is the lack of a necessary and urgent research agenda on tasks related to occupations in Brazil since the approach emulates the aggregation of tasks for similar occupations in other regions of the world. Even for those occupations that are comparable, it is clear that there are differences between the tasks performed by workers in the

[3] A program that maps the composition of occupations in the United States. Find out more: https://www.onetcenter.org/overview.html

same occupations in Brazil and Europe or the United States. Advancing this research agenda is challenging, especially due to the human and financial resources it requires. However, there are international examples that can be useful in doing so, such as the O*Net and the Programme for the International Assessment of Adult Competencies (PIAAC).[4]

In other words, it is necessary to learn about what workers do in their occupations to think about public policies for vocational training and mitigation of potential harmful effects of AI on work. On one hand, this would allow for the identification of the growth in demand for specific skills across different occupations, which would help on the training side, and those with downward demand, which would allow for the identification of occupations that are more threatened by concentrating tasks related to them. This approach extends beyond the impacts of AI, but it would also help to understand the impacts on work in general.

Due to the ability to reshape the demand for skills, career opportunities, and the distribution of occupations and sectors globally, predicting the impacts of AI is quite difficult. To overcome these limitations, it is necessary to collect detailed responsive data to rapid changes in the labor market, considering regional variabilities (Frank et al., 2019), because they deviate from the standards of technologies developed to perform specific tasks and can perform cognitive tasks. It is necessary to know what workers do before considering how AI might impact them so that public policies do not rely on anecdotal examples from very specific contexts.

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[4] Find out more: https://www.oecd.org/en/about/programmes/piaac.html

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Interview I

The impacts of Artificial Intelligence on the labor market

By Professor Morgan R. Frank

In this interview, Morgan R. Frank, an assistant professor at the University of Pittsburgh, discusses how Large Language Models (LLM) have been transforming work activities, the impacts of Artificial Intelligence (AI) on the labor market in different countries, and the importance and challenges of collecting data on these transformations.

Professor Morgan R. Frank
Assistant professor at the University of Pittsburgh.

Photo: Steve Osemwenkhae Federal Reserve Bank of Boston

Internet Sectoral Overview (I.S.O.)_ The impact of Artificial Intelligence (AI) on jobs is a topic of extensive debate, not only regarding job creation or loss but also the transformation of existing roles. In your opinion, are these changes already occurring? What do you believe will be the most significant transformations, and how quickly do you expect them to unfold?

Morgan R. Frank (M.F.)_ Absolutely, jobs are already transforming because of generative AI including Large Language Models (LLM). As a professor, I use LLM to make me much more productive. For teaching, I use LLM to create lesson plans and brainstorm examples that will appeal to students of different backgrounds – this is especially helpful if I am not familiar with a student's major or area of research. For research, I use LLM to summarize research papers and to edit my own technical writing. Also, I use LLM for simple programming tasks when conducting research. Despite these use cases, I am not worried about losing my job; rather, I am excited by my increased productivity.

Recent research from OpenAI and a researcher from the Wharton School at the University of Pennsylvania (Upenn) suggests that white-collar knowledge workers, like me, perform workplace activities that are most likely to be automated by LLM. And, like my case, I expect that many workers in these jobs will adapt and become more productive because of new AI tools. However, it will take many years to see the full impact because these changes are mostly subtle and noticeable only to those in the occupations that are exposed to AI. Further, work from Erik Brynjolfsson at Stanford University, and others shows that we have not been great at measuring productivity gains from AI in the past, and we may similarly falter for now.

Still, there are large parts of certain industries, such as customer service call centers and online search, where LLM have a more obvious presence because the public interacts with them. I also expect that LLM will have a big presence, for better or worse, in education where students must handle AI as a double-edged sword. On one hand, LLM are an on-demand tutor able to summarize vast amounts of knowledge and translate knowledge between domains. On the other hand, LLM

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may offer students a crutch that eases the completion of assignments without pushing students to internalize learning materials.

I.S.O._ Will the effects of AI on the labor market differ between high-, middle-, and low-income countries? If so, how?

M.F._ I expect there will be differences. Most of the large companies that will financially benefit the most from AI are in high-income countries and, similarly, the companies that continue to develop AI systems are in high-income countries. Meanwhile, low-income countries may not directly benefit from AI development but, instead, participate in AI development by completing "last mile" tasks such as data cleaning and entry. There is much demand for this work as AI systems are increasingly data-hungry, but the benefits from this work to low-income countries will be small and temporary. As the cost to use AI systems, including LLM, goes down and infrastructure improves, I expect more of the world to access AI as a tool to boost productivity at scale. This will lead to benefits across many economies through efficiency gains across sectors. However, creating this global impact requires countries to afford AI API fees and to support the digital infrastructure required to interact with AI.

I.S.O._ How important is it to collect data on the impacts of AI on the labor market, and what are the main barriers to doing so? Are there any examples in the United States of ongoing efforts to gather such data, or existing collections that could be adapted for this purpose?

M.F._ Data is the largest barrier to understanding AI's impact on workers. Policymakers and researchers worry about "job disruption" but rarely define what that looks like. Similarly, the term "AI" is amorphous, capturing everything from linear regression to LLM to computer vision to autonomous vehicles. It is critical that the future of work studies clarify the labor outcome they mean by "disruption" and the specific type of technology they are studying. The public is mostly worried about job loss or possibly unemployment, and so research needs to study these outcomes in addition to the current trend of studying how AI impacts workers' wages. The US is often a leader in publicly available economic data, but, even in the US, there is a lack of data stratifying unemployment or job separations by occupations and regions. Data reflecting the probability of job loss for software developers versus graphic designers versus taxi drivers, among others, will allow policymakers and researchers to relate research on workplace AI exposure to actual job loss. Similarly, future of work research focuses on how technology shifts skill demands and, often, workers adapt to these changes without job loss, but not always! Understanding which shifts in skill demands correspond to job loss will significantly narrow the number of disruptions (i.e., from technology or otherwise) requiring policy intervention (e.g., upskilling or reskilling programs).
Additionally, since recent advances in generative AI may automate the work of white-collar workers, it becomes increasingly important to understand how AI may alter the training required for white-collar positions. Mainly, this means finding new data on the skills taught during higher education to study which majors and/or colleges

are teaching skills to students that AI may automate. Just as in the workplace, AI automation may subtract from the relevance of some learning outcomes, but it may boost the importance of others. And, as in the workplace, more research on student outcomes (e.g., once they enter the workforce) is required to understand when exposure to AI in learning is beneficial or harmful. Even as AI shifts skills' relevance in the workforce, AI also offers students a new modality in which to learn, where new concepts can be interrogated in natural conversation or through metaphor on demand. Thus, AI in education may have a net positive impact as a tireless resource boosting the learning outcomes of currently under-performing students.

Article II

Buffer or bottleneck? Employment exposure to generative Artificial Intelligence and the digital divide in Latin America[5]

By Paweł Gmyrek,[6] Hernan Winkler,[7] and Santiago Garganta[8]

Public attention to generative Artificial Intelligence (AI) has been on the rise since the introduction of conversational models such as ChatGPT, Bard, or Gemini. The impressive abilities of the Large Language Models (LLM), followed by other neural network-based AI systems capable of generating images and even videos from simple text prompts, have raised a range of important ethical and security questions for national policymakers and international cooperation structures. However, the topic that captures the most daily attention of regular citizens is the potential impact of these quickly advancing tools on jobs.

In the United States, over half of all adults are more worried than excited about AI in daily life, citing the "loss of human jobs" as their most important concern (Faverio & Tyson, 2022; Pew Research Center, 2023; Rutgers, 2024). In Switzerland, a 2023 survey focused specifically on generative AI revealed that of 1,000 respondents already working with a computer, almost half (43%) were concerned about losing

[5] This is an adaptation of an original work by the International Labour Organization (ILO) and The World Bank. Responsibility for the views and opinions expressed in the adaptation rests solely with the author of the adaptation and are not endorsed by the ILO or The World Bank. The original version is available at: https://www.ilo.org/publications/buffer-or-bottleneck-employment-exposure-generative-ai-and-digital-divide

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An important contribution of this study is to provide a first attempt at adapting measures of jobs' exposure to generative AI to the context of developing countries, where even workers in occupations that are generally expected to benefit from generative AI may not be able to reap its benefits due to poor access to digital infrastructure.

their job in the next five years, with those frequently using generative AI at work being disproportionately (69%) more concerned (Grampp et al., 2023). This suggests a rapid departure from the more positive assessments of AI in surveys collected by the Organisation for Economic Co-operation and Development (OECD) prior to the arrival of publicly accessible chatbots in late 2022 (Lane et al., 2023; OECD, 2023).[9]

Not surprisingly, the potential transformation that might result from the interaction of generative AI with labor markets has also attracted growing attention among scholars. The main research questions have centered around the impact on employment, emerging occupations, productivity, and job quality.[10] A recent paper from the International Monetary Fund (IMF) provided a comprehensive overview of this literature, at the same time highlighting the scarcity of studies that go beyond high-income countries (HIC) (Comunale & Manera, 2024).

Bridging this research gap, our study provides new evidence on the potential impacts of generative AI across labor markets in the Latin America and the Caribbean (LAC) region. Building on the approach developed by Gmyrek et al. (2023) – we provide new evidence on AI exposure between and within countries by leveraging harmonized household and labor force surveys for LAC from the World Bank and the ILO. By building on the comparative strengths of the datasets from both institutions, we develop a complete regional overview, accompanied by country-level estimates of the potential occupational exposure, with further breakdowns by detailed demographic and labor market characteristics.

An important contribution of this study is to provide a first attempt at adapting measures of jobs' exposure to generative AI to the context of developing countries, where even workers in occupations that are generally expected to benefit from generative AI may not be able to reap its benefits due to poor access to digital infrastructure. We implement this adjustment by estimating measures of computer use at work across International Standard Classification of Occupations (ISCO) two-digit occupations, workers, and country-level characteristics based on Programme for the International Assessment of Adult Competencies (PIAAC) data and by subsequently imputing them into individual observations in country-level surveys included in the Socio-Economic Database for Latin America and the Caribbean (SEDLAC). We then use this measure to create two categories among workers who are expected to benefit from generative AI use because of the nature of their occupations: Those who have access to digital technologies, and those who do not. The size of the latter is an indicator of the number of workers who will not be able to enjoy the productivity benefits of generative AI even though their jobs could theoretically benefit from the transformation. We also discuss the detailed demographics of the groups that are most likely to be negatively affected by these infrastructure limitations.

Our findings indicate that between 30% and 40% of employment in the LAC region is exposed in some way to generative AI. This exposure is linked with the economic status of countries, suggesting that income levels are a strong correlate

[9] In OECD's survey of workers, "four in five workers said that AI had improved their performance at work and three in five said it had increased their enjoyment of work [...] Workers were also positive about the impact of AI on their physical and mental health, as well as its usefulness in decision making" (Lane et al. as cited as OECD, 2024).
[10] E.g., see Brynjolfsson et al., 2023; Hui et al., 2023, Beraja et al., 2023, Adams-Prassl et al., 2023.

of generative AI's impact on labor markets. This total level of exposure includes three categories: Exposed to automation, augmentation, and "the big unknown." The latter includes occupations that – depending on the progress of technology and the use of adjacent technological applications, such as LLM-based agents – could fall closer to automation or augmentation.

Certain characteristics consistently correlate with higher overall generative AI exposure. Specifically, urban-based jobs that require higher education, are situated in the formal sector, and are held by individuals with higher relative incomes are more likely to come into interaction with this technology. The share of jobs exposed to automation is relatively small but nontrivial at about 2% to 5% of total employment. Younger and female workers tend to face greater automation exposure, particularly in the finance, insurance, and public administration sectors. At the same time, the shares of jobs that could benefit from a productive transformation with generative AI are consistently higher than those with automation risks across all LAC countries, ranging between 8% and 12% of employment across countries. This is particularly the case for jobs in education, health, and personal services. In addition, the sectors oriented toward customer service (retail, trade, hotels, restaurants, etc.) face an elevated exposure to "the big unknown." This category encompasses the largest (14%-21%) share of employment in our estimates, demonstrating that, while the concept of occupational exposure is easier to establish, the precise effects on how many occupations might evolve are harder to predict for a large share of today's labor markets.

Finally, we find that access to digital technologies is a critical determinant of the extent to which workers can harness the potential benefits of generative AI. Nearly half of the positions that could potentially benefit from augmentation are hampered by digital shortcomings that will prevent them from realizing that potential. Specifically, 6.24% of jobs held by women and 6.22% of those held by men are affected due to these gaps. Similar limitations apply to the jobs in the "big unknown" category: Even though some of them could potentially pivot towards augmentation through increasing complementarity between generative AI and the human workers in these occupations, the digital gaps will prevent large shares of these jobs from such a scenario.

Finally, we find that access to digital technologies is a critical determinant of the extent to which workers can harness the potential benefits of generative AI. Nearly half of the positions that could potentially benefit from augmentation are hampered by digital shortcomings that will prevent them from realizing that potential.

LAC region and the theoretical effects of generative AI

The definition of the region of LAC can have a varying scope across different institutions. In the case of our study, we rely on a heuristic approach of including the maximum number of countries for which we can find data of sufficient quality in the databases of the World Bank, ILO, and any other relevant sources. The final sample includes 21 countries:[11] The region is very heterogeneous, ranging from

[11] The sample included lower-middle income, upper-middle income, and high income countries. The lower-middle income countries are: Bolivia, Honduras, and Nicaragua. The upper-middle income countries are: Argentina, Belize, Brazil, Colombia, Costa Rica, El Salvador, Ecuador, Grenada, Guatemala, Mexico, Peru, the Dominican Republic, and Suriname. The high income countries are: Barbados, Chile, Guyana, Panama, and Uruguay.

(...) the LAC region can be characterized as having economies with an average level of exposure to generative AI that is less than that of the most industrialized nations, yet higher than that found in low-income regions, making it a relevant intermediate benchmark.

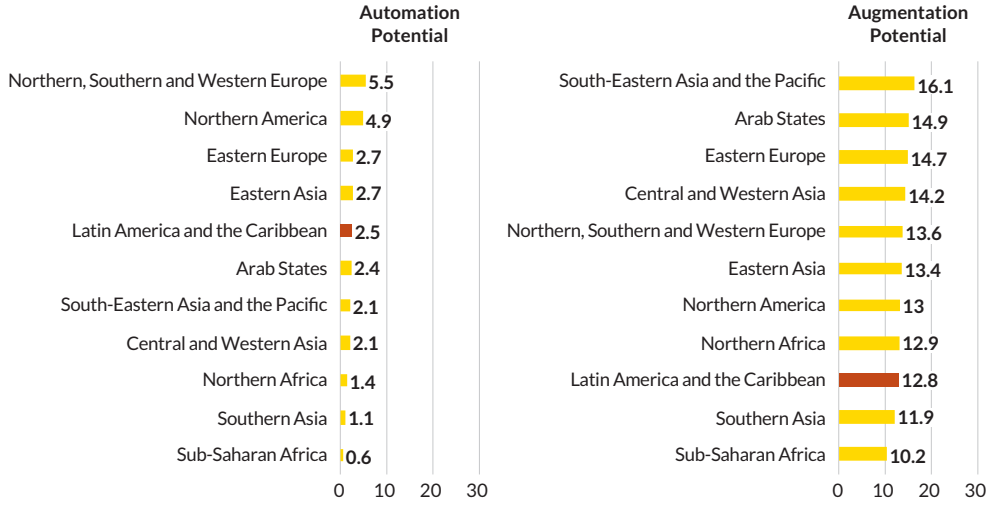
very small islands in the Caribbean with fewer than half a million inhabitants to countries with large populations such as Brazil and Mexico. Accordingly, it ranges from high-income countries such as Uruguay and Panama to lower-income countries such as Nicaragua and Honduras.

While there is a large body of literature analyzing the impacts of technological change on the labor market outcomes of LAC,[12] the expected incidence of generative AI is likely to be different from that of previous technological breakthroughs. Autor (2024) claims that the transformational impact of new technologies on labor is through the reshaping of human expertise, and he illustrates this hypothesis with two examples: The adoption of mass production in the 18th and 19th centuries, and the adoption of digital technologies since the 1960s. The emergence of mass production changed the complex work of artisans into self-contained and simple tasks carried out by production workers, using new machinery, and overseen by others with higher levels of education. The increased demand for this "mass expertise" was accompanied by an increasing number of high-school graduates, leading to the rise of a new middle class. Later, digital technologies allowed to be carry out routine tasks by encoding them in deterministic rules. Non-routine tasks could not be replaced by these technologies because they are not attained by learning rules, but through learning by doing. As a result, digital technologies gave rise to a new form of expertise by allowing professionals to obtain and process information more efficiently and thereby have more time to interpret and apply it. The routine jobs replaced by these technologies tended to be in the middle of the earnings distribution, while the non-routine jobs complemented by digitalization tended to be at the top, leading to a polarization of the labor market. AI, in contrast, can perform non-routine tasks that often require tacit knowledge. For example, it can allow non-elite workers (such as nurses) to engage in complex decision-making, and it can automate some of the tasks carried out by high-skill workers such as doctors, software engineers, and lawyers. However, as described below, the final impacts on jobs will depend on other factors as well. For example, the direct automation impacts of generative AI on jobs may be offset by positive impacts on productivity, which would strengthen labor demand.

While no previous granular assessments of occupational exposure to generative AI exist for the LAC region, there have been comparisons to other regions made in broader studies. For example, Gmyrek et al. (2023) places LAC somewhere in the middle of the regional ranking of potential automation exposure, with 2.5% of total employment falling into this category (Figure 1). In terms of augmentation potential, the same study ranked LAC as the third from the bottom (12.8% of employment). Similarly, while the World Economic Forum (WEF, 2023) global study did not provide a specific regional ranking, it projected a five-year structural labor churn in LAC of 22%, slightly below the global average (23%). In other words, the LAC region can be characterized as having economies with an average level of exposure to generative AI that is less than that of the most industrialized nations, yet higher than that found in low-income regions, making it a relevant intermediate benchmark.

[12] See Dutz et al. (2018).

Figure 1 - AUTOMATION AND AUGMENTATION POTENTIAL: LAC VERSUS OTHER REGIONS
Share of total employment (%)



Source: Prepared by the authors.

In theory, the rise of generative AI and its potential positive impacts on labor productivity could pose a significant opportunity for developing countries. Some recent private-sector studies have even suggested that the aggregate impact of widespread AI adoption could add between 0.1 and 1.5 percentual points of annual productivity growth in HIC, with slightly lower figures estimated for emerging markets (Goldman Sachs, 2023; McKinsey, 2023). Such projections might be particularly enticing for the LAC region, which has long grappled with a persistent productivity gap in comparison to other areas of the world. While the developing nations in Asia and Europe managed to narrow their productivity gap with the United States between 1990 and 2019, such gap increased for the LAC region during the same period (IMF, 2022). Recent trends also raise concerns since, despite some country variations (Erumban et al., 2024), the overall productivity growth has been almost zero in LAC ever since the start of the global productivity slowdown of the last 10 years (Dieppe, 2021). Compared to other regions, barriers to innovation and technology adoption have been particularly salient factors limiting productivity growth in LAC.

Could generative AI help unlock this productivity impasse? Recent empirical studies focused on the use of generative AI in particular occupational settings have suggested that the positive impacts on productivity can be large. For example, Peng et al. (2023) implemented a controlled experiment among professional programmers and found that access to a generative AI assistant reduced the time to complete programming tasks by 56%. Brynjolfsson et al. (2023) found that access to generative AI increases productivity among customer support workers in terms of issues resolved per hour, which is driven mostly by boosts in performance among novice and low-skill workers. Similarly, Noy and Zhang (2023) found that having access to ChatGPT helps improve the productivity of writing professionals by increasing the quality of outputs as well as by reducing the amount of time required to produce them, with the benefits being the largest for low-ability workers.

One of the main objectives of our paper is to quantify the limiting effects of such digital gaps in the LAC region, which also provides a proxy for the challenges that regions with even lower levels of income and digital infrastructure are likely to face.

While the results of this literature suggest a promising role for generative AI to boost productivity, in the context of LAC and emerging economies more broadly, there are important reasons to be cautious.

First, there are good chances that such initial macroeconomic projections are too optimistic and based on oversimplified models. As shown by Acemoglu (2024), when the tasks classified by Eloundou et al. (2023) as exposed to generative AI in the context of US-based occupations are linked to their actual impact on Gross Domestic Product (GDP), the average task-level savings, and the economic viability of AI deployment (Svanberg et al., 2024), the estimated impact amounts to a modest 0.71% of additional total factor productivity at the end of a 10-year period. Accounting for hard-to-learn tasks drops this estimate to 0.55% of total factor productivity (TFP), corresponding to additional GDP growth due to AI of 0.92% over 10 years. In addition, the actual impact on productivity in specific occupations might be largely dependent on how these technologies will be implemented in the workplace. For example, Doellgast et al., (2023) suggested that productivity benefits might be less consequential if the new AI tools are applied mainly for worker control, thereby limiting creativity and opportunities for larger value added through innovation in products and services. Acemoglu (2024) also demonstrated that the final impact on productivity largely depends on the type of new tasks that will emerge due to adoption and that some of such new tasks might either not contribute much new economic value or produce outright "public bads" that can be wrongly accounted as part of GDP growth based exclusively on their monetary value.[13]

Second, the rate of adoption and exposure to generative AI is likely to be slower in developing countries where fewer workers are using digital technologies than in their richer counterparts. More specifically, two individuals with the same occupation could have very different levels of generative AI exposure if one of them uses a computer or Internet at work, while the other one does not. Internet access in LAC countries varies from anywhere below 50% to over 90% of the population, with the digital divide clearly correlated with income-based differentials among countries. One of the main objectives of our paper is to quantify the limiting effects of such digital gaps in the LAC region, which also provides a proxy for the challenges that regions with even lower levels of income and digital infrastructure are likely to face. The underlying assumption of our approach is that having access to a computer and the Internet at work is a minimum requirement for drawing productivity benefits from generative AI tools. Consequently, workers without such digital basics will simply be excluded from any form of productivity gains that generative AI could offer in the professional context.

Third, beyond the hard infrastructure, software costs are likely to impact the economic viability of adoption in developing countries. Basic licensing of such products as ChatGPT or Microsoft Copilot can range around 20-30 USD per user per month, which can be significant, especially if applied to a range of workers in one company. Costs of enterprise-level solutions, either based on simple API integration or more complex proprietary AI systems can be significantly higher. In countries with high informality, including those of the LAC region, such costs are

[13] E.g., tasks related to dealing with the increasing complexity and costs of network security or content manipulation.

prohibitive for many small enterprises, which exist outside the reach of any public support schemes for rapid technological adoption. In the high-income context of the United States, Svanberg et al. (2024) calculated that among all occupations with high theoretical AI exposure, the current costs of automation with computer vision technology would make most businesses abstain from immediate implementation. Even a rapid decline in the costs of these technologies would still make the actual deployment a gradual process.[14] Given the lower income levels and higher digital limitations in the LAC countries, such a process should be proportionally slower, especially in smaller enterprises and those in the informal sector.

Fourth, workers need a minimum level of foundational skills to fully reap the benefits of these technologies (Autor, 2024), and such skills are likely to be scarcer in developing countries (OECD/ PIAAC, 2019). In the LAC region, the gap in the stock and quality of human capital compared to developed nations was already significant before 2020 (Bakker et al., 2020), and the school closures during the COVID-19 pandemic widened it even more (Schady et al., 2023). The recent experimental studies with generative AI are focused on very specialized groups of workers engaged in complex tasks who are likely to be at the top of the digital skills distribution across most developing countries. That is, the existing evidence of generative AI reduces skills inequality within these groups cannot be directly extrapolated to the whole economy or assumed to apply across the broader spectrum of the labor force typical in developing countries. In the case of LAC, the large informal sector is also likely to contribute to weak skills transferability across many occupations, with fewer opportunities for on-the-job training or state-supported skills development schemes that can be found in HIC.

In the case of LAC, the large informal sector is also likely to contribute to weak skills transferability across many occupations, with fewer opportunities for on-the-job training or state-supported skills development schemes that can be found in HIC.

Fifth, the results of these recent experiments and macroeconomic models do not consider general equilibrium or second-order effects on employment. For example, while increased productivity may bring employment and wage gains in sectors facing consumer demands that are growing rapidly, that may not be the case for sectors facing more stable consumer demands (Autor, 2024). The nature of these second-order effects is likely to be different across countries. In developing economies with a large fraction of the workforce in the informal sector, and where technology adoption and private sector investment are typically concentrated among a small share of formal firms (Cirera & Cruz, 2022), workers displaced from formal sector jobs may face more challenges finding high-quality jobs than their counterparts in high-income countries. While detailed macroeconomic modeling of such effects is beyond the scope of our study, the estimates of jobs' exposure to generative AI presented in this paper provide a profile of the socioeconomic groups more likely to experience the first-order impacts.

Historically, together with Sub-Saharan Africa, LAC is one of the most unequal regions in the world (World Bank, 2016a), with levels of income inequality strongly influenced by the changes in the structure of the labor market (Azevedo et al., 2013). Concerns about the impacts of new technologies on inequality in LAC are consistent with broader empirical evidence about the effects of recent waves of technological change on labor demand, which have tended to be skill-biased and

[14] Brynjolfsson et al. (2021) showed that technology adoption typically follows the J-curve, of which the flat part can extend over multiple years (Acemoglu, 2024).

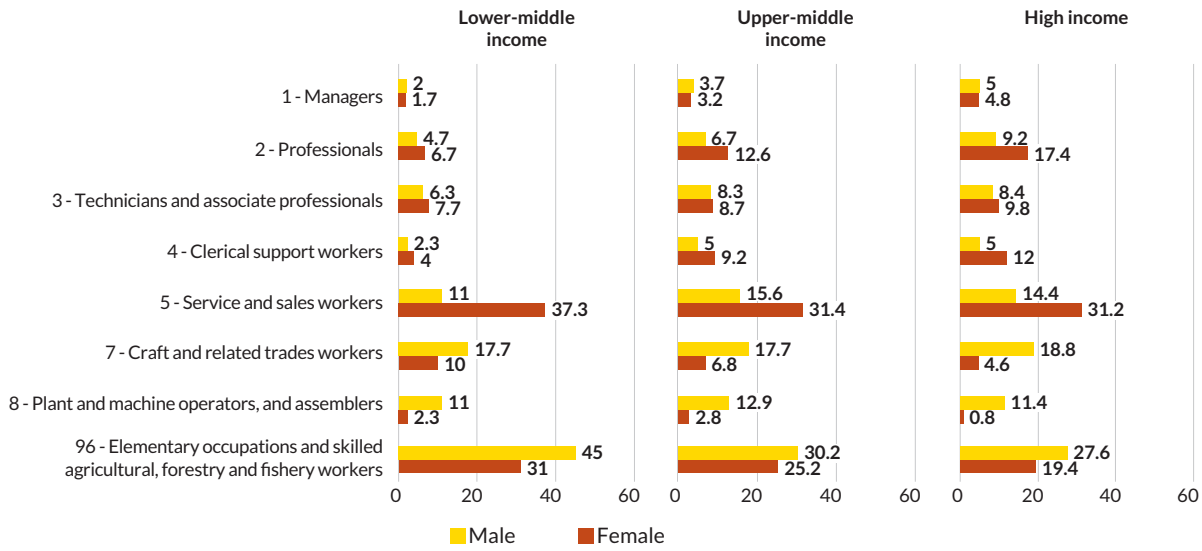
(...) the distributive impact of AI adoption depends strongly on how the effects of increased productivity and output could overcome labor displacement conducted by the substitution of technology for workers.

to widen the gap between low- and high-income workers (Acemoglu & Restrepo, 2022; Autor et al., 2008). Acemoglu's (2024) most recent modeling of generative AI outcomes on wages and inequality also suggested that in nearly all theoretical scenarios, the deployment of these technologies in the workplace is likely to increase the inequality between capital and labor and result in higher income inequality between different demographic groups, with particularly negative consequences for the incomes of low-education women in the United States.[15] In the case of LAC countries, Dutz et al. (2018) conducted a comprehensive discussion of the several challenges for the region in terms of digital technologies and how inclusive they might be, looking at diverse case studies of technology adoption in Latin America. In this regard, the distributive impact of AI adoption depends strongly on how the effects of increased productivity and output could overcome labor displacement conducted by the substitution of technology for workers. Although the use of AI technologies in Latin America remains still very low, recent empirical evidence has shown LAC labor patterns more consistent with the skill-biased technological change hypothesis than the job polarization model[16] (Brambilla et al., 2023; Messina et al., 2016; Messina & Silva, 2018). Similar conclusions have arisen from the literature on employment and automation in the rest of the developing world (Das & Hilgenstock, 2022), although Maloney and Molina (2016) found some evidence of incipient polarization in Brazil and Mexico.

To further theorize the potential effects of generative AI diffusion on inequality in the region, Figure 2 presents the most recent breakdown of LAC occupations by the highest, one-digit level of ISCO-08,[17] revealing visible differences in the employment structures across genders.

[15] Albeit with smaller wage effects than the previous waves of automation (see Acemoglu and Restrepo, 2022).
[16] The skill-biased technological change (SBTC) hypothesis suggests that technology benefits skilled workers, increasing demand for high-skill jobs and widening wage inequality. In contrast, the job polarization model posits that technology creates more high-skill and low-skill jobs, reducing middle-skill job opportunities and hollowing out the middle class.
[17] Elementary occupations are grouped together with agricultural, fishery and forestry work (96).

Figure 2 - OCCUPATIONS IN THE LAC REGION, BY ISCO ONE-DIGIT AND GENDER[18]
Mean share of employment within each income group (%)



Source: Prepared by the authors.

For men, most employment is in elementary, agricultural, forestry, and fishery work, followed by craft and related trade workers. For women, the largest employment categories concern service and sales work, followed by elementary jobs. Among the "service and sales workers," the pattern is very similar across country groups, with male employment dominant only in protective services, and female employment having much higher shares in personal care, sales, and personal service work. A more detailed analysis at the ISCO-08 2-digit level[19] reveals that – excluding IT, science, and engineering professions – women are significantly more represented across all professional categories, with particular prominence in teaching, health, business administration, and legal, social, and cultural occupations. This trend extends into clerical work and amplifies in line with countries' income status. This warrants attention since recent research has identified clerical and professional job categories as being more exposed to the risks of automation with generative AI (Cazzaniga et al., 2024; Gmyrek et al., 2023; Ozdeneron, Hakki, 2023; WEF, 2023), with pre-generative AI regional assessments also classifying female-held jobs in LAC as being at a higher risk of automation from digital technologies (Egana-delSol et al., 2022).

In accordance with the ISCO-08 technical documentation, such differences in occupational structures also correspond to varying levels of skills and educational attainment, as clerical support workers, technicians, and professionals are typically

[18] The breakdowns are presented as a share of male and female employment separately and calculated as a mean share of employment across the countries in each income bracket, based on ILO modelled estimates (ILO, 2023a).
[19] Plot A1 in the appendix shows a full breakdown of occupations at a 2-digit level of ISCO-08, by country and gender.

Given that educational attainment and earnings gaps across skills groups have been important drivers of income inequality in LAC (...), the impact of generative AI that follows existing labor market structures would likely also have an effect on overall income inequality.

classified in the mid- to high-skill level brackets (ILO, 2023b). Given that educational attainment and earnings gaps across skills groups have been important drivers of income inequality in LAC (Azevedo et al. 2013), the impact of generative AI that follows existing labor market structures would likely also have an effect on overall income inequality. In the best-case scenario, generative AI would boost the productivity of lower-skilled workers in the exposed occupations, allowing them to access higher incomes and therefore leading to a more broad-based income distribution. In the worst-case scenario, the technological transition could result in the automation of largely female-held jobs in the clerical, technical, and professional occupations, while the opportunities for new generative AI-augmented jobs could be limited, given the high concentration of current employment in elementary occupations and in the informal sector, where technology adoption and private sector investment are low. To better understand how the first-order effects of generative AI may affect inequality, this study provides a detailed profile of the socioeconomic groups most exposed to these technologies.

Finally, we acknowledge that the final outcomes of the technological transition process will also be largely dependent on the existing and future policy frameworks in the region. While the analysis of country-level policies and legal frameworks is beyond the scope of this regional study, the detailed country-level statistics that we make publicly available alongside this publication can serve as useful inputs to the discussions underpinning such policy responses.[20]

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Interview II

Artificial Intelligence and the labor market in Brazil: Opportunities, challenges, and public policy

By Paula Montagner

In this interview, Paula Montagner, undersecretary of Statistics and Labor Studies at the Ministry of Labor and Employment (MTE), discusses the impacts of adopting digital technologies in the labor market, as well as the importance and difficulties of collecting data on this adoption.

Photo: P. R.

Paula Montagner
Undersecretary of Statistics and Labor Studies at the Ministry of Labor and Employment (MTE).

Internet Sectoral Overview (I.S.O.)_ The intense adoption of digital technologies is expected to have significant impacts on the labor market. In the case of Artificial Intelligence (AI), what changes do you foresee may occur in the labor market? In your opinion, what are the main risks and opportunities for Brazil arising from these changes?

Paula Montagner (P.M.)_ With the inclusion of AI, the changes present us with enormous potentialities, especially when we consider that technology should be at the service of people and rather than merely replace them. Generative AI calls into question the way society operates, and it is noteworthy that all kinds of occupations and enterprises will face changes. If these changes are used to assist workers, improve their performance, and provide more time for people to address new challenges that are imposed – such as climate problems, existing environmental problems, the need to expand the use of clean energy, the possibility of delivering

"It is essential to better understand how all types of work might be changed to discuss how productivity can be increased in all sectors of activity, reshaping production and work processes."

better quality services in health, education, and information access across all regions – significant changes can be seen in medium- and high-qualification professions that once seemed safeguarded. How we approach these opportunities could radically transform everyone's quality of life. If all this potential is used only to increase the material wealth of a few people, it could set us back and reduce opportunities for the broader application of this new technology. At this juncture, we are learning about and can think of alternative ways of using technologies.

I.S.O._ Recently, the MTE established the Working Group on Artificial Intelligence (WG-AI). What are its goals and how does this group operate?

P.M._ The WG-AI's primary goal is to conduct research and integrate knowledge about the impacts of AI on the world of labor, considering Brazilian reality. It is essential to better understand how all types of work might be changed to discuss how productivity can be increased in all sectors of activity, reshaping production and work processes. So far, this technology seems to be more widely adopted in areas such as security, information, and communication; however, it is clear that there are other uses in the administrative and planning activities of practically every type of enterprise. We have learned a lot from experiences that aimed to empower workers, women, and associative enterprises in their use of these technologies, discussing their use not only when these tools become ready-made commercial packages, but also since their development. There are many studies that show how the use of exclusionary languages in technology can deter social groups from entering certain professions – such as women, marginalized groups, and the Black population. It is possible to actively avoid the maintenance of language biases, bringing together perspectives of different social groups and, by integrating diversity, expanding markets and generating new jobs. Girls in science, working in software development fields, have been creating social networks where knowledge is more widely shared and new solutions are generated, as they recognize their isolation. This changes access and language and can become an important practice.
Additionally, it is necessary to understand how AI usage could also recreate archaic patterns of labor exploitation (low pay, long working hours without rest or vacation), loss of social contact, and physical and mental illness, such as in platform-based work. Dialogue and negotiation can lead to better working conditions. The intention is to learn not only about the advancements made by market-leading enterprises but also to research alternative experiences that can empower different groups, such as women in science and workers engaged in disseminating culture and popular knowledge.
The challenges are significant, especially for countries with a larger proportion of young people and adults than elderly people, since the number of working-age people represents a substantial portion of the population. However, the energy transition poses new challenges: Climate deterioration and innovations, which demand new solutions, can not only change the ways of working with new occupations but also modernize existing ones. This is what we want to know to, in subsequent phases of the group's activities, propose guidelines that allow the creation of training and work requalification programs, in coordination with our

partners: Technical and technological schools. It will also be essential to assess how public services in the areas of work, intermediation, and capacity-building can perform better if they use more information and knowledge mobilized by AI.

I.S.O._ How important and difficult is it to collect data on the impacts of AI on the labor market? In Brazil, are there starting points for this type of collection?

P.M._ Quantitative and qualitative information have a primary role in this process, because, in addition to the use of tools, we must understand the types of knowledge that must be mobilized together to improve not only cognitive aspects but also skills and attitudes. This poses challenges about how to combine well the use of quantitative and qualitative information, which tend to be more well-known by sociologists and anthropologists, but also by communication areas since more meanings are involved. It is not enough just to read and speak; it is necessary to listen, write, and use new equipment with new demands on the use of time and language.

The starting points already exist and have been collaboratively thought about by researchers from different countries seeking to understand how AI modifies occupations and the necessary knowledge for each one. Undoubtedly, alongside the information and the intensity of different technologies usage, they are in search of knowing — often through qualitative studies — how this affects these workers' lives, their health, their ethics, and their perception of others. These are new objects that require a multidisciplinarity approach to be better understood.

In Brazil, many working groups collaborate with researchers from other countries, which has generated a significant difference, since we already have common indicators and multiple knowledge being mobilized. This seems to me a promising path to multiply the use of the information collected and develop new ways of using it to scrutinize the present, combining information from different sources, and looking for similarities, frequencies, and articulations. This approach seems promising for this knowledge to be mobilized both for labor union negotiations and the improvement of public and educational services.

I. S. O._ Among other objectives, the Brazilian Artificial Intelligence Plan (Plano Brasileiro de Inteligência Artificial [PBIA]) aims to awaken, train, upskill, and requalify AI talent at all levels, to meet the urgent need for qualified professionals and foster critical understanding of technology in our society. In general terms, what are the actions foreseen in the PBIA for this purpose? What is the role of the MTE to take them forward?

P.M._ The PBIA represents an important advance and coordinates the government's strategic projects. It is also an opportunity to think about democratizing citizens' access to public information and services. In an unequal country with a high-income concentration and still challenging levels of literacy, it is essential to develop solutions and services that are inclusive.

Initiatives, such as the PBIA, contribute to inform discussions within our WG, because, as I said before, it coordinates projects at the government level. As we critically assess our services and how they are communicated and made available to citizens,

"In an unequal country with a high-income concentration and still challenging levels of literacy, it is essential to develop solutions and services that are inclusive."

"Decent work, a fundamental basic agenda of our Ministry, requires us to consider the democratization of knowledge and access to physical and technological resources for every citizen."

we are also challenged to think about another aspect of training and professional qualification. However, this is not any type of qualification, merely instrumental, devoid of the debate on ethics, but on how we can use technology to overcome social inequalities and promote positive social impact.

Our project in the PBIA includes using AI in the intermediation processes of people looking for work, offering vacancies that are aligned with the worker's profile, as well as qualification courses to promote capacity-building and requalification necessary to meet new economic demands.

We know that the difficulties faced by citizens imply not only access to quality Internet or equipment (smartphones, computers). They also encounter difficulties in reading and understanding a piece of information, a command. On the other hand, the public power needs to rethink the language, the terms, the functionalities offered, and the ability to generate personalized information for citizens.

Decent work, a fundamental basic agenda of our Ministry, requires us to consider the democratization of knowledge and access to physical and technological resources for every citizen.

Domain Report

Domain registration dynamics in Brazil and around the world

The Regional Center for Studies on the Development of the Information Society (Cetic.br), department of the Brazilian Network Information Center (NIC.br), carries out monthly monitoring of the number of country code top-level domains (ccTLD) registered in countries that are part of the Organisation for Economic Co-operation and Development (OECD) and the G20.[21] Considering members from both blocs, the 20 nations with the highest activity sum more than 93.96 million registrations. In November 2024, domains registered under .de (Germany) reached 17.69 million, followed by the China (.cn), United Kingdom (.uk), and Netherlands (.nl), with 9.75 million, 9.04 million and 6.21 million registrations, respectively. Brazil had 5.39 million registrations under .br, occupying 6th place on the list, as shown in Table 1.[22]

[21] Group composed by the 19 largest economies in the world and the European Union. More information available at: https://g20.org/

[22] The table presents the number of ccTLD domains according to the indicated sources. The figures correspond to the record published by each country, considering members from the OECD and G20. For countries that do not provide official statistics supplied by the domain name registration authority, the figures were obtained from: https://research.domaintools.com/statistics/tld-counts. It is important to note that there are variations among the date of reference, although the most up-to-date data for each country is compiled. The comparative analysis for domain name performance should also consider the different management models for ccTLD registration. In addition, when observing rankings, it is important to consider the diversity of existing business models.

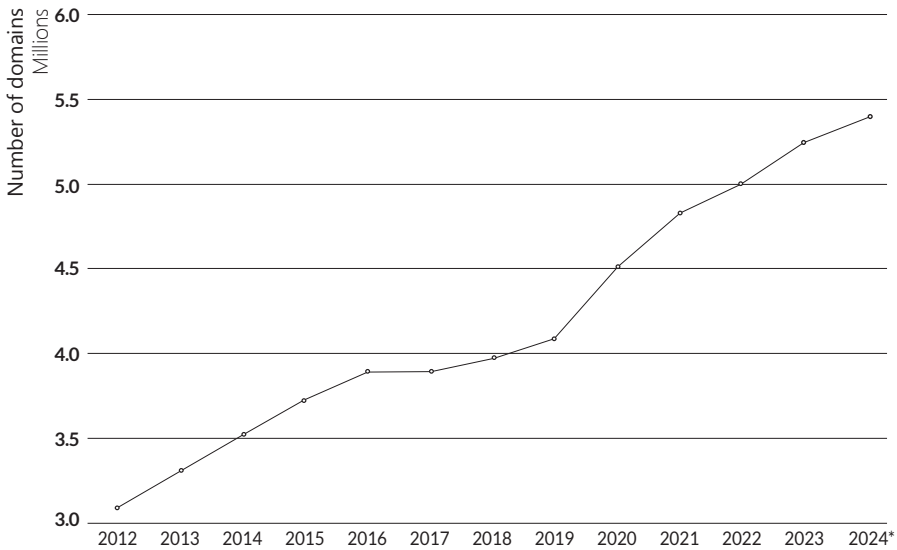
Table 1 – TOTAL REGISTRATION OF DOMAIN NAMES AMONG OECD AND G20 COUNTRIES

Position	Country	Number of domains	Date of reference	Source (website)
1	Germany (.de)	17,695,640	01/11/2024	https://www.denic.de
2	China (.cn)	9,754,503	01/11/2024	https://research.domaintools.com/statistics/tld-counts/
3	United Kingdom (.uk)	9,043,118	31/10/2024	https://www.nominet.uk/news/reports-statistics/uk-register-statistics-2024/
4	Netherlands (.nl)	6,211,827	01/11/2024	https://stats.sidnlabs.nl/en/registration.html
5	Russia (.ru)	5,850,671	01/11/2024	https://cctld.ru
6	**Brazil (.br)**	**5,399,286**	**31/10/2024**	**https://registro.br/dominio/estatisticas/**
7	Australia (.au)	4,240,096	01/11/2024	https://www.auda.org.au/
8	France (.fr)	4,206,978	30/10/2024	https://www.afnic.fr/en/observatory-and-resources/statistics/
9	European Union (.eu)	3,636,363	01/11/2024	https://research.domaintools.com/statistics/tld-counts/
10	Italy (.it)	3,500,957	31/10/2024	https://stats.nic.it/domain/growth
11	Canada (.ca)	3,396,327	01/11/2024	https://www.cira.ca
12	Colombia (.co)	3,303,805	01/11/2024	https://research.domaintools.com/statistics/tld-counts/
13	India (.in)	3,029,991	01/11/2024	https://research.domaintools.com/statistics/tld-counts/
14	Switzerland (.ch)	2,570,097	15/10/2024	https://www.nic.ch/statistics/domains/
15	Poland (.pl)	2,497,599	01/11/2024	https://research.domaintools.com/statistics/tld-counts/
16	United States(.us)	2,148,031	01/11/2024	https://research.domaintools.com/statistics/tld-counts/
17	Spain (.es)	2,081,668	30/09/2024	https://www.dominios.es/es/sobre-dominios/estadisticas
18	Portugal (.pt)	1,903,669	01/11/2024	https://www.dns.pt/en/statistics/
19	Japan (.jp)	1,769,106	01/11/2024	https://jprs.co.jp/en/stat/
20	Belgium (.be)	1,722,273	01/11/2024	https://www.dnsbelgium.be/en

Collection date: November 1, 2024.

Chart 1 shows the performance of .br since 2012.

Chart 1 – TOTAL NUMBER OF DOMAIN REGISTRATIONS FOR .BR – 2012 to 2024*



*Collection date: October 31, 2024.
Source: Registro.br
Retrieved from: https://registro.br/dominio/estatisticas

In November 2024, the five generic Top-Level Domains (gTLD) totaled more than 185.27 million registrations. With 154.53 million registrations, .com ranked first, as shown in Table 2.

Table 2 – TOTAL NUMBER OF DOMAINS AMONG MAIN gTLD

Position	gTLD	Number of domains
1	**.com**	154,532,622
2	**.net**	12,496,610
3	**.org**	11,004,584
4	**.xyz**	3,696,507
5	**.info**	3,545,566

Collection date: November 1, 2024.
Source: DomainTools.com
Retrieved from: research.domaintools.com/statistics/tld-counts

Would you like to learn more about the use of

Artificial Intelligence

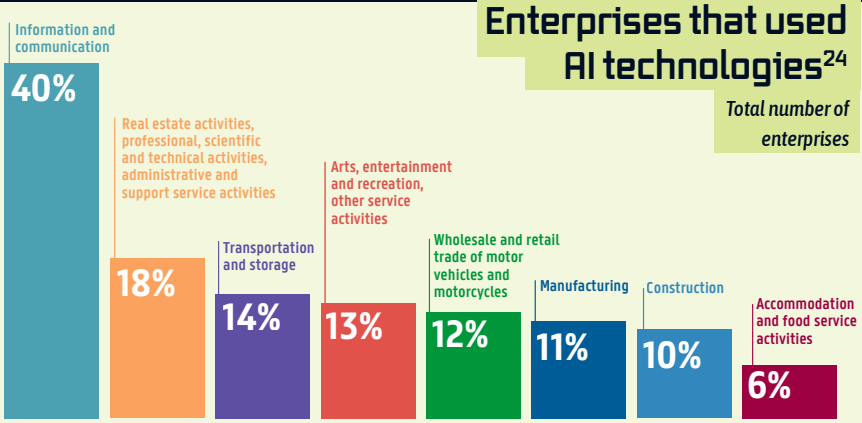
in Brazilian enterprises?

Check out some indicators from the ICT Enterprises 2023 survey[23]

Artificial Intelligence (AI) can improve production activities by automating repetitive tasks, reducing errors, and optimizing processes with greater efficiency. It allows enterprises to make more informed decisions using large volumes of real-time data. Moreover, AI can also predict demands and identify opportunities for innovation. For these reasons, many Brazilian enterprises are using this technology in their production activities.

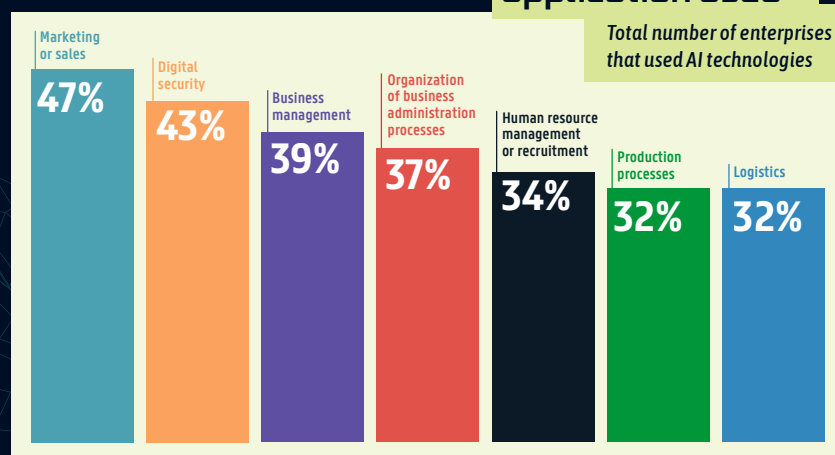
Enterprises that used AI technologies[24]

Total number of enterprises



Type of AI application used[25]

Total number of enterprises that used AI technologies



[23] Available at: https://www.cetic.br/en/publicacao/pesquisa-sobre-o-uso-das-tecnologias-de-informacao-e-comunicacao-nas-empresas-brasileiras-tic-empresas-2023/

[24] Data from the ICT Enterprises 2023 survey, conducted by Cetic.br|NIC.br. Available at: https://cetic.br/en/tics/pesquisa/2023/empresas/H9/

[25] Data from the ICT Enterprises 2023 survey, conducted by Cetic.br|NIC.br. Available at: https://cetic.br/en/tics/pesquisa/2023/empresas/H10/

/Credits

TEXT

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ABOUT CETIC.br

The Regional Center for Studies on the Development of the Information Society – Cetic.br (https://www.cetic.br/en/), a department of NIC.br, is responsible for producing studies and statistics on the access and use of the Internet in Brazil, disseminating analyzes and periodic information on the Internet development in the country. Cetic.br acts under the auspices of UNESCO.

ABOUT NIC.br

The Brazilian Network Information Center – NIC.br (http://www.nic.br/about-nic-br/) is a non-profit civil Entity in charge of operating the .br domain, distributing IP numbers, and registering Autonomous Systems in the country. It conducts initiatives and projects that bring benefits to the Internet infrastructure in Brazil.

ABOUT CGI.br

The Brazilian Internet Steering Committee – CGI.br (https://cgi.br/about/), responsible for establishing strategic guidelines related to the use and development of the Internet in Brazil, coordinates and integrates all Internet service initiatives in the country, promoting technical quality, innovation, and dissemination of the services offered.

*The ideas and opinions expressed in the texts of this publication are those of the respective authors and do not necessarily reflect those of NIC.br and CGI.br.

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