The Impact of Wages, Unemployment and Economic Growth on Artificial Intelligence: Evidence from Countries Divided into Three Groups in the Government Artificial Intelligence Readiness Index

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Abstract: We investigate the impact of wages, unemployment and economic growth on the advancement of artificial intelligence (AI) in developed and developing countries, using a theoretical model validated empirically. Investigating the relationship between these indicators on a panel of 90 countries divided into 3 groups, we find that the policy of the state on the development of AI depends on the wages, unemployment and economic growth of the country. We use the AI Government Readiness Index as a proxy of AI and find a positive correlation with wages for all 90 countries. Investigating the impact of unemployment rates and real GDP, divided into three groups according to their place in the Government AI Readiness Index, we observe heterogeneous dependencies between these indicators. For example, the relationship between AI and unemployment has not been established in any group. And the relationship between real GDP and AI in developing countries actively implementing AI was positive and strong, but such a relationship was not found in other groups of countries.

Keywords: Artificial intelligence, wages, unemployment, real GDP
JEL Classification: C12, C36, E24, E71, O32

1. INTRODUCTION

Artificial intelligence (AI) has been developing rapidly in recent years, enabling increased productivity and economic growth. The world economy has reached its highest level of development as a result of technological change. However, throughout history, there has been a fear that automation, which includes mechanization, computing, and more recently artificial intelligence and robotics, will kill jobs and cause irreversible damage to the labor market.

The 21st century is witnessing a high level of technological transition. The driving force behind economic progress is automation, and the introduction of AI in various aspects of economic activity. The process phase began with the industrial revolution, which used the steam engine and then electricity for automation. Later on, computer chips continued this trend, and now artificial intelligence comes into play as the next level of process technology.

Developed countries are achieving economic growth through the introduction of AI in almost all areas of life. The benefits of artificial intelligence are not only felt in the developed world, but emerging economies are also introducing automation technologies into their production processes. However, some other emerging economies, due to their respective economic structures and limitations, are slow to adopt AI or are not yet ready to adopt AI.

The volume of AI implementation can determine the level of development of the country and the place of the country in the world market. The scale of the introduction of AI into the country's economy depends not only on the level of development of the country, but also on the economic policy pursued in relation to AI. Developed, least developed or emerging economies cannot reap the same benefits that AI brings. Countries may need different strategies as levels of AI adoption vary.

The United Nations Conference on Trade and Development argues «the increased use of robots in developed countries risks eroding the traditional labour cost advantage of developing countries. If robots are considered a form of capital that is a close substitute for low-skilled workers, then their growing use reduces the share of human labour in total production costs. Adverse effects for developing countries may be significant» (UNCTAD, 2016).

According to the World Bank, for developing countries as a group, the share of occupations that could experience significant automation is actually higher in developing countries than in more advanced ones, where many of these jobs have already disappeared, and this concerns about two-thirds of all jobs (World Bank, 2016). But experts from the International Telecommunication Union argues that «many developed countries may have no choice but to push AI to capture higher productivity growth as their GDP growth momentum slows, in many cases partly reflecting the challenges related to aging populations. Moreover, wage rates in these economies are high, which means that there is more incentive than in low-wage, developing countries to substitute labor with

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machines. Developing countries tend to have other ways to improve their productivity, including catching up with best practices and restructuring their industries, and may therefore have less incentive to push for AI» (ITU Issue paper, 2018).

Therefore, it is critical to explore the reasons why the use of AI in developing countries may not provide the expected economic effect relative to the growth rates of similar developed countries. Reasons that may underlie the economic effect may be the economic structure and specific constraints of the country.

The objective of this paper is to determine whether the policy pursued by countries to implement AI depends on wages, unemployment and economic growth. To determine the dependence of these indicators, we use OLS and IV approach, designed to identify endogeneity between AI and wages, using the new instrument "Global Talent Competitiveness Index" for wages, which measures the performance of countries in terms of the competitiveness of specialists.

The paper is organized as follows: The second section contains a review of the literature on the relationship between wages, i.e., AI and unemployment. The third section presents the research hypotheses, methodology, and data for the study, and the fourth section is devoted to the analysis of the results. We end up with conclusion in section five.

2. LITERATURE REVIEW

Recently, one of the factors of economic progress is automation and dramatic changes in technological innovation. The AI revolution is a major driver of productivity and further prosperity. Opinions about the impact of AI on wages, employment and economic growth are mixed, and are divided between pessimistic and optimistic views. Graetz and Michaels (2015) found that robot densification increased both total factor productivity and wages, while industrial robots do not affect overall employment in developed countries. This statement can also be seen in the work of Dauth et al., (2018) in a study of the impact of the introduction of robots on the German labor market, they found that it has changed the distribution of jobs by industry without without decreasing the aggregate level of employment. De Backer et al. (2018) do not share this conclusion; they found that there is a positive correlation of robot investment on employment growth for developed economies, while Acemoglu and Restrepo (2017) do find a negative impact of robots on employment and wages. Similar conclusions can be seen in the work of the Webb (2019), who found that occupations with high exposure to automation technologies saw declines in employment and wages.

The impact of artificial intelligence on unemployment is one of the most widely discussed topics in the scientific community, and scientists disagree. Investigating the impact of robots on employment in developing countries, Carbonero et al., (2018) finds the following results: «First, robots have a detrimental effect on employment growth at the global level, more than eleven times stronger in emerging economies than in developed economies. Second, the impact of robots on employment is not affected by the level of labour intensity in developed economies, while the evidence on such non-monotonic effects is mixed for emerging economies». According to Frey and Osborne (2017), 47% of jobs could potentially be automated in the next two decades. And according to published reports from the World Economic Forum, about 75 million jobs will disappear in the near future, and AI will take over 52% of the share of all jobs (WEF, 2020). Such a statement can be seen in the works of the Acemoglu and Restrepo (2016), where the authors note that «new technologies will render labor redundant in a framework in which tasks previously performed by labor can be automated and new versions of existing tasks, in which labor has a comparative advantage, can be created. In a static version where capital is fixed and technology is exogenous, automation reduces employment and the labor share, and may even reduce wages, while the creation of new tasks has the opposite effects». As some studies show, the growth of robotization and the active introduction of AI in developed countries can lead to a redistribution of production. The firms in developed countries may find it more profitable to bring production back home after having it previously off-shored to low-cost, emerging economies and robotization in developed countries negatively affects employment in emerging countries, providing the first evidence of cross-country effects via robot-driven re-shoring (Carbonero et al., 2018).

It should also be noted the important contributions of scientists who have explored the impact of AI on economic growth. In recent years, GDP growth in developed countries has slowed down to solve this problem, and the governments of these countries are undertaking various strategies to stimulate economic activity. One of these strategies is to push AI for higher productivity growth. Furman (2017) reports that 36 of 37 advanced economies had slower productivity growth in 2006-2016 compared to 1996-2006. Across these economies, growth has slowed from a 2.7 percent average growth rate in the earlier decade to a 1.0 percent average annual growth rate in the past decade. In order to boost productivity growth, it will be important to ensure that there are policies in place supporting efficient AI development and use, by both incumbent firms and start-ups. If we consider the theories that have studied the relationship between AI and economic growth in developing countries, the results obtained by M. Haseeb et al., (2019) show that AI exhibits the potential to be the main driver of Asia-Pacific’s economic growth.

In addition to studying the impact of artificial intelligence on unemployment, the role of wages in incentives to innovate is a subject of great interest to scholars, in which Lommerud and Straume (2012) show that «increased flexicurity – interpreted as less employment protection and a higher reservation wage for workers – unambiguously increases firms’ incentives for technology adoption». Songül et al., (2021) found a positive relationship between wages and the impact of AI, «that is, high-income occupations appear to be more affected by the intensity of AI research than low-income occupations». Investigating the factors influencing the firm's decision to replace labor with machines, Georgios (2018) say that «firms’ market strategies and investments are endogenous to technology shocks: Even if the presumed technological advances materialise, there is no guarantee that firms would choose to automate; that would depend on the costs of substituting machines for labour and how much wages change in response to this threat». Cristian et al. (2020) turned their attention to the effects of wages on the demand for robots and concluded that «in the developing country, with low wages and low share of robots in output, the increase in demand for robots is smaller».

While the aforementioned scientists mainly studied the impact of AI or robots on wages, unemployment and economic growth, our study, on the contrary, aims to study how wages, unemployment and economic growth affects the policies pursued by countries in relation to AI.

3. DATA AND METHODOLOGY

3.1. Research Hypotheses

Based on these theories and empirical research, we explore four research hypotheses about how the wage level, the unemployment rate and GDP growth in a country can affect the course of AI development. First, for developed countries, we expect to see a positive correlation between wages and AI adoption, and no correlation between AI and employment (H1). Several authors (Gretz, Michaels, 2018; Dauth *et al.*, 2018; Lommerud, Straume 2012; Songül *et al.*, 2021; Georgios, 2018) reveal some aspects of this hypothesis: high wage rates and labor shortage forces as a result of population aging is forcing developed countries to replace labor with machines; industrial robots do not affect overall employment in developed countries, but only distribute jobs by industry. The impact of AI on wages and employment has been extensively studied in the literature, but the impact of wage levels and unemployment rates on decisions to implement AI is currently under-reported.

Second, for developing countries, we expect a positive (negative) correlation between the unemployment rate and AI (H2). In this hypothesis, we expect to see whether high unemployment in developing countries really leads to a lack of incentive to implement AI, because in such countries reducing unemployment is more important than supporting artificial intelligence. To test this hypothesis, we use theories (Carbonero *et al.*, 2018; Frey, Osborne, 2017; Acemoglu, Restrepo, 2017; Webb, 2019; WEF, 2020), according to which AI has a negative impact on unemployment in some developing countries, as a result of a decrease in the share of professions due to active or lack of incentive to implement AI. But these theories have not explored the impact of unemployment on AI. Therefore, in this hypothesis, we will study how the unemployment rate can affect the ranking of AI.

In the third hypothesis, we expect to see how AI progress remains weak in developing countries with low wages due to a lack of incentives (H3). This hypothesis is consistent with the theory of Cristian et al., (2020), who found that developing countries indeed are less robot-intensive, and that robot use is negatively correlated with wages, in the same time labor-substituting automation endogenously takes place more intensively in advanced countries, because wages are higher.

We expect to see a negative correlation between GDP growth rates and AI rankings for developed countries, and a positive correlation for developing countries actively implementing AI (H4). Because low GDP growth in developed countries is forcing them to use more AI to improve productivity (Furman, 2017), and for developing countries, economic growth is one of the sources of AI development (M. Haseeb et al., 2019).

These hypotheses shows that the expected results of the study should give heterogeneous effects in the three groups, depending on the level of AI implementation. In different groups, the effect of indicators on AI may be different depending on the effect of "forcedness" and the effect of "lack of stimulus". The “forcedness” effect is due to the fact that high wages and labor shortages as a result of an aging population force developed countries to replace labor with machines, and also developed countries are forced to use more AI to increase productivity. The “no stimulus” effect postulates that high unemployment and low wages in developing countries lead to a lack of incentive to implement AI.

These hypotheses form the basis of this study and will be explored using the methodology presented below.

3.2. Data and Descriptive Statistics

To test these three hypotheses, we investigate the relationship between AI, wages, unemployment and GDP growth. Our data set consists of a panel of 90 countries divided into 3 groups based on the level of AI adoption by 2021. We begin our empirical analysis by describing the ranking of the Government AI Readiness Index, the average annual wages, the annual percentage change in real GDP and the unemployment rate in the thirty countries analyzed.

Our main source of data on the Government AI Readiness Index as a proxy of AI is the Oxford Insights (2021), that are “the index, published yearly, ranks countries based on 42 indicators across three pillars: Government; Technology Sector; and Data and Infrastructure”. Initially, we planned to conduct our research based on the change in the Government AI Readiness Index from 2017 to 2021, but given that different indicators are used to determine this ranking in different years, we limited ourselves to 2021 data. The Government AI Readiness Index will be ranked as follows: 1-the top 30 developed countries in the Government AI Readiness Index, 2-developing countries actively implementing AI, and 3-developing countries with scores below the global average in AI government readiness. According to the Oxford Insights (2021)[1], the global average for government AI readiness is 47.42 out of 100.

Our second major source of data for this paper is the Organization for Economic Co-operation and Development (OECD), and official statistical websites of countries. This data includes information on average annual wages, which are reported in units of local currency in the source, we convert them to US dollars to compare these data across countries. For most countries, we used average annual wages data for 2021 from the OECD[2] and various official sources. However, one problem with the data is that due to the lack of data

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[1]https://static1.squarespace.com/static/58b2e92c1e5b6c828058484e/t/61ead0752e7529590e98d35f/1642778757117/Government_AI_Readiness_21.pdf
[2] https://stats.oecd.org/Index.aspx?DataSetCode=AV_AN_WAGE

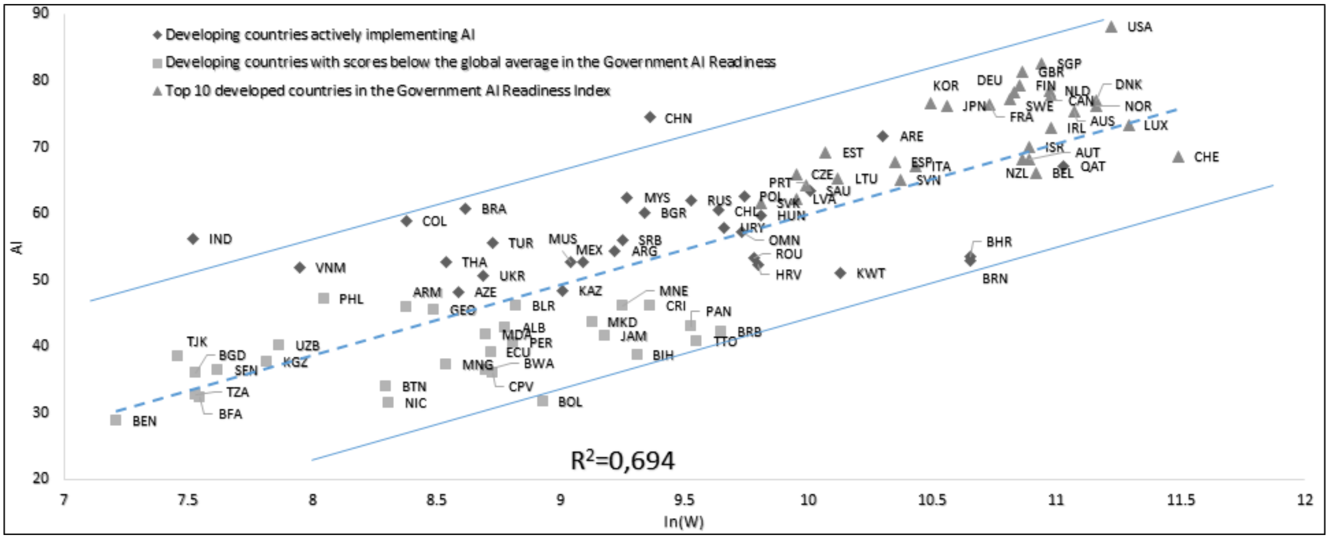

Fig. (1). The Government AI Readiness Index and average annual wage

Note: Data on The Government AI Readiness Index from the Oxford Insights. Data on average annual wage from the Organization for Economic Co-operation and Development (OECD), and official statistical websites of countries.

for 2021 for some countries in the second and third groups, we used data for 2018, 2019 and 2020 from various official sources. In addition, to improve the accuracy of the indicators obtained in the study of the impact of economic growth and unemployment on AI ranking, we use data on the average value of percentage change in real GDP and the unemployment rate for the period 2013-2021 from the World Economic Outlook (2022)[3] as explanatory variables. All of the above data are presented in Table **1**.

Our dependent variable is the Government AI Readiness Index, where the scores were normalized to range from 0 to 100. The main explanatory variables are the average annual wages, the average value of percentage change in real GDP and the unemployment rate. For each country, we calculate the log wage based on 2021 data, unless otherwise noted, and the average percentage change in real GDP and unemployment rate over the period 2013-2021 is expressed as a percentage. To confirm the plausibility of the results obtained with the OLS, we crosschecked them with an IV approach, using an instrument that shows the country's level of endowment with highly qualified staff. For the instrumental variable, we use data on "Global Talent Competitiveness Index" from INSEAD in 2021[4].

Some concerns could be raised in the process of obtaining accurate results when studying the relationship between the above indicators. First, in the study, we were unable to analyze the changes in the relationship between artificial intelligence, economic growth, wages and unemployment over the years, because different indicators are used to determine the Government AI Readiness Index in different years. Therefore, the analysis of the relationship between indicators was limited to comparing the data of 2021. Second, whether the Government AI Readiness Index could fully demonstrate the potential of the country from point of view on artificial intelligence. Although most studies use robots and patents as indicators of AI, these indicators are absent in our sample of countries. For this reason, the Government AI Readiness Index, while not fully satisfactory, are currently an available indicator for many countries.

As shown in Table, in 2021, the United States was the leading country in terms of the Government AI Readiness Index and while Switzerland in average annual wages. Singapore and the United Kingdom ranked next places in the Government AI Readiness Index, while Luxembourg and Denmark ranked next in the average annual wage. From developing countries such as the United Arab Emirates, Qatar and Saudi Arabia, AI rankings and average annual wage are better than some developed countries. China also ranks higher in the AI rankings than some developed countries because China is the second most powerful unicorn after the US. Table 1 also shows the values for our explanatory variables, the annual percentage change in real GDP and the unemployment rate. Among developed countries, the highest average unemployment rate is in Spain, and in developing countries in North Macedonia.

Fig. (**1**) shows the scatter plot of the relation between the Government AI Readiness Index and log of average annual wage for a cross-section of 90 countries in 2021. Countries with higher wages have substantially higher ranking the Government AI Readiness Index, with the slope of the fitted line is positive, indicating that the Government AI Readiness Index varies proportionally compared to wages. Here, 69% of AI variability is explained by wages. The remainder of the variability is due to some explanatory variables, like the annual percentage change in real GDP and the unemployment rate, and other explanatory variables that were not measured in this experiment.

Out of 90 countries, we can determine that 3 countries are outside the trend range, and the rest are all normally distrib-

[3]https://www.imf.org/en/Publications/WEO/Issues/2022/07/26/world-economic-outlook-update-july-2022
[4] https://www.insead.edu/sites/default/files/assets/dept/fr/gtci/GTCI-2021-Report.pdf

uted, which means that more than 95% of the countries are in the confidence interval. In India, Bolivia, and China, there is no correlation between wages and AI ranking, i.e., in India and China, AI rankings are higher relative to salary levels, while in Bolivia, on the contrary, salary levels are higher compared to AI rankings. If we compare 3 groups with each other, we can see that they are located sequentially along the trend line, i.e. developed countries are at the top of the interval, developing countries with scores below the global average in AI government readiness are at the bottom.

Table 1: Summary Statistics by Country.

Country	AI	ln(W)	U (%)	Y (%)	Country	AI	ln(W)	U (%)	Y (%)	Country	AI	ln(W)	U (%)	Y (%)
Top 30 developed countries in the Government AI Readiness Index					Developing countries actively implementing AI					Developing countries with scores below the global average in the Government AI Readiness				
United States of America	88,16	11,22	5,5	2,0	China	74,42	9,36***	4,6	6,6	Philippines	47,2	8,05**	2,8	4,7
Singapore	82,46	10,94**	3,8	3,1	United Arab Emirates	71,6	10,3	2,3	2,3	Belarus	46,2	8,82	5,3	0,7
United Kingdom	81,25	10,86	5,0	1,5	Qatar	67,18	11,03**	0,2	2,1	Costa Rica	46,19	9,36**	11,1	3
Finland	79,23	10,85	8,1	1,6	Saudi Arabia	63,42	10,01**	6,1	2	Montenegro	46,1	9,25***	17,3	2,5
Netherlands	78,51	10,97	5,3	1,8	Poland	62,5	9,74	5,7	3,3	Armenia	45,93	8,38	18,5	3,6
Sweden	78,16	10,83	7,5	2,1	Malaysia	62,46	9,27**	3,5	3,6	Georgia	45,41	8,49***	15,3	3,6
Canada	77,73	10,98	7,0	1,7	Russian Federation	61,93	9,53	5,2	1,2	North Macedonia	43,73	9,13*	22,3	2,1
Germany	77,26	10,81	4,1	1,1	Brazil	60,64	8,62	11	0,2	Panama	42,98	9,53***	5,4	3,6
Denmark	76,96	11,16	5,9	2	Chile	60,42	9,64***	7,5	2,4	Albania	42,9	8,78*	14,3	2,6
Republic of Korea	76,55	10,49	3,5	3,1	Bulgaria	60,07	9,34	7,5	2,2	Barbados	42,2	9,65**	9,8	-1,7
France	76,41	10,73	9,3	1	Hungary	59,72	9,81	5,5	3,2	Republic of Moldova	41,71	8,7	4,3	4,6
Japan	76,18	10,56	3,0	0,5	Colombia	58,91	8,38	10,2	2,8	Jamaica	41,5	9,18	11,4	-0,6
Norway	76,14	11,16	4,1	1,9	Uruguay	57,93	9,66**	8,2	1,6	Trinidad and Tobago	40,78	9,55**	3,4	-2,5
Australia	75,41	11,07	5,7	2,2	Oman	57,26	9,73**	2,9	2,5	Peru	40,56	8,81**	4	2,9
Luxembourg	73,37	11,29	5,9	2,8	India	56,11	7,52**	5,7	5,5	Uzbekistan	40,13	7,87	5,8	5,8
Ireland	72,8	10,98	8,2	8,8	Serbia	55,98	9,25*	14,6	3,1	Ecuador	39,19	8,72***	4,3	1,1
Country	AI	ln(W)	U (%)	Y (%)	Country	AI	ln(W)	U (%)	Y (%)	Country	AI	ln(W)	U (%)	Y (%)
Top 30 developed countries in the Government AI Readiness Index					Developing countries actively implementing AI					Developing countries with scores below the global average in the Government AI Readiness				
Israel	70,01	10,89	4,8	3,8	Turkey	55,49	8,73***	11,3	5,8	Bosnia and Herzegovina	38,67	9,31*	21,5	2,5
Estonia	69,18	10,07	6,4	3,2	Argentina	54,36	9,22	8,9	-0,1	Tajikistan	38,49	7,46	7,5	7
Switzerland	68,56	11,49	4,8	1,7	Bahrain	53,54	10,65	1,3	2,4	Kyrgyzstan	37,61	7,82***	7,7	3,5
New Zealand	68,08	10,86	4,9	3	Romania	53,22	9,78*	5,5	3,7	Mongolia	37,2	8,54***	5,8	4,4
Austria	68,07	10,89	5,5	1	Brunei Darussalam	52,93	10,65	7,8	-0,1	Senegal	36,34	7,62***	5	5,2
Spain	67,68	10,35	18,8	0,9	Mauritius	52,71	9,04	7,0	1,6	Botswana	36,33	8,7*	21,9	3,8

Italy	67,07	10,43	11,0	-0,3	Thailand	52,63	8,54***	0,8	1,9	Bangladesh	36,1	7,53***	4,6	6,4
Belgium	66,16	10,92	7,1	1,4	Mexico	52,62	9,09	4,1	1,4	Cabo Verde	36,07	8,73**	12,7	1,7
Czech Republic	65,95	9,95	3,8	2,4	Croatia	52,3	9,8*	11,8	2,6	Bhutan	34,02	8,3	2,9	3,3
Lithuania	65,19	10,12	8,4	3,7	Viet Nam	51,82	7,95***	1,8	5,8	Tanzania	32,69	7,53***	2,3	6,3
Slovenia	65,05	10,37	6,9	2,6	Kuwait	50,97	10,13**	2,6	-1	Burkina Faso	32,24	7,55	4,5	5,3
Portugal	64,31	9,99	9,9	1,3	Ukraine	50,58	8,69	8,8	-0,7	Bolivia	31,62	8,93	4,3	3,3
Latvia	62,27	9,95	8,9	2,3	Kazakhstan	48,43	9,01	4,9	3,1	Nicaragua	31,57	8,31***	4,9	2,8
Slovakia	61,62	9,81	9,2	2,2	Azerbaijan	48,26	8,59	5,3	1,5	Benin	28,73	7,21	1,8	5,4

Note: AI stands for the Government AI Readiness Index, Global Ranking. Average annual wages (W) are measured in US$, while the average value of percentage change in real GDP (Y) and the unemployment rate (U) for the period 2013-2021 are in percentage terms.* 2020 data, ** 2019 data, *** 2018 data.

3.3. Methodology

In the previous section, we have described the construction of our data containing information on AI, wages, unemployment, and real GDP changes for 90 countries. Now, to examine the relationship between exposure scores in the Government AI Readiness Index, wages, employment, and real GDP, I evaluate variants of the following regression:

$$AI_{ct}^{k} = \beta_0 + \beta_1 Y_{ct}^{k} + \beta_2 U_{ct}^{k} + \beta_3 W_{ct}^{k} + \varepsilon_{ct}^{k} \quad (1)$$

We run our analysis assuming that AI_{ct}^{k} is the Government AI Readiness Index in the rating group *k* in country *c* at time *t* depends only on factors of the average annual wages *W*, the annual percentage change in real GDP *Y*, the unemployment rate *U* and ε_{ct}^{k} is the error term. Here AI is the dependent variable. We estimate equation 1 using data 2021 with OLS and IV approaches.

4. EMPIRICAL RESULTS

Table **2** contains descriptive statistics for all collected information, including means, medians, maximum and minimum values, and standard deviation for 90 countries.

Table 2. Descriptive Statistics.

	AI	ln(*W*)	U	Y
Mean	56,406	9,532	7,196	2,620
Maximum	88,160	11,490	22,300	8,800
Minimum	28,730	7,210	0,200	-2,500
Standard Deviation	14,901	1,115	4,642	1,940
Observations	90	90	90	90

The average the Government AI Readiness Index score among the selected countries is 56.406, this indicates that this indicator is close to the global average level of government AI readiness. The standard deviation is 14,901, which indicates that the AI in the 90 countries in our sample is significantly different.

Table **3** presents a correlation matrix of variables, which shows the relationship between the average annual wages, the annual percentage change in real GDP, the unemployment rate and the Government AI Readiness Index in the model.

Table 3. Correlation Matrix.

Dependent Variable:	$AI^{k=0}$	$AI^{k=1}$	$AI^{k=2}$	$AI^{k=3}$
Y^k	-0,208	-0,032	0,298	-0,340
U^k	-0,163	-0,386	-0,147	0,397
W^k	0,833	0,636	0,324	0,527

Note: The correlation matrix shows those coefficients that are related to the influence of three indicators on AI.

The dependent variable AI presented in Table **3** is the AI Government Readiness Index, $AI^{k=0}$ for all 90 countries, $AI^{k=1}$ for the top 30 developed countries in the Government AI Readiness Index, $AI^{k=2}$ for the developing countries actively implementing AI and $AI^{k=3}$ for the developing countries with scores below the global average in the Government AI Readiness.

The estimated effect of the wages for $AI^{k=0}$ has a coefficient of 0.833, this means that the correlations between the wages and AI are positive and strong. On the other hand, we observe a negative correlation between AI and the annual percentage change in real GDP, with a coefficient of -0.208, suggesting that the lower the GDP growth of countries, the more they are interested in AI adoption. We can also see that the unemployment rate has a low correlation with AI.

The study of the Government AI Readiness Index by rating group provides us to draw some conclusions. First, we can see that for all three groups, a positive correlation was found between wages and AI adoption. In particular, for $AI^{k=1}$ and $AI^{k=3}$ group of countries the correlations between AI and the wages are positive and strong, with a coefficient of 0.636 and 0.527 respectively, for the second group of countries $AI^{k=2}$ the effect of wages on AI is not very strong, with a coefficient of 0.324. Second, the matrix shows negative and weak correlation between unemployment rate and AI rating for $AI^{k=0}$, $AI^{k=1}$ and $AI^{k=2}$ groups, while for $AI^{k=3}$ group the correlation is positive. Third, we found that the annual percentage change in real GDP is negatively correlated with AI for $AI^{k=0}$, $AI^{k=1}$ and $AI^{k=3}$, and for $AI^{k=3}$ group the correlation is positive. In the analysis below, we use the OLS and IV approach to test the robustness of our results.

Table **4** contains the results for the OLS approach, which shows globally and by country group the impact of wages, unemployment and real GDP on inflation.

Table 4. The Government AI Readiness Index Regressed on the Annual Percentage Change in Real GDP, the Unemployment Rate and the Average Annual wages. OLS Approach.

Dependent Variable:	$AI^{k=0}$	$AI^{k=1}$	$AI^{k=2}$	$AI^{k=3}$
Y^k	0,158**	-0,085	0,446**	0,140
	(0,063)	(0,148)	(0,177)	(0,268)
U^k	-0,071 (0,058)	-0,181 (0,160)	0,002 (0,174)	0,197 (0,181)
W^k	0,893*** (0,063)	0,572*** (0,159)	0,466** (0,183)	0,556* (0,288)
N	90	30	30	30
R^2	0,723	0,436	0,284	0,323

Note: Robust standard error in parentheses. * $p < 0.10$ ** $p < 0.05$ *** $p < 0.01$.

An analysis of standardized coefficients shows that the wages factor has the greatest influence on the AI rating, since it corresponds to the largest coefficient value of 0.893, which is statistically significant at the level of 1%. This means that at the global level, one percent increase in wages increases the AI rating by 0.893 points. This result reflects that the higher the wages of a country, the higher these countries are in the ranking.

If we consider the relationship between wages and AI at the level of country groups, then group $AI^{k=1}$ has the highest indicator with a coefficient of 0.572, statistically significant at the level of 1%. Here, the AI rating will change by an average of 0.572 points, assuming that wages change by one percent. For other groups, the statistical significance of the coefficient is 5 and 10%.

The second most significant coefficient, which shows the relationship between real GDP and AI rankings for $AI^{k=0}$ and $AI^{k=2}$, is statistically significant at the 5% level. At the global level, the relationship between these indicators is positive, but quite weak, and for group $AI^{k=2}$ one percent increase in real GDP increases the AI rating by 0.446 points. The results of the regression (Table **4**) demonstrate that the unemployment factor is not statistically significant.

To check the validity of the results obtained with OLS, we use the IV approach. The results of the IV approach are presented in Table **5**.

The results in Table **5** show that all coefficients of the IV approach are larger than those with OLS, and they turn out to be even more accurate. We see that at the global level, one percent increase in wages increases the AI rating by 1.087 points, and in group $AI^{k=1}$ by 0.741. These results are quite similar to those we report using OLS. For the groups $AI^{k=2}$ and $AI^{k=3}$, our IV estimate of the effect of wages on AI is about 50 percent larger than the OLS estimate, but less statistically significant at the level of 5%.

Table 5. The Government AI Readiness Index Regressed on the Annual Percentage Change in Real GDP, the Unemployment Rate and the Average Annual Wages. IV Approach.

Dependent Variable:	$AI^{k=0}$	$AI^{k=1}$	$AI^{k=2}$	$AI^{k=3}$
Y^k	0,241***	-0,086	0,631**	1,875*
	(0,068)	(0,152)	(0,218)	(0,958)
U^k	-0,047 (0,061)	-0,118 (0,167)	0,151 (0,210)	-0,416 (0,447)
W^k	1,087*** (0,073)	0,741*** (0,186)	1,016** (0,297)	2,921** (1,234)
N	90	30	30	30
R^2	0,737	0,467	0,358	0,236

Note: Robust standard error in parentheses. * $p < 0.10$ ** $p < 0.05$ *** $p < 0.01$.

When checking the relationship between real GDP and AI, we found that at the global level the relationship of these indicators is positive and weak, but the effect is different for groups of countries. For example, in group $AI^{k=2}$, one percent increase in real GDP increases the AI rating by 0.681, although the estimates are not significant at the five percent level. Finally, Table **5** shows that, as it was in the OLS estimate and in the IV estimate, the unemployment factor is not statistically significant.

We will now analyze our research hypotheses based on the results obtained. First, we can confirm first hypothesis, as the results presented in Table **4** and **5** show that for developed countries $AI^{k=1}$ wages (W^k) are positively correlated with AI, and also no correlation between employment (U^k) and AI.

Secondly, we can say that H2 is not confirmed, because we didn't find a positive correlation between unemployment and AI for $AI^{k=2}$ and $AI^{k=3}$ groups.

The hypothesis H3, that in developing countries $AI^{k=3}$ with low wages due to lack of incentives, the progress of AI remains weak is fully validated. If compare the effect of wages on AI in groups $AI^{k=1}$ and $AI^{k=3}$, we can see that the correlation is stronger in group $AI^{k=1}$ than in group $AI^{k=3}$, with a coefficient of 0.636 and 0.527 respectively. So we can argue that AI progress remains weaker in developing countries ($AI^{k=3}$) with low wages than in advanced countries ($AI^{k=1}$).

The last hypothesis H4, postulating that in developed countries there is a negative correlation between GDP growth rates and AI rating, and in developing countries actively implementing AI, positive correlation is only partially validated for $AI^{k=2}$, and no significant effects are found for $AI^{k=1}$.

5. CONCLUSION

Several studies have examined the impact of artificial intelligence or robots on wages, unemployment, and economic growth. Some studies show that the identification of robots increases both total factor productivity and wages, while industrial robots do not affect overall employment in developed countries. Other studies are finding that the identification of robots can have negative effects on employment and wages. Other statements of researchers argued that the degree of influence of artificial intelligence or robots on wages, unemployment, and economic growth depends on the development of the country. Moreover, we studied the feedback between these indicators.

We have estimated, for the first time, the effects of the wages, real GDP, and unemployment on the Government AI Readiness Index using panel data for 90 countries divided into 3 groups by development level. We found that higher wages clearly increase countries' incentives to adopt AI. Our OLS and 2SLS estimates show a significant impact of wages on AI ranking across all country groups, although the statistical significance of the indicators varies across these groups. Moreover, wages are much more likely to affect the AI ranking of advanced economies than emerging economies. We find that the unemployment rate is not affected by AI in any group of countries. This study confirmed the hypothesis that the unemployment rate does not affect AI in developed countries, for developing countries actively implementing AI, we expected to see a negative correlation between the unemployment rate and AI, yet this hypothesis has not been confirmed. We also examined the impact of real GDP on AI rankings. In particular, we found that at the global level, the correlation between AI and the annual percentage change in real GDP is negative, while it is positive in developing countries actively implementing AI. However, there exists no correlation between these indicators in developed countries.

As discussed in the previous section about data and descriptive statistics, the results obtained would be more accurate if we could analyze the changes in the relationship between artificial intelligence, economic growth, wages and unemployment over the years. Unfortunately, the Government AI Readiness Index data varies by year, and thus we could not use data from 2017-2020.

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Received: Nov 10, 2022 Revised: Nov 15, 2022 Accepted: Dec 30, 2022