Class structure and technological replaceability of the European workforce.

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Gregorio Buzzelli

Abstract

In this excerpt of my Master's thesis, I describe the class structure and the degree of technological replaceability of the workforce in thirteen European countries. This investigation allows me to test the "routine-biased technical change" framework, which states that middle-class workers are the most exposed to the automation risk (Autor et al., 2003). The class analysis is based on the occupational scheme elaborated by Daniel Oesch (2006), and the countries are clustered into four welfare regimes (Esping-Andersen, 1990). I also plot a longitudinal analysis describing the evolution of the class structure since the early 2000s. Some relevant differences emerge among regimes. Conservative and Mediterranean countries appear committed to preserving the clerical and industrial workforce, whereas Liberal countries are characterized by large groups of entrepreneurial and low-skill service occupations. The Social Democratic regime shows a great effort in upskilling workers without altering the service transition. As regards technological replaceability, education seems to matter more than what is stated by the RBTC scholars. More specifically, low-skill occupations – especially in the interpersonal service sector – appear more replaceable than expected. Hence, the middle class can be split into two groups based on educational attainment, and the least skilled branch turns out to be more replaceable than the most educated. Finally, automation affects national workforces differently: the Nordic and Anglo-Saxon labor forces appear more resilient than the Continental and Mediterranean ones.

In this chapter I will outline the class structure of some European countries, using the Oesch's scheme (2006), together with the proneness to automation shown by those classes, which it will be measured with the "Routine Task Index" (RTI). I will divide the chapter in two paragraphs, devoting the first section to class analysis and the second one to RTI. The class analysis will serve as an empirical test of the molding influence of welfare institutions on the labor market, investigating the quality and direction of service transition (Wren, 2013). Hence, the preliminary conclusions of this chapter would enable me to answer to the first research question of this work, regarding the replaceability of the middle-class occupations due to the technical change.

1. Class analysis: the Oesch's scheme applied to the ESS dataset

In the previous chapter the Oesch's model of social stratification has been widely described both in terms of theory and operationalization. I decided to rely on his classification because its focus on occupations and skills fits perfectly with the aim of this work, bringing out the linkage between labor market position and social class. As already mentioned, I will mainly refer to the 8-class version to outline the class structure of the European countries of interest. However, the 16-class scheme will be also employed when more detailed information are deemed useful. For instance, I will use the more specific classification to release some comments on the "large" middle class that I define by merging those groups of occupations labeled as "associate professional/managerial" and "generally/vocationally skilled". Before moving to quantitative analysis, few words should be spent with regard to the data and methodology chosen.

1.1. Data and methodology

The quantitative analyses performed in this chapter refer to the data collected in the European Social Survey (ESS), and they are processed by the statistical software Stata. The ESS project was established in 2001, becoming one of the most popular cross-national survey, which provides information about social structure and conditions, together with moral, political and economic attitudes in Europe (Schnaudt et al., 2014). It is released every two years, covering more than thirty European countries, and it involves tens of thousands of respondents randomly selected amongst the general population. The ESS counts nine waves, enabling both single-country and cross-national analyses. Moreover, longitudinal studies can also be performed thanks to the ESS Cumulative Data Wizard.

As regards methodology, I will apply the Oesch's scheme to the ESS dataset by running the do-files produced by Tawfik and Oesch, available online[1], which permit to construct the class indicators using the variables isco08, emplrel, emplno, isco08p, emprelp. It should be underlined that the larger Oesch's classification only involves 16 classes rather than the 17 categories presented by the author (Oesch, 2006). The reason lies in the operationalization process, which merges the "routine operatives" with the "routine agriculture" workers in the "low-skilled manual" class.

Since the main aim of this chapter is to highlight the differences in terms of class structure among welfare regimes, and the associated propensity to automation, I will cluster countries

[1] Tawfik, A., Oesch, D., *Script for Social Class*. Available at http://people.unil.ch/danieloesch/scripts/.

according to the welfare state's classification elaborated by Esping-Andersen (1990). However, as pointed out in the second chapter, I will add a distinct ideal-type to his classification, composed by the Mediterranean countries. This analytical need appears quite undeniable, given the distinctive and homogenous features outlined in the literature (e.g., universal healthcare systems, familism, etc.). The statistical tool that I will use to plot the differences among welfare regimes is the frequency distribution, represented both by tables and histograms. The countries chosen to represent each welfare family are the following: Austria, France, Belgium and Germany for the Christian Democratic type; the United Kingdom and Ireland for the Liberal model; Sweden, Norway, Finland and Denmark for the Social Democratic cluster; Italy, Portugal and Spain for the Mediterranean family. As regards the Scandinavian countries, it should be noted that neither the Swedish nor the Danish 9th round data had yet been released at the time of writing. Moreover, Denmark did not take part in the previous ESS round. Therefore, in order to work with comparable data concerning the Nordic countries, I will rely on the 7th ESS round (2014) when performing analyses on their class structure. Besides, a similar issue rises with regard to the Southern nations since neither Portugal nor Spain had released their data for the last ESS wave. Hence, I will use the 8th round data (2016) when referring to this cluster.

A further annotation needs to be pointed out regarding weights. The ESS dataset provides three types of weight variables: the "design weight" (dweight), adjusting for different selection probabilities; the "post-stratification weights" (pspwght), adjusting for sampling error, non-response bias, and different selection probabilities; the "population size weights" (pweight), which should be applied when analyzing aggregates of two countries or more. The second weight variable mentioned should be used when working with a single country, whereas the product between pspwght and pweight is required when looking at cross-national aggregates. However, since the pspwght had not yet been released for the last ESS wave at the time of my analysis, I will replace it with the dweight when using that dataset.

Finally, I will plot time series using the ESS Cumulative Data to outline the evolution of class structures and their features in Europe, particularly focusing on the middle class.

1.2. Class structure and welfare regimes: differences among European countries

1.2.1. Work logics and the 8-class scheme

Following the criteria elaborated by Oesch (2006) to create his classification, I would first plot the relative sizes of the different work logics in each welfare cluster.

TABLE 1: The worklogic distribution

Work Logic – Conservative Regime	Country				
	AT	BE	DE	FR	Total
	%	%	%	%	%
Independent	11.46	14.40	11.99	13.15	12.56
Technical	26.96	27.68	28.99	29.13	28.85
Organizational	26.19	26.58	29.67	27.08	28.31
Interpersonal service	35.39	31.34	29.35	30.64	30.29
Total	100.00	100.00	100.00	100.00	100.00

Work Logic – Liberal Regime	Country		
	GB	IE	Total
	%	%	%
Independent	18.46	14.85	18.23
Technical	18.53	20.77	18.67
Organizational	27.67	27.08	27.64
Interpersonal service	35.34	37.30	35.46
Total	100.00	100.00	100.00

Work Logic – Mediterranean Regime	Country			
	ES	IT	PT	Total
	%	%	%	%
Independent	18.72	22.78	19.22	20.76
Technical	28.19	32.24	34.24	30.75
Organizational	19.96	20.43	17.62	19.96
Interpersonal service	33.14	24.55	28.92	28.53
Total	100.00	100.00	100.00	100.00

Work Logic – Social Democratic Regime	Country				
	DK	FI	NO	SE	Total
	%	%	%	%	%
Independent	10.34	13.33	10.44	12.06	11.65
Technical	25.32	31.54	22.88	23.42	25.48
Organizational	24.31	19.19	25.67	23.75	23.26
Interpersonal service	40.03	35.94	41.00	40.76	39.61
Total	100.00	100.00	100.00	100.00	100.00

The frequency distributions charted here confirm some of the arguments reported in the previous chapters, which were taken from the literature. Firstly, the relative size of the independent work logic in the Liberal countries (18,2%) is well above that one measured in the other clusters. This observation is in line with the market friendly attitude of the Liberal regime. Secondly, the reduced size of the interpersonal service logic in the Conservative countries relative to the other two clusters confirms their hostility towards this economic sector (Wren, 2013). Moreover, the Social Democratic regime seems to outperform the Liberal cluster in the interpersonal service dimension, although a deeper analysis is required to detect the different occupations responsible for those results. Finally, a last difference emerges with regard to the technical work logic, peaking in the Conservative group (28,9%) and in Finland, an exception among the Scandinavian countries, while falling in the Liberal cluster (18,7%), These figures may be traced back to the corporatist preservation of the traditional working-class occupations (Cirillo and Guarascio, 2015), despite it should be checked in the Oesch's more detailed classification.
As already said, I consider as noteworthy to present separately the distribution of work logic for the so-called Mediterranean countries, in order to point out some of the differences between this cluster and the Conservative one. Indeed, this table shows a significant performance of the independent work logic and the weakness of the organizational dimension relative to the Conservative group (respectively above and below 20%), whose causes need to be investigated more in detail using the class scheme. Meanwhile, the technical and interpersonal service logics present similar figures in both the Christian Democratic and the Southern regimes.
Once the differences in terms of work logic has been outlined, we can move to the Oesch's 8-class distribution in order to acquire more specific information on class structure.

TABLE 2: Oesch's 8-class distribution

Final Oesch class position - 8 classes – Conservative regime	Country				
	AT	BE	DE	FR	**Total**
	%	%	%	%	**%**
Self-employed professionals and large employers	1.51	2.88	3.11	2.77	**2.88**
Small business owners	9.95	11.53	8.88	10.38	**9.67**
Technical (semi-)professionals	5.60	11.45	10.41	8.77	**9.61**
Production workers	21.36	16.23	18.58	20.36	**19.25**
(Associate) managers	11.82	16.00	16.91	13.46	**15.28**
Clerks	14.37	10.58	12.76	13.62	**13.03**
Socio-cultural (semi-)professionals	10.90	12.94	15.37	10.61	**13.19**
Service workers	24.49	18.40	13.98	20.03	**17.10**
Total	100.00	100.00	100.00	100.00	**100.00**

Final Oesch class position - 8 classes – Mediterranean regime	Country			
	ES	IT	PT	**Total**
	%	%	%	**%**
Self-employed professionals and large employers	2.85	3.66	2.40	**3.20**
Small business owners	15.87	19.12	16.83	**17.55**
Technical (semi-)professionals	6.45	4.47	4.39	**5.28**
Production workers	21.74	27.77	29.85	**25.47**
(Associate) managers	12.72	9.72	8.06	**10.80**
Clerks	7.24	10.71	9.56	**9.16**
Socio-cultural (semi-)professionals	6.63	7.93	8.21	**7.42**
Service workers	26.51	16.62	20.71	**21.11**
Total	100.00	100.00	100.00	**100.00**

Final Oesch class position - 8 classes – Social Democratic regime	Country				
	DK	FI	NO	SE	**Total**
	%	%	%	%	**%**
Self-employed professionals and large employers	2.39	1.64	1.69	2.23	**2.03**
Small business owners	7.95	11.70	8.75	9.83	**9.61**
Technical (semi-)professionals	6.68	9.62	9.35	7.55	**8.15**
Production workers	18.64	21.92	13.53	15.88	**17.32**
(Associate) managers	13.90	10.89	19.56	14.14	**14.44**
Clerks	10.41	8.30	6.11	9.62	**8.83**
Socio-cultural (semi-)professionals	12.42	12.86	12.90	16.08	**13.98**
Service workers	27.61	23.08	28.10	24.68	**25.63**
Total	100.00	100.00	100.00	100.00	**100.00**

Final Oesch class position - 8 classes – Liberal regime	Country		
	GB	IE	**Total**
	%	%	**%**
Self-employed professionals and large employers	2.76	2.01	**2.72**
Small business owners	15.69	12.84	**15.51**
Technical (semi-)professionals	7.40	7.68	**7.41**
Production workers	11.13	13.10	**11.26**
(Associate) managers	17.99	13.83	**17.73**
Clerks	9.68	13.26	**9.90**
Socio-cultural (semi-)professionals	11.86	13.64	**11.97**
Service workers	23.48	23.65	**23.49**
Total	100.00	100.00	100.00

Firstly, it seems clear that the variation of the independent work logic among welfare regimes has to be traced back to the small business owners' class, since the figures regarding large employers and self-employed professionals are quite homogenous across clusters. On the contrary, the small entrepreneurs count for the exceptional size of the independent work dimension in both Mediterranean and Liberal countries, peaking in Italy (almost 20%). As regards technical professionals, Conservative countries show the highest result, whereas the Southern group presents the lowest share in this class. Coupling this evidence with the data concerning production workers, it corroborates the argument of Cirillo and Guarascio (2015) according to which the German-centered core countries have upskilled their laborers, preserving the traditional working-class jobs (19,25%). Moreover, these countries were also able to retain the largest share of clerks (13%), ranking above the rest of the nations included in the analysis. At the same time, the oversized amount of production workers in Southern Europe, which is a quarter of its whole workforce, seems to demonstrate the capability of this welfare regime to preserve those routine jobs.

Unsurprisingly, the Liberal cluster shows the highest relative size of associate managers (almost 18%) and a remarkable figure for service least-skilled workers (23,5%). However, the Nordic countries outperform the British Isles in the entire interpersonal service dimension, including both high-skill socio-cultural professionals (14%) and low-skill service workers (25,6%). Hence, relying on this evidence, the Scandinavian way to support service employment appears more successful than the Anglo-Saxon one, boosting the whole sector. Combining these data with the literature (Wren, 2013), the Nordic approach to service transition may turn out to be the most efficient and sustainable, although further investigations are needed to understand the quality of jobs created in the least tradable service sector.

Instead, the service dimension looks more polarized in the other two welfare clusters. While in the Christian Democratic group the number of socio-cultural professionals almost equals the

Nordic figure (13,2%) and the share of low-skill service workers is more constrained (17,1%), in the Mediterranean family the share of service employees exceeds 20% and their high-skill counterpart shows its lowest comparative result (7,4%). Thus, the hostility of Central European countries to low-skill and low-paid service jobs seems confirmed (Wren, 2013), whereas the more flexible Southern wage-setting institutions have not hampered their expansion. Moreover, the vocational training system of the Conservative regime does not seem to have constrained the growth of highly educated service occupations. This observation is in contrast to the argument of Anderson and Hassel (2013), who argue that the Continental European training systems mainly provide workers with specific skills that are less employable in the service sector. Indeed, the overall share of socio-cultural professionals in Central European countries comes very close to the one shown by the Scandinavian group, outperforming the Liberal result. On the contrary, the Mediterranean institutional configurations turn out to be the worst equipped to train service professionals.

Although homogenous trends have been detected within the welfare clusters, I have to point out some differences which slightly undermine their internal consistency. Starting from the Conservative group, Austria stands out clearly for its anomalous class structure, especially referring to two work logics. Firstly, this country shows, within the interpersonal service dimension, a significantly larger share of low-skill service workers relative to socio-cultural professionals (respectively 24,5% and 10,9%). Moreover, looking at the technical logic, the production workers are almost four times as much as the technical professionals (respectively 21,4% and 5,6%). Hence, the Austrian workforce looks less skilled than the rest of the Central European countries, resembling to the Southern cluster. However, the important share of highly skilled service workers, together with the constrained figure of small business owners, requires a more detailed analysis to assess whether Austria comes closer to the Mediterranean or the Scandinavian cluster, particularly focusing on the quality of the least-educated service jobs.

In the Mediterranean group, the outliers are less threatening for the welfare state's classification than the one previously mentioned. Italy presents a restrained share of service workers (16,6%), which is more in line with the Conservative rather than the Southern figures, which might be the result of a stricter wage-setting institutions, while leading in the small business sector (19,1%). On the other hand, Spain shows a clearly de-industrialized labor market, displaying a significant amount of service workers (26,5%) and an overall higher skilled industrial workforce than the other "cluster-mates" (21,7% of production workers and 6,5% of technical professionals). Nevertheless, in order to check the quality of Spanish service transition, a deeper investigation is needed.

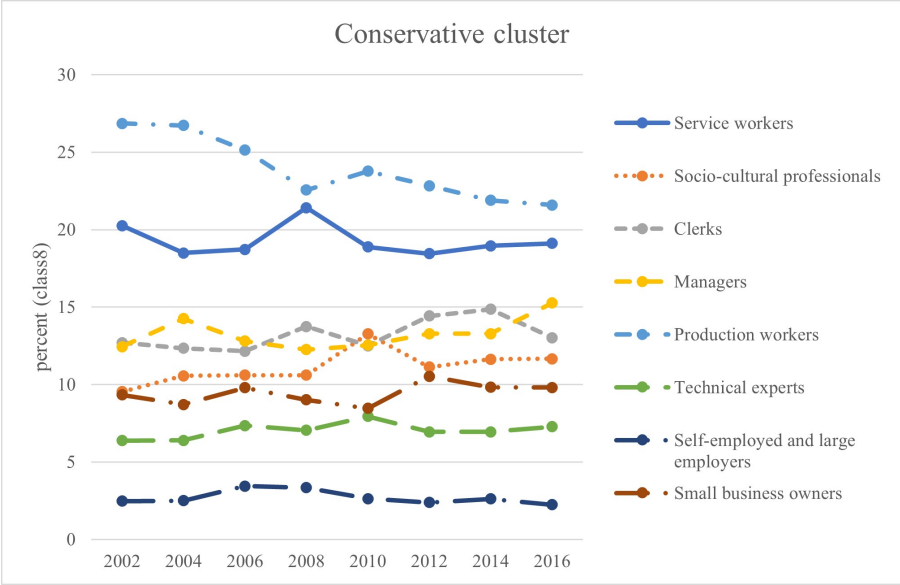
Finally, the remaining two welfare regimes show few outlying values. As regards the Social Democratic family, Norway presents a slightly more de-industrialized and market-friendly class structure, thanks to the remarkable sizes of the associate managers (19,6%) and service workers (28,1%) relative to the production laborers, whereas Finland seems able to retain its industrial workforce (almost 22%), being more cautious in fostering the expansion of low-skill services (23,1%). Lastly, in the Liberal group, Ireland appears more able to hold the routine occupations,

i.e., production workers (13,1%) and clerks (13,3%), and to train socio-cultural professionals (13,6%) than the United Kingdom.
[...]

1.4. The evolution of class structure in Europe

Once a snapshot of the current European class structure is taken, it might be interesting to describe the evolution of social classes in different welfare regimes across time. The intent of this analysis is twofold. On the one hand, it would be possible to detect which classes have been most severely hit by the automation process. On the other hand, the different institutional strategies of social protection, and their various outcomes, are likely to newly emerge.
In this regard, time series are a fruitful statistical instrument to record societal trends, which can be plotted thanks to the ESS Cumulative Data Wizard, including data from the first eight ESS waves. However, some additional methodological notes need to be pointed out. Firstly, the ESS is based on survey data, hence the reliability of trends reported depends on the quality of sampling. Secondly, a change has to be made in the composition of the Conservative cluster. Namely, the French data referring to the first five ESS rounds can be hardly processed by the Tawfik and Oesch's do-file, thus it will be excluded from the sample. Furthermore, the time coverage of each cluster varies because of the inconstant participation of some countries to the ESS surveys. More precisely, the sample of Scandinavian countries covers up to the 7th round, since Denmark did not participate to the following edition. Moreover, the Mediterranean cluster only includes four waves (1st, 2nd, 6th and 8th), given that Italy did not participate to the others.

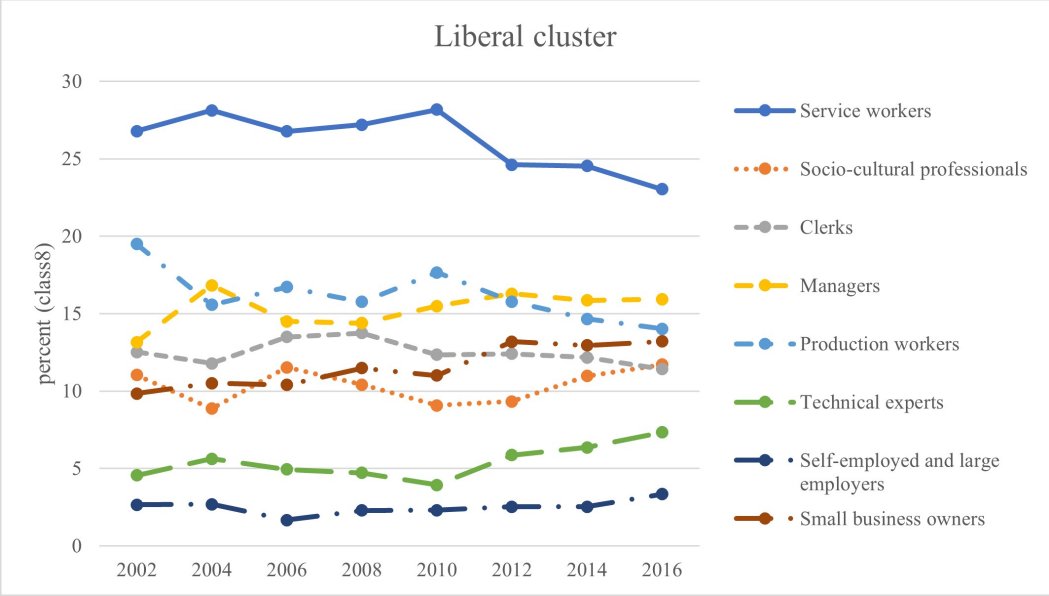
FIGURE 1: The evolution of the 8-class structure in the Conservative cluster



Starting with the Conservative cluster, the most evident change affects the production workers, who suffered an overall drop of five percentage points (from 26,9% in 2002 to 21,6% in 2016). It should be noted that the decline has accelerated during the Great Recession in 2008, hence

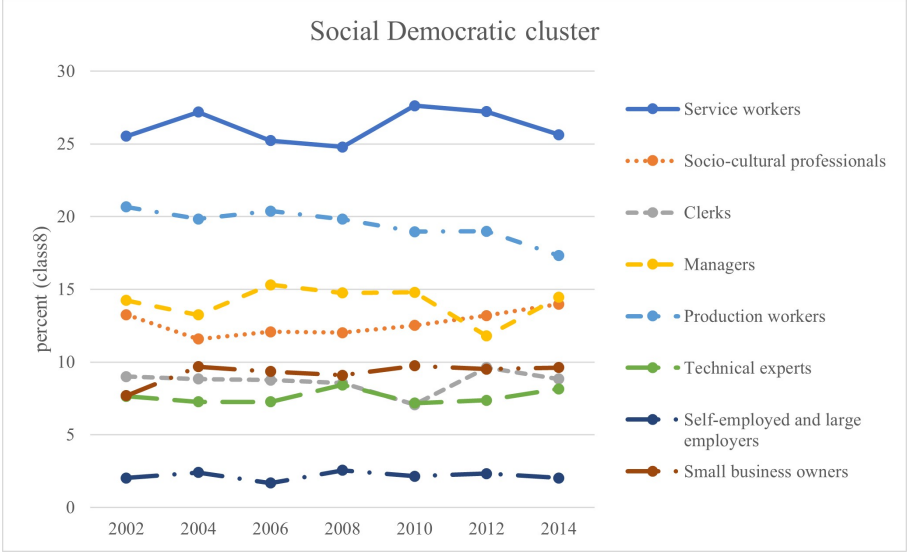
supporting the jobless recovery option (Cortes, Jaimovich and Siu, 2017; Jaimovich and Siu, 2018). On the contrary, both the managers and the socio-cultural professionals show a slight increase in the period considered (respectively +3 and +2 percentage points). As regards the other classes, the data do not detect any significant variation.

FIGURE 2: The evolution of the 8-class structure in the Liberal cluster



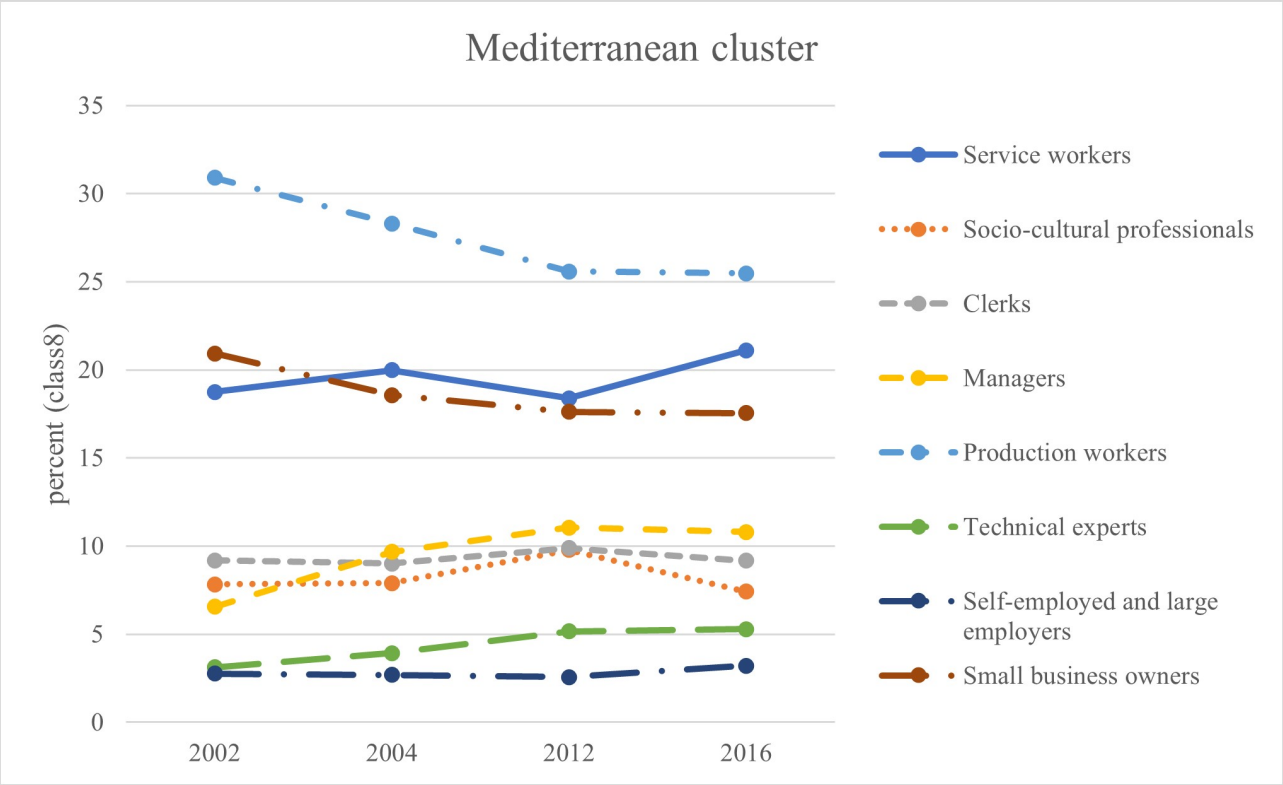
The Liberal countries present a similar drop for production workers (from 19,5% to 14%), although their higher skilled colleagues, the technical experts, show a remarkable increase of three percentage points (from 4,6% to 7,3%) during the same crisis period. Surprisingly, the service workers fell by 3% (from 26,8% to 23%), showing a significant decrease in the last three rounds considered. The remaining classes present stable trends, except for the managers and small business owners which present a slight increase (both around three percentage points).

FIGURE 3: The evolution of the 8-class structure in the Social Democratic cluster



The Scandinavian countries show the least changeable class structure. Indeed, the only noticeable change regards the production workers, who lost 3% of their workforce (from 20,7% in 2002 to 17,3% in 2014). The other classes mostly retain their figures, except for the increase of the small business owners (from 7,7% in 2002 to 9,6% in 2014).

FIGURE 4: The evolution of the 8-class structure in the Mediterranean cluster



On the contrary, the Mediterranean cluster shows a quite lively labor market. As detected in the other groups, the traditional working class fell by more than five percentage points (from 30,9% to 25,5%). Another decrease has affected the small business owners, which has passed from 20,9% to 17,6%. On the other hand, in the tertiary sector both service workers and managers experience a noticeable increase, respectively +3% and +2%. However, the most remarkable rise, considering their relative class size, concerns the technical experts who grew from 3,1% in 2002 to 5,3% in 2016.

Overall, a clear decreasing trend characterizes the production workers, accelerating during the last economic crisis. As previously mentioned, this observation corroborates the jobless recovery thesis which argue that the loss of routine occupations is mainly concentrated in periods of crisis, since they are less capable to recover after the recession (Jaimovich and Siu, 2018). Nevertheless, a significant increase is detected in the most skilled group of industrial occupation, the technical professionals, proving the general upgrading of the secondary sector's workforce, accompanied by job cuts at the bottom of the skill distribution (Cirillo, 2018). Instead, the tertiary sector looks less dynamic since few changes have been found. The expected rise of low-skill service workers,

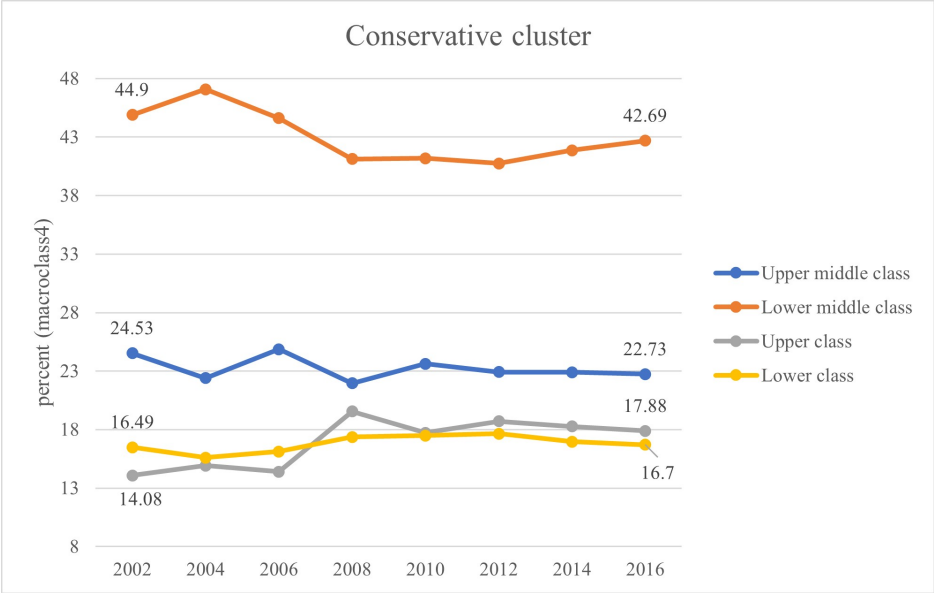
due to the service transition, is only traced in the Mediterranean countries, whereas their relative size remains stable or decreases in the other clusters. However, a consolidated rise of managers is detected at the top of the skill distribution, while socio-cultural professionals only grow in the Conservative group. Finally, the small business owners present various trends across clusters. Namely, their relative size increases in the Liberal and Social Democratic cluster, shrinks in the Mediterranean group, and remains stable in the Conservative countries.

Although the 8-class scheme might be useful to trace labor market changes, it is not suitable to plot the evolution of middle class, which is the main topic of this work. As already said, I would adopt a "large" definition of middle class, using the Oesch's 16-class model. The author divides a "restricted" middle class, composed by technicians, associate managers and socio-cultural semi-professionals, from what he calls the "twilight zone" (Oesch, 2006, p. 67), formed by the skilled members of clerks, service and production workers. Hence, based on the 16-class scheme, I will plot four time series, covering all the welfare state typologies, which will include four "macro-classes": the middle class will be split into the upper and lower components, following the Oesch's division previously mentioned, and two residual classes will involve the most and the least skilled working categories.

FIGURE 5: Oesch's class scheme. Source: Oesch, 2006, p. 68. Note: the rectangles identify the four "macro-classes", i.e., upper class, upper middle class, lower middle class ("twilight zone"), lower class

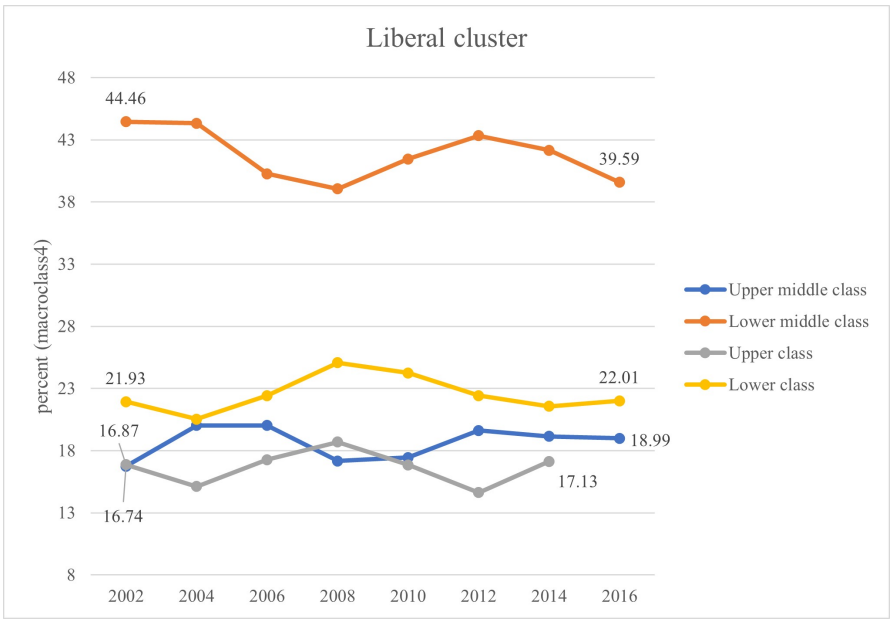
Self-employed		*Employees*			
Independent Work Logic		*Technical Work Logic*	*Organizational Work Logic*	*Interpersonal Service Work Logic*	*Marketable Skills:*
1. Large employers (>9) Firm owners Hotel owners Salesmen	**2. Self-employed professionals** Lawyers Accountants Medical doctors	**5. Technical experts** Mechanical engineers Computing professionals Architects	**10. Higher-grade managers** Business administrators Financial managers Public administrators	**14. Socio-cultural professionals** University teachers Medical doctors Journalists	Professional/ managerial
3. Small proprietors, artisans, with employees (<9) Restaurant owners Farmers Garage owners		**6. Technicians** Electrical technicians Computer equipment operators Safety inspectors	**11. Associate managers** Managers in small firms Tax officials Bookkeepers	**15. Socio-cultural semi-professionals** Primary school teachers Physiotherapists Social workers	Associate professional/ managerial
4. Small proprietors, artisans, without employees Shopkeepers Hairdressers Lorry drivers		**7. Skilled crafts** Machinery mechanics Carpenters Electricians	**12. Skilled office** Secretaries Bank tellers Stock clerks	**16. Skilled service** Children's nurses Cooks Beauticians	Generally/ vocationally skilled
		8. Routine operatives Assemblers Machinists Freight handlers	**9. Routine agriculture** Farm hands Loggers Gardeners	**13. Routine office** Mail sorting clerks Call centre employees Messengers	**17. Routine service** Shop assistants Home helpers Waiters	Low/ un-skilled

FIGURE 6: The evolution of the four "macro-classes" in the Conservative regime.



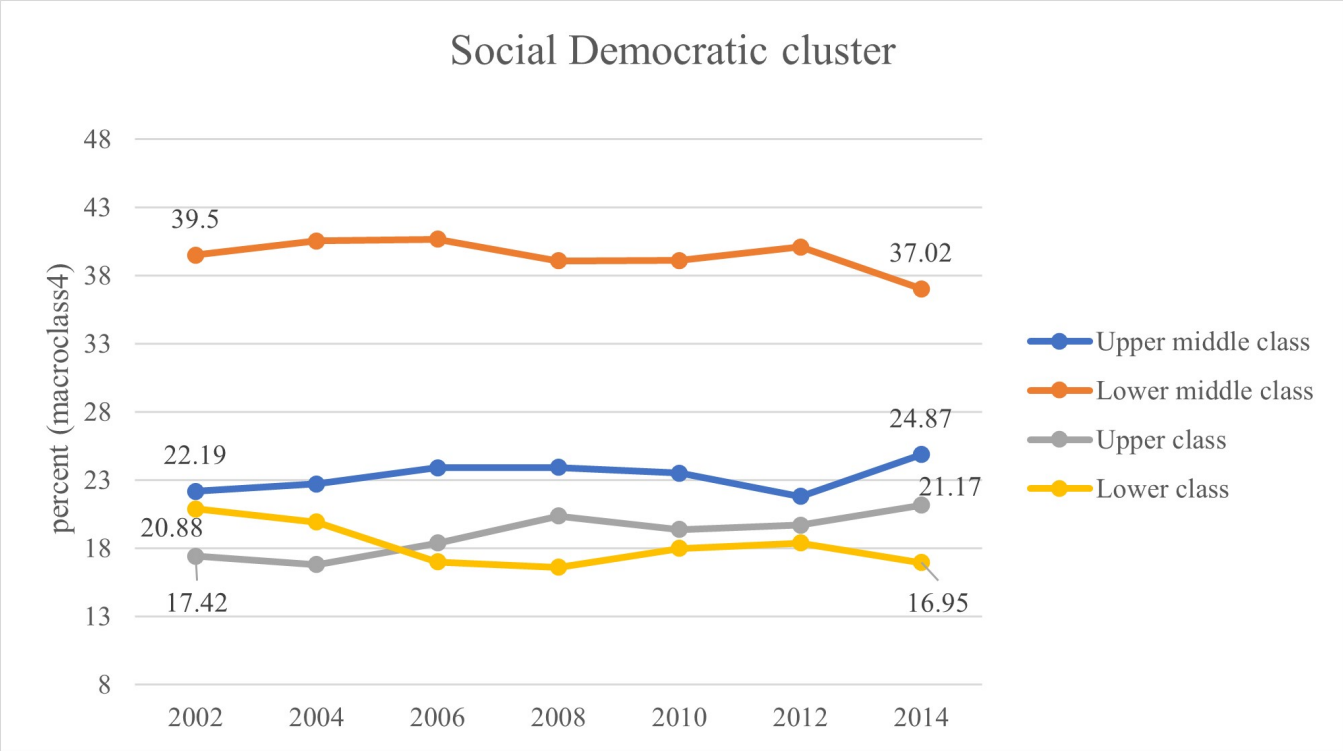
The conservative cluster presents a remarkable decrease of the "lower-middle class" (-2,2%), particularly falling between 2004 and 2008. At the same time, the "lower class" shows a slight increase within a general stable trend. On the contrary, the "upper-middle class" is characterized by a decreasing trend (almost -2%), especially during the economic crisis, which seems to be partially compensated by the rise of the "upper class" (+3,8%), which peaks in 2008. Therefore, it could be asserted that a slight polarization has taken place, since the middle-class occupations have been shrunk relative to the residual extreme "macro-classes", especially in favor of the most skilled.

FIGURE 7: The evolution of the four "macro-classes" in the Liberal regime



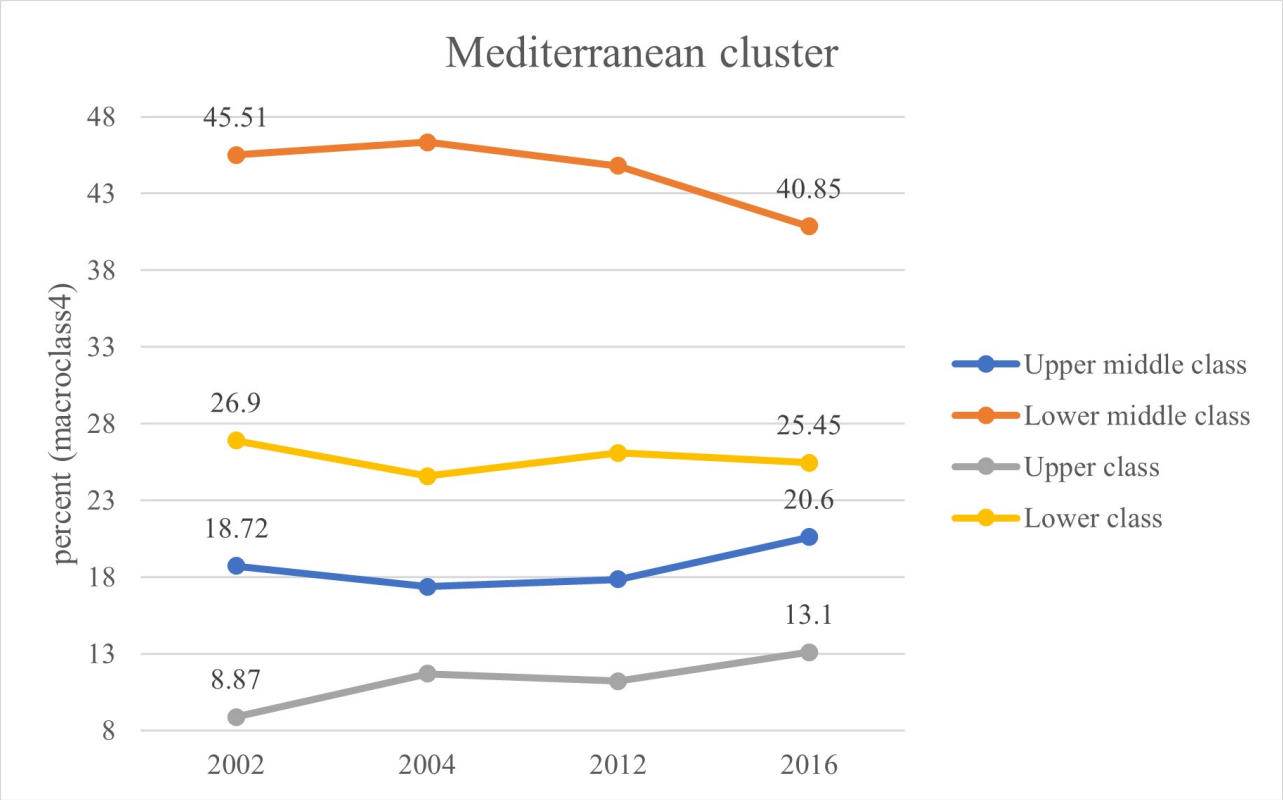
A similar trend characterizes the Liberal cluster, despite being more pronounced. Indeed, the "lower-middle class" experienced a significant drop around 2008, repeated in 2016 after a short period of recovery (overall -5%). While the "lower class" seems to compensate the contraction of the "lower-middle class" in 2008, it has newly curbed its trend thereafter. On the upper side of class structure, the "restricted" middle class presents a reduction in the period of crisis, recovering immediately after. These changes seem to be counterbalanced by the growth of the "upper class" in 2008, which has decreased in the following surveys. All in all, the most significant contraction has affected the so-called "lower-middle class", which includes the most routine middle-class occupations.

FIGURE 8: The evolution of the four "macro-classes" in the Social Democratic regime



The two remaining clusters show the least polarized "macro-class" structure. The Social Democratic regime presents a similar trend for the "lower" and "lower-middle" classes, both constantly decreasing (respectively -4% and -2,5%). On the other hand, the two most skilled "macro-classes" display a rising trend, peaking in 2014.

Figure 9: The evolution of the four "macro-classes" in the Mediterranean regime



An analogous trend could be detected in the Mediterranean group, although few surveys are available to trace it. In fact, both the least skilled "macro-classes" has reduced their relative sizes, despite the contraction of the "lower-middle class" is definitely the most marked (losing five percentage points). Moreover, the "upper" and "upper-middle" classes show a rising trend, which is substantial for the former (from 8,9% to 13,1%).

In conclusion, some of the preliminary methodological notes should be recalled. The inter-temporal analyses presented above are based on survey data, which cannot be relied upon to plot the shifts of workers among occupations and classes. Indeed, panel data are required since they are a fundamental instrument to track the changes within the same cohort of people across years. However, these time series might be fruitful to draw some general changes affecting the class structure and the impact of institutional configurations.

As mentioned above, a major division elapses between the Nordic and Southern clusters, which have experienced a slight converging process in their class structure, and the Conservative and Liberal groups, that show a polarizing class scheme. As expected, the Social Democratic regime presents the most egalitarian societal arrangement. The relative size of the "large" middle class ("upper-middle" and "lower-middle") remains almost unchanged (61,7% in 2002 and 61,9% in 2014). Moreover, the lower side of the class structure reduces its dimension relative to the most skilled "macro-classes". This upgrading trend could be led back to the regime's capability to shelter and upskill the routine workers (Anderson and Hassel, 2013).

A converging trend within class structure also characterizes the Mediterranean cluster, although it seems to be grounded on different reasons. Namely, the comparatively significant share of

small business owners and production laborers, together with the rising amount of service workers, seem to account for the resilience of the Southern middle class. Moreover, the increasing number of managers and technical experts has fostered the upward trend of the most educated classes. Although the total size of the "large" middle class results constrained, from 64,2% in 2002 to 61,4% in 2016, this change can be mainly ascribed to the decrease of the "lower-middle class", which in turn does not provoke the expansion of the "lower class".

As regards the Christian Democratic group, a slightly polarizing process seems to characterize its class structure, which does not radically undermine the Central European societal arrangement. Those countries show the most remarkable contraction of the "large" middle class, passing from 69,4% in 2002 to 65,4% in 2016. This decrease can be mainly attributed to the drop of production laborers and the limited figure of service workers. Meanwhile, the rise of the managerial class seems to be the main responsible for the expansion of the "upper class". Overall, the societal polarization looks to be biased towards the top of the skill distribution, hence being accompanied by a general upgrading trend.

On the contrary, the "macro-class" polarization stands out clearly in the Liberal regime. Indeed, the drop of both service and production workers appears to undermine the "lower-middle class" size, whereas the rise of managers and technical experts fosters the growth of the most educated classes. Although the total variation of class structure does not seem dramatic, comparing the figures of 2002 with those of 2016, the Anglo-Saxon societal arrangement proves to be the most sensible to the economic downturns (Wren, 2013). In fact, a surge of class polarization is plotted around 2008, when the financial crisis has significantly hollowing out both the components of the "large" middle class. All in all, the dimension of the intermediate class has shrunk from 61,2% in 2002 to 58,6% in 2016, confirming to be the smallest of the sample.

Assembling all the observations, it could be argued that the welfare regime which is mostly affected by class polarization is the Liberal cluster. Instead, the Conservative group experiences a light polarization, due to the fall of the traditional working-class occupations, but it is still able to prevent the rise of low-paid jobs. The Mediterranean class structure shows a converging trend, although the least educated "macro-class" continues to be the largest of the sample (a quarter of the whole Southern population). Moreover, its exposure to the market changes cannot be analyzed since the data from third to the fifth ESS round are not available (from 2006 to 2010). Finally, the Social Democratic regime confirms to be the most able to shield its middle class from economic downturns, preserving the most egalitarian societal structure (followed by Central Europe).

As regards occupations, it would be expected to see the contraction of both industrial and service middle-skill occupations. Nevertheless, production workers seem to be the worst affected in terms of job loss, particularly during the economic crisis, whereas the service employees, both in the interpersonal and organizational dimensions, appear to be more resilient. In order to assess whether these differences could be led back to automation, a further analysis is required. Namely, the RTI should be applied to those groups of occupations, checking whether technical change plays a role in the evolution of class structure. Moreover, this investigation would help to better understand the impact of the welfare state institutions on job polarization.

2. The proneness of the European class structure to automation

Once the European societal structure has been analyzed in detail, the propensity of social classes to automation can be measured using the RTI. Before reporting the data and findings, I would briefly present the methodology employed. In this paragraph I will first apply the RTI to the Oesch's 8-class scheme of the four welfare clusters, then I will outline the distribution of RTI on the class structure ordered in accordance with the educational attainment (v. paragraph 2.1.3.3). The aim of this investigation is two-fold: on the one hand, it would enable to test whether the middle-class occupations are the most prone to automation, on the other hand, it would point out which group of countries is likely to be most severely hit by this transition.
As regards the Routine Task Index, I will use the indicator calculated on the occupations at the 3-digit ISCO that it is based on the dataset of the American Occupational Information Network (O*NET), developed under the sponsorship of the U.S. Department of Labor/Employment and Training Administration. However, another measurement of the RTI has been realized by Sacchi et al. (2019) at the 4-digit ISCO combining two Italian databases: the *Indagine Campionaria sulle Professioni* (ICP) and the *Rilevazione Continua sulle Forze di Lavoro* (RCFL). Although the Italian scholars employ the same methodology of O*NET, the tasks composing each occupation vary, hence resulting in different RTI scores for the same occupation. Although the latter provides a more detailed measurement, I will apply the O*NET definition of RTI to the European countries sampled in order comply with the widely recognized scientific standard. Nevertheless, I will attach the tables elaborated with the Italian-based RTI in the appendix, which would enable to make comparisons between these two measurements in this paragraph.

2.1. The distribution of RTI in the Oesch's class scheme

I will apply the O*NET version of RTI on the Oesch's 8-class scheme of the four welfare clusters. As already pointed out, the data for the Conservative and the Liberal clusters are taken from the 9th ESS round, those for the Mediterranean group come from the 8th wave, and the information for the Social Democratic regime are based on the 7th ESS survey. The tables below represent the distribution of quintiles of RTI in each group of countries, taking the value 1 for the least automatable occupations and 5 for those who are most at risk of replacement. The quintiles distribution is calculated on the RTI scores of the whole ESS dataset, hence making the values reported below comparable both between classes and clusters. I would expect a higher concentration of routine tasks in the classes composing the technical and organizational work logics, particularly in the low-skill groups of occupations, due to the rigid command structure which may involve repetitive tasks. Meanwhile, the independent and interpersonal service work dimensions are likely to result less routine since their tasks are carried out in a more changeable context, including problem-solving skills and in-person interactions.

TABLE 3: The distribution of RTI quintile in the 8-class scheme

Conservative cluster	5 quantiles of RTI					
	1	2	3	4	5	Total
	%	%	%	%	%	%
Self-employed professionals and large employers	59.08	19.77	19.10	0.99	1.07	100.00
Small business owners	13.44	39.46	20.32	14.47	12.31	100.00
Technical (semi-)professionals	3.92	37.62	20.15	38.31	0.00	100.00
Production workers	0.00	5.78	26.00	17.05	51.17	100.00
(Associate) managers	50.53	34.41	7.90	7.16	0.00	100.00
Clerks	0.00	9.21	7.01	26.08	57.69	100.00
Socio-cultural (semi-)professionals	75.76	5.06	19.18	0.00	0.00	100.00
Service workers	1.91	46.76	7.81	36.65	6.87	100.00
Total	21.08	24.29	15.39	19.30	19.94	100.00

Liberal cluster	5 quantiles of RTI					
	1	2	3	4	5	Total
	%	%	%	%	%	%
Self-employed professionals and large employers	46.19	19.29	34.41	0.00	0.11	100.00
Small business owners	20.85	31.35	28.52	8.98	10.30	100.00
Technical (semi-)professionals	8.17	27.48	42.39	21.96	0.00	100.00
Production workers	0.00	4.81	19.35	17.50	58.34	100.00
(Associate) managers	63.49	17.70	11.76	7.05	0.00	100.00
Clerks	0.00	13.99	17.64	36.39	31.97	100.00
Socio-cultural (semi-)professionals	77.47	6.71	15.81	0.00	0.00	100.00
Service workers	1.05	56.45	6.96	28.49	7.05	100.00
Total	25.00	27.32	17.78	16.98	12.92	100.00

Mediterranean cluster	5 quantiles of RTI					
	1	2	3	4	5	Total
	%	%	%	%	%	%
Self-employed professionals and large employers	61.17	11.84	25.02	0.80	1.17	100.00
Small business owners	10.39	41.48	23.98	13.38	10.77	100.00
Technical (semi-)professionals	27.76	4.30	36.47	31.47	0.00	100.00
Production workers	0.00	4.11	24.15	26.26	45.47	100.00
(Associate) managers	35.42	45.81	7.61	11.15	0.00	100.00
Clerks	0.00	3.37	19.54	21.17	55.91	100.00
Socio-cultural (semi-)professionals	88.50	5.54	5.52	0.43	0.00	100.00
Service workers	2.59	37.97	4.82	46.27	8.36	100.00
Total	15.76	22.79	17.12	23.95	20.38	100.00

Social Democratic cluster	5 quantiles of RTI					
	1	2	3	4	5	Total
	%	%	%	%	%	%
Self-employed professionals and large employers	65.85	11.19	19.13	3.33	0.50	100.00
Small business owners	14.95	36.60	22.39	13.26	12.80	100.00
Technical (semi-)professionals	21.98	6.00	38.85	33.17	0.00	100.00
Production workers	0.00	5.76	31.29	23.43	39.52	100.00
(Associate) managers	54.28	29.87	8.03	7.81	0.00	100.00
Clerks	0.00	9.46	13.00	26.04	51.50	100.00
Socio-cultural (semi-)professionals	77.97	7.59	14.44	0.00	0.00	100.00
Service workers	1.41	56.17	3.69	26.59	12.14	100.00
Total	22.61	26.14	16.44	18.70	16.11	100.00

First of all, I will outline some cross-cluster observations. The social classes which appear to be the least prone to automation are the self-employed professionals and large employers, the socio-cultural professionals and the managers. The distribution of technical professionals and the service workers instead is more concentrated in the central RTI quintiles. Finally, the production laborers and the clerks turn out to the workers who are most likely to be replaced by machines.
Looking at the RTI calculated on the Italian dataset (v. Appendix), some differences emerge. Namely, the highly skilled technical occupations result to be less routine than in the O*NET-based analysis. Moreover, the clerks present a much lower concentration of respondents in the last quintiles, appearing less replaceable, whereas in the tables reported above the clerical occupations turn out to be the most prone to automation compared to the rest of the classes. Lastly, the RTI distribution of production workers in appendix looks more biased towards the last quintiles.
The origins of these variations could be led back to the different allocation of the RTI scores to the tasks composing each occupation. It could be asserted that the tasks included in the same occupation, and their degree of routine, vary between the American and the Italian labor markets. Hence, the RTI score of an occupation, and its social class, changes between these two datasets, despite the authors use almost the same methodology. Moreover, the American scholars rely on expert surveys, updated regularly, whereas their Italian surveys are addressed to workers. These methodological difference may also partially account for the variations of the RTI values. Therefore, bearing in mind the differences outlined above, it could be supposed that the American clerks perform tasks which are more repetitive than those realized by their Italian colleagues.
Some relevant differences emerge among welfare clusters. The Conservative group presents the most routinized clerical occupations (57,7% of clerks are in the 5th RTI quintile) and an easily automatable low-skill working class (51,2% of production workers lie in the last RTI quintile). On the contrary, the Central European technical professionals and service workers show relatively lower values in terms of RTI. The Anglo-Saxon production workers turn out to be the most replaceable of the sample (58,3% of them occupies the last RTI quintile), whereas the clerks and managers show the lowest RTI figures compared to the other welfare regimes. Instead, the whole Southern technical work logic results harder to be replaced relative to the first clusters mentioned (27,8% of technical experts lies in the first quintile and 45,5% of production workers occupies the last interval), together with the socio-cultural professionals, while the managers and service employees display the comparatively highest RTI score (only 35,4% of the former in the first quintile and 54,6% of the latter in the last two intervals). Finally, the Social Democratic regime shows the least automatable production workers (only 39,5% of them lie in the 5th quintile) and service employees (whose RTI distribution looks similar to the Liberal group).
As previously pointed out, the RTI quintiles distribution based on the Italian datasets (v. Appendix) presents some differences which slightly alter the findings exposed above. Namely, the Central European production workers look less replaceable, while their Anglo-Saxon colleagues are even more concentrated in the last RTI quintile (69,52%). Moreover, the distribution of RTI in the clerical occupations appears to be more biased towards the central quintiles (especially the 2nd and 3rd intervals), while the socio-cultural professionals seem to be more homogenously

distributed across clusters, being almost entirely placed in the first RTI quintile. Overall, the allocation of classes along the RTI quintile distribution characterizing each welfare regime is influenced by the cross-cluster variations presented above, hence confirming the inter-regime variations detected with the O*NET-based analysis.

In order to evaluate the impact of automation on the different welfare clusters I will sum the total relative sizes of the last two RTI quintiles in each group. The regime which appears to be the most affected by automation is the Mediterranean cluster, that places 44,4% of its labor force in the 4th and 5th RTI quintiles. On the contrary, the Liberal countries show the lowest share of easily replaceable workforce, namely 29,9%. In the middle of the ranking, the Social Democratic group presents a smaller number of automatable workers (34,8%), while the Conservative cluster comes closer to the Southerners (39,2%). The order of the standings does not change using the Italian-based RTI, since the Anglo-Saxons result to be the most sheltered from automation (22,5% in the last two RTI quintiles), followed at a close distance by the Nordics (27,1%) and the Central Europeans (27,2%). The last place is newly occupied by the Mediterranean group (40,2%). However, it should be noted that the Social Democratic and the Conservative regimes show much more similar figures in this second analysis. The reason for this shift might be found in the relevant share of clerks characterizing the Conservative cluster, which are considered as less replaceable using the RTI measurement elaborated by Sacchi et al. (2019). On the contrary, the Southerners present similar scores in both the analyses. In this case, the large share of production workers, which are deemed more automatable in the Italian RTI design, seems to counterbalance the clerks' contribution to the remarkable Southern RTI score shown in the O*NET-based analysis.

All in all, the Mediterranean cluster appears the group of countries which will be hit hardest by automation. On the contrary, the workforce of the Liberal regime shows the lowest proneness to replacement. Finally, the Social Democratic cluster presents a remarkable resilience to automation, while the impact on the Conservative regime heavily depends on the methodology employed, resulting more sheltered when the clerical occupations are deemed less routine (Sacchi et al., 2019).

In order to provide a more detailed investigation of the automation impact on each cluster, I will tabulate the distribution of RTI quintiles along the Oesch's 16-class scheme (v. Appendix for the tables based on the RTI calculated on the Italian datasets). However, I will only select the least-skilled classes (i.e., clerks, production and service workers), since most of the contribution to routinization have been found in those groups of occupations.

TABLE 4: The distribution of RTI quintiles in the 16-class scheme (low-skill classes)

Conservative cluster	5 quantiles of Autor					
	1	2	3	4	5	Total
	%	%	%	%	%	%
Skilled manual	0.00	9.40	42.06	18.03	30.51	100.00
Low-skilled manual	0.00	0.00	0.32	15.49	84.19	100.00
Skilled clerks	0.00	10.43	6.81	29.53	53.22	100.00
Unskilled clerks	0.00	0.00	8.51	0.00	91.49	100.00
Skilled service	3.36	75.49	9.05	11.42	0.68	100.00
Low-skilled service	0.31	15.22	6.45	64.35	13.66	100.00

Liberal cluster	5 quantiles of Autor					
	1	2	3	4	5	Total
	%	%	%	%	%	%
Skilled manual	0.00	10.58	42.59	23.47	23.36	100.00
Low-skilled manual	0.00	0.00	0.00	12.52	87.48	100.00
Skilled clerks	0.00	15.45	19.31	40.19	25.06	100.00
Unskilled clerks	0.00	0.00	1.67	0.00	98.33	100.00
Skilled service	2.39	83.07	5.47	7.25	1.83	100.00
Low-skilled service	0.00	35.55	8.13	45.17	11.15	100.00

Mediterranean cluster	5 quantiles of Autor					
	1	2	3	4	5	Total
	%	%	%	%	%	%
Skilled manual	0.00	7.74	44.52	15.12	32.62	100.00
Low-skilled manual	0.00	0.00	1.08	38.89	60.03	100.00
Skilled clerks	0.00	3.96	18.39	24.85	52.79	100.00
Unskilled clerks	0.00	0.00	26.16	0.00	73.84	100.00
Skilled service	6.00	73.59	6.09	14.32	0.00	100.00
Low-skilled service	0.25	13.60	3.96	68.12	14.08	100.00

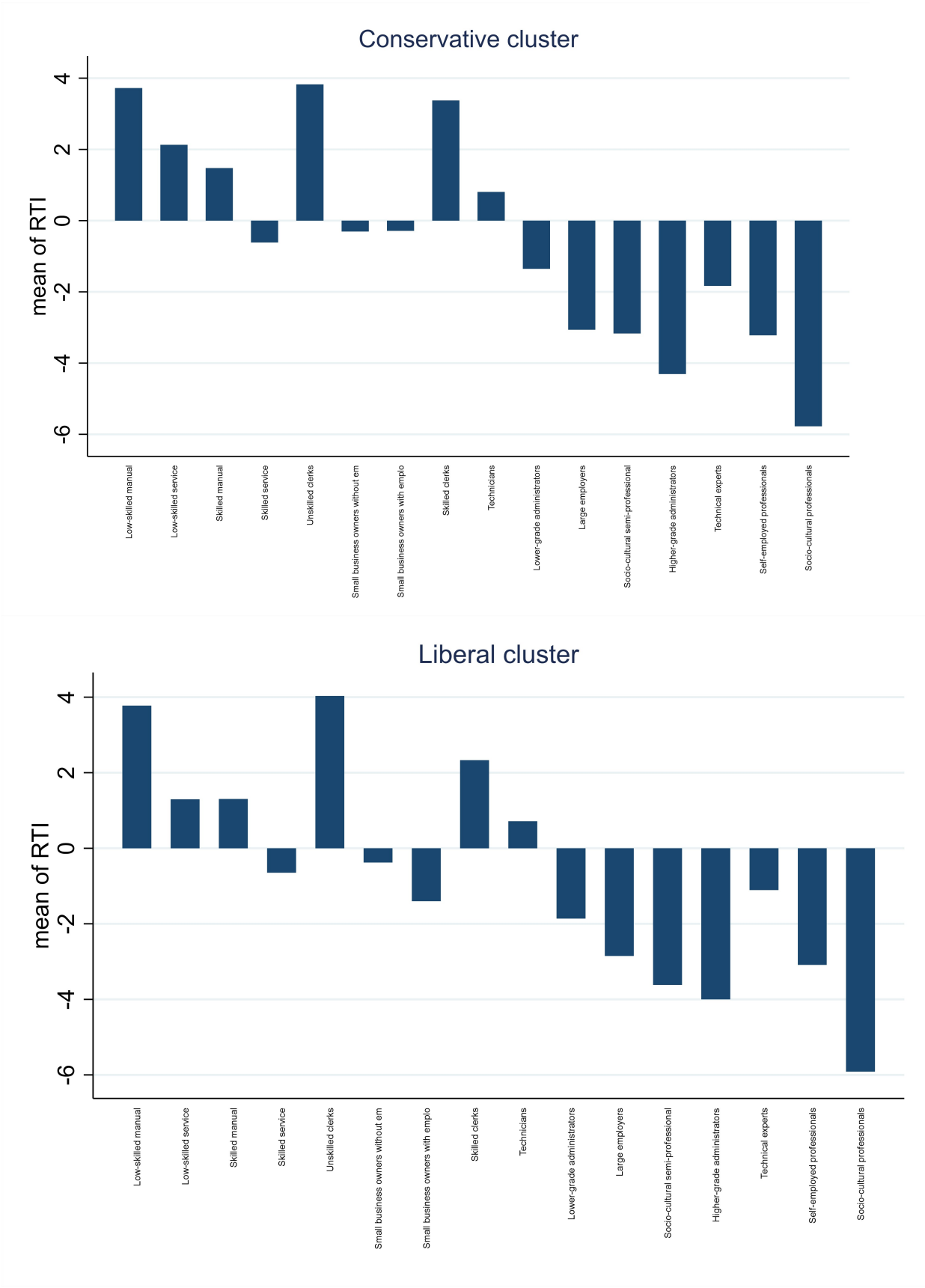
Social Democratic cluster	5 quantiles of Autor					
	1	2	3	4	5	Total
	%	%	%	%	%	%
Skilled manual	0.00	8.67	45.95	21.07	24.31	100.00
Low-skilled manual	0.00	0.00	2.34	28.09	69.56	100.00
Skilled clerks	0.00	11.51	10.38	31.66	46.45	100.00
Unskilled clerks	0.00	0.00	25.13	0.00	74.87	100.00
Skilled service	2.62	82.64	3.80	10.63	0.31	100.00
Low-skilled service	0.00	25.28	3.57	45.21	25.94	100.00

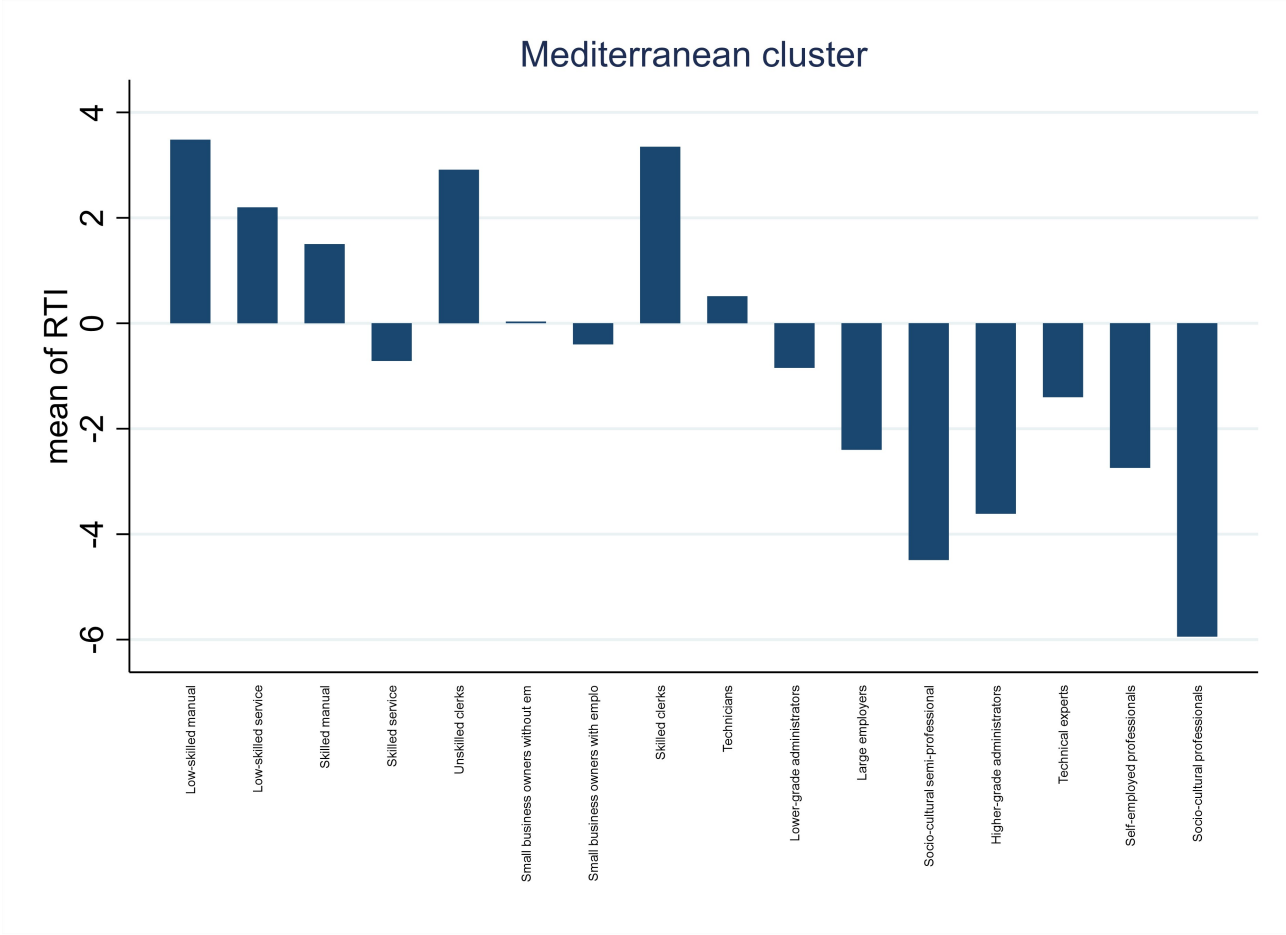
It looks crystal clear that the lower skilled workers present higher RTI scores than their more educated colleagues. It could be noted that the low-skilled production workers look much more replaceable in the Conservative and Liberal clusters than those in the other two groups. Although the Mediterranean unskilled production workers result to be comparatively less automatable, their significant relative seize (11,9% of the workforce) is likely to increase the proneness of the Southern labor market to automation. Moreover, the large share of Southern unskilled service workers (which amount to 12,5% of the workforce) in the last two RTI intervals further contributes to toughen the impact of the ICT revolution on the Mediterranean labor force. As regards Central Europe, bearing in mind its remarkable share of skilled clerks (11,5% of the workforce), it could be asserted that their concentration in the last RTI quintile seems to bring down the whole Conservative resilience to automation. As expected, the influence of unskilled clerks on the Conservative RTI figures results softened when considering the indicator tailored on the Italian datasets (v. Appendix). On the contrary, the lower concentration of the Scandinavian skilled-manual and skilled service workers in the last RTI quintile appears to significantly contribute to the predicted smoother impact of automation on its labor market. Lastly, the limited number of clerks and production workers in the Liberal countries (respectively 9,9% and 11,3% of the workforce), together with the reduced risk of service workers to be replaced, seems to justify the limited concentration of the Anglo-Saxon low-skilled workers in the higher RTI quintiles.
In the end, the expectations regarding the impact of automation on different work logics are confirmed. As a matter of fact, the independent and interpersonal dimensions appear to be the most resilient to replacement, whereas the technical and organizational logics, especially the low-skilled classes, are those hit hardest by the spread of ICT. Therefore, the countries showing higher share of traditional industrial and clerical occupations, i.e., the Conservative and the Mediterranean clusters, are more likely to suffer from job losses.

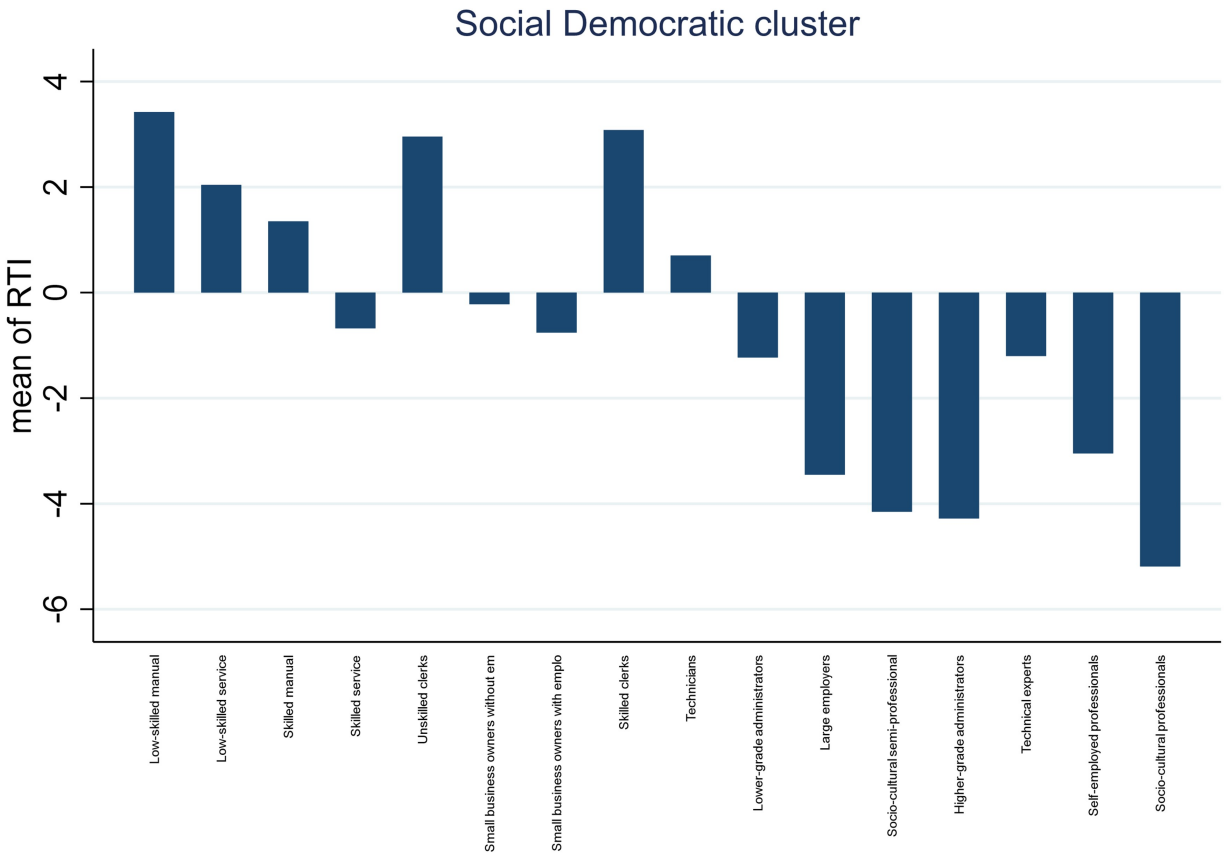
2.2. The impact of automation on the middle class

In this section I investigate the influence of the ICT revolution on the middle class. I have reordered the Oesch's 16-class scheme with the view to distribute the social classes on a single skill continuum. Plotting the distribution of RTI on the reordered Oesch's 16-class scheme it would be possible to test whether the job polarization hypothesis is confirmed. However, it should be noted that the American RBTC scholars usually refer to the wage as a proxy of the skills level. Thus, I also represent the RTI scores of the 8-clss scheme (ordered according to the ISCED classification), which may resemble the wage distribution due to its more limited focus on the educational attainment of respondents.
The RTI is expected to peak in the middle of the class distribution, while showing negative scores at both extremes. Hence, the trend of the RTI distribution is supposed to present an inverted-U shape (Autor and Dorn, 2013), meaning that the typical middle-class occupations are the most exposed to the replacement risk.

FIGURE 10: The distribution of the mean of RTI in the 16-class scheme reordered




Mediterranean cluster
mean of RTI
-6
-4
-2
0
2
4
Low-skilled manual
Low-skilled service
Skilled manual
Skilled service
Unskilled clerks
Small business owners without em
Small business owners with emplo
Skilled clerks
Technicians
Lower-grade administrators
Large employers
Socio-cultural semi-professional
Higher-grade administrators
Technical experts
Self-employed professionals
Socio-cultural professionals


Social Democratic cluster
mean of RTI
-6
-4
-2
0
2
4
Low-skilled manual
Low-skilled service
Skilled manual
Skilled service
Unskilled clerks
Small business owners without em
Small business owners with emplo
Skilled clerks
Technicians
Lower-grade administrators
Large employers
Socio-cultural semi-professional
Higher-grade administrators
Technical experts
Self-employed professionals
Socio-cultural professionals

However, the graphs reported above do not entirely mirror our expectations. Although all the welfare clusters present remarkable positive RTI scores in the middle of their class distribution and negative figures for the most skilled occupations, significantly positive results are detected for the least educated classes. Therefore, the risk of automation does not seem to affect the middle-class occupations only, while also threatening the lower-class jobs. Namely, the least skilled occupations which result most automatable are the production and low-skilled service workers, whereas the middle-class jobs more routinized belong to the clerical class. A similar picture is portrayed by the graphs elaborated using the RTI tailored on the Italian datasets (v. Appendix).

TABLE 5: The 8-class scheme reordered by skills

The 8-class scheme sorted by educational attainment (ISCED)
Service workers
Small business owners
Production workers
Clerks
Technical experts
Managers
Self-employed professionals and large employers
Socio-cultural professionals

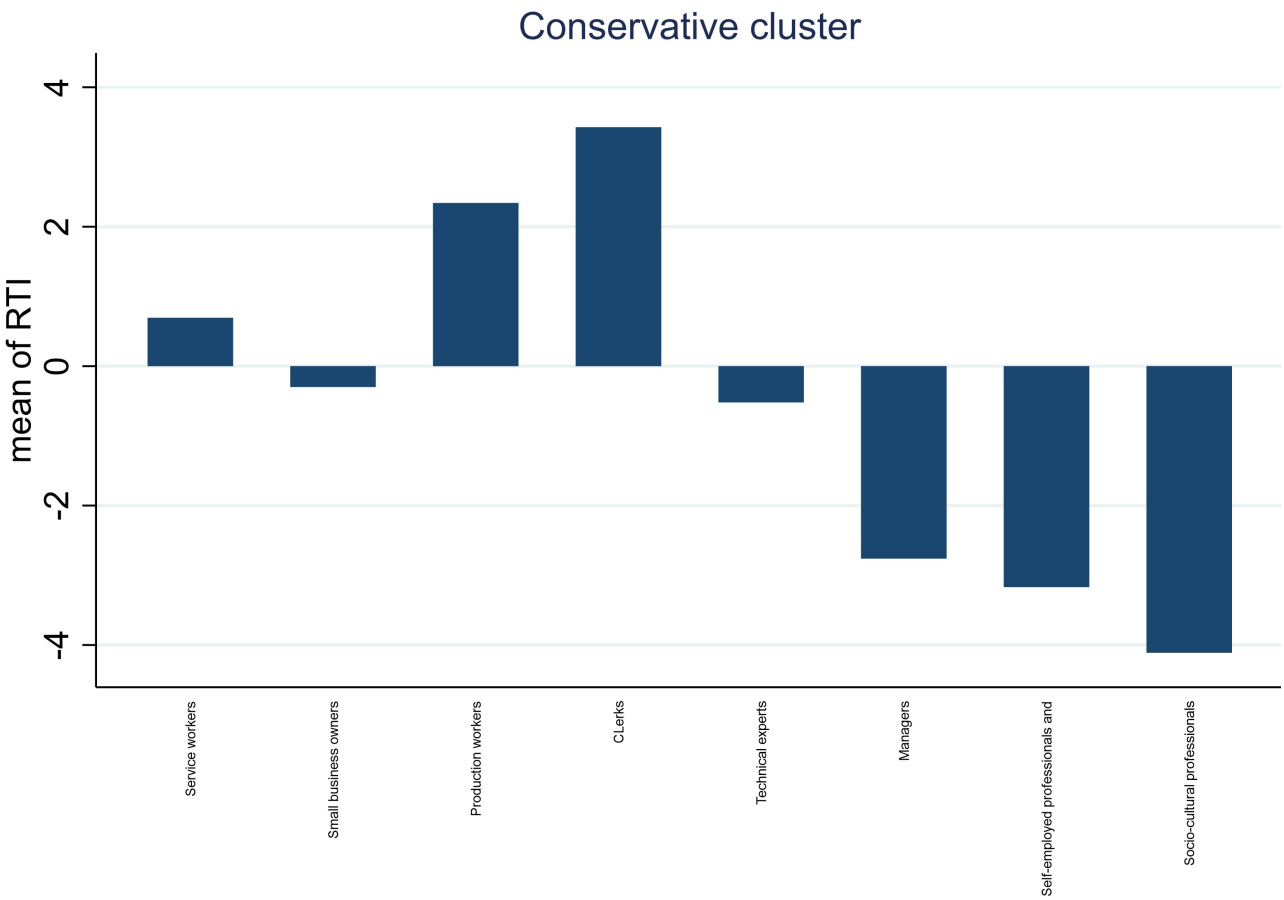
Although these graphs dos not entirely confirm the RBTC hypothesis, at the same time they present a clear polarization of the replacement risk between the lower- and the upper-end of the class distribution. One of the reason for justifying this apparently disappointing outcome could be traced back to the criterion employed to order the social classes. Indeed, the American scholars usually refer to the wage as a proxy of the skills level. On the contrary, I have made directly reference to the educational attainment of workers, hence I might have presented a different allocation of classes along the x-axis. In order to make the skills continuum look like the wage distribution, I need to reduce the degree of detail of class scheme. As a matter of fact, using the 8-class scheme reordered according to the educational level, the class structure would closely resemble to the wage distribution within different economic sectors.

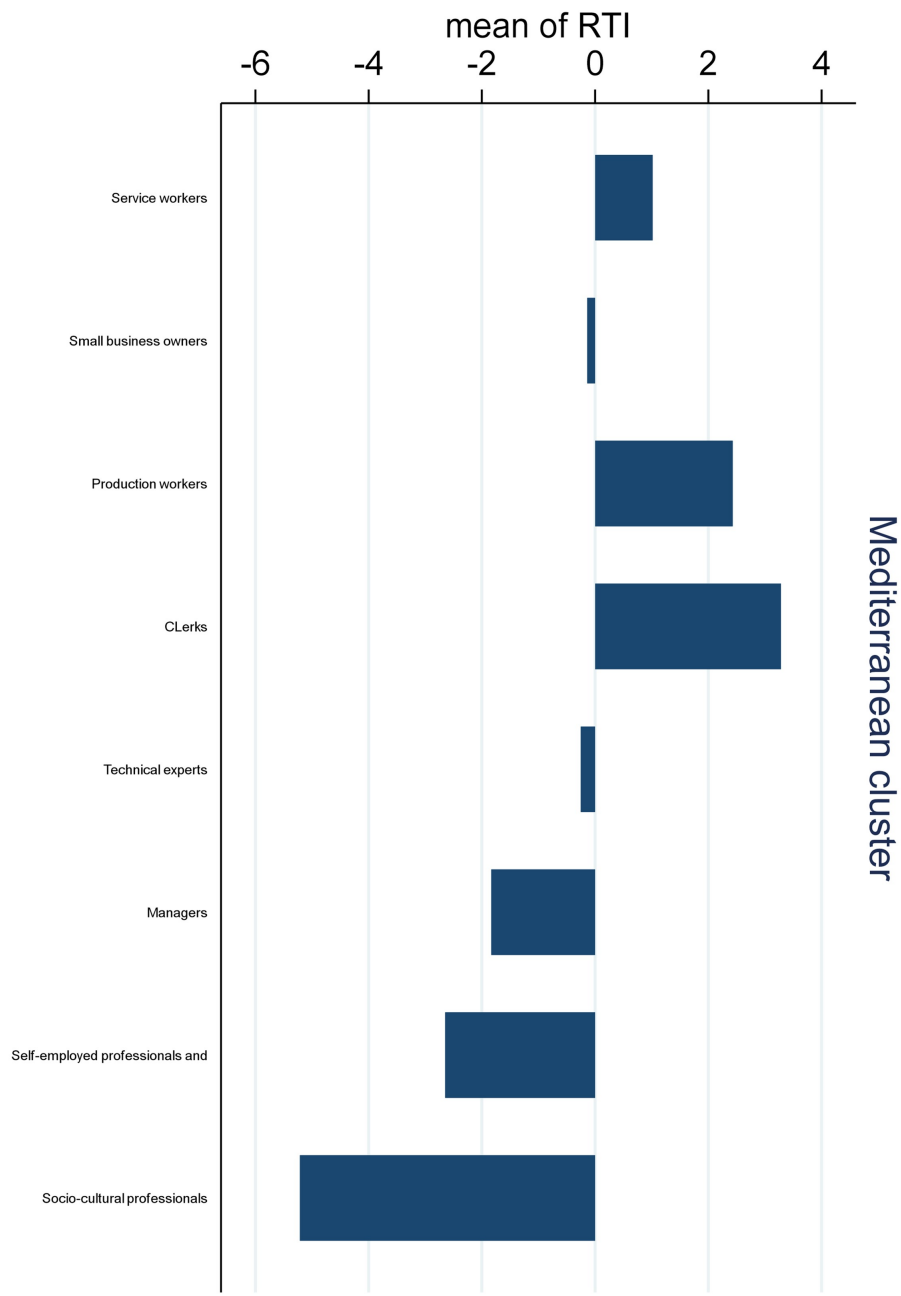
The graphs plotted below present an RTI distribution which more closely resembles the one presented by RBTC scholars (Autor and Dorn, 2013). Indeed, the highest RTI scores are reached by the middle-class occupations (i.e., production workers and clerks), while much lower figures characterize the least and the most educated occupations. However, it should be noted that the service workers still present positive scores in all clusters, despite close to zero. Moreover, as

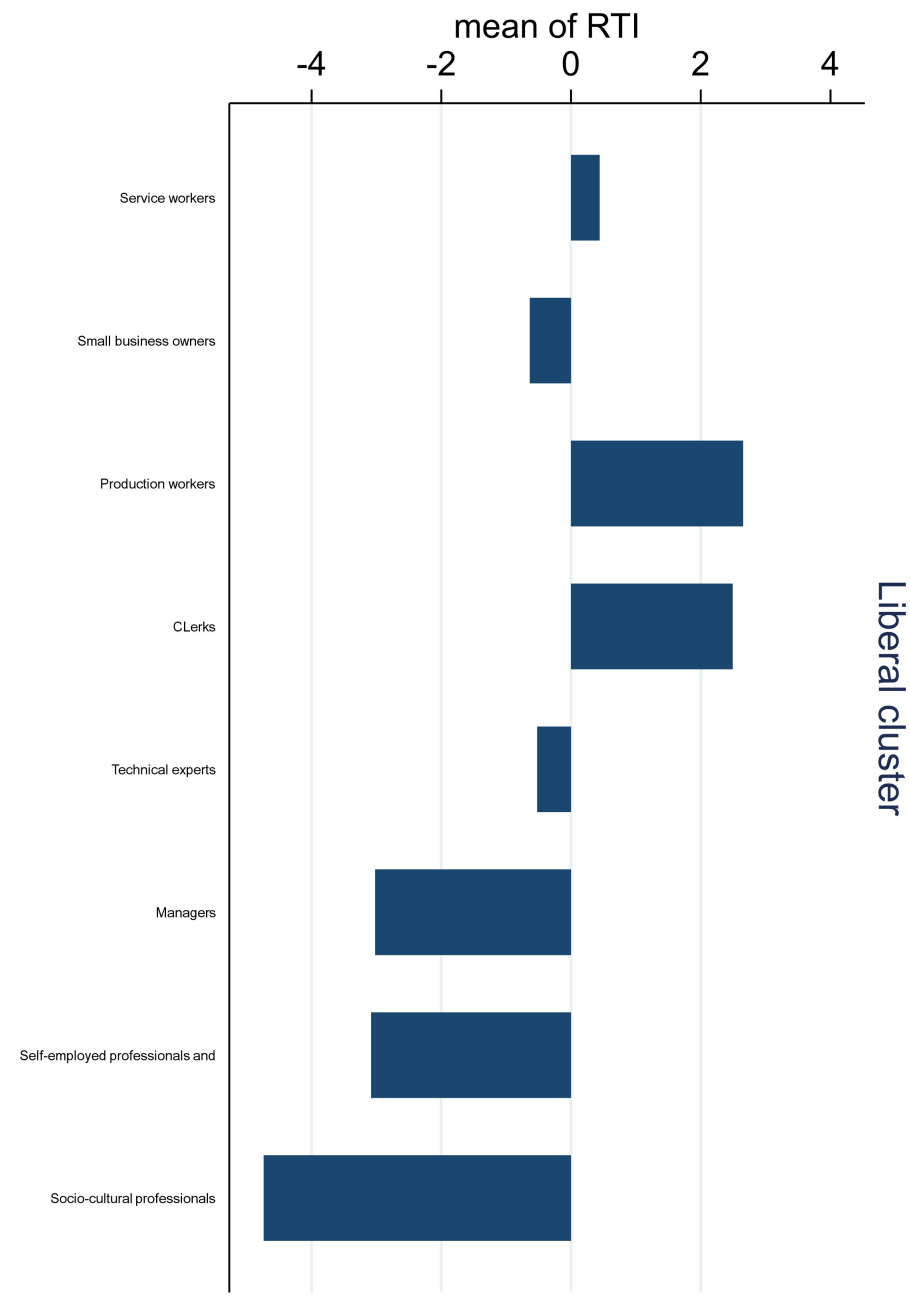
expected, the 8-class bar charts realized using the methodology of Sacchi et al. (2019) attributes a lower risk of replacement to clerks.

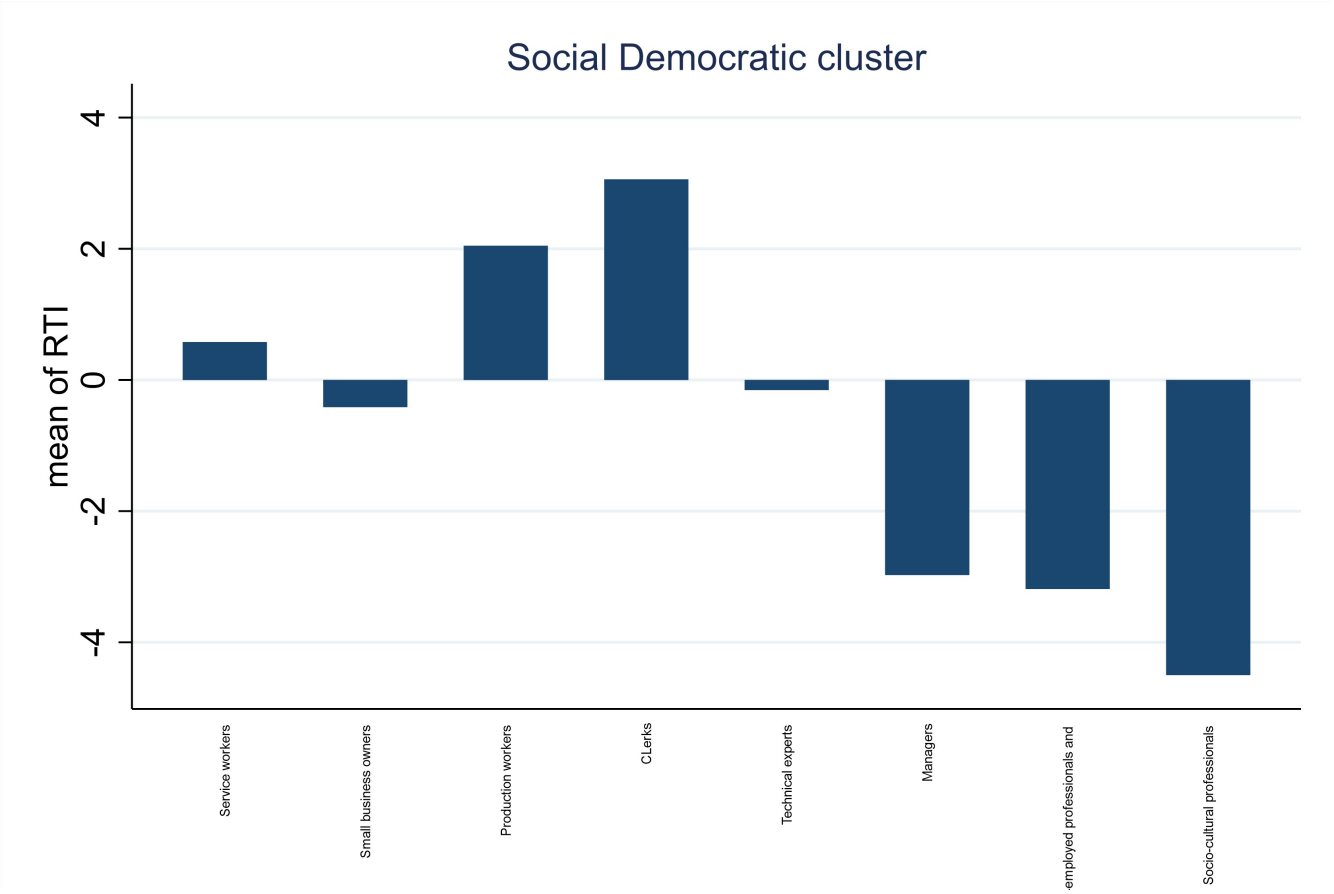
Overall, the quantitative descriptive analyses realized so far demonstrate that the RTI distribution in the European class structure does not fully comply with the RBTC hypothesis. Although the simplified version of class structure, resembling to the wage distribution, presents an allocation of automation risk which appears more in line with RBTC, the interpersonal service workers still show a much higher proneness to automation compared to the most skilled group of occupations. The lower tail of the expected U-shaped occupational distribution, mainly composed by low-skilled interpersonal service workers, would appear less pronounced than the upper tail, composed by the most educated occupations (e.g., socio-cultural professionals, etc.). Therefore, the RBTC hypothesis could be only partially verified since the service employees result more replaceable than expected.

FIGURE 11: The distribution of the mean of RTI in the 8-class scheme reordered



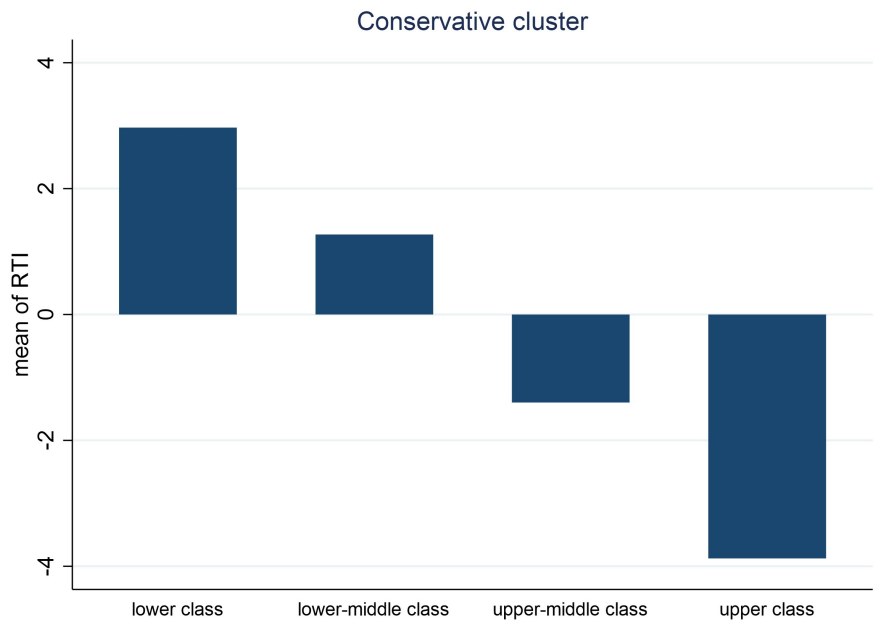

mean of RTI
-6
-4
-2
0
2
4
Service workers
Small business owners
Production workers
CLerks
Technical experts
Managers
Self-employed professionals and
Socio-cultural professionals
Mediterranean cluster

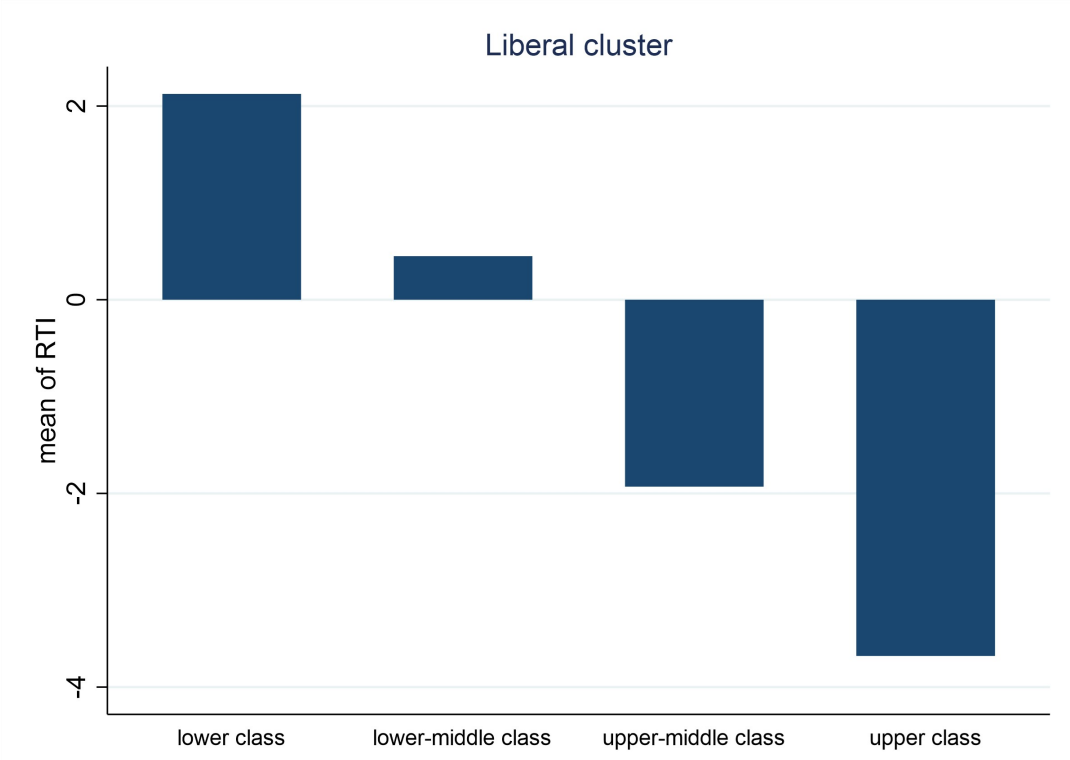

mean of RTI
-4
-2
0
2
4
Service workers
Small business owners
Production workers
CLerks
Technical experts
Managers
Self-employed professionals and
Socio-cultural professionals
Liberal cluster

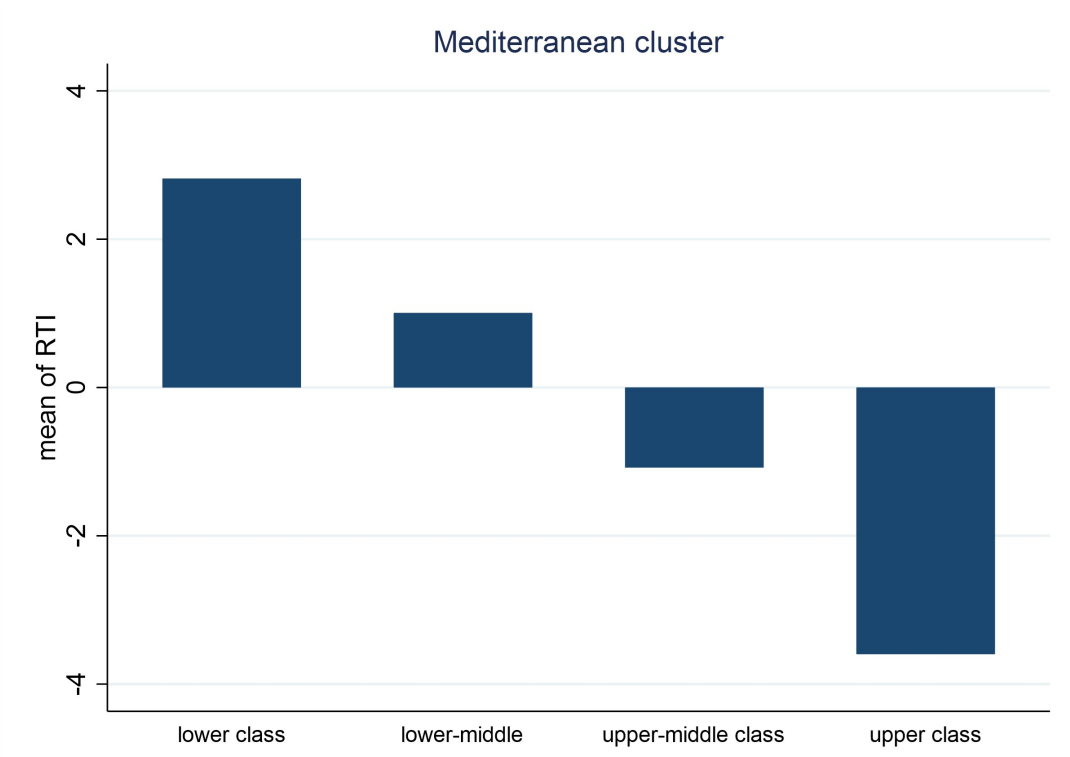


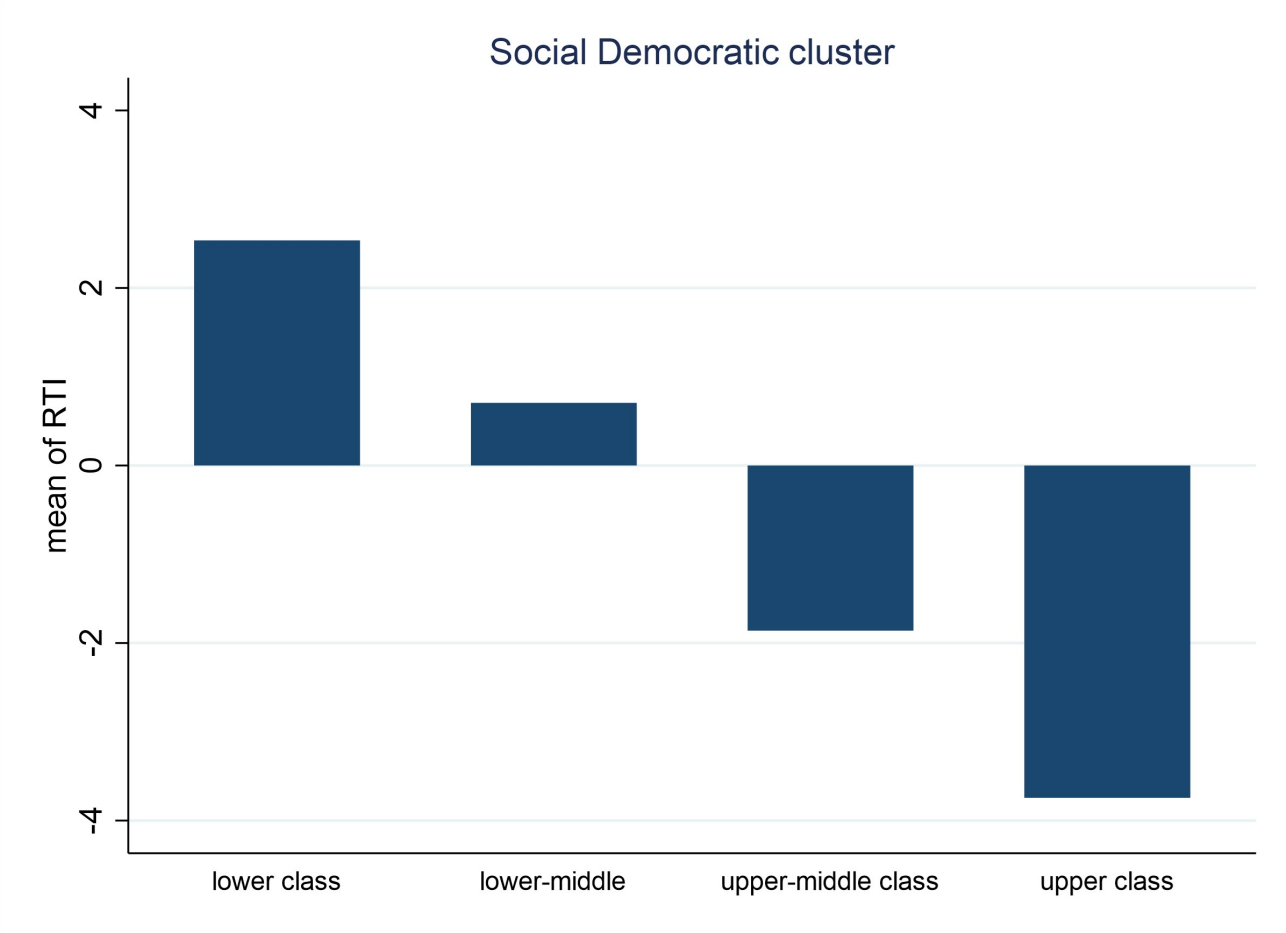
Nevertheless, the non-full compliance with the theory of Autor et al. (2003) does not automatically condemn the "shrinking" middle class hypothesis (Kurer and Palier, 2019). Indeed, the polarization of the replacement risk, detected in the first more detailed analysis, between the lower-end and the upper-end of the class distribution might suggest the emergence of a cleavage within the middle class. In order to provide a synthetic representation of this fracture I will plot the distribution of RTI along the four "macro-classes" already defined.

FIGURE 12: The distribution of the mean of RTI in the four "macro-classes"




Liberal cluster
mean of RTI
2
0
-2
-4
lower class
lower-middle class
upper-middle class
upper class


Mediterranean cluster
mean of RTI
4
2
0
-2
-4
lower class
lower-middle
upper-middle class
upper class



These graphs clearly display the polarization of the automation risk, assigning the lowest RTI score to the upper "macro-class" and the highest one to the lower counterpart. Moreover, the expected cleavage results to divide the "upper-middle macro-class", which appears more resilient to automation, from the so-called "lower-middle class", that looks more prone to be replaced by machines. Furthermore, it should be underlined that the Scandinavian and the Anglo-Saxon "upper-middle macro-classes" show comparatively lower RTI scores, whereas the "lower-middle macro-class" in Central-Southern Europe results to be more likely to be replaced. As regards the first two clusters, the significant sizes of the Nordic socio-cultural semi-professionals and the Anglo-Saxon low-grade managers seem to strengthen their own "macro-class" against automation, while the large shares of clerks in the Conservative cluster and production workers in the Mediterranean group appear to make their "lower-middle class" more vulnerable.

All in all, the RBTC hypothesis appears only partially confirmed and the framing role of class structure looks crucial to determine its validity. In fact, the inverted-U-shaped distribution of RTI only makes its apparition when the groups of occupations are collapsed to the 8-class version. Anyway, the service workers do not show the expected resilience to automation, hence undermining the job polarization hypothesis. As regards the impact of the ICT diffusion on welfare clusters, the Mediterranean regime turns out to be the most affected, mainly due to its remarkable share of low-skilled manual and service workers. On the contrary, the Social Democratic and the Liberal clusters are likely to be hit more softly by the spread of new

technologies. While the former seems to provide the least educated workers with the skills needed to be sheltered from automation, the latter has strongly reduced the labor force in the traditional routine economic sectors. Finally, the future of the Conservative class structure appears less predictable, since its proneness to automation is strongly linked to the degree of routine assigned to its numerous white-collar workers.

3. Preliminary conclusions on the European class structure: between RBTC and SBTC

The main aim of this chapter is to assess the impact of automation on the middle class. Unfortunately, a straight answer cannot be provided. Indeed, the descriptive analyses performed on the European class structure using the "Routine Task Index" do not release a clear picture.

What could be conceivably asserted is that welfare regimes matter when it comes to social classes. In fact, the societal arrangements in the four welfare clusters present significant differences. While the Conservative group results to be committed in preserving its traditional clerical and industrial workforce, the Liberal countries turns out to be more interested in supporting the managerial and entrepreneurial occupations without hampering the rise of low-paid interpersonal service jobs. The Social Democratic regime instead appears to be engaged in upskilling workers, without substantially altering the market outcomes. Finally, the Mediterranean countries result to be more effective in preserving the traditional working class, despite being not as capable in sheltering its labor force from automation risk.

As regards the proneness to be replaced by new technologies, the educational attainment turns out to be of great importance. Indeed, a quite linear polarization occurs in the distribution of RTI along the skills continuum. Although the traditional middle-skilled occupations present the highest RTI scores, the least educated social classes seem to be characterized by a remarkable automation risk too. The middle class looks split in half, with its most skilled workers resulting less automatable and its least educated members hit harder by replacement. Performing correlations between the educational attainment and RTI, a mild negative relation emerges in all clusters. Namely, the Conservative group presents a coefficient r equal to -0,48, the Liberal regime -0,45, the Mediterranean countries -0,47, and the Scandinavian cluster -0,44.

Therefore, the complex societal picture drawn seems to stand in the middle between the skill- and the routine-biased technical change. Indeed, the role of competences looks to matter more than in the RBTC, despite the middle-skilled occupations are confirmed to be the most affected by automation. In the end, what emerges is an uneven distribution of the replacement risk towards the least educated occupations, breaking the "large" middle class in two subclasses in accordance with the workers' educational requirement. Looking at the bar charts referring to the "macro-classes", the dimension and the replaceability of the lower-middle class appear to be the main determinants of the resilience of the "large" middle class.

Some noticeable differences in the proneness of middle class to automation emerge among welfare regimes. In order to better understand these variations, it should be look at the longitudinal analysis performed above. The Scandinavian and the Anglo-Saxon "large" middle classes appear the most resilient to automation, showing a decrease in the size of the lower-

middle class. Nonetheless, the reasons are different. In the Nordic case, many of the workers included in the lower-middle class have been successfully retrained, hence reducing their replaceability. Indeed, the relative size of the lower and the lower-middle class has been partially brought down. On the contrary, the Liberal countries have consistently reduced their traditional low-skill workforce (i.e., production workers and clerks), showing an overall constrained RTI score. However, the significant dimension of the lower class might account for the downgrading of the former lower-middle workers. Finally, both the Conservative and the Mediterranean middle classes result to be more likely to be automized. In the Central European countries, the large share of clerks seems to justify that observation, whereas the relevant number of production workers and the general low education of the Southern labor force push many people in the higher RTI quintiles. Once again, the main difference between these two cluster could be led back to the dimension of the lower class. In fact, its larger relative size in the Mediterranean group, compared to the Conservative regime, envisages a worse impact of automation on the former.

Therefore, the welfare regimes most committed in providing the required competences, as well as sheltering the labor force with encompassing compensation policies, will enable workers to face painlessly the challenge of the ICT revolution.

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