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Perception of Artificial Intelligence in Spain

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Abstract

The present paper analyses perception of AI of individuals in Spain and the factors associated with it. Data on 6,308 individuals from the Spanish survey (CIS, 2018) are used. The data include several measures of perception, innovation, place of residence (autonomous regions and province), gender, age, educational level, and other socioeconomic and technical variables. A binary logit regression model is formulated and estimated for the attitude towards robots and artificial intelligence and its possible determinants. The results indicate that people have a negative attitude if they are not interested in scientific discoveries and technological developments and if AI and robots are not helpful at work.

Key words and phrases: perception, innovation, artificial intelligence, survey data, binary logit.

JEL Classifications: C21, C25, D12, D83, L63, L86, L96, P36.

1. Introduction.

In April 2018, the first European strategy for Artificial Intelligence (AI) was presented addressing opportunities and challenges of the AI advances in the EU (European Commission, 2018). The general idea is to promote the development and deployment of AI in the UE countries but taking into account human and ethical implications of AI (von der Leyen, 2019).

The AI strategy in UE has been condensed in the "White Paper On Artificial Intelligence - A European approach to excellence and trust" by European Commission (2020) which the development and deployment of AI technologies inside an appropriate regulatory framework that addresses potential negative effects is promoted. So, two main points are considered related to research and trust on IA:

- Research on an AI: searching for collaboration between Member States, increasing investment in AI development and industrial applications deployment.
- Promote trust in AI: how to create a legal framework to ensure development safety and respect to fundamental rights.

Commission's White Paper express many opportunities that AI can bring to Europe's economy and society in order to build an ecosystem of excellence and trust in Europe for AI involving cross sectoral coordination across all areas of Europe through a number of legislative and non-legislative actions to be a global competitive player in AI. Europe needs top-class cyber-secure digital infrastructure to develop and run AI upon in order to foster full capacities in this area, and this needs a broad deployment of 5G that creates opportunities for everyone in Europe (European Commission, 2020).

Europe will be a pioneer in defining AI through regulation which could grant it competitive international influence. The definition provided for by the Commission's High-Level Expert Group on AI (AI HLEG, 2019) is clearer than definition included in White Paper (describing AI's main elements simply as "data" and "algorithms" would include all contemporary software). AI HLEG (2019) considers that AI depends on humans where a machine can only execute an action assigned from the outset by a human in any capacity (e.g. manufacturer, operator, developer or data supplier). So, according to AI HLEG (2019), "Artificial intelligence (AI) systems are software (and possibly also hardware) systems designed by humans that, given a complex goal, act in the physical or digital dimension by perceiving their environment through data acquisition, interpreting the collected structured or unstructured data, reasoning on the knowledge, or processing the information, derived from this data and deciding the best action(s)

to take to achieve the given goal. AI systems can either use symbolic rules or learn a numeric model, and they can also adapt their behaviour by analysing how the environment is affected by their previous actions. As a scientific discipline, AI includes several approaches and techniques, such as machine learning (of which deep learning and reinforcement learning are specific examples), machine reasoning (which includes planning, scheduling, knowledge representation and reasoning, search, and optimization), and robotics (which includes control, perception, sensors and actuators, as well as the integration of all other techniques into cyber-physical systems)."

Supporting human capital to understand and advance AI is the clue. Businesses should play a closer role in influencing all levels of national education so that foreseen labour market needs, such as embracing AI, can be linked closer to national curriculums so that our citizens (including our workforce) gain the relevant STEM and transversal skills required to take part in the digital economy. There are three core roles (with corresponding skill sets) that are required within these programmes to make them a success:

- Developers (people who can create AI systems);
- Trainers (people who can train AI systems e.g. preparing and testing data sets);
- Operators (e.g. people who can operate AI systems).

Nevertheless, it is more important to obtain trust in AI from the users. Europe should incentivise trust in its AI framework without interfering with the efficiency of AI decision making itself. Otherwise, we are simply holding back the power of AI to improve our societies and become global leaders in this strategic technological area (AI HLEG, 2019). Enabling trust in AI through any new provisions should put transparency at the core:

- Consumer transparency: so, citizens understand when an AI is being used, which functions are AI enabled, if any human oversight validation exists and where the responsibility for decision making could be placed;
- Business transparency: to trigger a positive feedback loop so that industry has transparency of the AI decision making process with as much accuracy as possible. They should also understand their own responsibilities and the responsibilities of other actors that are involved in the delivery of that AI would support accountability.

Trust is a concept that is very important in the common life and has different levels. McKnight and Chervany (1996) considered that there are different levels of trust. Trusting Beliefs is the

most important and is the determinant of Trusting Intention (based on perceptions) and Trusting Behaviour. Friedman, Khan and Howe (2000) said that people only trust on people and people do not trust in technology, they give some keys to try to obtain online trust. DeCamp and Tilburt (2019) explained why it is not a good idea (actually, it is an error) to talk about trust in AI in medicine. However, it is true that talk about trust in AI in all the cases is not good, so that, it is the main reason by this paper will be focus on perception and attitude towards AI.

Innovation perception in Spain is getting down, it was lower in 2019 compared with 2017 (COTEC, 2020). The groups of people that have changed their perception the most, the most sceptical now, they are women, young people between 18-29 years old, students and training profiles and low income (COTEC, 2020). More than 54% of respondents believe that innovation increases social inequality. Unemployed people and workers with basic education are the most concerned about the effect of technological change on social inequality (COTEC, 2020). However, these findings are not unique to Spain. Fast and Horvitz (2017) analyses the perception of artificial intelligence in the New York Times over 30 years, and found that till 2009 it was increased, but then change. The main reason is that people get worried about the negative impact of AI on work, and ethical and loss of control of AI. Also, they found that the perception of AI in healthcare and education never stop to grow up.

Therefore, Fundación Telefónica (2020) said that AI is global and emerging in all the households and companies, but the focus is on companies and how the CEOs want to improve their companies with investment in AI.

European Commission (2017) used a survey that contains some of the questions that are related in this paper. The survey was gathered on March 2017 and for the 28 country members. In figure 1 it could be seen that 61% on average have a positive attitude with robots and AI (in Spain is only 56%) and it could be seen the attitude by country. Figure 2 shows one perception related to jobs, and it is that will disappear more than will be new ones. The 74% of European think that it is true. Spain is the most agreeable country with that idea.

The 68% of Europeans think that AI is good to help people in their jobs and daily tasks at home (see figure 3) and 84% considers that robots are good to do hard and dangerous jobs (see figure 4). In Spain this percentage are 82% about robots that could do hard and dangerous jobs for people (figure 4), and 69% thinks that robots and AI is good to help people.

Spanish people (90%) think that robots and AI steal people's jobs, it is the second country with this opinion, while the European average is 72% (see figure 5).

[Figures 1-5 go here]

European Commission (2020) is taking care about trust in a legal framework and fundamental rights, but not about to be comfortable with. This paper adopts the point of view of individuals about artificial intelligence, rather than business who provides the artificial intelligence.

The rest of the paper is organized as follows: section 2 contains the description of the data used; section 3 includes the binary logit model of positive attitude towards robots and AI. Section 4 concludes.

2. Data.

The sample consists of a survey with data on 6,308 personal interviews about the perception on innovation and artificial intelligence "Innovarómetro", conducted by Spain's Centro de Investigaciones Sociológicas (CIS, 2018). The centre is an official government body that produces high-quality statistics that are well-suited to the analysis. The CIS micro-data have been made freely available through the Internet (CIS, 2018). The basic tabulation of the survey is available in the CIS website (2018). The survey is about individual private people perception and includes questions about socio-demographics, innovation perception, use and knowledge of ICT and so on.

The data was gathered using personal interviews, and ten different measures of innovation perception. The innovation perception scale ranged between 1 and 4, where 1 corresponds to the lowest level of perception and 4 to the maximum. Then, there are three questions about the perception of artificial intelligence, and have the same scale ranged as innovation perception.

The collected data are representative nationwide by gender, thus making them appropriate for the analysis. Gender is a significative variable that needs to be include in this analysis because Goswami and Dutta (2016) concludes that in the ICT context men are more technologically adept than women. The gender gap it is not the focus of this paper, but the variable is included

it because the database is representative by gender and will confirm or not if there is difference between men and women about their perception of artificial intelligence.

The descriptive statistics of the different measures of innovation perception with different aspects of economy growth, consumption, quality of life and artificial intelligence perception are shown in table 1.

[Table 1 goes here]

In figure 6 it could be seen the percentage of respondent about the innovation perception. It could be seen that there is a good perception on innovation related to economic growth, quality of life and even with company's savings. However, the perception is not good if they think about de difficulty to adapting to new innovations. It has not good seeing the innovation related to work, because most of the respondent think that innovation leads to job losses and even makes face-to-face communication worse.

[Figure 6 goes here]

Figure 7 shows that the perception about robots and AI is bad if people are relating them with job, because think that will disappear more jobs than create new ones. But, if they are asking about the useful or helpful than could be robots and artificial intelligence, people think that is good. They know that robots help with the hard and dangerous work. This is in line with Randstad (2018) where it is stated that 63% of people in Spain believe that artificial intelligence will be positive for their work.

[Figure 7 goes here]

The correlation matrix of the main variables, table 3, shows that different variables little linear correlation among themselves, with simple correlations below 0.542 (the maximum one) and multiple correlations with coefficients of determination below 0.7 in all cases, so there is no evidence of multicollinearity in any case.

[Table 2 goes here]

3. Empirical model.

This section presents the results of the model of innovation and Artificial Intelligence perception that have been developed. It is used a logit specification for a binary dependent variable (Wooldridge, 2010) who tries to answer if the interest on innovation of individual private people of Spain depends or not of their perception of AI. IBM SPSS was used to perform the data analysis.

[Table 3 goes here]

This model explains the attitude (positive or negative) towards artificial intelligence and robots of respondent. The binary logit regression uses as reference category that people have a positive attitude. So, the dependent variable was generated as a dummy variable taken the value 1 if the attitude is positive or high positive, and 0 otherwise. The independent variables about the interest in scientific discoveries and technological developments have five categories and "no interest" is the reference one (note: "enough interest" is a category that only appear if the respondent is not able to answer, the respondent does not know that could select that option), the other independent variables have four categories (and it is used the same reference category). This binary logit model is almost 80% correctly classify and the main findings are the following.

It could be seen that males are more interesting than females in technological developments. This result is consistent with He and Freeman (2010).

About AI, it is clear that if people think that robots and AI is useful, then they are more interested in developments, but if they are afraid that AI and robots will lead to the elimination of jobs, people is less interest in scientific discoveries and technological developments.

If people are afraid about innovation, they are less interest in that. It could be seen with the variables about the difficulties in adapting to innovations, their thinking about innovation leads to job losses and that innovation makes face-to-face communication worse.

If they think that innovation could be good for them, they are much interest in developments. As it could see with the importance that people have about innovation is essential for economic growth and that it increases people's quality of life.

In brief, for having the best attitude towards AI and robots, the individual should think that they are good for society (helping doing jobs). In particular, this variable has the biggest coefficient

and also it is significative. The second bigger coefficient has much interest in scientific discoveries and technological developments. And finally, thinking that robots are really needed for hard and dangerous works.

On the contrary, a negative attitude will come from respondents who thinks that many people have difficulties in adapting to innovations, innovations lead to job losses, innovation makes face-to-face communication worse and that the use of robots and AI will disappear jobs.

4. Conclusions

The present paper analyses perception of AI of individuals in Spain and the factors associated with it. It is not the first time that this topic is analysed. Fast and Horvitz (2017) found that the perception of AI of New York people till 2009 was increased, but then changed. The main reason is that people get worried about the negative impact of AI on work, and ethical and loss of control of AI. In addition, they found that the perception of AI in health care and education over 30 years never stops growing.

In a European context, European Commission (2017) conducted a survey and found that there is different perception in AI and robots, but only a basic tabulation of the question was done. Turning to Spanish studies, CIS (2018) and COTEC (2020) analyses the same data used in this paper although they only achieve a basic tabulation of each question and reaches no specific conclusion.

One of the main findings in this paper is that there is a gender gap with the attitude towards AI and robots, that is consistent with Goswami and Dutta (2016) and He and Freeman (2010). The attitude no positive to AI and robots is due to responders think that people may have difficulties in adapting to, relationships face-to-face will be worse and that will steal jobs. On the contrary, the positive attitude is coming from the thinking that robots and AI are helpful and for a good perception of innovation. If people perceived innovations like something good, they have a better attitude with AI and robots.

Unfortunately, one of the limitations of the present study is the cross-section data used. So, with this type of data there is not enough information to make a proper approximation to the evolution of AI perception and try to find why people trust or not on it. It should be better having a time series database or panel data.

Three types of policy recommendations could be derived from these conclusions:

1) From the point of view of artificial intelligence companies, create a special program to workers to be able to adapt to AI and robots. Let people see the importance of robots and AI to help, not to destroy jobs.
2) From the policy maker point of view, it is important to write the regulation about privacy, but you should take care of consumers (future users of AI). Some education policy should be done, to help future users to be prepare. It is as important companies as future users' perception.
3) Improving customer perception is desirable in itself and it will be reflected in they could use if they know the benefits.

Finally, this paper suggests the need for further research on this topic and related to, perhaps with a panel data analysis if available and/or European comparison.

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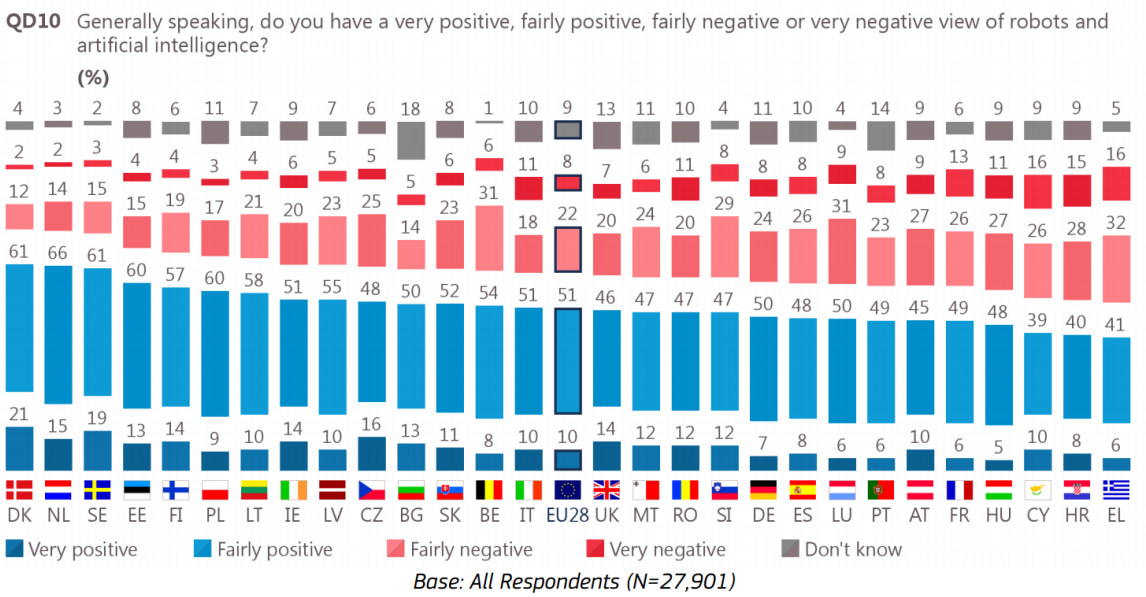

Figure 1. Attitude about robots and AI

Source: European Commission (2017)

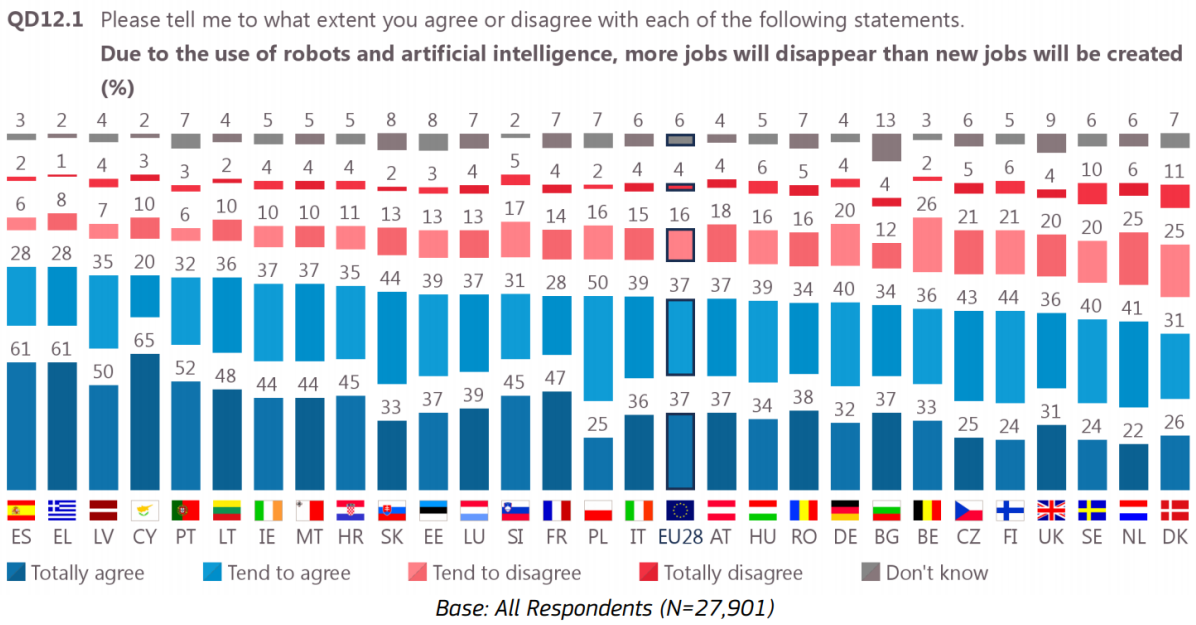

Figure 2. Using of robots and AI, more jobs will disappear than new ones will be created

Source: European Commission (2017)

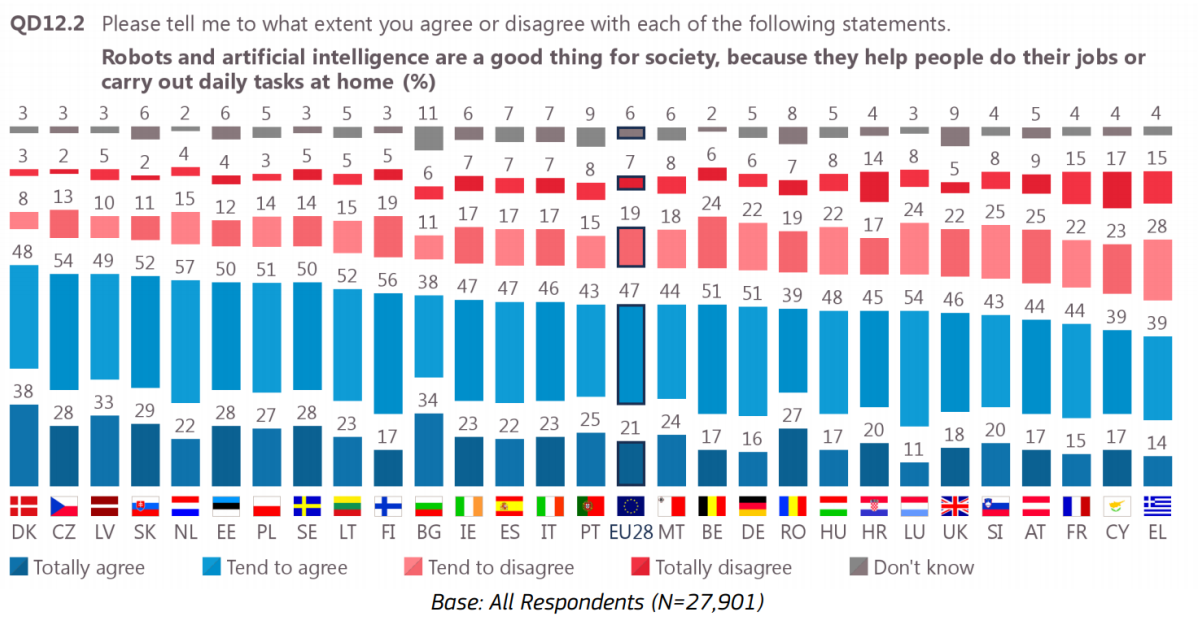

Figure 3. Robots and AI are good for society

Source: European Commission (2017)

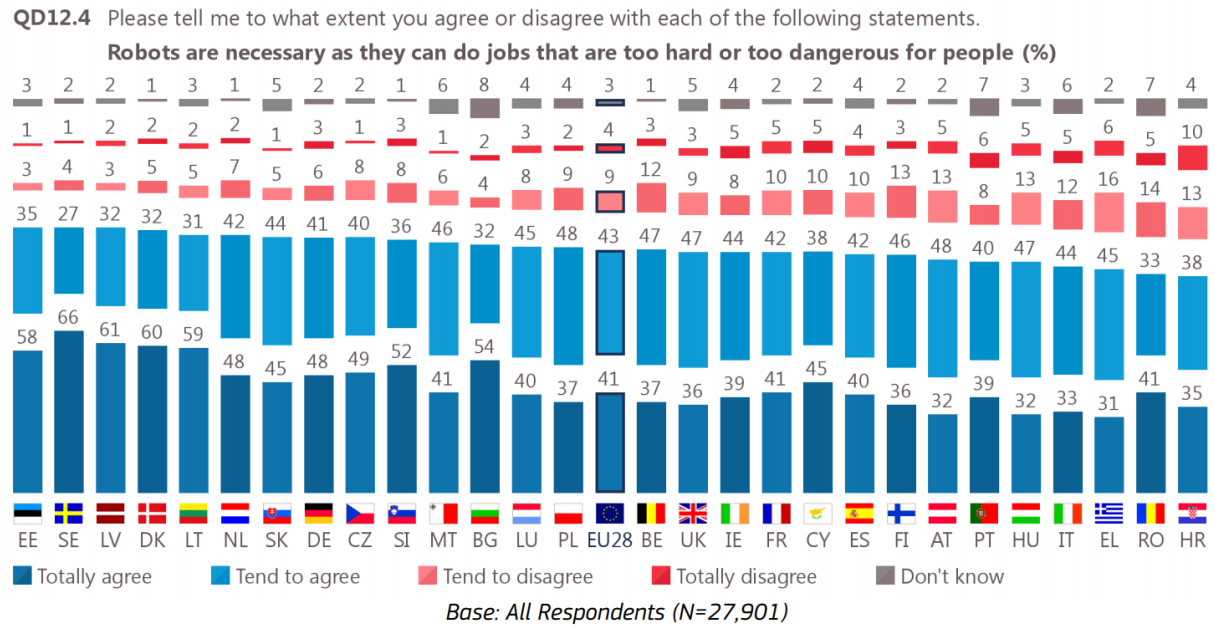

Figure 4. Robots are necessary for hard and dangerous jobs

Source: European Commission (2017)

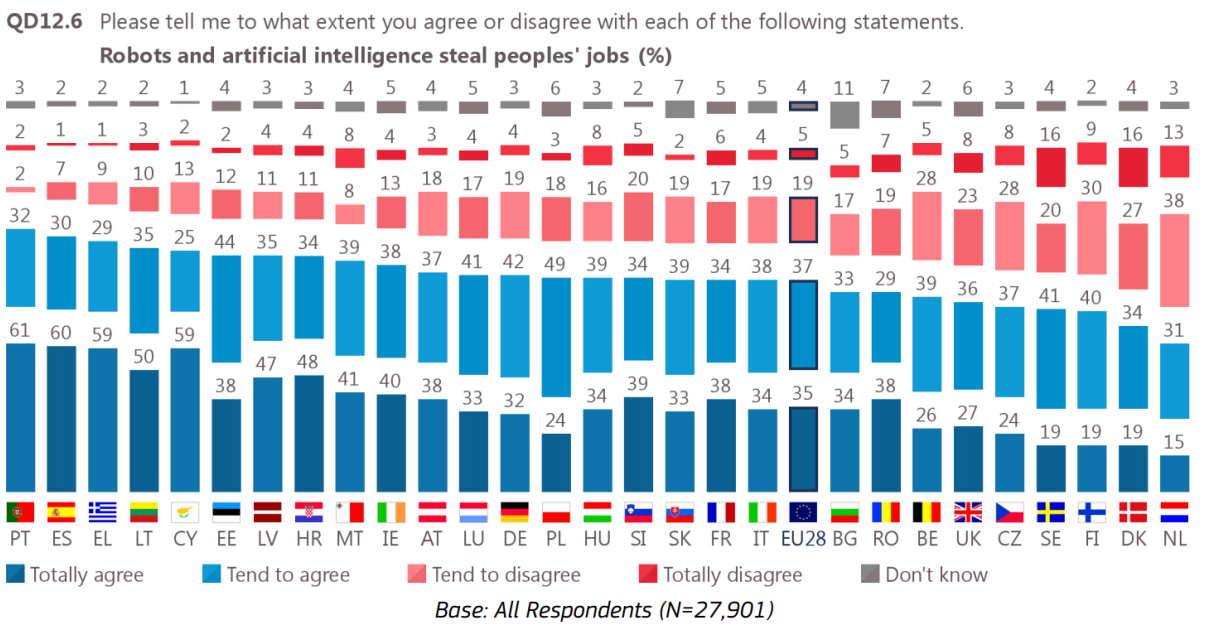

Figure 5. Robots and AI steal people's jobs

Source: European Commission (2017)

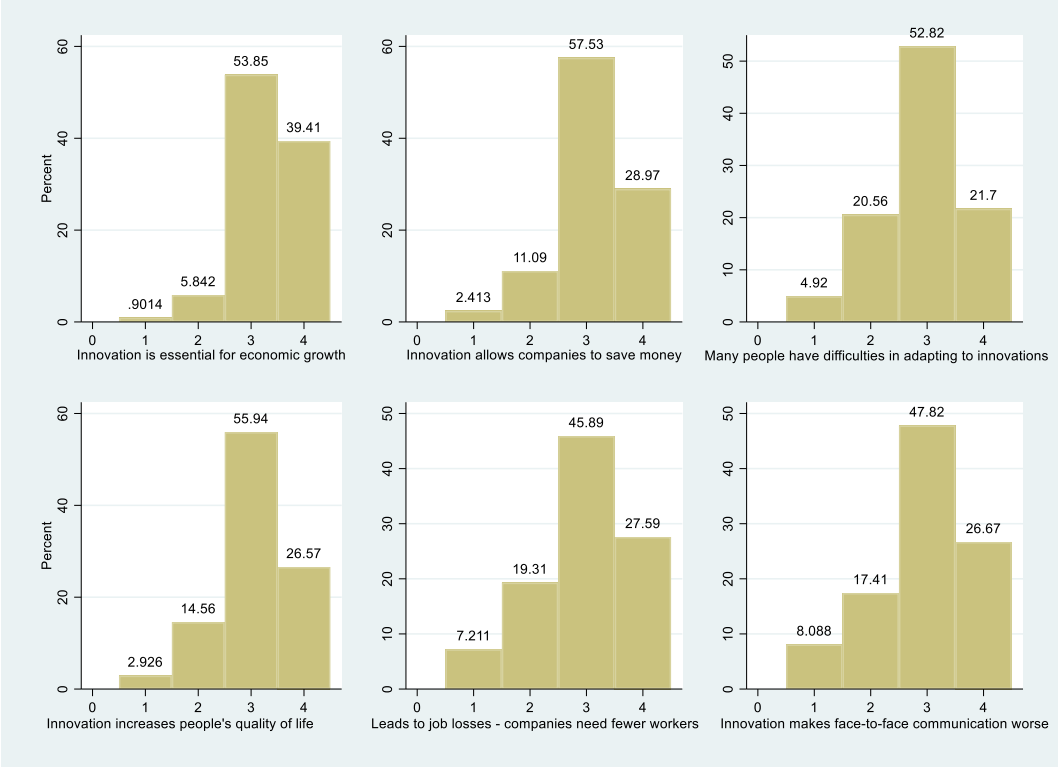

Figure 6. Percentage of innovation perception

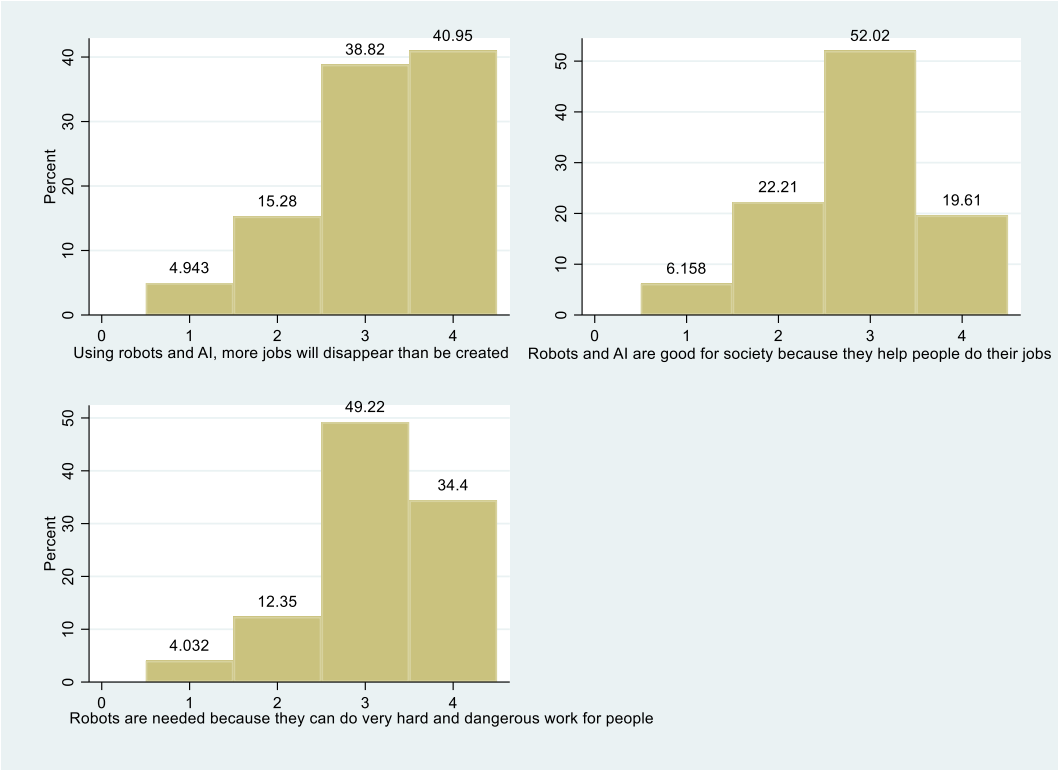

Figure 7. Percentage of artificial intelligence perception

Table 1. Descriptive stats

	Min.	Max.	Std. Dev.	Mean	Median	Mode	n
Interest in scientific discoveries and technological developments	1	5	1.129	3.74	4	4	6260
Innovation is essential for economic growth	1	4	0.623	3.31	3	3	6009
Innovation allows companies to save money	1	4	0.69	3.12	3	3	5588
Many people have difficulties in adapting to innovations	1	4	0.776	2.92	3	3	6028
Innovation increases people's quality of life	1	4	0.728	3.04	3	3	5920
Innovation leads to job losses because companies need fewer workers	1	4	0.859	2.94	3	3	6013
Innovation makes face-to-face communication worse	1	4	0.866	2.93	3	3	6021
Due to the use of robots and artificial intelligence, more jobs will disappear than can be created	1	4	0.852	3.16	3	4	6001
Robots and artificial intelligence are good for society because they help people do their jobs	1	4	0.807	2.86	3	3	5919
Robots are needed because they can do both very hard and dangerous work for people	1	4	0.776	3.16	3	3	5964
Male	0	1	0.500	0.49	0	0	6308
Positive attitude towards AI and robots	0	1	0.500	0.51	1	1	6048

		Frequency	Percent
Gender	Male	3066	48.6
	Female	3242	51.4

Table 2. Correlation matrix 2018

Positive attitude towards AI and robots											
Interest in scientific discoveries and technological developments	-0.179										
Innovation is essential for economic growth	0.186	-0.224									
Innovation allows companies to save money	0.105	-0.135	0.333								
Many people have difficulties in adapting to innovations	-0.161	0.090	-0.019	0.050							
Innovation increases people's quality of life	0.217	-0.188	0.403	0.280	-0.068						
Innovation leads to job losses because companies need fewer workers	-0.229	0.111	-0.090	0.007	0.367	-0.149					
Innovation makes face-to-face communication worse	-0.191	0.076	-0.087	0.015	0.387	-0.130	0.483				
Due to the use of robots and artificial intelligence, more jobs will disappear than can be created	-0.279	0.128	-0.118	-0.065	0.259	-0.155	0.474	0.320			
Robots and artificial intelligence are good for society because they help people do their jobs	0.341	-0.107	0.190	0.152	-0.070	0.230	-0.128	-0.103	-0.113		
Robots are needed because they can do both very hard and dangerous work for people	0.258	-0.150	0.185	0.140	-0.031	+0.166	-0.081	-0.061	-0.056	0.542	
Male	0.134	-0.055	0.050	0.060	-0.015	0.051	-0.055	-0.062	-0.053	0.083	0.079

Table 3. Binary Logit Regression

	Positive attitude towards AI and robots				
		Little interest	**Enough interest**	**Quite interest**	**Much interest**
Interest in scientific discoveries and technological developments	***	2.161*** (0.25)	1.667*** (0.25)	2.728*** (0.23)	2.940*** (0.24)
Innovation is essential for economic growth	**	0.623 (0.44)	----	0.659 (0.42)	0.686 (0.43)
Innovation allows companies to save money	**	0.433** (0.27)	----	0.446** (0.25)	0.474*** (0.26)
Many people have difficulties in adapting to innovations	***	1.038 (0.19)	----	0.760 (0.18)	0.586*** (.19)
Innovation increases people's quality of life	***	0.711 (0.25)	----	0.952 (0.24)	1.433 (0.24)
Innovation leads to job losses because companies need fewer workers	***	1.679** (0.17)	----	1.126 (0.16)	0.948 (0.17)
Innovation makes face-to-face communication worse	**	1.156 (0.16)	----	1.000 (0.15)	0.736** (0.16)
Due to the use of robots and artificial intelligence, more jobs will disappear than can be created	***	0.853 (0.21)	----	0.490*** (0.20)	0.290*** (0.20)
Robots and artificial intelligence are good for society because they help people do their jobs	***	1.373 (0.20)	----	4.090*** (0.19)	5.964*** (0.21)
Robots are needed because they can do both very hard and dangerous work for people	***	1.042 (0.26)	----	1.649** (0.24)	2.289*** (0.25)
Male	1.439*** (.068)				
Constant	.310** (.588)				
-2 Log likelihood	5167.84				
Nagelkerke R^2	0.323				
Cox and Snell R^2	0.241				
Correctly classify	79.9%				
n	6308				

Notes: Exp (B) and Standard deviation in parenthesis. The reference category is “No interest”