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Boosting Growth in Uruguay Through Structural Reforms and Artificial Intelligence

Maria Alexandra Castellanos, Christopher Evans, Roberta Guarnieri, and Hector Perez-Saiz

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Boosting Growth in Uruguay Through Structural Reforms and Artificial Intelligence

Prepared by Maria Alexandra Castellanos, Christopher Evans, Roberta Guarnieri, and Hector Perez-Saiz*

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November 2025

ABSTRACT: Over the last decades, Uruguay has made significant progress in advancing structural reforms, positioning itself as a regional leader in governance, macroeconomic stability, and trade openness. However, despite these achievements, economic convergence has stalled, and key structural gaps remain. This paper provides a broad view of Uruguay's structural reform landscape and artificial intelligence preparedness, identifying areas where policy action can unlock innovation, productivity growth and global competitiveness, and providing estimates of potential output gains. The paper concludes by outlining a set of reform priorities, highlighting the potential benefits of financial deepening, AI adoption, and other measures to enhance global competitiveness.

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Boosting Growth in Uruguay Through Structural Reforms and Artificial Intelligence

Uruguay

Prepared by Maria Alexandra Castellanos, Christopher Evans, Roberta Guarnieri, and Hector Perez-Saiz (all WHD)[1]

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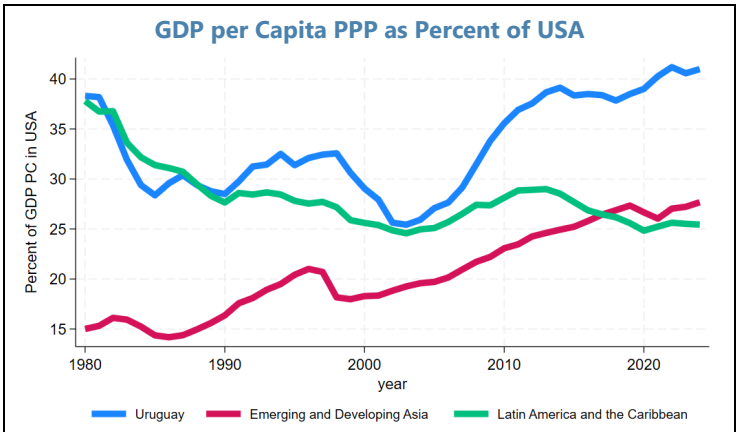
ANNEXES

BOOSTING GROWTH IN URUGUAY THROUGH STRUCTURAL REFORMS AND ARTIFICIAL INTELLIGENCE[1]

Over the last decades, Uruguay has made significant progress in advancing structural reforms, positioning itself as a regional leader in governance, macroeconomic stability, and trade openness. However, despite these achievements, economic convergence with high-income countries has stalled, and key structural gaps remain. This paper provides a broad view of Uruguay's structural reform landscape, identifying areas where policy action can unlock innovation, productivity growth and global competitiveness. The analysis indicates that well-targeted reforms in credit markets, trade facilitation, and labor market flexibility could increase output growth by up to 1.5 percentage points over the medium term, while advancements in artificial intelligence (AI) could raise GDP by as much as 10 percent over the next 30 years. Additionally, we analyze the granular impact of household- and firm-level constraints, highlighting the need to foster innovation and AI preparedness, reduce regulatory barriers, and enhance trade competitiveness. The paper concludes by outlining a set of reform priorities, highlighting the potential benefits of financial deepening, AI adoption, and other measures to enhance global competitiveness.

A. Introduction

1. Despite advances in the early 2000s, convergence of Uruguay towards countries with higher income level has stalled in the last decade. Since 1980, GDP per capita (in PPP) in Uruguay has hovered around 35 percent of the GDP per capita of the US. In contrast, convergence in many emerging and developing Asian countries has continued in the recent decades. A very successful example is South Korea, with a GDP per capita that is now nearly 80 percent of that of the United States, a significant increase from about 20 percent in 1980, when it was notably lower than Uruguay's GDP per capita.



Source: IMF staff calculations.

2. The path to economic convergence may crucially depend on the implementation of structural reforms and export-led growth strategies, particularly for middle-income countries. Structural reforms play a vital role in fostering long-term economic growth by improving efficiency, enhancing productivity, and creating an environment conducive to investment and innovation. According to

[1] Prepared by Maria Alexandra Castellanos, Christopher Evans, Roberta Guarnieri and Hector Perez-Saiz.

endogenous growth theory, as developed by Romer (1990) and Lucas (1988), long-run growth is driven by factors such as human capital accumulation, technological progress, and knowledge spillovers—all of which can be influenced by reforms. Acemoglu and coauthors (see Acemoglu, 2009) highlight the importance of institutions and market structures, emphasizing how improvements in property rights, regulation, competition, and education can spur innovation and entrepreneurship. In parallel, export-led growth through global competitiveness has long been a cornerstone of development theory, rooted in classical economic principles such as specialization (Smith, 1776), comparative advantage (Ricardo, 1817), and scale economies (Marshall, 1890). Modern trade and endogenous growth models demonstrate that exports enhance productivity through increased competition, learning-by-exporting, and resource reallocation—findings that are also supported by empirical evidence (De Loecker & Syverson, 2021). For middle-income countries, the risk of falling into a "middle-income trap" (Kharas and Bhattasali, 2007; World Bank, 2024) underscores the need for innovation-driven growth, diversification into high-value-added industries, and technological adoption (Aghion & Howitt, 2009), supported by strong human capital and high-tech exports (Lee, 2020). Reaching high-income status also requires improvements in governance, trade openness, financial development, or R&D (Barro & Sala-i-Martin, 2004; Acemoglu & Robinson, 2012).

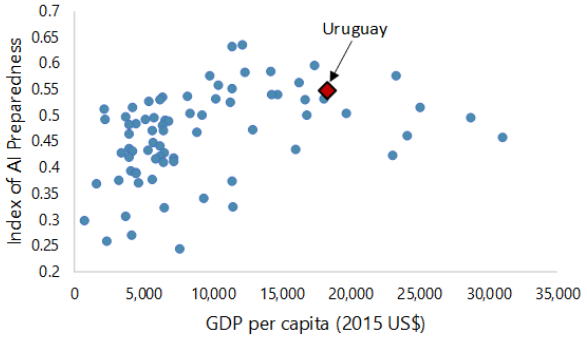
3. Compared to Latin America and the Caribbean, Uruguay's performance is generally strong across various socio-economic indicators. Uruguay is an example for other regional peers in terms of human capital, poverty reduction, sound and stable macroeconomic policies, solid governance and institutions. In some indicators, such as control of corruption, Uruguay even performs better than many advanced economies. However, investment and total factor productivity growth have been disappointing, contributing to the lackluster growth. Youth unemployment has remained high, and regional disparities persist, especially in the northern departments. Uruguay's global integration and participation in global value chains is limited due to regulatory barriers and low competitiveness. The dominance of state-owned enterprises (SOEs) in key sectors contributes to inefficiencies and potential conflicts of interest, while infrastructure bottlenecks, particularly in logistics and transport, further hinder competitiveness. The financial sector, though stable, is heavily dollarized, restricting credit access for micro, small, and medium-sized enterprises. Firms perceive labor markets practices as rigid, and the education system faces persistent challenges related to quality, completion rates, and early learning outcomes.

4. Artificial intelligence (AI), which has the potential to profoundly change the global economy, could also enhance Uruguay's growth. AI promises to boost long-term productivity and growth, however its consequences on the structure of economies and distribution of the labor market are uncertain. AI adoption will likely lead to reallocation between labor and capital, while certain tasks may be replaced by AI and others complemented (Barr, 2025). The field of AI, and available AI technologies, is experiencing a swift evolution and strong growth. Generative AI technologies such as large language learning models have broadened AI's potential application and

accessibility.[2] AI models can also be more specialized, focusing on discrete tasks such as pattern identification or repetition. The automation of repetitive tasks can help boost productivity and reshape job functions and the division of labor. Research into the economic impact of artificial intelligence is growing field (see Acemoglu (2025), Goldman Sachs (2023), Korinek (2024)), which this work aims to contribute to through the lens of a country case, Uruguay.

5. Uruguay ranks highly in AI preparedness compared to other Emerging Market economies. The IMF's AI Preparedness Index aggregates information on the countries' digital infrastructure, human capital and labor market policies, innovation and economic integration, and regulation and ethics.[3] Uruguay ranks highly amongst other emerging market economies using the overall AI preparedness Index (AIPI), which aggregates the separate components, and particularly high for regulation and ethics, placing her in the top 5 countries for this category.[4] Other AI indices corroborate Uruguay's high ranking. Uruguay ranks third in Latin America according to the Latin American Artificial Intelligence Index by CEPAL or the Government AI Readiness Index by Oxford Insights, scoring also higher in government, technology, data & infrastructure compared to the Latin America and the Caribbean average.[5]

AI Preparedness Index for Emerging Market Economies and GDP per capita



Source: IMF staff calculations.

6. This suggests that structural reforms aimed at closing gaps in areas such as competitiveness and harnessing the benefits of AI will be essential to enhance Uruguay's growth potential. During the 1990s, Uruguay embarked, as did many countries, on a series of ambitious structural reforms aimed at transforming its economy. In the last two decades, however, the pace of structural reforms has notably slowed due to political and economic changes, or public resistance. Gaining the necessary social and political support to enact and sustain these policies and reforms has been a formidable challenge (WEO, 2024).

7. This paper analyzes the state of structural reforms in Uruguay, providing an empirical assessment of key indicators in financial markets, business competitiveness or innovation (AI).

[2] Generative AI, which learns by training on extensive data, can create new content, such as text, images and code and solve complex mathematical problems.

[3] https://www.imf.org/external/datamapper/datasets/AIPI

[4] Regulation and ethics measure of the AIPI is a measure of strong legal frameworks and enforcement mechanisms. (i.e. legal framework's adaptability to digital business models, government effectiveness, and voice and accountability). Further, Uruguay has agreed to adhere to the OECD AI Principles, which promote trustworthy and responsible AI systems.

[5] The 2024 Government AI Readiness Index by Oxford Insights examines 40 indicators across three pillars: Government, Technology Sector, and Data & Infrastructure. It highlights progress, identifies gaps, and provides actionable insights for policymakers working to integrate AI into public service delivery.

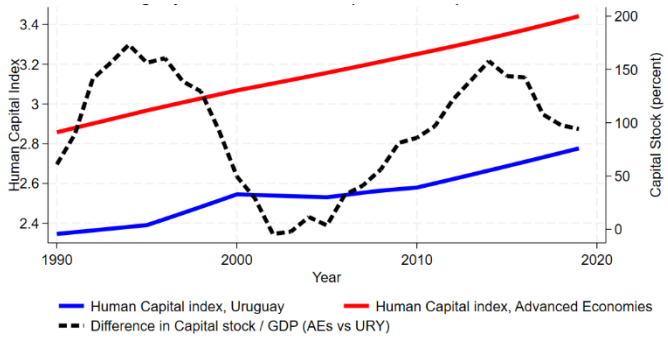
It starts with a short discussion of potential growth in section B. Then, it examines structural gaps and AI preparedness relative to global benchmarks in section C, before providing potential output gains in section D. Firm-level constraints on productivity and innovation are discussed in section E, and drivers of firms' export orientation are discussed in section F. Finally, the paper concludes by outlining a set of reform priorities, highlighting the potential benefits of financial deepening, artificial intelligence, and other measures to enhance competitiveness and boost growth.

B. Growth and Economic Structure of Uruguay in Historical Context

8. Uruguay's real GDP growth history has been characterized by the influence of external shocks (Figure 1). Average growth over the last 60 years has been 2.2 percent, lower than the 3.9 percent of its other LA7 peers[6], and has been subject to significant volatility. Over the last 10 years, growth has been dampened by a series of shocks—a recession in Brazil in 2015, Covid-19 and recently the most severe drought in the last 100 years—resulting in an average growth rate of 1.2 percent per year.

9. Uruguay has made substantial progress in transforming its economic structure over the past four decades, yet disparities with advanced economies continue to pose challenges. There has been a marked decline in agriculture and manufacturing as shares of value added, while services have become increasingly dominant—mirroring trends in both Latin America and emerging Asia. Structural changes in the economy, alongside good macroeconomic resilience, have been supported by steady progress in human capital and competitiveness. Uruguay has steadily strengthened its human capital and capital stock since 1990, laying the groundwork for long-term productivity gains. However, gaps with advanced economies remain—and in some cases, have widened. Additional policy efforts are needed to convert these gains into sustained total factor productivity growth.[7]

Uruguay vs AEs: Human Capital and Capital Stock



Source: Penn World Tables 10.0.

10. Conducting a growth accounting exercise allows to better understand the drivers of economic growth and informs assessments of potential growth going forward. A growth accounting exercise decomposes growth into contributions from labor, capital, and total factor productivity (TFP). Relying on data from the Penn World Tables 10, we show that over the last 30 years capital accumulation has been a consistent component in the driver of growth for Uruguay,

[6] LA7 consists of Brazil, Chile, Colombia, Mexico, Peru, Paraguay and Uruguay.

[7] Uruguay has also maintained a solid track record of prudent macroeconomic policies, contributing to a stable economic environment characterized by manageable inflation, a relatively stable exchange rate, and sustainable fiscal accounts—conditions conducive to business growth.

while TFP has played an important but volatile role. Labor has played a diminished role in Uruguay's growth—throughout the period studied, employment has increased while average hours worked has fallen. Going forward, potential growth could be around 2.2 percent assuming (i) real investment grows around 3-4 percent per year (the average of the last 25 years) (ii) labor force grows at 0.2 percent, as migration flows continue and population grows according to the historical trend of the last 10 years outlined in the 2023 census (iii) the contribution from TFP growth is around 1 percent, close to the average over the last 20 years (excluding 2020-2021 due to covid). These results are similar, albeit slightly lower than what the Ministry of Economy and Finance has concluded, based on inputs from a Committee of Experts in charge of assessing the outlook for investment, labor and total factor productivity growth.

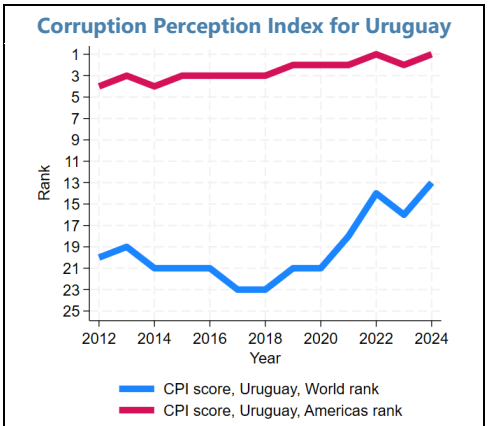
Figure 1. Uruguay: Economic Growth in Historical Perspective

Sources: United Nations National Accounts; Fraser Institute; Penn World Tables 10.0; and IMF Staff calculations.
Notes: Emerging East and Southeast Asia includes China, Cambodia, Indonesia, Laos, Malaysia, Mongolia, Philippines, Thailand and Vietnam. Human capital index and capital stock are from PWT 10.0. database. The agriculture sector includes the Agriculture, hunting, forestry and fishing sector (ISIC A-B); manufacturing includes construction (ISIC F), manufacturing (ISIC D) and mining, Manufacturing and utilities (ISIC C-E). Services includes all other sectors.
Notes: Figure 1.c presents the results from statistically filtering quarterly real GDP using different methods and combining these estimates with the potential output from an estimated DSGE model (Rabanal and Sbrancia, 2024). Statistical filters used are: Christiano and Fitzgerald band-pass filter, Butterworth high-pass filter, Boosted Hodrick-Prescott filter, Holston-Laubach-Williams multivariate filter.

11. Estimates using different statistical filtering methods over higher frequency data yield a range of 1.9-2.5 percent for potential output growth. These are derived by using a mixture of univariate and multivariate filters as well as an estimated DSGE model. Using quarterly data up to 2024Q3 and taking the median of the different estimates, potential output over the last couple of years is around 2.2 percent. To separate real GDP into trend and cyclical components the univariate filters used are the Christiano-Fitzgerald (band-pass filter), Butterworth filter (high-pass filter) and the Boosted Hodrick-Prescott filter (see Phillips and Shi, 2021). The multivariate filter follows the approach of Holston-Laubach-Williams (2023) to jointly estimate potential output and the real neutral rate using a Kalman filter. The statistical approach is combined with a medium-scale DSGE model estimated for Uruguay (Rabanal and Sbrancia, 2024), which jointly estimates the real neutral rate and potential growth.

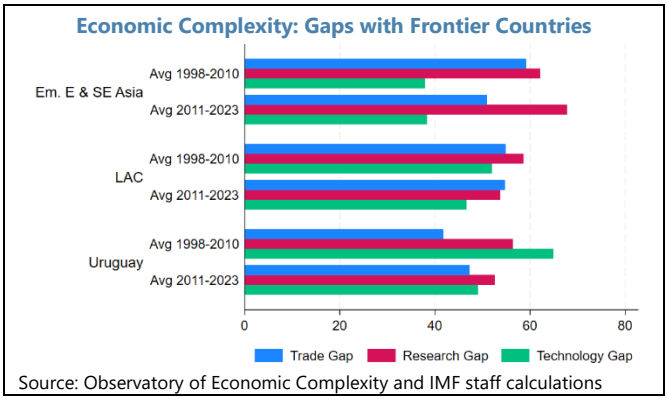
C. Main Structural Gaps and AI Preparedness

12. While Uruguay has made substantial progress in economic development through the implementation of structural reforms, gaps persist in certain areas. Widely-used cross-country indicators of economic and governance performance—such as those from the World Bank and Fraser Institute—are employed to benchmark Uruguay against global leaders and regional peers. According to such standard indicators (Figure 2), the country is one of the top performers in the Latin America and Caribbean (LAC) region and among emerging markets in the areas of governance, external sector policies, and business regulation. For instance, Uruguay's performance in Transparency International's Corruption Perceptions Index (CPI) places it as the least corrupt country in the Americas, while at the global level, the rank was 13th globally, above many advanced economies.



Source: Transparency International

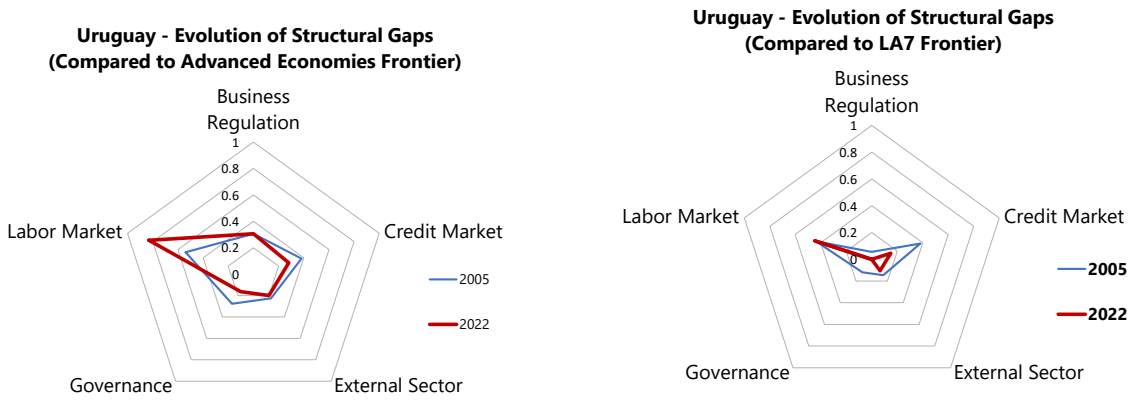
13. However, moderate gaps compared to peers exist in other areas, such as credit and labor market regulation, and economic complexity, suggesting room for further improvement. Labor market regulations have been increasingly perceived as rigid over time due the centralized nature of wage-setting and hiring practices (Figure 2). Improving in these areas could enhance economic efficiency and foster a more competitive business environment, making Uruguay's regulatory framework more flexible and aligned with advanced



Source: Observatory of Economic Complexity and IMF staff calculations

economies. Using the Economic Complexity Index (ECI),[8] Uruguay appears to exhibit some widening gaps in economic complexity relative to frontier countries, particularly in trade and research dimensions. Between periods 1998–2010 and 2011–2023, the trade gap increased in Uruguay, indicating a growing divergence in export sophistication and diversity. While the technology gap has narrowed somewhat, Uruguay still faces substantial challenges in catching up in terms of innovation and research capabilities. Compared to peers in Latin America and Emerging East and Southeast Asia, Uruguay performs similarly in research and technology gaps but has fallen further behind on trade-related complexity.

Figure 2. Uruguay: Evolution of Structural Gaps



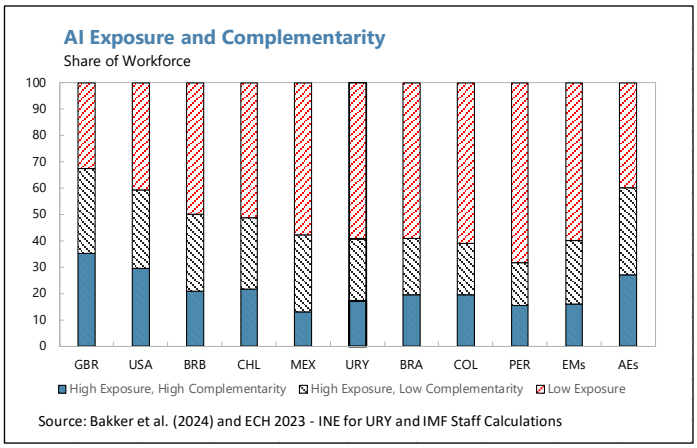
Sources: Fraser Institute, World Bank, and IMF staff calculations.
Note: In this chart, structural Reforms—business regulation, the credit market, the external sector, governance, and the labor market—are compared to global leaders in selected peer groups (Advanced Economies and LA7). LA7 includes Brazil, Chile, Colombia, Mexico, Paraguay, Peru and Uruguay. Each reform indicator is normalized between 0 and 1 over the time-period 2000-2022, with higher value implying better quality of institutions and regulation. For a given year, structural gaps are calculated as the absolute difference in values between the frontier (maximum value in each comparator group) and Uruguay. Thus, a larger structural gap implies that the country is further away from the frontier. Table in Annex provides a brief description of what each indicator captures

14. Regarding the preparedness of the labor force to AI, Uruguay's labor force has similar exposure to AI compared with the average Emerging Market economy. The level of AI exposure, the degree to which a task can be substituted by AI, and the ability of an occupation to be complemented by AI, such that AI enhances human capital, are used to compare the structure of labor markets across economies. Uruguay's labor market is similarly exposed to AI as the average emerging market economy, which ranks below advanced economies. Within this level of exposure to AI the share of Uruguayan workforce that work in occupations that are highly complementary with AI is also similar to the average emerging market economy. Uruguay's AI exposure is below that of Chile and Mexico and more similar to Brazil and Colombia (Bakker et al., 2024).

[8] The Economic Complexity Index (ECI) is a composite metric designed to quantify the productive knowledge embedded in an economy by analyzing the diversity and sophistication of its exports https://oec.world/en/rankings/eci/hs6/hs96

15. AI exposure measures the ability of an AI to replicate human abilities. To study the effect of technological innovation on jobs, this paper follows the literature and conceptualizes individual occupations as a bundle of tasks and considers which tasks can be replaced or complemented by technology (see for instance Acemoglu and Restrepo 2022; and Moll, Rachel, and Restrepo 2022 for recent applications). Felten, Raj, and Seamans (2021, 2023) define "exposure" to AI as the degree of overlap between AI applications and required human abilities in each occupation. To study exposure to AI, this paper considers the AI Occupational Exposure (AIOE) index proposed by Felten et al. (2021). This index considers the overlap between AI applications in several fields and the human abilities needed to perform a given occupation, thus appraising the degree to which AI can replicate the skills essential to each job. Using the Uruguayan *Encuesta de Continua de Hogares* (ECH, household survey) from INE, workers occupations at the 4-digit ISCO 08 occupation level are matched to the AI exposure index by Felten et al. (2021).

16. The measure of AI Complementarity is used to assess an occupation's shielding and complementary potential to AI (see Annex). This index reflects an occupation's likely degree of shielding from AI-driven job displacement and, when paired with high AI exposure, gives an indication of AI complementarity potential. An occupation has several types of outputs, some of which may be easily automatized or completed by AI (high exposure to AI) but there could be other tasks that have limited scope for unsupervised AI (high complementarity to AI). One such profession that has high-exposure and high-complementarity to AI are lawyers. For example, advances in textual analysis could complement lawyers' daily activities by providing them assistance to quickly analyze and review large volumes of legal documents, contracts, and case laws, and therefore increasing their productivity. However, an important part of a lawyer's job is their interpersonal interactions through meeting clients, negotiating terms with other lawyers, presenting a case in court, activities that AI is not currently suited to. Other cognitive jobs with a high degree of responsibility and interpersonal interactions, such as surgeons or judges are also categorized as high-exposure high-complementarity to AI occupations. Box 1 presents the measures of exposure to AI and complementarity for different demographics.[9]

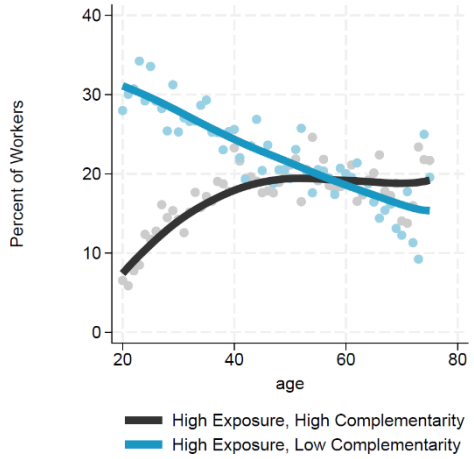


[9] We analyze our measure of AI exposure across demographics following Guntin (2021), who looks at the share of Uruguayan workers working from home during the pandemic. For our analysis we adapt the code that kindly accompanies that paper.

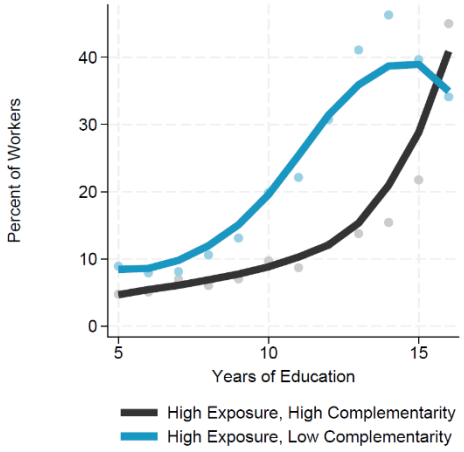
Box 1. Demographics of AI Exposure

As Uruguayan workers age, they are less likely to be in high-exposure low-complementary occupations, while more years of education increases exposure to AI. Cazzaniga et al., (2024) show that as workers age the share of high-exposure high-complementarity workers increase, especially for college educated workers. For Uruguayans this transition happens particularly between the ages of 20-40, until their career progression stabilizes in their 40s and 50s, when typically workers have reached senior roles and are less likely to make significant job switches. Older workers, which may find it more difficult to reskill and adapt to AI, may struggle with reemployment. Younger workers are typically more adaptable to new technologies, however, AI adoption may diminish crucial learning opportunities. Additional years of education levels are associated with a greater share of employment in high-exposure occupations, but this is especially pronounced in occupations with high complementarity to AI.

AI Exposure and Complementarity
(by age)



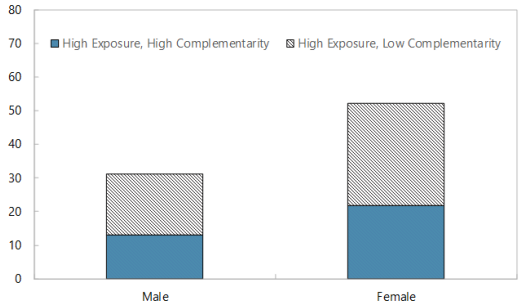
AI Exposure and Complementarity
(by years of education)



Source: ECH 2023 (INE) and IMF Staff calculations

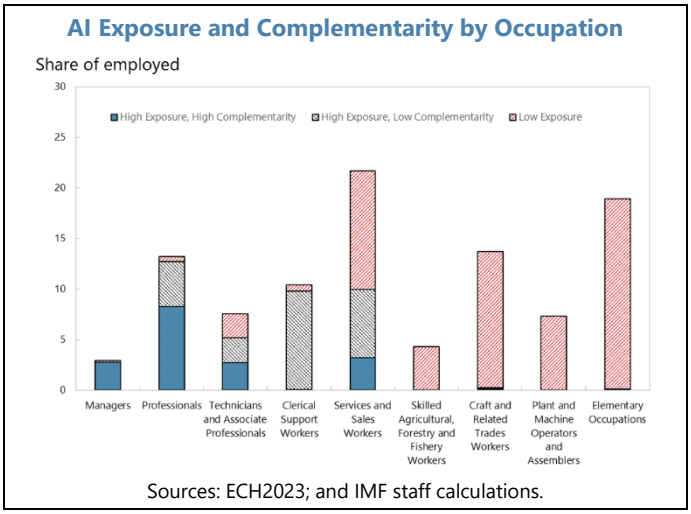
Exposure and complementarity to AI is unequal across genders. For Uruguay, as with other countries studied, females tend to work in occupations that are more exposed to AI than males. Part of this can be explained by the rise of the service sector, where the increase in the service sector has been accompanied by a decline in male-to-female participation gaps (Alvarez, 2022). The service sector, which uses relatively less "brawn" skills and more "brain" skills (Ngai and Petrongolo, 2017) is particularly susceptible to AI exposure. In Uruguay, a larger share of female workers are also in occupations that are highly complementary to AI compared to males, this can be interpreted to mean that women face both greater risks and greater opportunities from AI adoption.

AI Exposure and Complementarity by Gender
(as a percent of group's employment)



Source: ECH 2023 (INE) and IMF staff calculations

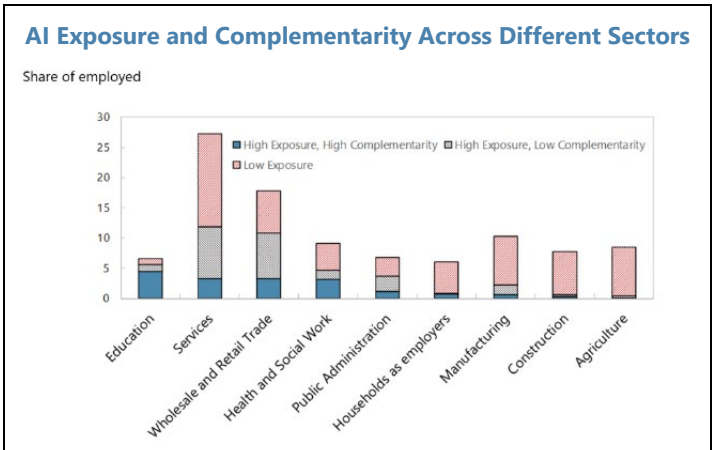
18. The majority of Uruguayans work as service and sales workers, which have varied exposure to AI. In Uruguay, most workers are employed as 'service and sales workers', facing high exposure to AI, though with varying degrees of complementarity. For instance, cooks, waiters, and hairdressers have low AI exposure due to the hands-on nature of their tasks. Sales assistants are highly exposed but with low complementarity, while teachers' aides and childcare workers face high exposure with high complementarity—making them more likely to benefit from AI without being displaced.



Sources: ECH2023; and IMF staff calculations.

19. Workers in managerial and professional occupations have the highest exposure to AI. Uruguay has a sizable portion of employment in professional and managerial occupations (above 15 percent of the employed population), which exhibit high exposure and high complementarity, and in clerical support workers and technician occupations, which generally present high exposure and low complementarity to AI. In contrast, manual labor occupations in traditional industries, may initially face fewer AI-induced disruptions. For example, skilled agricultural workers, craftsmen, plant operators and workers in elementary occupations have low exposure to AI. In general, Uruguay's labor market exhibits a mixed exposure to AI, akin to other emerging markets such as Brazil, which is less technical and therefore less exposed to AI than the UK (Cazzaniga et al, 2024).

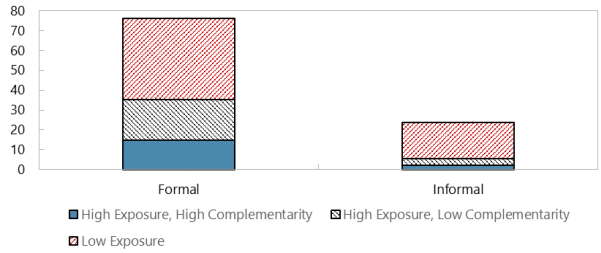
20. AI exposure and complementarity is dispersed across a multitude of sectors. An analysis of Uruguay's AI exposure and complementarity by ISIC Rev. 4 economic classifications reveals varying levels of exposure across sectors. Wholesale, retail trade, and services—where most Uruguayans are employed—contain a mix of occupations, some highly exposed and complemented by AI, others with low or no complementarity. The education sector stands out, with many roles both highly exposed and highly complementary to AI, indicating strong potential for AI to enhance learning and administrative tasks. The health sector similarly benefits, with AI improving diagnostics, patient care, and efficiency. Although sectors such as agriculture, construction, and manufacturing are less exposed to AI due to their reliance on manual labor, they remain innovative, as shown by initiatives led by institutions like INIA.



Sources: ECH2023; and IMF staff calculations.

21. Informal workers are mostly in low exposure to AI occupations. Uruguay consistently enjoys one of the lowest informality rates in Latin America and the Caribbean, around 20-25 percent. Within the informal workforce, the majority of workers are in low-exposure occupations. The formal workforce, which houses around 75 percent or workers, displays a mixture of high exposure and low exposure workers. AI-driven solutions present a transformative opportunity to integrate informal workers into broader economic systems, effectively enhancing productivity and bolstering financial inclusion (Bakker et al., 2024).

AI Exposure and Complementarity by Labor Status
(share of employed)

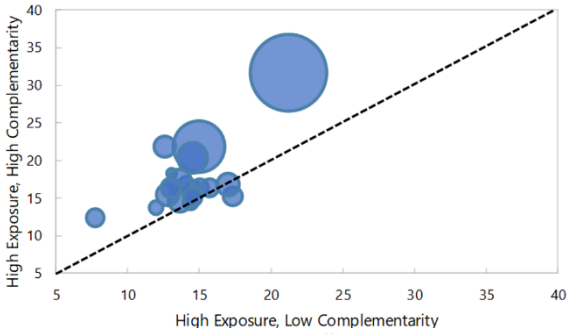


Sources: ECH2023; and IMF staff calculations.

However, AI adoption may cause displacement in the formal sector, where firms pay a cost for formality (labor tax wedge), especially for those most at risk (high exposure – low complementarity), which could lead to those jobs to become informal if not adequately managed.

22. The Uruguayan workforce is concentrated in Montevideo, working in occupations with high exposure to AI. From the 19 departments in Uruguay, Montevideo, the capital, is the most populous and where forty percent of the population live. Montevideo's working population is comprised of a mix of occupations that are 'high exposure, highly complementarity', 'high exposure, low complementarity' and 'no-exposure'. This diversity reflects that Montevideo is home to a wide range of industries, from tech and innovation-focused sectors to more traditional roles that may not heavily engage with AI technologies. Further, the mix of occupations signals the potential benefits Montevideo may receive from AI adoption but also highlights the possibility of displacement for the local labor force. The department of Canelones, famous for its agriculture and wine production, has a majority share of workers not directly exposed to AI. Targeted interventions could help bridge the gaps between regions, ultimately enhancing the workforce's resilience and adaptability to AI.

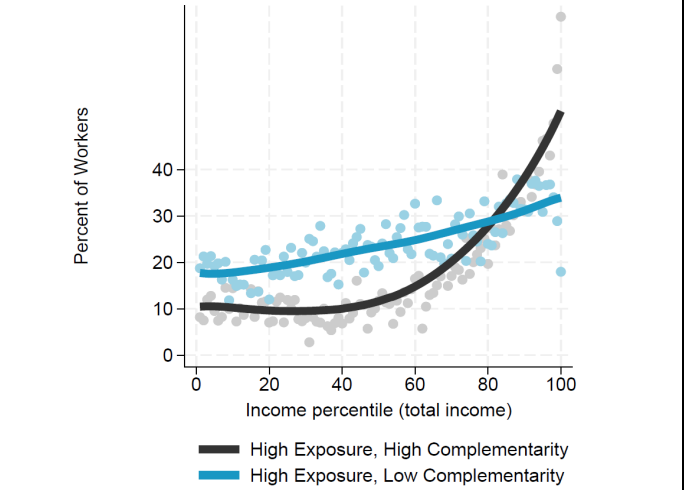
AI Exposure and Complementarity by Regional Departments
(By share of employed in each department. Bubble size is department's population)



Sources: ECH2023; Census 2023; and IMF staff calculations.

23. The literature has noted the positive correlation between high income workers and high complementarity to AI (Wang et al., 2024). AI Exposure is spread along the labor income distribution, but potential gains from AI are positively correlated with income. The share of employment in occupations at risk of displacement (high-exposure, low complementarity jobs) is increasing across income quantiles (with a mildly positive trend). This differs from previous waves of automation and information technology during which risks of displacement were highest for

middle-income earners (Moll et al., 2022). AI differs from traditional automation by potentially affecting jobs of workers throughout the income distribution. However, employment in occupations that have a high potential for complementarity with AI (high-exposure, high-complementarity jobs) is more concentrated in the upper-income quantiles, especially in top 20 percent of earners. This suggests that AI's gains will likely disproportionately accrue to higher-income earners in Uruguay, which is also true in countries such as India and to a lesser extent, the US (Cazzaniga and et al, 2024).



Sources: ECH2023 (INE); and IMF staff calculations.

D. Potential Output Gains

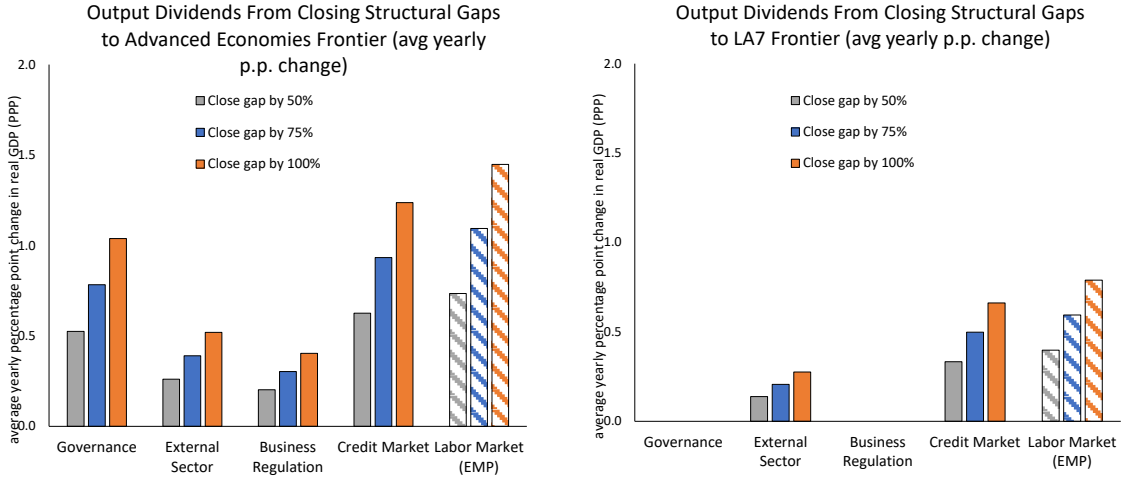
24. According to empirical model estimates (Budina et al. 2023) applied to Uruguay, the potential economic impact of closing some of these structural gaps is considerable (Figure 3). This methodology uses the local projection method, originally developed by Jordà (2005), to estimate the dynamic effects of structural reforms on output across emerging market and developing economies. This approach involves regressing future values of output on current and past values of structural reform indicators, along with control variables, to trace the temporal impact of reforms while accounting for potential confounding factors (see also Annex). Estimates show that reforms closing the gap between Uruguay and the most advanced country in the area of governance, business regulation or external orientation, could increase Uruguay's annual growth by up to 1 percentage points.

25. Further reforms in credit markets could yield additional gains in output and employment. Financial development plays a crucial role in fostering economic growth by improving the allocation of capital, facilitating entrepreneurship, and reducing credit constraints that hinder productive investment. There is a relatively large literature on financial sector development and long-term economic growth,[10] and its findings are in line with simple correlations between GDP per capita and relevant structural indicators (Figure 4). The empirical model estimates from Budina et al. (2023) suggest that achieving the same score as the global frontier in terms of credit market could

[10] For instance, Buera, Kaboski, and Shin (2011) provides a structural framework to analyze how financial frictions impact long-run growth and transitional dynamics. Their model highlights how financial underdevelopment disproportionately restricts high-productivity firms from expanding, leading to a misallocation of capital and labor that lowers aggregate total factor productivity (TFP). As financial markets deepen, TFP and capital accumulation rise together, leading to a higher capital-output (K/Y) ratio and economic growth, underscoring the importance of financial reforms in accelerating economic growth by enabling capital to flow to its most productive uses. See also Greenwood, Sanchez and Wang (2010), Buera and Shin (2013), or Moll (2014), among others.

increase growth by up to 1.2 percentage points. Similarly, although with weaker statistical significance, the estimates suggest that labor market reforms that enhance flexibility in hiring and wage-setting practices, could dynamize the economy.

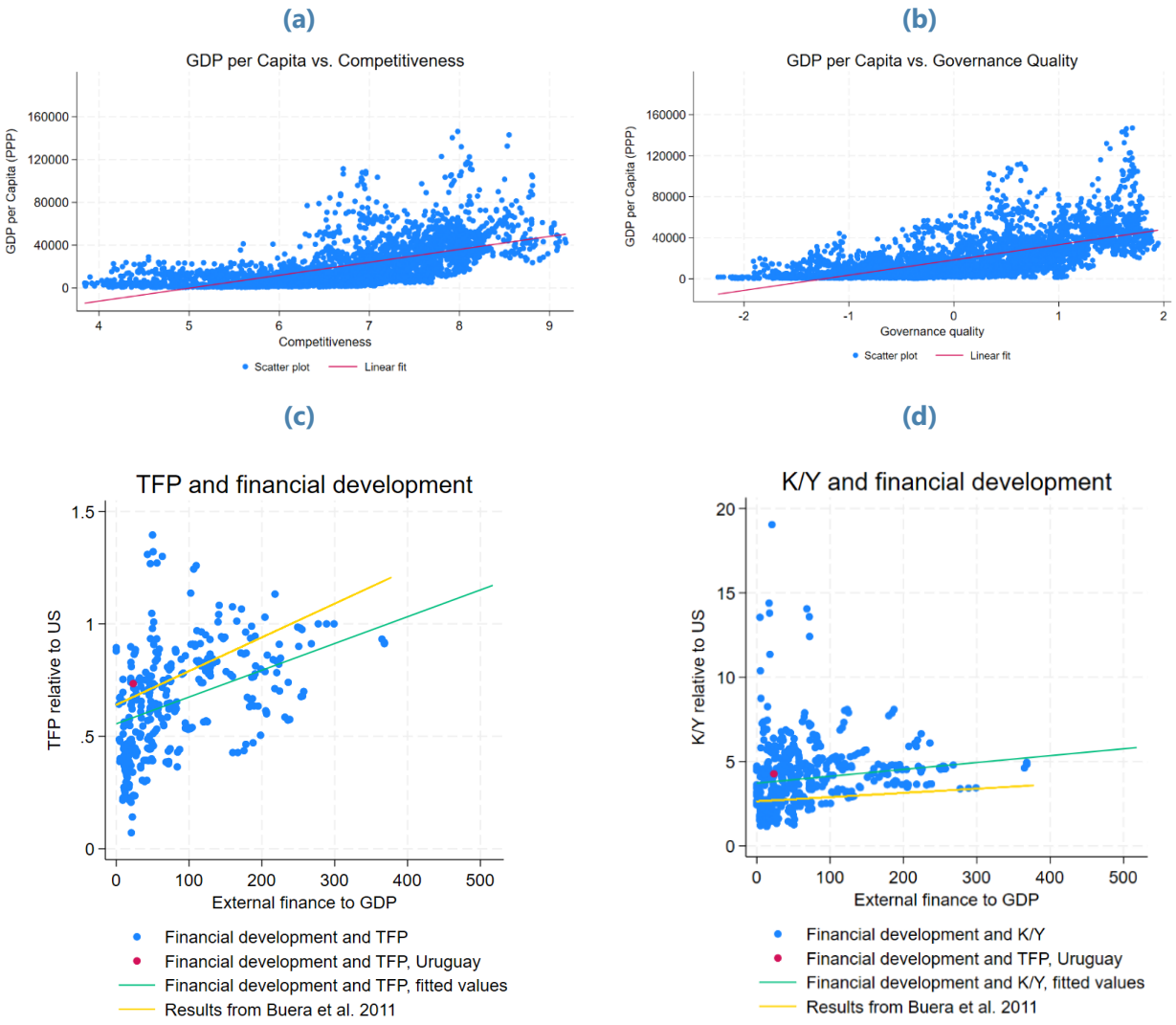
Figure 3. Uruguay: Average Additional GDP Growth
(Percentage points)



Sources: IMF staff calculations. Note: Each bar shows the average additional annual real GDP growth (in pp.) in response to a reform which would see Uruguay closing the gap to the Advanced Economies / Emerging Markets frontier by 50%, 75%, or 100%. We use the coefficient at the end of the projection horizon (average of last two periods), which represents the cumulative percent change in real output (or employment) over a period of five years and convert it to annual contribution to growth using the compound annual growth rate formula. Filled bars indicate results are statistically significant at the 10% level.

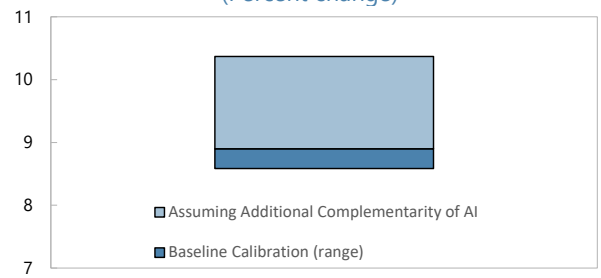
26. To estimate the long-term macroeconomic impact of AI, we calibrate a model using a mixture of household survey data and macroeconomic indicators. The model takes as given the household's income distribution from the ECH and their AI exposure as explained previously. To understand the investor behavior of households we use the 2014 Uruguayan Household Finance Survey (Encuesta Financiera de los Hogares Uruguayos or EFHU-2). The EFHU asks participants questions on real assets and related debts, liquid assets, other debts, business ownership, income and employment history, pensions, consumption and use of electronic payments and thus allows a detailed overview of household balance sheets. To calibrate the model, historical data on the capital and labor share of output is also needed, which is taken from the Penn World Table version (Feenstra et al., 2015).

Figure 4. Uruguay: Per Capita GDP and Other Relevant Variables



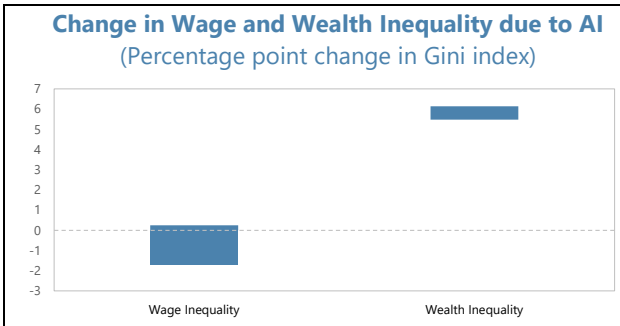
Sources: Scatter plots in the upper charts use average competitiveness indicators from the Fraser Institute, and the average across governance indicators from the World Bank's World Governance Indicators database. GDP per capita (PPP) is from the IMF's WEO database. Regression lines in yellow in the lower charts are obtained from Buera et al (2011). Scatterplots in the lower charts use updated data from Penn World Table (Feenstra et al. 2015) and the latest 2019 update of the Financial Structure Database (Beck et al. 2000).

25. The adoption of AI has also the potential to boost Uruguay's output. Following the approach of Rockall et al. (2024), which builds on a study by Moll et al. (2022), a range of output, wealth and income effects from the adoption of AI for Uruguay are estimated. The model is calibrated using labor market data from the ECH. A range of possible values is obtained by altering the calibration values for the share of investors in the economy, capital risk and the assumed degree of complementarity of AI. The model estimates show that Uruguayan output due to AI adoption is expected to increase between 8.5 percent and 9 percent over 30 years, with possible additional gains due to increased levels of complementarity with AI. The rise is productivity is expected to increase in all scenarios following Acemoglu (2025), which forecasts a 1.5 percent increase due to AI adoption.[11] These results fall within the range of the productivity and output increase for an Emerging Market Economies Latin America found by Cerutti and others (2025), who assess the impact of AI over 10 years in a multi-country DSGE model.



Sources: IMF staff calculations; ECH (INE); PWT.
Note: Estimated output gain between 2014-2048. Results are shown as a range as model calibrated to a range of capital risk and share of investors parameters.

26. Additionally, inequality of wages could lessen, whereas wealth inequality may rise. Inequality is high in Uruguay—as in other Latin American countries— as measured by a Gini index of around 40 (World Bank). The adoption of AI is expected to amplify wealth gaps and reduce wage disparity within Uruguay. AI associated gains accrue predominantly with the top earners, as capital income rises. At the same time, labor inequality decreases in most of our scenarios as there is a higher concentration of AI exposed workers at the top of the income distribution. AI adoption could therefore help lower income inequality at the bottom of the distribution in Uruguay[12], but raises concerns for a surge in wealth inequality at the top of the distribution (top 5 percentile, and even stronger for the top 0.1 percentile), driven by the returns to capital.



Sources: IMF staff calculations; ECH (INE); PWT.
Note: Estimated change in inequality between 2014-2048. Results are shown as a range as model calibrated to a range of capital risk and share of investors parameters. We also assume different degrees of complementarity to AI.

[11] Acemoglu (2025) estimates an annual rise in Total Factor Productivity of 0.05 percent, which if assumed constant, we take as 1.5 percent rise over 30 years.

[12] See World Bank's new inequality indicator.

Box 2. Sectoral Exposure to AI and Contribution to Growth

High value-added sectors driving growth in the Uruguay economy are also highly exposed to AI. The figure below shows the relationship between value added and AI exposure using industry data from INE for 2017 aggregating to the 2-digit industry classification covering 108 industries. This broad classification helps to capture a wide array of industry activities. The findings indicate a compelling positive correlation between sectors that significantly contribute to GDP growth and those that exhibit higher exposure to AI.

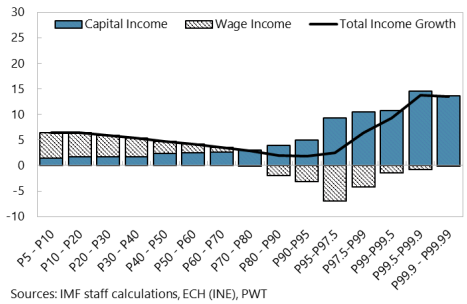
Growth may also become more volatile when driven by sectors also undergoing rapid technological change. Industries driving economic expansion are often the same ones that are integrating advanced technologies into their operations. As a result, these sectors become increasingly sensitive to technological changes, which can lead to both opportunities and challenges in their performance. Indeed, this also suggests that these sectors may experience sudden shifts in their operational capacities as they are more dependent on technological progress, leading to instability in output.

Value Added of Industry per Employee and by AI Exposure

Sources: ECH 2023; and IMF staff calculations.

27. Looking across the income distribution, high-wage earners could be displaced by AI but benefit from higher capital income. In the mode, wages increase due to the aggregate productivity gain from AI. However, some workers see a negative impact on their wages due to job displacement as they are highly exposed to AI. These higher income workers are more likely to have capital income, which increases due to higher capital returns. Despite the labor displacement due to AI, the baseline calibration of the model indicates that the overall impact on income for all earners is positive compared to a no-AI world.

Total Income Growth from AI over the Income Distribution
Percent change



Sources: IMF staff calculations, ECH (INE), PWT
Note: Estimated change in income between 2014-2048.

28. Overall, the impact of AI is highly uncertain. The descriptive analysis in Section C provides a snapshot of the Uruguayan economy of which professions and sectors of the economy are most exposed to AI. The model analysis that follows assumes that the distribution of workers in AI-exposed professions does not change over the forecast period. However, over longer horizons, workers will likely migrate across different sectors and roles, or acquire new skills, and jobs will evolve. Additionally, the fact that sectors most exposed to AI are also those currently driving growth

suggests that AI's potential to boost economic performance is not without risks (see Box 2). The analysis also abstracts from global benefits of AI, which could occur through trade linkages and cross-border spillovers of AI exposure, or the unpredictable pace of AI adoption.

Table 1. Uruguay: Business Environment and Innovation Variables Across Regions

Business environment and innovation variables	URY	LAC	Emerging & Developing	OECD	AE
Regulation/licensing:					
Days to obtain an import license	37.4	26.5	20.9	15.1	16.6
Days to obtain an operating license	167.0	47.6	13.5	27.4	28.5
Percent of firms identifying business licensing/permits as a major constraint	25.1	18.4	8.1	12.9	8.6
Days to clear direct exports through customs	2.9	10.5	9.5	5.7	6.0
Days to clear imports from customs	3.4	18.0	12.2	7.3	7.4
Percent of firms identifying customs and trade regulations as a major constraint	28.4	17.0	10.0	10.8	7.8
Labor market:					
Percent of firms identifying labor regulations as a major constraint	22.5	15.9	6.2	16.3	12.5
Percent of firms identifying an inadequately educated workforce as a major constraint	41.7	21.1	9.6	26.1	26.0
Percent of firms choosing practices of the informal sector as their biggest obstacle	18.7	8.0	11.4	5.5	5.2
Tax policy and administration:					
Percent of firms identifying tax rates as a major constraint	52.7	27.4	13.8	35.9	26.1
Percent of firms identifying tax administration as a major constraint	30.4	21.3	10.4	20.0	12.9
Innovation:					
Percent of firms that introduced a new product/service over last 3 years	72.6	32.5	21.2	20.6	24.1
Percent of firms whose new product/service is also new to the main market	59.4	48.9	69.8	57.8	58.8
Percent of firms that introduced a process innovation over last 3 years	53.7	17.3	14.9	12.6	17.3
Percent of firms that spend on R&D in the last fiscal years	29.8	16.5	25.2	22.2	26.6
Percent of firms using technology licensed from foreign companies	15.7	11.6	6.6	13.2	13.8
Percent of firms having their own web site	80.6	75.5	43.0	76.0	84.0
Others:					
Percent of firms choosing political instability as their biggest obstacle	2.0	6.0	6.3	7.6	9.3
Percent of firms choosing crime, theft and disorder as their biggest obstacle	3.4	20.7	4.4	3.5	2.6
Percent of firms identifying corruption as a major constraint	24.2	62.4	15.5	15.2	7.4
Percent of firms believing the court system is fair, impartial and uncorrupted		13.4	66.5	58.1	62.8

Note: Comparison of weighted averages of key indicators for business environment and innovation for Uruguay, Latin American and Caribbean (LAC), emerging and developing economies, OECD countries and advanced economies (AE). Years used: 2016-2025. Source: Enterprise Surveys database from the World Bank.

E. Firm-level Evidence on the Business Environment and Innovation

29. This section uses the World Bank Enterprise Surveys (WBES) to provide evidence on how Uruguayan firms perceive the business environment, leveraging the cross-country perspective given by the WBES. Firm surveys are important for understanding barriers reported by firms, and the WBES is unique in maintaining such granularity while having a broad geographical scope. The WBES covers multiple areas related to business climate and competitiveness, such as constraints to doing business, productivity, labor dynamics, access to finance, infrastructure, and competition. This dataset is valuable for analyzing Uruguay's competitiveness by benchmarking its firms against those in peer countries, identifying key obstacles to growth, and assessing the impact of regulatory and institutional factors on firm performance.

30. The recently released 2024 survey for Uruguay provides an opportunity to track the evolution of key business environment indicators since the initial survey conducted in 2006

(see Annex). A summary of the main findings is that while progress has been observed in areas such as technology adoption, firm-level innovation, and financial inclusion, evidenced by a steady rise in the share of firms with websites and bank accounts, challenges remain in the efficiency of regulatory regimes and in skills availability. In particular, the time required to obtain import licenses has substantially increased in recent years, and the long time needed to obtain an operating license remains high. Customs or trade regulations, and access to an adequately educated workforce continues to be a growing concern for many firms. At the same time, firms' access to credit has improved, although internal financing remains the predominant source of funds for investment. These trends underscore the importance of sustained reforms to reduce bureaucratic hurdles, strengthen human capital, and broaden access to finance in support of private sector development.

31. Table 1 presents firms' answers to questions on the business environment, where Uruguay's performance is mixed. Firms in Uruguay experience significantly shorter customs clearance times for both imports (3.4 days) and exports (2.9 days) compared to Latin America and other Emerging Markets and Developing Economies (EMDEs).[13] However, obtaining an operating license in Uruguay (167 days) takes much longer than in other regions, highlighting a key regulatory bottleneck. About 25.1 percent and 28.4 percent of firms in Uruguay see business licensing and customs/trade regulations as a major constraint (compared to 18.4 percent and 17 percent, respectively, in Latin America). Concerns about labor market inefficiencies are also pronounced in Uruguay, with 22.5 percent of firms citing labor regulations as a major constraint—higher than in any comparator group. Similarly, 41.7 percent of firms identify an inadequately educated workforce as a major constraint, exceeding the Latin American, OECD, and advanced economy averages. In Box 1, we examine with more detail administrative burdens faced by small businesses in LAC using data from the Adam Smith Center for Economic Freedom.

32. Table 2 focuses on financial constraints, an area where Uruguay's performance is broadly in line with peers. 64.1 percent of Uruguayan firms have a bank loan or line of credit—significantly higher than EMDE peers but in line with the Latin American average—but the percentage of Uruguayan firms identifying access to finance as a major constraint remains high (19 percent). The country also has a very high proportion of firms with a checking or savings account (98.9 percent), surpassing all comparator groups. While rejection rates for loan applications are low in Uruguay (2.6 percent), credit constraints persist, with 10 percent of firms either fully or partially constrained, though this is lower than the regional average.

33. Regarding investment financing, Uruguayan firms rely heavily on internal funds. On average, 69 percent of investment is financed with internal funds, a value below emerging and advanced economies but above the Latin American average. Bank financing for investment is slightly lower (18.5 percent) than in LAC (19.3 percent) but similar to OECD and advanced economies. Supplier/customer credit plays a more significant role in Uruguay (9.0 percent) than in other regions, and equity financing is slightly above regional and global levels. In terms of working capital,

[13] According to the World Bank's 2023 Logistics Performance Index, Uruguay ranks 61st out of 139 countries, with an overall score of 3.00 out of 5, similar to Chile and Peru. This places Uruguay in the mid-range globally, indicating moderate performance in logistics efficiency (see also 2024 Article IV report for Uruguay).

Uruguayan firms finance a majority internally (60.3 percent), though they rely much more on supplier/customer credit (20.2 percent) than OECD and AE firms. The percentage of firms using banks for working capital (46.1 percent) is higher than any other comparator groups.

Table 2. Uruguay: Financial Sector Variables Across Regions

Financial sector variables	URY	LAC	Emerging & Developing	OECD	AE
Credit access and demand:					
Percent of firms with a bank loan/line of credit	64.1	53.5	26.9	41.7	45.0
Percent of firms identifying access to finance as a major constraint	18.6	19.0	11.6	13.5	9.0
Percent of firms not needing a loan	54.2	52.2	59.5	66.5	66.4
Percent of firms whose recent loan application was rejected	2.6	21.4	11.3	5.8	3.7
Percent of firms that are fully credit constrained	2.6	4.4	11.3	5.6	5.3
Percent of firms that are partially credit constrained	10.0	27.8	12.2	9.6	7.0
Percent of firms that are credit unconstrained	87.4	67.8	76.5	84.7	87.6
Percent of firms with a checking or savings account	98.9	93.5	91.2	93.1	94.7
Investment:					
Percent investment financed internally	69.0	65.0	82.7	71.7	71.1
Percent investment financed by banks	18.5	19.3	11.2	18.9	18.4
Percent investment financed by supplier/customer credit	9.0	9.7	2.2	3.8	3.9
Percent investment financed by equity or stock sales	2.2	3.2	2.3	2.8	3.3
Percent investment financed by other financing	1.4	2.8	1.5	2.7	3.4
Percent loans requiring collateral	35.7	38.6	48.2	42.1	42.2
Percent of firms using banks to finance investments	28.8	37.0	20.8	32.9	28.7
Working capital:					
Percent working capital financed internally	60.3	65.5	82.0	79.9	81.1
Percent working capital financed by banks	18.0	9.6	9.5	10.4	10.6
Percent working capital financed by supplier/customer credit	20.2	21.8	5.9	7.4	5.6
Percent of firms using banks to finance working capital	46.1	43.1	28.8	32.7	29.3

Note: Comparison of weighted averages of key indicators for financial sector for Uruguay, Latin American and Caribbean (LAC), emerging and developing economies, OECD countries and advanced economies (AE). Years used: 2016-2025.
Source: Enterprise Surveys database from the World Bank.

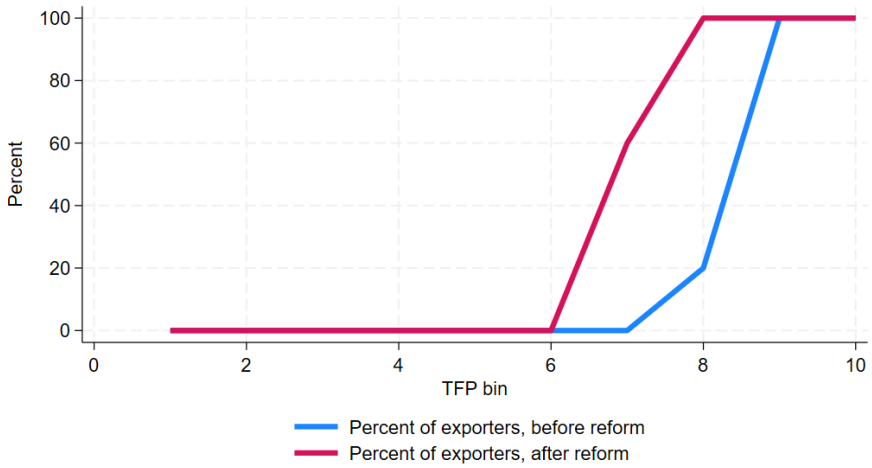
34. In terms of innovation, Uruguayan firms exhibit relatively strong performance (Table 1), which could also indicate relatively high levels of AI preparedness. According to the WBES, 72.6 percent of firms introduced a new product or service in the three years previous to the survey, far surpassing Latin America (32.5 percent) and even advanced economies (24.1 percent). Additionally, 53.7 percent of firms introduced a process innovation, again greatly outperforming all comparison groups. Also, spending on research and development (29.8 percent) is greater than the other groups. These results indicate a relatively high level of preparedness to the adoption of new technologies, including AI. Regarding the broader business climate, Uruguay faces significant tax burdens, with 52.7 percent of firms citing tax rates as a major constraint, the highest among all groups. However, the country has low levels of perceived corruption (24.2 percent). Political instability is not considered a major obstacle for most Uruguayan firms.

Box 3. Productivity, Exports and Trade Reforms in Uruguay

Using a simplified version of Melitz (2003), a model is used to evaluate the reallocation effects of a trade reform in Uruguay that reduces the cost of exporting. The Melitz (2003) model describes how heterogeneous firms decide whether to enter, produce, and export based on their productivity (TFP). Firms face fixed and variable trade costs, and only the most productive firms enter the export market as these are the most profitable ones. The model establishes a cutoff productivity level for domestic production and a higher cutoff for exporting. Trade liberalization, by reducing trade barriers, shifts these cutoffs, influencing firm decisions and aggregate outcomes.

The model is used to evaluate the effect of structural reforms that would reduce trade costs by 30 percent in Uruguay. It uses the WBES, as it identifies export firms and also includes estimated TFP values. The lowest TFP level among observed exporters is used as a proxy for the TFP cutoff value. A reduction in trade costs would make exporting more profitable, lowering the TFP cutoff required to export, which would also reduce average TFP. Using calibrated parameters of the model,[1] a simulation is run with lower trade costs, which finds that new firms that are able to export. The simulations in the chart below show the distribution of TFP across exporters, before and after the trade reform, showing also the cutoff productivity level above which firms export would decline. As a result of the reform, the number of exporting firms would increase by about 60 percent in Uruguay.

TFP typically increases because of trade reforms. In practice, high-productivity exporting firms typically scale up their operations, gaining additional market share, and attracting more resources (capital and labor). At the same time, some least productive firms may still exit the market due to increased competition from external competitors. This selection effect drives aggregate TFP upward.



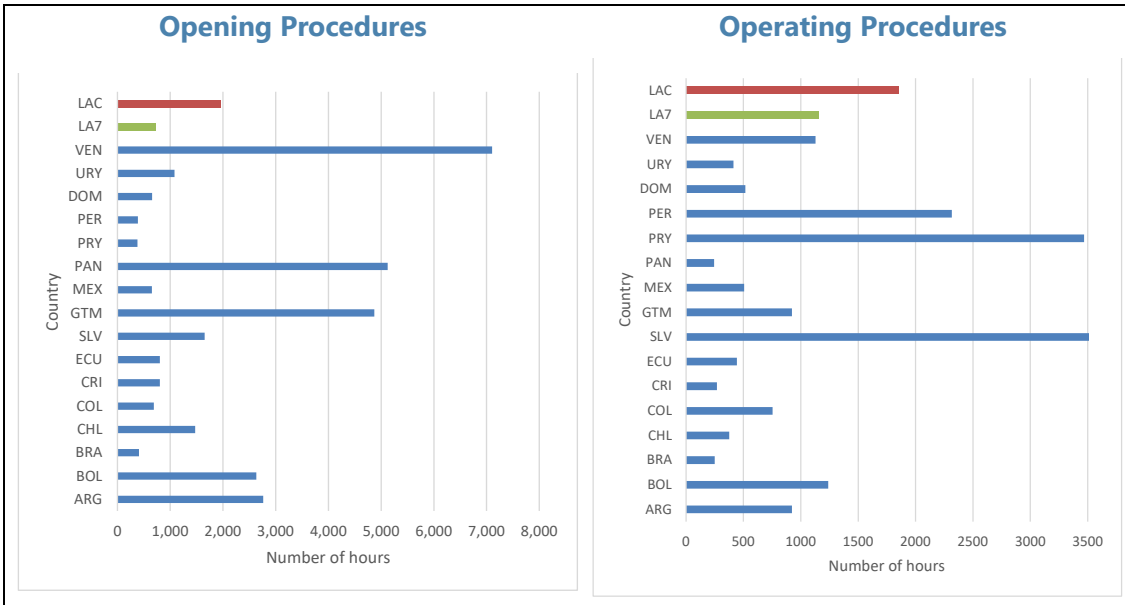
Sources: WBES database with observed TFP values and export indicators for Uruguay, and IMF staff calculations.

[1] The simple model is calibrated assuming an elasticity of substitution between different goods equal to 4 for the CES demand function. Fixed and variable trade costs of exporters are calibrated to match the observed distribution of exports pre-reform. TFP bins are generated using TFP deciles.

Box 4. Opening and Operating Procedures for Firms in LAC

To better understand the licensing challenges reported by firms in the WBES, we complement the analysis with data from the Bureaucracy Index compiled by the Adam Smith Center for Economic Freedom. The 2024 Index of Bureaucracy, published by the Adam Smith Center for Economic Freedom, examines the administrative burdens faced by small businesses in Latin America. The report includes 16 countries in Latin America and three in Europe (see Annex C for detailed information).

Streamlining administrative processes of Uruguayan firms could further enhance the Uruguay's business environment and competitiveness. The figure provides information on opening and operation procedures for 16 countries in LAC, including Uruguay. Opening procedures take Uruguayan firms around 1,080 hours, which is higher than the LA7 average (724 hours) but lower than the overall LAC average (1,968 hours). While identification and registration (840 hours) represent a major burden, Uruguay performs better in registration with national entities (72 hours) and sector-specific procedures (5 hours) compared to peers (see details in Annex). In terms of operating procedures, Uruguay requires 414 hours annually, significantly below the LAC (1,850 hours) and LA7 (1,155 hours) averages. Its main bureaucratic costs stem from employment administration (201 hours) and taxation (136 hours), though it fares better than several peers. Overall, streamlining identification processes, employment administration, and tax compliance could further enhance the Uruguay's business environment and competitiveness.



Note: LA7 includes Brazil, Chile, Colombia, Mexico, Paraguay, Peru and Uruguay. Source: 2024 Index of Bureaucracy, published by the Adam Smith Center for Economic Freedom (see Annex). Certain countries with very high values have been omitted from the table to facilitate presentation.

F. Exports, Productivity and Innovation

35. This section discusses the factors that affect the export orientation of firms in Uruguay, still leveraging the WBES data. This is important given the beneficial impact of exports on economic growth through economies of scale, competitiveness, specialization or productivity gains via "learning by exporting" (Young 1991) and innovation. Exports also act as a critical mechanism for reallocating resources to more productive firms—the "market selection" effect—as

firms compete on a global scale and stronger competition prompt inefficient players to exit and allowing more productive ones to expand (see Box 3 and also De Locker and Syverson, 2021 for a recent survey). A cursory look at the WBES (see Annex) confirms that exporting firms, in Uruguay as well as in LAC and EMDEs, tend to be larger, foreign owned, and more visible on the internet.

Table 3. Uruguay: Decision to Export, Business Environment and Economic Freedom

Variables	(1) Export	(2) Export	(3) Export	(4) Export	(5) Export	(6) Export	(7) Export
Firm-level indicators:							
days to clear exports (log)	0.0463						
	(0.0736)						
days to clear imports (log)	-0.128*						
	(0.0698)						
Proportion of investment financed by banks (%)	0.00268*						
	(0.00162)						
Country-level indicators:							
Government efficiency		0.0923***					0.0667**
		(0.0231)					(0.0298)
Legal/property rights			0.171***				0.210***
			(0.0290)				(0.0311)
Sound macroeconomics				0.0823***			0.107***
				(0.0124)			(0.0236)
Free trade					0.111***		-0.0409
					(0.0179)		(0.0477)
Regulation						0.152***	-0.0570
						(0.0278)	(0.0518)
Other firm-level controls:							
Foreign	0.346**	0.557***	0.563***	0.546***	0.546***	0.557***	0.544***
	(0.141)	(0.0470)	(0.0468)	(0.0470)	(0.0471)	(0.0469)	(0.0472)
Age of the establishment (years)	-0.00598**	0.00172*	0.00139	0.00178**	0.00202**	0.00200**	0.00139
	(0.00303)	(0.000882)	(0.000880)	(0.000889)	(0.000886)	(0.000884)	(0.000893)
Number workers (logs)	0.134	0.303***	0.313***	0.293***	0.294***	0.298***	0.303***
	(0.102)	(0.0318)	(0.0317)	(0.0319)	(0.0318)	(0.0317)	(0.0319)
Observations	532	12,010	12,010	12,010	12,010	12,010	12,010
Other firm variables	YES	YES	YES	YES	YES	YES	YES
Year fixed effects	YES	YES	YES	YES	YES	YES	YES
Country fixed effects	YES	NO	NO	NO	NO	NO	NO

Note: Probit regression. One observation is a firm in a given country and year. Only LAC countries in 2016-2024 (includes Uruguay). Robust standard errors in parentheses. *** p<0.01, ** p<0.05, * p<0.1. Government size, legal/property rights, sound macroeconomics and free trade are indexes on economic freedom from the Fraser Institute that assess the degree to which countries' policies and institutions support economic freedom. A higher value in any of these indexes indicates fewer economic restrictions or less interventionism. These indexes are widely used by researchers, policymakers, and educators to analyze and compare economic environments globally. Source: WBES, the Economic Freedom Indexes from the Fraser Institute, and IMF staff calculations.

Table 4. Uruguay: Decision to Innovate, Business Environment and Economic Freedom

Variables	(1) New product/ service	(2) Introduced a process innovation	(3) Spent on R&D	(4) New product/ service	(5) New product/ service	(6) New product/ service	(7) New product/ service	(8) New product/s ervice
Firm-level indicators:								
Exporter	0.141***	0.125***	0.224***					
	(0.0423)	(0.0429)	(0.0502)					
Country-level indicators:								
Government efficiency				-0.0768***				
				(0.0161)				
Legal/property rights					0.217***			
					(0.0201)			
Sound macroeconomics						0.104***		
						(0.00775)		
Free trade							0.170***	
							(0.0119)	
Regulation								0.189***
								(0.0185)
Other firm-level controls:								
Foreign	0.151***	0.0723*	0.108**	0.207***	0.198***	0.169***	0.170***	0.187***
	(0.0428)	(0.0434)	(0.0501)	(0.0408)	(0.0409)	(0.0413)	(0.0412)	(0.0412)
Age of the establishment	-0.000174	-0.000806	0.00161*	8.87e-05	-0.000176	0.000313	0.000593	0.000536
	(0.000695)	(0.000703)	(0.000855)	(0.000676)	(0.000677)	(0.000676)	(0.000677)	(0.000676)
Number workers (logs)	0.192***	0.143***	0.221***	0.210***	0.210***	0.204***	0.196***	0.198***
	(0.0259)	(0.0259)	(0.0312)	(0.0247)	(0.0248)	(0.0249)	(0.0249)	(0.0248)
Observations	11,955	11,942	6,562	11,955	11,955	11,955	11,955	11,955
Other firm variables	YES	YES	YES	YES	YES	YES	YES	YES
Year fixed effects	YES	YES	YES	YES	YES	YES	YES	YES
Country fixed effects	YES	YES	YES	NOT	NOT	NOT	NOT	NOT

Robust standard errors in parentheses

Note: Probit regressions. One observation is a firm in a given country and year. Explained variable in column 1 and 4-7 is an indicator variable equal to one if firm introduced a new product/service over the last 3 years. In column 2 is an indicator if the firm introduced a process innovation over the last 3 years. In column 3, explained variable is an indicator equal to one if the firm spent on R&D in the last fiscal year. Only LAC countries in 2016-2024 (includes Uruguay). Robust standard errors in parentheses. *** p<0.01, ** p<0.05, * p<0.1.
Sources: WBES; the Economic Freedom Indexes from the Fraser Institute; and IMF staff calculations.

36. There is evidence that reducing individual-level trade-related frictions or reducing interventionism in countries could positively affect the decision of firms to export. The probit regression results in Table 3 (column 1) indicate that several business environment factors significantly influence a firm's likelihood of exporting. Notably, longer import clearance times, as reported at the firm-level, negatively impact export probability. However, the time required to clear exports does not have a significant effect. Firms that are foreign-owned are consistently more likely to export, highlighting the role of foreign investment in integrating firms into global trade networks. The size of the firm (measured by the log of workers) also has a positive and significant effect in the decision to export. The probit regression results in columns 2-7 show that various country-level

economic freedom indicators, such as strong legal and property rights or sound macroeconomic conditions, significantly impact the probability of a firm being an exporter.

37. There is also evidence that exporters tend also to innovate more and that firms are more likely to innovate in countries with less economic restrictions or less interventionism. The probit regression results in Table 4 (columns 1-3) suggest that firm characteristics play a significant role in driving innovation. Export firms are more likely to introduce new products and process innovations, as well as invest in R&D, with statistically significant and positive coefficients in three out of four specifications. However, export status does not significantly influence whether a product is entirely new to the main market. Foreign-owned firms also show a strong positive relationship with product innovation and market novelty. Larger firms (measured by the log of workers) are significantly more likely to innovate. The probit regression results in Table 7 (columns 4-8) suggest that various aspects of economic freedom significantly influence a firm's likelihood of introducing a new product or service.

G. Conclusion

38. Uruguay has an opportunity to implement a comprehensive structural reform agenda. This agenda could be aimed at boosting productivity, fostering innovation, and ensuring sustained long-term growth. These efforts could help Uruguay achieve higher income per capita and accelerate convergence with the world's most developed economies.

39. While Uruguay has made significant progress in many areas, there is room for further structural reforms. The empirical evidence presented in this paper suggests that reforms in financial markets, competition, labor market regulation, and trade policies could enhance economic efficiency and unlock new sources of growth.

40. Strengthening Financial Market Development: Financial sector deepening is important for improving capital allocation, reducing credit constraints, and fostering entrepreneurship. Empirical evidence and recent IMF assessment of the financial markets (see FSAP recommendations included in IMF, 2024) highlights the benefits from:

a. Adapting regulations to facilitate a level playing field in the financial markets to contribute to financial development.

b. Reducing frictions in the credit markets by enhancing credit information.

c. Developing capital markets to provide additional and well-diversified funding options for firms by adapting regulations to the size and capacity of firms.

41. Enhancing Competition and Business Regulation: Despite Uruguay's strong institutional framework, barriers to entry and regulatory bottlenecks still hamper business dynamism (see World Bank, 2022). Key recommendations include:

a. Streamlining bureaucratic procedures by simplifying administrative requirements for firm registration, operating licenses, and taxation.

b. Enhancing competition.

c. Adapting the regulatory framework to foster innovation, particularly in high-impact industries.

42. Harnessing AI adoption to provide equitable growth: Although Uruguay ranks highly in AI preparedness, its exposure to and shielding from AI across demographics, sectors of the economy and geographical areas (departments) is uneven. Key recommendations include:

a. To further enhance AI preparedness, investment in digital infrastructure and human capital should be prioritized. Digital infrastructure assesses the level of information and communication technology in the country, which is essential for the ability to adopt new technologies (Nicoletti, Rueden, and Andrews 2020).

b. Promoting equitable and ethical integration of AI-driven innovation into education, industry and the public sector can help harnessing the growth potential of AI.

c. To limit labor force disruptions caused by AI adoption, retraining programs for vulnerable workers could be offered. Education and training are important for AI diffusion and providing opportunities for the next generation of workers to maximize gains from AI and reduce inequality.

43. Labor market reforms to improve flexibility and skill development: Uruguay's centralized bargaining and wage-setting framework present several trade-offs. Labor market institutions have contributed to stability and relatively low inequality, and have allowed coordinated mechanisms to navigate crises. However, firms perceive wage-setting and hiring practices as restrictive which can pose challenges for employment growth and firm competitiveness. The following reforms could enhance labor market efficiency:

a. Modernizing wage bargaining frameworks and accounting for firm heterogeneity would increase labor market flexibility, contribute to a more efficient labor allocation and strike a balance between worker protection and firm adaptability.

b. Promoting active labor market policies such as retraining programs, job-matching services, and targeted incentives for hiring young workers.

c. Boosting education quality, encouraging school completion and other relevant initiatives to align education and training programs with evolving labor market needs, ensuring firms have access to a skilled workforce.

44. Deepening trade liberalization and export competitiveness: Trade openness has been a key driver of economic growth. To improve trade performance in both trade of goods and services, the country could:[14]

a. Reduce trade-related costs by simplifying customs procedures or enhancing logistics efficiency. Diversify export markets by negotiating new trade agreements and leveraging regional trade blocs to expand market access.

b. Prioritize policies that enhance the competitiveness of services export industry, particularly in high-value sectors like IT, consulting, and business services. By attracting skilled labor, fostering talent development, and reducing regulatory barriers, the country can strengthen its position as a regional hub for knowledge-based services.

45. In summary, Uruguay could pursue a comprehensive structural reform agenda while prioritizing the most critical gaps identified. Uruguay could increase productivity, attract investment, and enhance competitiveness, ensuring sustainable long-term growth. The reforms outlined above would help close structural gaps, create new economic opportunities, and position Uruguay as a leader in Latin America in economic resilience and innovation.

46. For a middle-income country such as Uruguay, this means building on a carefully designed long-term growth strategy to avoid the "middle income trap" (World Bank, 2024). Countries such as Uruguay at this stage of development should leverage its already solid institutional foundations by expanding strategic investments in crucial areas to strengthen competitiveness. In a later stage, Uruguay could focus on infusing global knowledge and technologies, accelerating their adoption across sectors—particularly through trade integration, foreign direct investment, and innovation partnerships. Finally, as Uruguay grows, it could prioritize domestic innovation, fostering a dynamic environment where new industries and ideas can emerge. Achieving this requires not only targeted R&D and support for high-tech sectors, but also institutional reforms to promote competition and skill development.

[14] See also accompanying SIP on tax expenditures that propose possible alternatives of a future reform on tax expenditures to redirect additional fiscal resources toward high-priority public investment areas.

Annex I. Structural Indicators and Impact of Reforms

1. The potential impact of structural reforms in the context of Uruguay is based on the empirical analysis featured in Budina and others (2023). The empirical framework relies on local projection approach[1] in a panel data setting to estimate the impact of reforms on output, following the specification below:

$$y_{i,t+k} - y_{i,t-1} = \alpha_i + \lambda_t + \beta_k \Delta SR_{i,t} + \theta X'_{i,t} + \epsilon_{i,t},$$

where $y_{i,t+k}$ is the log of real GDP (PPP) for country i in year $t+k$, α_i and λ_t denote the country and year fixed effects, which help control for unobservable cross-country heterogeneity as well as common global factors, $\Delta SR_{i,t}$ is the change in the average structural reform score[2] indicator for country i between *t and t-1*, and $X'_{i,t}$ is the set of time-varying controls, including lags of the dependent variable, and past reforms. For additional robustness, $X'_{i,t}$ also controls for simultaneous and past reforms in other areas of reform which could affect the estimated output response (i.e., when estimating the impact of business regulation reforms, simultaneous and past reforms in other areas such as external sector, credit market, labor market and governance are accounted for). It is important to note that the local projection approach is less robust to addressing endogeneity, and hence the large coefficients should be interpreted with caution. Budina and others (2023) provide the empirical estimates of β_k derived from the panel (across country) estimates, which are applied to the gap measures for Uruguay presented in Figure 2.

Annex I. Table 1. Uruguay: Definitions of Structural Indicators

Structural Indicator	Source	Definition
Governance	World Bank, Worldwide Governance Indicators	Measures the perception of the quality of governance along six dimensions: voice and accountability, rule of law, political stability, government effectiveness, regulatory quality, and control of corruption.
External sector	Fraser Institute, Index of Economic Freedom	Measures the degree of trade and financial openness along four main dimensions: tariff and non-tariff barriers, exchange rate flexibility and constraints of the movement of capital.
Business regulation	Fraser Institute, Index of Economic Freedom	Measures the degree to which regulation and bureaucratic procedures restrain entry and reduce competition. This indicator also captures the presence of impartial public administration.
Credit market regulation	Fraser Institute, Index of Economic Freedom	Measures the extent to which credit is supplied to the private sector, the presence of interest rate controls, and the extent to which the banking industry is privately owned.
Labor market regulation	Fraser Institute, Index of Economic Freedom	Measures the degree of flexibility of hiring and firing regulation, and centralized collective bargaining.

[1] See Jordà and Taylor (2025) for a survey on the literature.

[2] Each reform area includes multiple sub-indicators, with 1 representing the highest score.

Annex II. Evolution of Some WBES Indicators for Uruguay

Annex II. Table 1. Uruguay: Comparison WBES Indicators Across Years

Enterprise Surveys Database: Selected Variables	URY 2006	URY 2010	URY 2017	URY 2024
Regulation/licensing:				
Days to obtain an import license	13.6	10.0	14.1	37.4
Days to obtain an operating license	133.8	108.0	176.0	167.0
Percent of firms identifying business licensing/permits as a major constraint	11.1	8.4	11.1	25.1
Days to clear direct exports through customs	2.7	6.9	2.1	2.9
Days to clear imports from customs	6.7	9.2	11.4	3.4
Percent of firms identifying customs and trade regulations as a major constraint	15.5	8.4	17.9	28.4
Labor market:				
Percent of firms identifying labor regulations as a major constraint	22.7	25.5	24.0	22.5
Percent of firms identifying an inadequately educated workforce as a major constraint	24.5	30.8	37.0	41.7
Percent of firms choosing practices of the informal sector as their biggest obstacle	32.4	23.2	16.2	18.7
Tax policy and administration:				
Percent of firms identifying tax rates as a major constraint	66.3	45.5	50.7	52.7
Percent of firms identifying tax administration as a major constraint	31.1	27.1	30.5	30.4
Innovation:				
Percent of firms that introduced a new product/service over last 3 years	63.3	58.5	71.4	72.6
Percent of firms whose new product/service is also new to the main market	0.0	46.3	66.9	59.4
Percent of firms that introduced a process innovation over last 3 years	57.5	42.5	66.6	53.7
Percent of firms that spend on R&D in the last fiscal years	42.7	55.5	18.2	29.8
Percent of firms using technology licensed from foreign companies*	4.7	4.2	23.0	15.7
Percent of firms having their own web site	33.3	50.9	69.1	80.6
Credit access and demand:				
Percent of firms with a bank loan/line of credit	45.0	48.6	54.1	64.1
Percent of firms identifying access to finance as a major constraint	31.3	16.0	20.6	18.6
Percent of firms not needing a loan	40.2	44.7	48.1	54.2
Percent of firms whose recent loan application was rejected	0.0	0.0	4.2	2.6
Percent of firms that are fully credit constrained	0.0	0.0	2.4	2.6
Percent of firms that are partially credit constrained	0.0	0.0	14.2	10.0
Percent of firms that are credit unconstrained	0.0	0.0	83.4	87.4
Percent of firms with a checking or savings account	88.0	90.8	96.9	98.9
Investment:				
Percent investment financed internally	82.0	69.6	69.9	69.0
Percent investment financed by banks	8.4	9.1	18.8	18.5
Percent investment financed by supplier/customer credit	4.8	6.6	5.1	9.0
Percent investment financed by equity or stock sales	0.2	6.6	3.1	2.2
Percent investment financed by other financing	4.5	8.0	3.2	1.4
Percent loans requiring collateral	78.3	55.1	40.4	35.7
Percent of firms using banks to finance investments	6.9	13.7	31.8	28.8
Working capital:				
Percent working capital financed internally	72.3	69.9	62.4	60.3
Percent working capital financed by banks	7.0	7.6	11.7	18.0
Percent working capital financed by supplier/customer credit	15.0	18.6	23.3	20.2
Percent of firms using banks to finance working capital	20.6	26.4	39.8	46.1
Others:				
Percent of firms choosing political instability as their biggest obstacle	5.7	0.4	2.0	2.0
Percent of firms choosing crime, theft and disorder as their biggest obstacle	5.1	7.2	1.3	3.4
Percent of firms identifying corruption as a major constraint	43.0	21.1	17.5	24.2
Percent of firms believing the court system is fair, impartial and uncorrupted	55.0	50.0	55.1	0.0

Note: Comparison of weighted averages of key indicators for all surveys in Uruguay.
Source: Enterprise Surveys database from the World Bank.

Annex III. The "Exporter Premium"

1. Using the WBES, we estimate the "exporter premium" across different world regions and find results that are somewhat consistent with previous literature results. The regression estimates in Table 3 reveal notable differences in the effects of exporting status across emerging economies, Latin America and the Caribbean (LAC), and advanced economies (OECD and AE). In advanced economies and OECD, exporters exhibit lower total factor productivity (TFP) compared to non-exporters, with negative and statistically significant coefficients for both types of TFP estimates. In contrast, emerging and developing economies show a positive TFP effect, while in LAC or Uruguay, we do not observe statistically significant differences. Exporting firms in all these regions are typically larger, employing significantly more workers and are more likely to be foreign owned. However, the proportion of skilled workers among exporters is consistently lower across all regions, particularly in advanced economies and the OECD. Real annual sales and productivity growth are significantly higher in emerging and advanced economies, suggesting that exporters in these regions experience stronger expansion and efficiency gains, while the impact in LAC is weaker. Exporter firms in these regions are also more likely to have a website, suggesting greater innovation or sophistication.

Annex III. Table 1. Uruguay: The "Exporter Premium"
(e.g. Statistical Differences of Exporters Across Regions)

Variable	Uruguay	LAC	Emerging & Developing	OECD	AE
TFP (output method)	-0.234	0.0418	0.0134	-0.0259	-0.0771***
TFP (VA method)	-0.288	-0.0385	0.0849***	-0.210***	-0.234***
Age of the establishment (years)	9.670***	5.404***	3.846***	6.116***	6.389***
Ownership type (foreign vs. domestic)	0.141***	0.175***	0.176***	0.145***	0.144***
Number of workers	78.91***	127.9***	132.9***	74.30***	56.55***
Proportion of skilled workers, out of	-3.310	-2.136***	-2.320***	-3.259***	-3.210***
Real annual sales growth (%)	-1.728	0.371	1.223***	0.628***	0.549**
Annual employment growth (%)	-0.439	-0.376	0.154	-0.254*	-0.0429
Real annual labor productivity growth	-1.111	0.576	1.217***	0.803***	0.565***
Capacity utilization (%)*	3.152*	3.438***	1.631***	1.072***	0.603*
sales per worker (in USD 2009)	91,431***	14,668	-4,434	30,044***	48,627***
Percent of firms having their own web	26.42***	24.35***	25.25***	12.61***	8.437***

Note: We show estimates of separate regressions for several explained variables including TFP, age, ownership and other relevant variables of individual firms for each region/country. We regress these variables on an indicator variable equal to one if the firm is an exporter. We also include country and year fixed effects. The table shows the estimation of the parameter of the exporter indicator for each region/country and each separate regression. We use all years available for all regions and for Uruguay. Robust standard errors in parentheses with *** p<0.05, ** p<0.1, * p<0.2. Source: WBES and IMF staff calculations.

2. Uruguay presents a slightly distinct pattern compared to other regions, although this may be attributed to the much smaller sample available. Unlike other regions, exporting firms in Uruguay show a non-statistically significant effect on TFP, suggesting that exporters are not necessarily more productive than non-exporters in the short term. Similarly, exporters in Uruguay do not experience significant gains in real annual sales growth or labor productivity growth, with coefficients close to zero or negative. However, exporting firms in Uruguay tend to be significantly

older, employ more workers, and are more likely to be foreign owned than domestic firms, which aligns with broader trends in Latin America. Interestingly, exporters in Uruguay have the highest website adoption rate among firms, surpassing LAC and even OECD firms, suggesting that Uruguayan exporters may be more digitally integrated.

Annex IV. Index of Bureaucracy Costs

1. The 2024 Index of Bureaucracy, published by the Adam Smith Center for Economic Freedom, examines the administrative burdens faced by small businesses in Latin America. The report includes 16 countries in Latin America and three in Europe, highlighting the intricate processes, pervasive corruption, and cumbersome administrative procedures that hinder innovation and economic growth. It provides detailed analysis on the time required to comply with mandatory national bureaucratic procedures, both for establishing and maintaining small enterprises. The findings aim to offer policymakers actionable recommendations to streamline these processes, thereby fostering more dynamic and resilient economies.

3. The administrative burden on small businesses is calculated considering time required to comply with national bureaucratic procedures. The methodology involves identifying and categorizing the essential administrative tasks needed to start and operate a small business, including tax compliance, labor regulations, and mandatory reporting. Researchers conducted structured interviews with business owners, legal experts, and policymakers to estimate the time needed to complete each task. The total bureaucratic burden is then quantified in terms of working days per year, allowing for cross-country comparisons. The index also incorporates qualitative assessments to capture inefficiencies such as redundant paperwork, digitalization levels, and the prevalence of corruption in administrative processes.

4. A notable insight from the report is the significant disparity in bureaucratic efficiency among the surveyed countries. For instance, it takes an average of 3.7 months, or 154 working days, to start a business, with an additional 112 working days per year dedicated to compliance to keep the business operational. Brazil, Costa Rica, and Mexico rank among the least bureaucratic countries, with relatively efficient procedures for starting and operating a business. Conversely, Venezuela and Bolivia face challenges in both dimensions, while other countries perform well in one area but not the other. In Uruguay's case, inefficiencies are particularly evident in business opening procedures, primarily due to challenges in identification and registration processes. These findings underscore the critical need for targeted reforms to reduce administrative hurdles, promote transparency, and enhance efficiency within public bureaucracies to support small business growth and economic development.

Annex IV. Table 1. Uruguay: Index of Bureaucracy Cost. Opening Procedures

	Uruguay	Brazil	Argentina	Dominican Republic	Ecuador	El Salvador	Spain	LA7	LAC
Total (annual hours)	**1,080**	**408**	**2,765**	**656**	**806**	**1,654**	**13,837**	**724**	**1,968**
Identification and registration	840	253	1,080	257	90	171	5,461	294	332
Registration with national entities	72	24	363	63	15	121	1,541	144	241
Municipal Registration & Permits	-	42	60	-	40	339	11	284	489
Request for utilities	168	131	84	73	32	843	211	117	218
Specific by productive activity	5	26	1,178	399	709	640	8,364	176	1,014

Note: LA7 includes Brazil, Chile, Colombia, Mexico, Paraguay, Peru and Uruguay.
Source: 2024 Index of Bureaucracy, Adam Smith Center for Economic Freedom.

Annex IV. Table 2. Uruguay: Index of Bureaucracy Cost. Operating Procedures

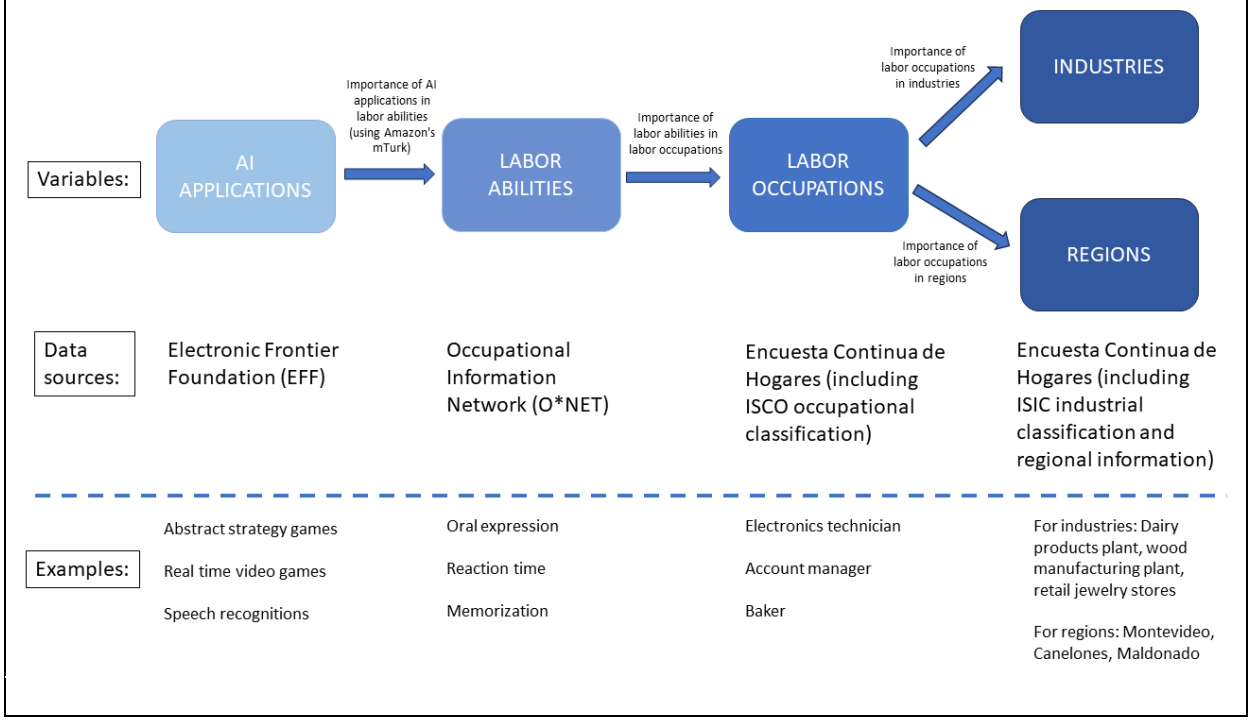
	Uruguay	Brazil	Argentina	Dominican Republic	Ecuador	El Salvador	Spain	LA7	LAC
Total (annual hours)	**414**	**251**	**923**	**517**	**443**	**15,820**	**463**	**1,155**	**1,850**
Employment Administration	201	32	412	33	57	2,976	90	207	364
Wages, taxes, and contrib.	174	21	361	30	25	756	57	158	222
Hiring and firing	27	10	51	2	32	2,220	33	49	137
Operations Management	156	83	469	472	168	2,988	366	763	690
Taxation	136	73	437	472	152	2,988	277	127	256
Waste Management	12	10	3	.	.	.	52	5	7
Vehicle	5	133	17	.	4	.	3	4	3
Occupational health/safety	3	115	12	.	12	1,946	34	626	426
Other	57	133	42	13	218	9,856	6	185	789
Regulatory update	10	119	37	7	67	273	3	26	58
Specific by activity	47	8	5	6	150	9,583	4	159	736

Note: LA7 includes Brazil, Chile, Colombia, Mexico, Paraguay, Peru and Uruguay. Source: 2024 Index of Bureaucracy, Adam Smith Center for Economic Freedom.

Annex V. Measuring Exposure to Artificial Intelligence

1. To measure the exposure of labor occupations or industries to AI, we use the methodology of Felten (2021), also used in recent articles, such as Cazzaniga et al. (2024). AI exposure refers to the degree to which AI technologies can perform tasks currently done by humans and increase overall productivity. The AI exposure measure used is the AIOE index of Felten, Raj and Seamans (2021), which measures the correspondence between 10 AI applications and 52 human skills. They source their set of AI applications from the Electronic Frontier Foundation AI Progress Measurement project, and combine this with data on occupational abilities from the Occupational Information Network (O*NET) database developed by the United States Department of Labor. This overlap between AI and human abilities is weighted by the degree of importance and complexity of such skills in each occupation. The focus is on AI's ability to replicate the function of a human task but does not consider the likelihood of AI serving as a complementary technology. For our analysis, the AI Exposure Index is mapped to the Encuesta Continua de Hogares at the 4-digit International Standard Classification of Occupations (ISCO-08) level.

Annex V. Figure 1: Creation and Use of AI Exposure Measure



2. The AI exposure measure is built on by Pizzinelli et al. (2023) to include a complementary index. The authors of Pizzinelli et al. (2023) augment the AIOE to take into account that AI can be complementary to work tasks, the new measure proposed is the C-AIOE. To develop this index, the authors used O*NET, but drew from two different areas: work contexts and skills. Work contexts include social and physical aspects of how work in a given occupation is carried out. The authors went case-by-case to assign the complementarity based on the work context, how likely society will be to allow unsupervised use of AI in that particular environment. For example, crucial

life-impacting decisions should be decided by AI, this means that occupations such as judges and doctors rank highly for their AI complementarity or shielding from AI despite elevated levels of AI exposure. Although the augmented measure of AI exposure to include complementarity (C-AIOE) measures jointly AI exposure and AI complementarity, in the SIP we choose to assess the measure of AI exposure (AIOE) and complementarity (on its own the measure of complementarity to AI is given by θ) separately following Cazzaniga et al. (2024).

Annex VI. Estimating the Macroeconomic Impact of AI: Model Description

1. This annex summarizes the model used in Section D to analyze the macroeconomic impact of AI adoption. The model was created through a combination of two models found in Drozd, Taschereau-Dumouchel, and Tavares (2023) and Moll, Rachel, and Restrepo (2022). A full description of the model can be found in Rockall, Pizzinelli, and Tavares (2024) but is summarized below for readability.

2. The analysis uses a task-based model of production. The final consumption good in the model is produced using intermediate goods that are obtained through the completion of a continuum of tasks aggregated according to a Cobb-Douglas production function. The Cobb-Douglas form is maintained, which details that output *Y* is produced using a mixture of technology *A*, capital *K* and labor ℓ . Tasks are produced using capital and labor, with workers (also called households/agents) heterogeneous in their skills and ability to invest in capital markets, leading to variations in their capital endowments. This level of heterogeneity allows the model to replicate the income and wealth inequality. Workers are endowed with heterogeneity in skill types, *z*, and workers supply their labor inelastically across different sectors of the economy. The productivity of labor for each of these tasks is defined by ψ_z , with α_z denoting the displacement of tasks from labor to capital due to AI. The degree of complementarity of labor for each task is given by η_z. As is standard in macroeconomic models, workers maximize their utility from consumption subject to a budget constraint and debt limit.

$$Y(K) = AK^{\sum_z \alpha_z \eta_z} \prod_z (\psi_z \ell_z)^{(1-\alpha_z)\eta_z}$$

3. For simplicity, it is assumed that households inelastically supply labor. This means that there is no unemployment in the model but rather displacement of labor from tasks but not jobs. Displacement of labor means that a worker will continue in their existing job but demand for their labor will decline and therefore labor income will fall. This setup implies that workers are unable to switch occupations, which would be equivalent to a model with significant job-switching costs. Households are heterogeneous in their occupation and therefore in their labor income, they also differ in their wealth and portfolio holdings and therefore their capital income. Moreover, this model features a finite capital supply elasticity, as households are risk averse and face some probability of a "wealth dissipation shock" where their stock of assets fully disappears. The advantage of such a setup is it delivers a non-degenerate wealth distribution and that a rise in the capital share due to technological innovation will also bring about an increase in the return on capital.

Households have Epstein-Zin preferences over their consumption:

$$v_0 = E_0 \int_0^\infty \frac{\rho(1-\gamma)v}{1-\sigma}\left(\left(\frac{c}{((1-\gamma)v)^{1/(1-\gamma)}}\right)^{1-\sigma} - 1\right)dt$$

$$da_{z,t} + db_{z,t} = (r_K a_{z,t} + r_B b_{z,t} + w_z - c_{z,t})dt + a_{z,t} v dW_t$$

Where $\rho = \varrho + p$ represents households' discount rate, which is a function of their impatience (ϱ) and the probability that they are hit with a wealth dissipation shock (p). The parameter γ captures the risk aversion, and σ is the inverse intertemporal elasticity of substitution. The return on capital is given by r_K and the return on bonds is r_B, where only a fraction of households can invest in capital (this fraction is calibrated and given by χ).

4. Sector-level capital shares determine the level of displacement induced by AI. The parameter α_z captures the change in the sector-level capital share and is the most important parameter governing the results. To calibrate this parameter, we follow Moll (2022) in using a shift-share approach, based on the historical change in the aggregate capital share of production. Moll (2022) apportions the historical change (1980-2014) in the aggregate capital share into changes in sectoral capital shares based on the routine exposure of each sector to automation. In this spirit we follow Rockall, Pizzinelli, and Tavares (2024) who follow the same strategy as Moll (2022) but focus sectoral exposures to AI using the AI exposure measure of Felten et al. (2021): ω_z^{AIOE} . Since we are interested in the future impact of AI and we do not know what the aggregate change in the capital share induced by AI is, we will ultimately need to make an assumption. The baseline model used in this Selected Issues Paper assumes that the change in the aggregate capital share in response to AI will be of the same magnitude as that observed for automation; that is, it assumes the change in the aggregate capital share over 2014-2048 will match the change in the aggregate capital share from

$$\frac{1}{1-\alpha_{z,2048}} - \frac{1}{1-\alpha_{z,2014}} = \omega_z^{AIOE}\left(\frac{1}{1-\alpha_{2048}} - \frac{1}{1-\alpha_{2014}}\right) = \frac{1}{1-\alpha_{2014}} - \frac{1}{1-\alpha_{1980}}$$

1980-2014.[1]

5. Another important set of parameters govern the sectoral complementarity with AI. In an alternative scenario a sectors complementarity to AI is also accounted for. Complementarity to AI is modelled as a change in the sector's weight in the Cobb-Douglas production function η_z in response to technology adoption, consistent with the idea that the value-added of the sectors with greater complementarity increases. If η_z increases for a sector, even if workers employed in sector z perform fewer tasks, the tasks they do perform are now worth relatively more. To see this more intuitively, consider the equation for wages within a sector:

$$w_z = (1-\alpha_z)\frac{\eta_z}{l_z}Y(K)$$

[1] For an extension that allows for an endogenous capital share see Rockall, Pizzinelli, and Tavares (2024).

Therefore, technological innovation within a sector exerts downward pressure on wages through a higher α_z but may cause wages to rise through a higher η_z . The initial η_z is calibrated to match the wage distribution in Uruguay in 2014. The baseline model keeps η_z fixed following AI adoption, however the alternative model allows for an increase in η_z due to the relative complementarity of each sector to AI. The AI complementarity measure of Pizzinelli et al. (2023) is used for the calibration. Allowing for η_z to increase implicitly means that complementarity shifts the relative weights in production such that some sectors will experience higher income (and therefore higher wages) at the expense of other sectors. A further robustness exercise is conducted that allows for complementarity to additionally increase aggregate productivity in a way that makes all sectors better off.

6. AI adoption occurs in three ways in the model. Firstly, labor displacement arises because tasks originally performed by labor are now carried out by capital, given technological progress of AI that improves the feasibility of AI to perform these tasks. An important assumption in the model is that capital is more productive than labor, therefore labor displacement increases overall productivity. Secondly, the degree of complementarity of AI alters labor demand therefore income. The importance in production is reallocated from workers who have low-complementary to AI to workers with high-complementarity. Lastly, AI is assumed to increase the output and wages of high AI complementarity workers.

7. The model is calibrated to match the Uruguayan economy. Macroeconomic data (output, labor, capital) for the Uruguayan economy is taken from the Penn World Tables 10.01 (Feenstra et al. 2015). The distribution of wages and incomes is derived from the ECH by INE and this is matched to AI exposure using the AIOE measure explained above. To calibrate the needed financial variables of the model such as the share of investors in the economy and capital risk that requires detailed information regarding financial assets and income we use a mixture of the ECH and the Encuesta Financiera de los Hogares Uruguayos (Uruguayan Household Financial Survey), which is an additional module of the ECH. We use the 2014 survey, which is EFHU2, as it is the most detailed household financial survey available for Uruguay. Since we use the 2014 EFHU2 survey we calibrate the model to 2014, which allows us to estimate the impact of AI adoption using the capital deepening of 1980-2014 as a guide for 2014-2048. Following Moll et al. (2022) we calibrate the share of investors using the tail index of income – as the highest Uruguayan earners are likely underrepresented in the survey we use income of the top 1% and top 10% to calculate a tail index of 0.42 and 0.58, respectively. We use the tail index of 0.58 as our baseline. Due to difficulty measuring financial assets we calibrate the model to a range of possible values for the share of investors in the economy and capital risk, using the values for the UK and US as a guide, which are provided in Rockall et al. (2024) and Moll et al. (2022) respectively.

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