

Anatomy of the Italian occupational structure: organization, knowledge and power beyond RBTC

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The socio-economic impact of technological change

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Aim of the (on-going) work

This work intends to present an anatomy of the Italian occupational structure addressing the question of which factors determine wages.

This will be done accounting for differences across occupational groups and trying to disentangle the role played by technological change, exploiting the rich and highly detailed amount of data of ICP, both in terms of quantitative and qualitative information.

THEORETICAL BACKGROUND (1)

TECHNOLOGICAL CHANGE AND LABOR

- The debate goes back to Smith, Ricardo and Marx.
- Schumpeter claims that : “The fundamental impulse that sets and keeps the capitalist engine in motion comes from the new consumers goods, the new methods of production or transportations, the new markets, the new form of industrial organization that capitalist enterprise creates” (Schumpeter, The theory of economic development (1961, p.82-83)
- Neoclassical approach initially looks at technological change as an “exogenous factor” (Solow, 1956), gradually revised by the endogenous growth theory.
- Evolutionary scholars offer a different analysis of technological change, seen as a complex phenomenon intrinsically embedded in economic dynamics, shaped by institutions, capabilities and interactions among agents (Nelson and Winter, 1982; Dosi ,1988).

THEORETICAL BACKGROUND (2)

TECHNOLOGICAL CHANGE, LABOR AND WAGE

- According to mainstream perspective, wages are determined in equilibrium, given by the marginal contribution of individual productivity to the production.
- Relaxing some of the neoclassical assumptions (i.e. perfect competition of the labor market, identical workers), a still exogenous technology can produce different outcomes, favouring the more skilled (SBTC) or the workers employed in jobs with a low degree of routinarity (RBTC). This process will be reflected in employment and wage dynamics.
- From an evolutionary perspective, wages are not simply the result of individual productivity. They depend on the degree of knowledge workers have, their position inside the organization, the control they exert vs others. From a heterodox viewpoint wages reflect power relations among classes and strength of institutions.

CURRENT DEBATE on JOB POLARIZATION

Employment shares grow among high skill-high wage jobs and low skills-low wage jobs (SBTC).

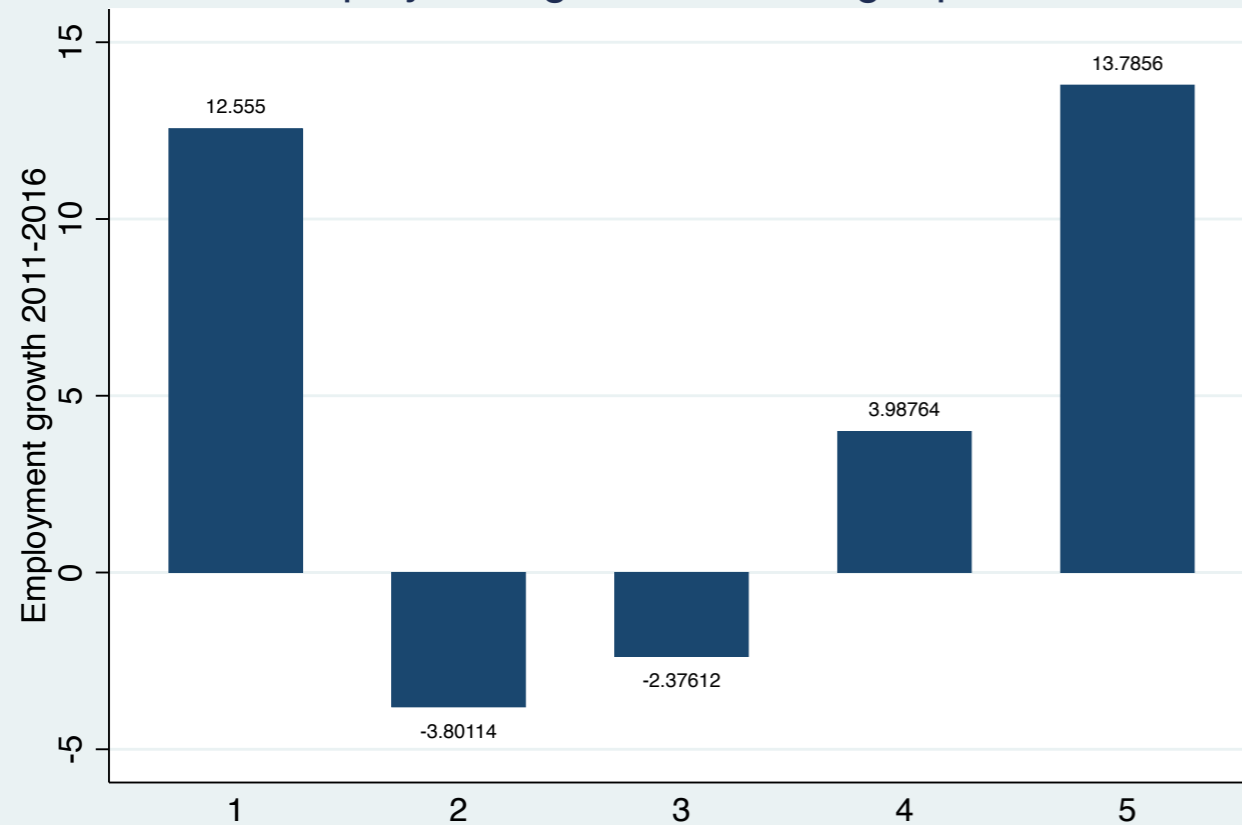
Jobs with repetitive tasks are being substituted by technology, whereas jobs with abstract (i.e. creativity) or non routine manual tasks (i.e. with high physical dexterity) are less likely to be displaced by new technology (RBTC).

➔ While high wage jobs and low wage jobs are increasing, the number of middle wage jobs decreases.

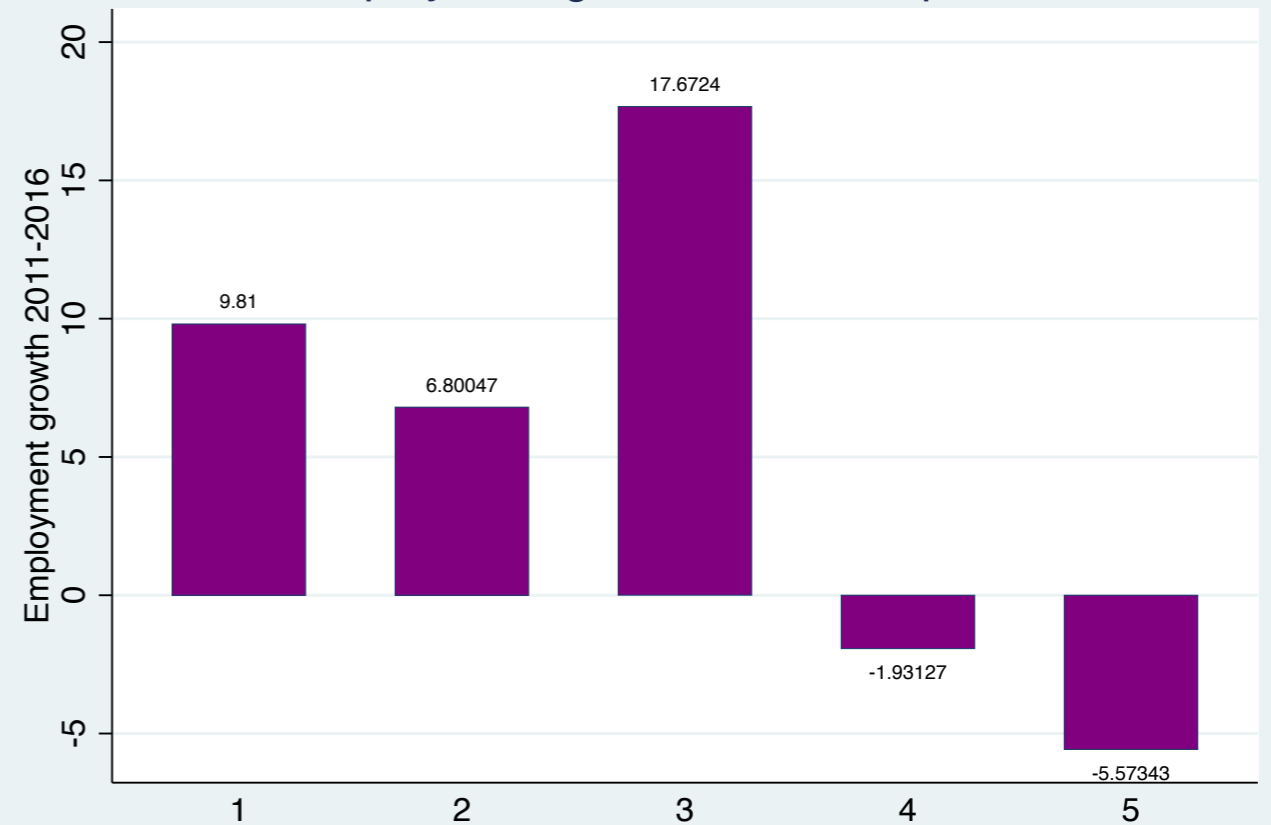
What about Italy?

Employment dynamics over the period 2011-2016 seem partly consistent with RBTC (see Guarascio et al. 2018)

Employment growth over wage quintiles



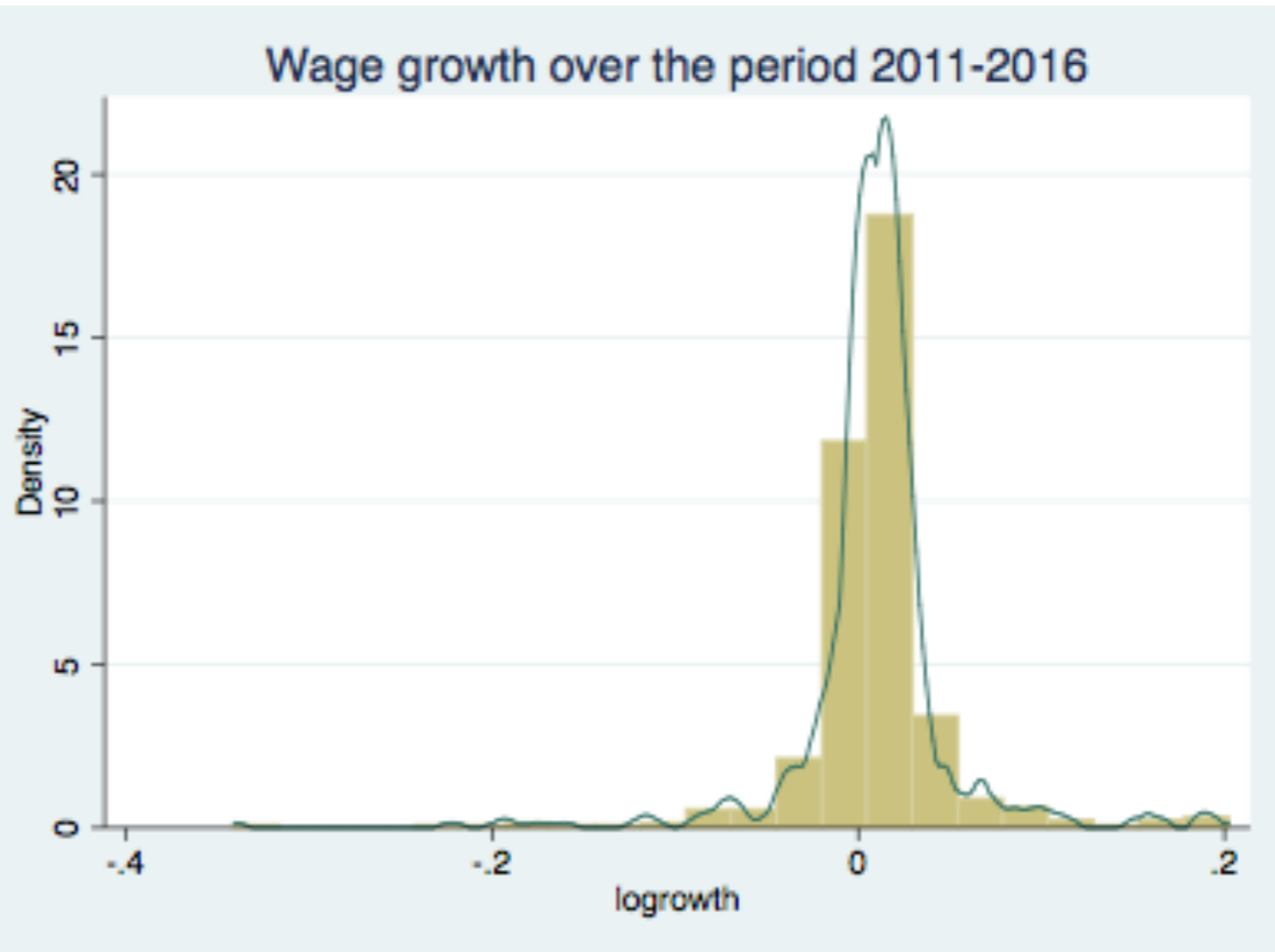
Employment growth over RTI quintiles



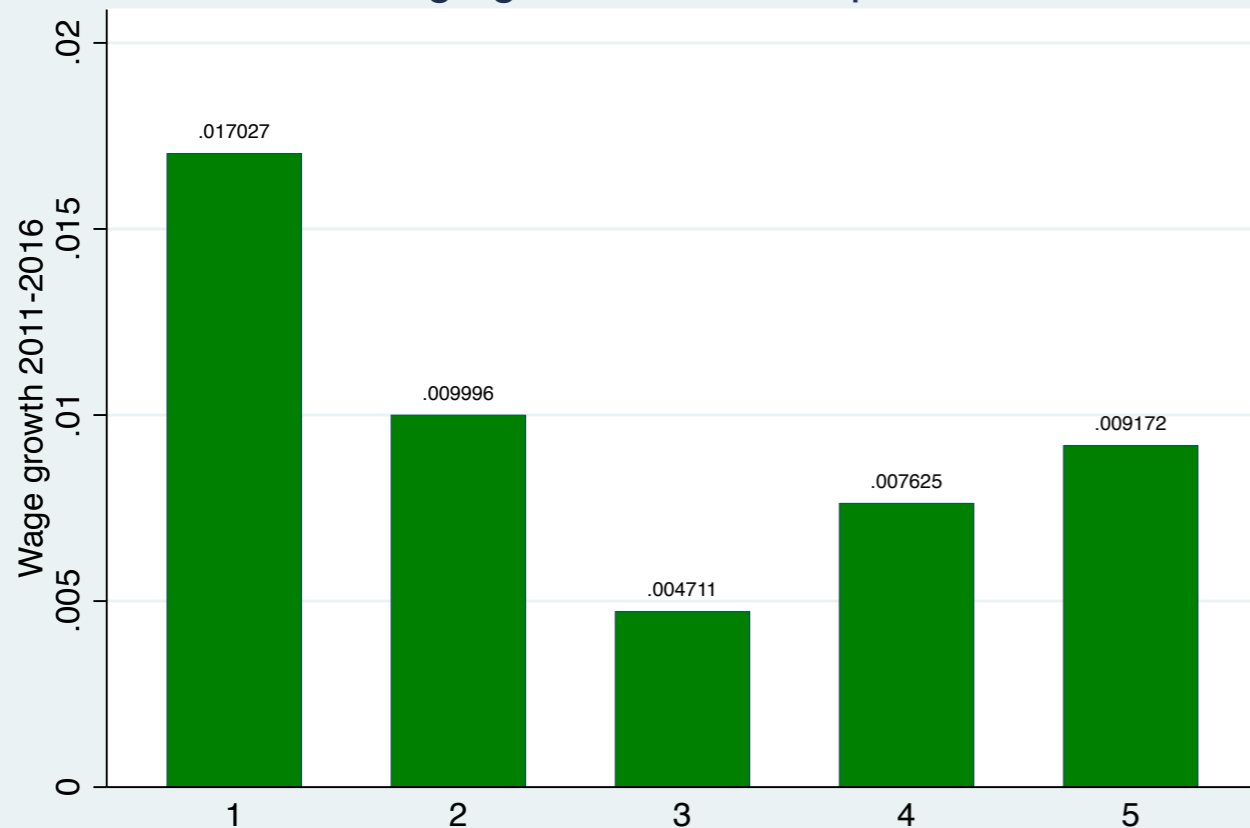
$$RTI_{j,t} = RC_{j,t} + RM_{j,t} - (NRCA_{j,t} + NRCI_{j,t} + NRM_{j,t} + NRMIA_{j,t})$$

from Autor and Dorn (2013)

Wages show a stagnating growth over the period 2011-2016, that stems both from the impact of the crisis and the structural problems of the Italian economy (i.e. slowdown of labour productivity).

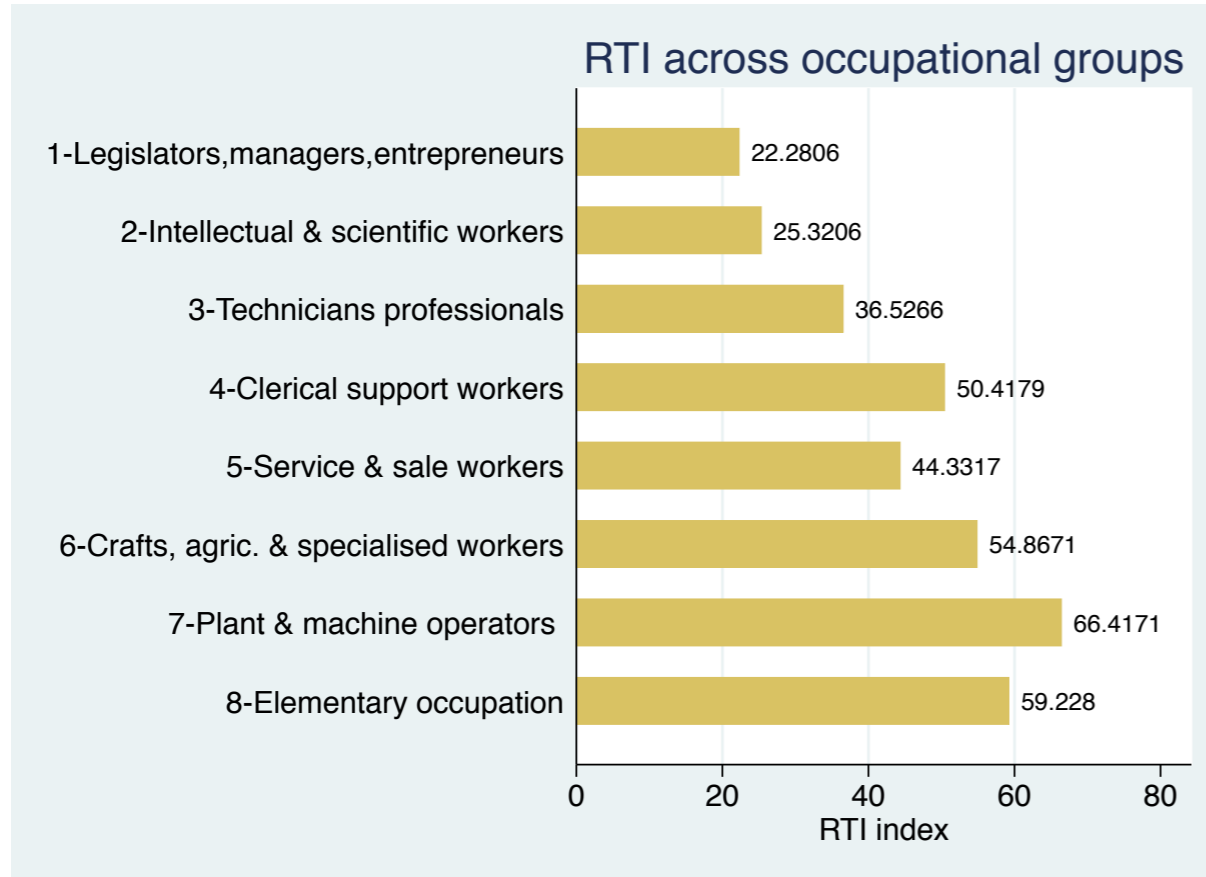


Wage growth over RTI quintiles

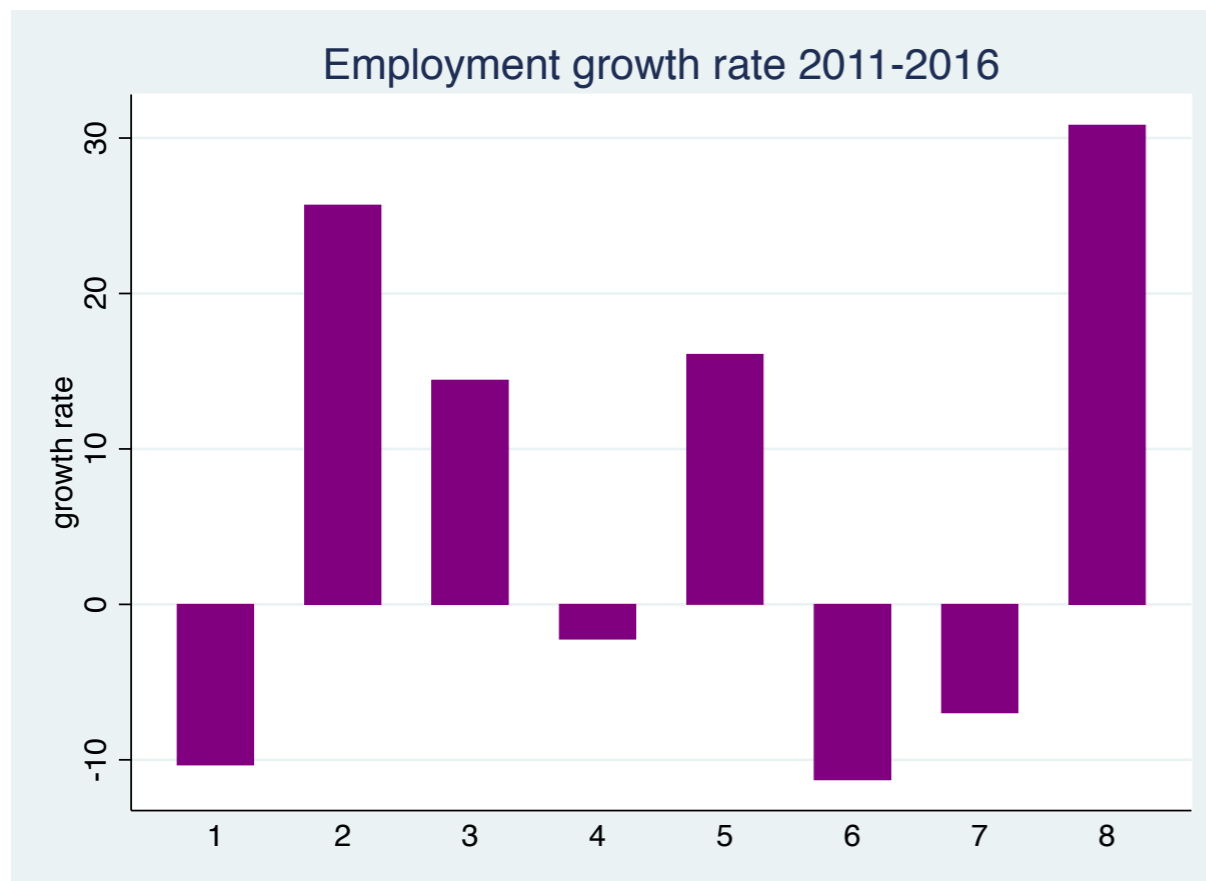


A less clear relation with the RTI index emerges: wages “increase” more in the first quintile, but also in the second and the fifth one.

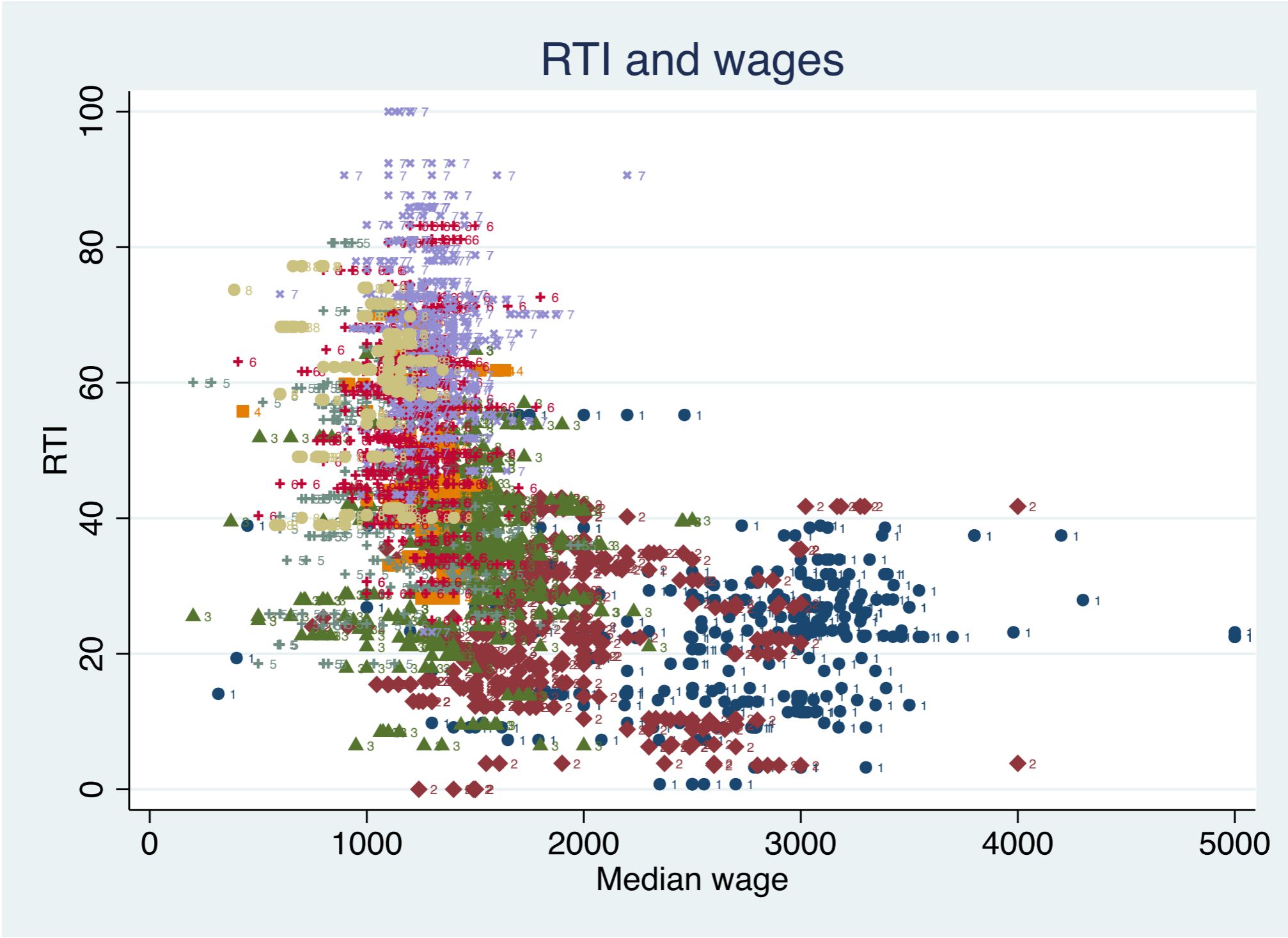
OCCUPATIONAL GROUPS



- Significant differences in terms of RTI emerge across professions.
- Employment increases the most in the elementary occupations that display the second highest RTI index, in service occupations and in low RTI index jobs such as intellectual workers and technicians.
- Wages “increase” only in the first group and very slightly for crafts, plant and machine operators and elementary occupations.



RTI INDEX AND WAGES BY OCCUPATIONAL GROUPS



- Legislators, Managers, Entrepreneurs
- ◆ Technicians and associate professionals
- ▲ Intellectual and scientific workers
- Clerical support workers
- + Service and sales workers
- + Craft workers, agriculture and specialised workers
- × Plant and machine operators
- Elementary occupations

Our research question

Which are the important factors we should take into account in order to study the **impact of technological change** (and the key mediating role of skills, knowledge and organisational elements) on **work and wages distribution?**

- very preliminary stage -

What do we mean for **work**?

Thank to ICP (Indagine campionaria delle professioni) of ISTAT-INAPP, we can use a very comprehensive database, that map Italian professions from 1 digit to 5 digits level of disaggregation over two time periods (2005-2010 and 2011-2016).

Indeed, we have very detailed data on 800 occupations sampled by 16000 workers through a complex sampling strategy. For each occupation at 5 digit, that is very likely to correspond to a real job, we can look at:

- the specific productive process and sequence of tasks in which the worker is employed (thanks to ATLANTE);
- the prevalent economic sector for each occupation;
- the composition of the workforce in terms of education, gender, geographical origin and job contracts;
- wage and employment dynamics;
- a very comprehensive qualitative analysis.

We can move across different levels of analysis (from aggregate to highly disaggregate) and different objects of analysis (from production processes to social interactions).

Example: The highest and lowest wage jobs

4 Digit	Occupation	Main activities	Mediam wage	Women (%)	Tert. education (%)	Indet. Contracts (%)	RTI
5442	Children surveillance personnel and similar occupations	supervise and inform parents about children's behavior, organize play activities, take care of children's hygiene	598.67 Euro	.94	.13	.61	21.34
1111	Members of government bodies and national assemblies with legislative and regulatory power	participate to conferences, and congresses, appoint administrators of institutions, institutions, public companies, plan and make new law proposals	3.764.833 Euro	.34	.80	.33	22.5

TECHNOLOGICAL CHANGE SEEN AS INNOVATION

We look at **the concept of innovation** as directly reported by the workers, thanks to a specific question present in ICP and a vast amount of micro information.

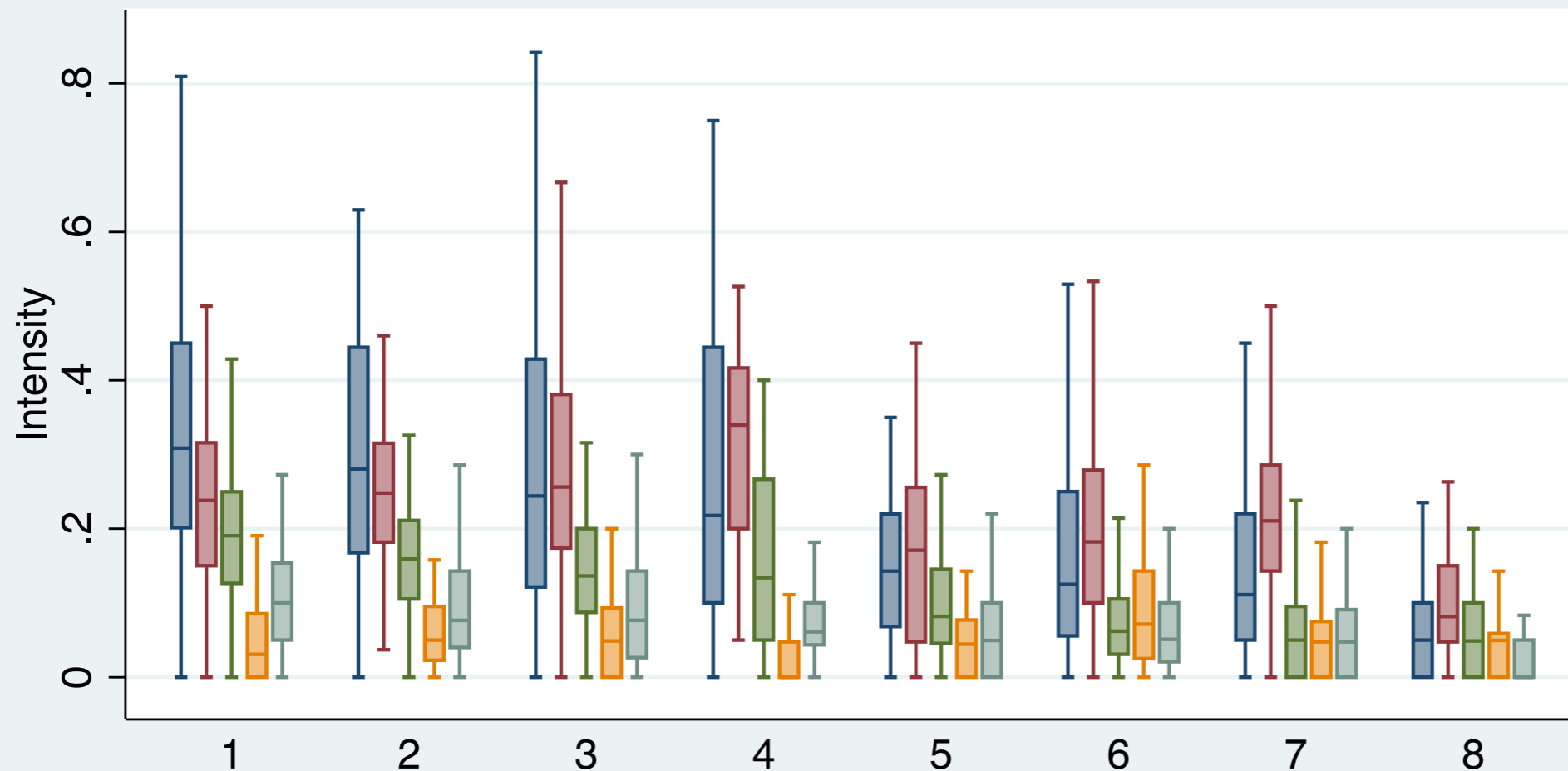
“Have external factors occurred in the last three years that have changed the way in which you work?”

Which kind of innovation has taken place?

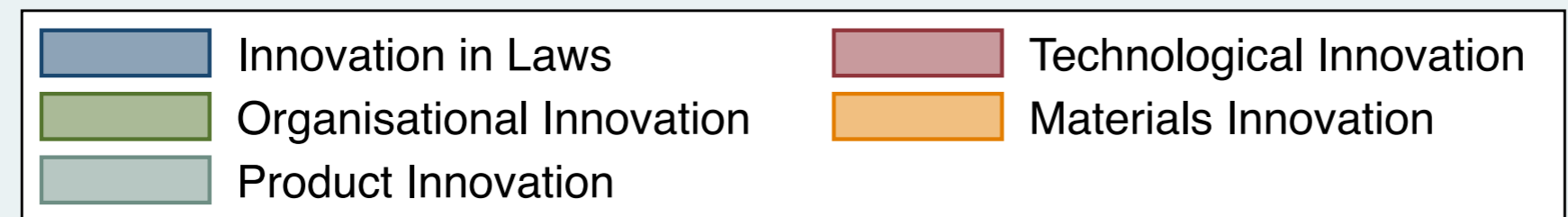
- 1. Change in the used technologies*
- 2. Change in the legislation*
- 3. New goods or services made*
- 4. Change in the work organisation*
- 5. Change in the materials used*

INNOVATION ACROSS OCCUPATION GROUPS

INNOVATION



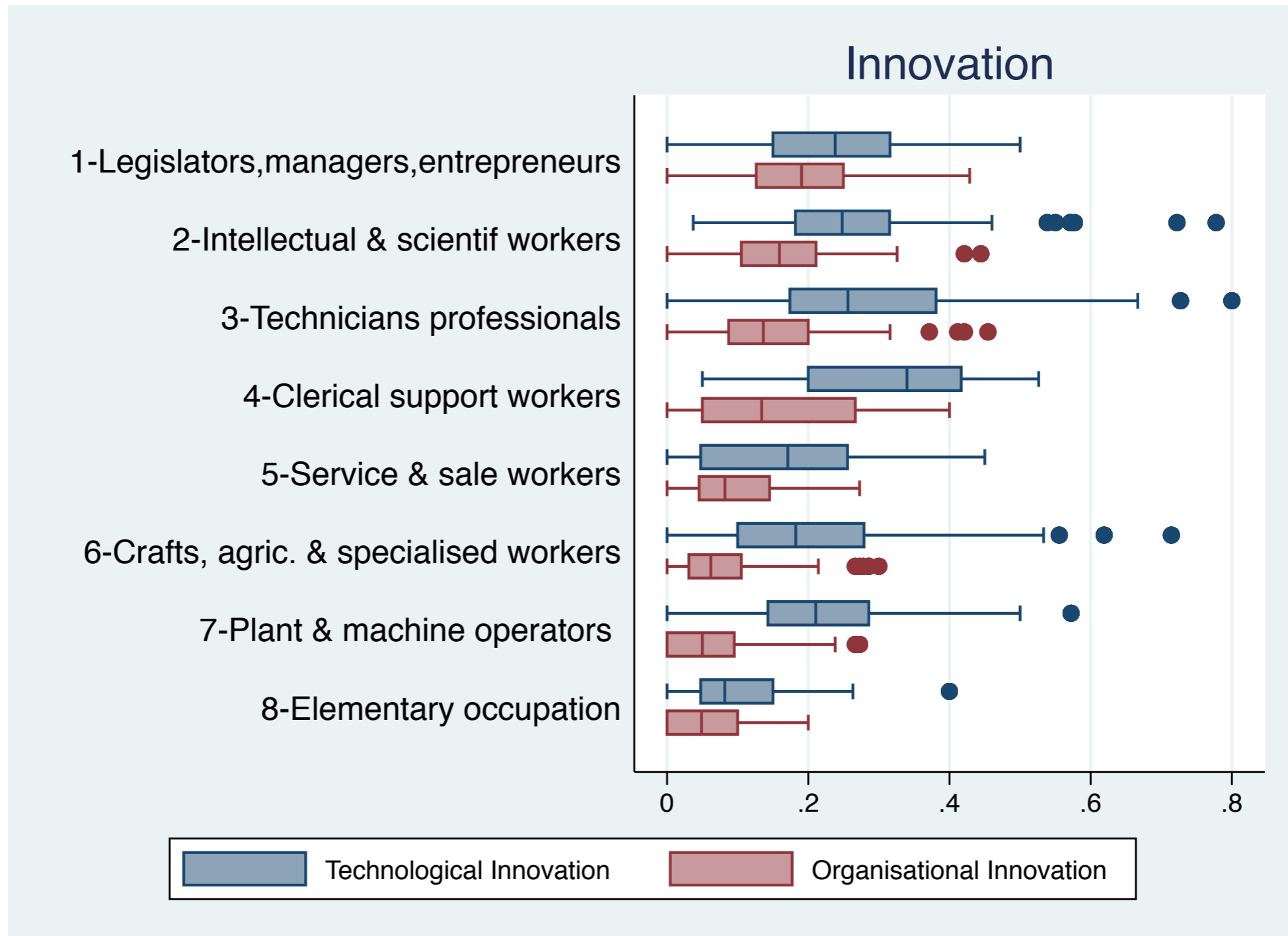
1	Legislators, Managers, Entrepreneurs
2	Intellectual and scientific workers
3	Technicians and associate professionals
4	Clerical support workers
5	Service and sales workers
6	Craft workers, agriculture and specialised workers
7	Plant and machine operators
8	Elementary occupations



excludes outside values

Significant heterogeneity **among** occupation groups for all types of innovation, relevant dispersion **within** some groups.

More specifically, we focus on technological innovation and organisational innovation



How can we account for determinants of **wage differences** across occupational groups?

- DIGITAL SKILLS,
- WORK ORGANISATION,
- KNOWLEDGE AND LEARNING,

- EDUCATION,
- GENDER,
- ECONOMIC FACTORS,
- INSTITUTIONAL FACTORS,
- INTERNATIONAL MARKETS - GVC.

DIGITAL SKILLS*

*Consistent with Eurostat definition of “e-skills”, see DESI

KNOWLEDGE OF
INFORMATICS AND
ELECTRONICS -
from normal user to expert

USE OF MAIL ADDRESS
required by the job

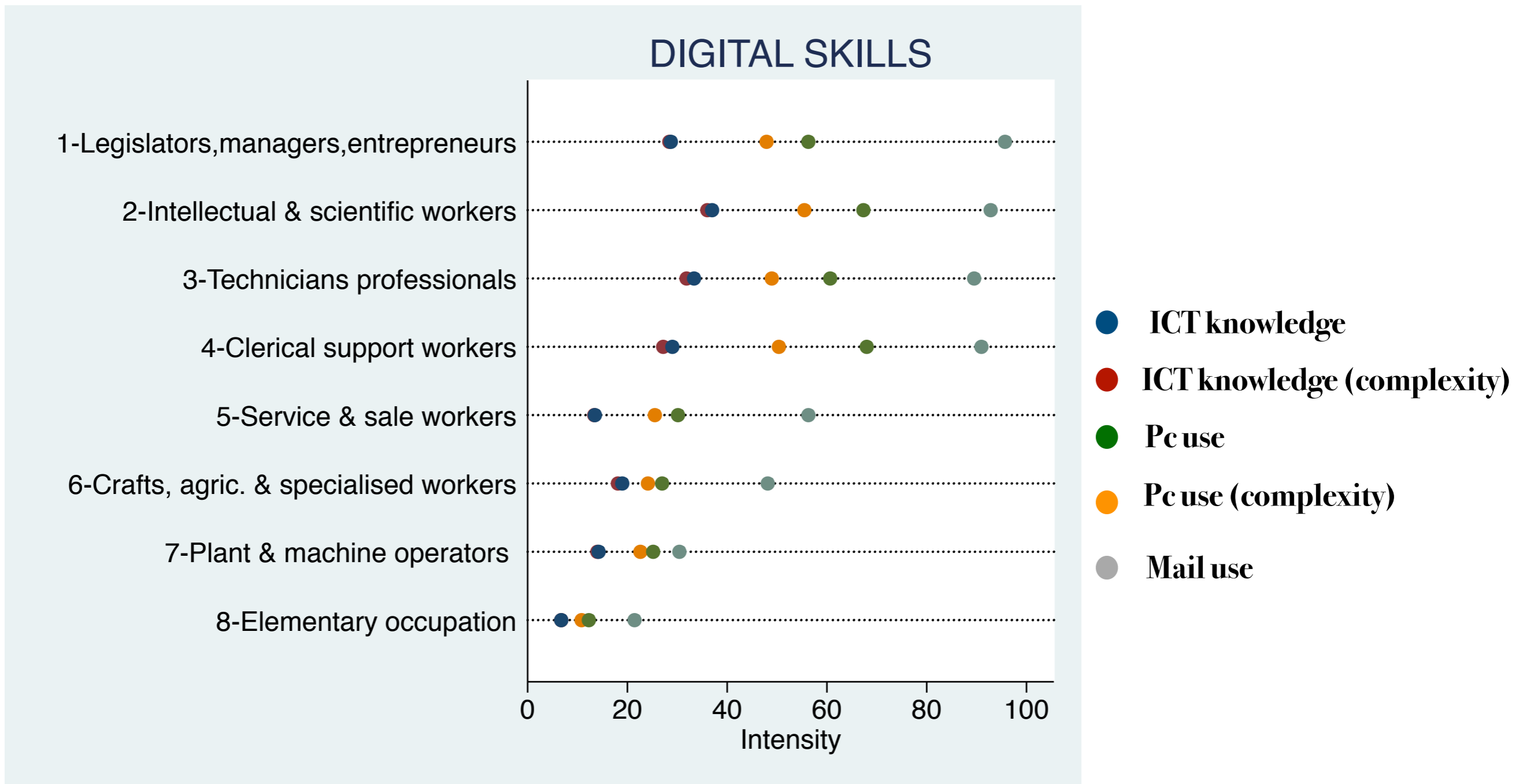
USE OF PERSONAL
COMPUTER AND
SOFTWARES -
from normal user to expert

Correlation matrix *significance at 1%

	Median wage	Tech Innovation	Org Innovation	ICTknow	ICTknowC	PCuse	PCuseC	Mailuse
Median wage	1.0000							
Tech Innovation	0.1480*	1.0000						
Org Innovation	0.3605*	0.3283*	1.0000					
ICTknow	0.3210*	0.4280*	0.2802*	1.0000				
ICTknowC	0.3496*	0.4354*	0.2892*	0.9791*	1.0000			
PCuse	0.4465*	0.4380*	0.4518*	0.8004*	0.8085*	1.0000		
PCuseC	0.4847*	0.4242*	0.4369*	0.7975*	0.8301*	0.9686*	1.0000	
Mailuse	0.4867*	0.3418*	0.4916*	0.6332*	0.6653*	0.8523*	0.8498*	1.0000

All digital skills correlate positively with technological, organisational innovation and wages. In particular, the use of personal computer (especially if for complex tasks) shows the highest correlation values in line with RBTC theory.

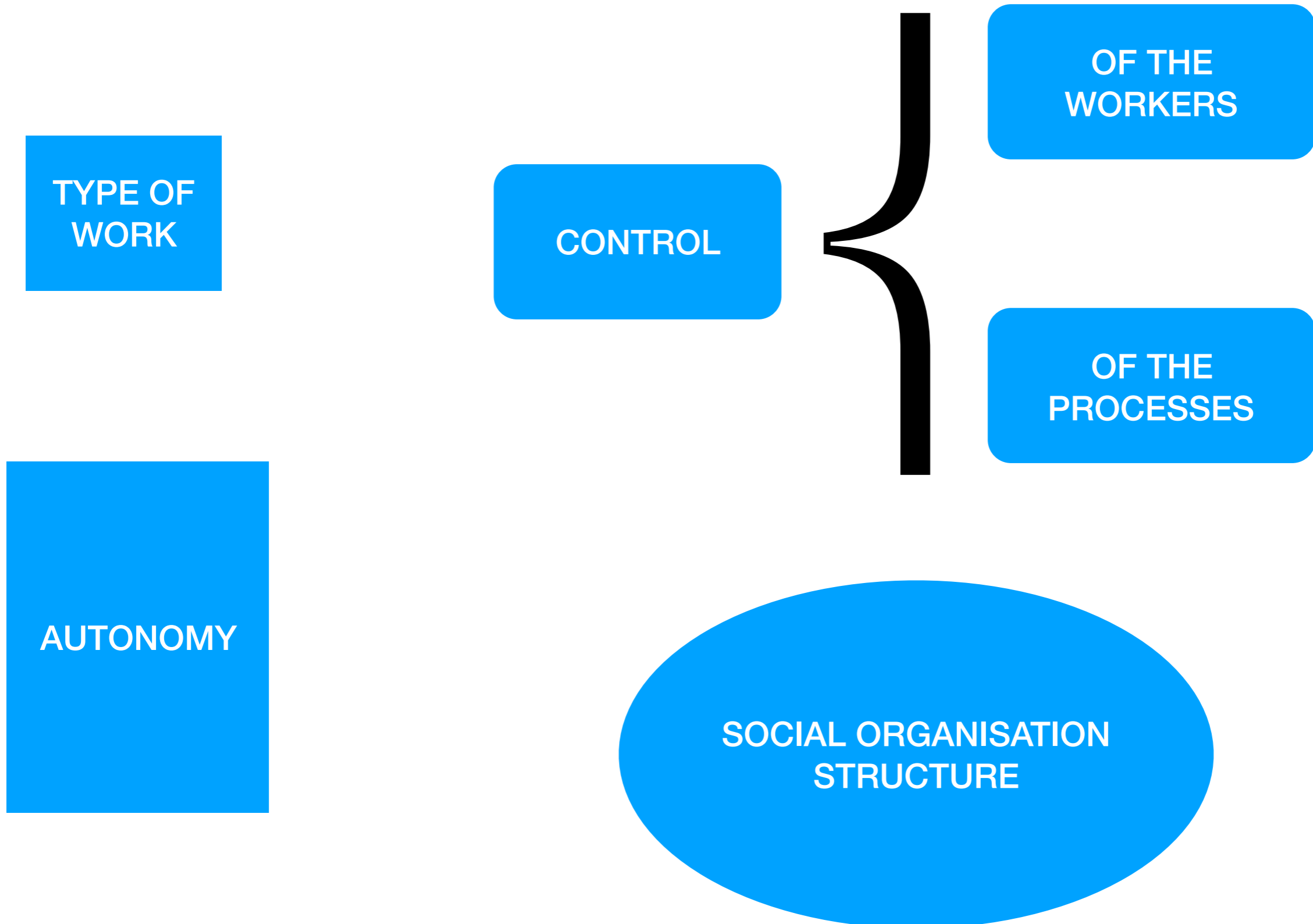
DIGITAL SKILLS OVER OCCUPATIONAL GROUPS



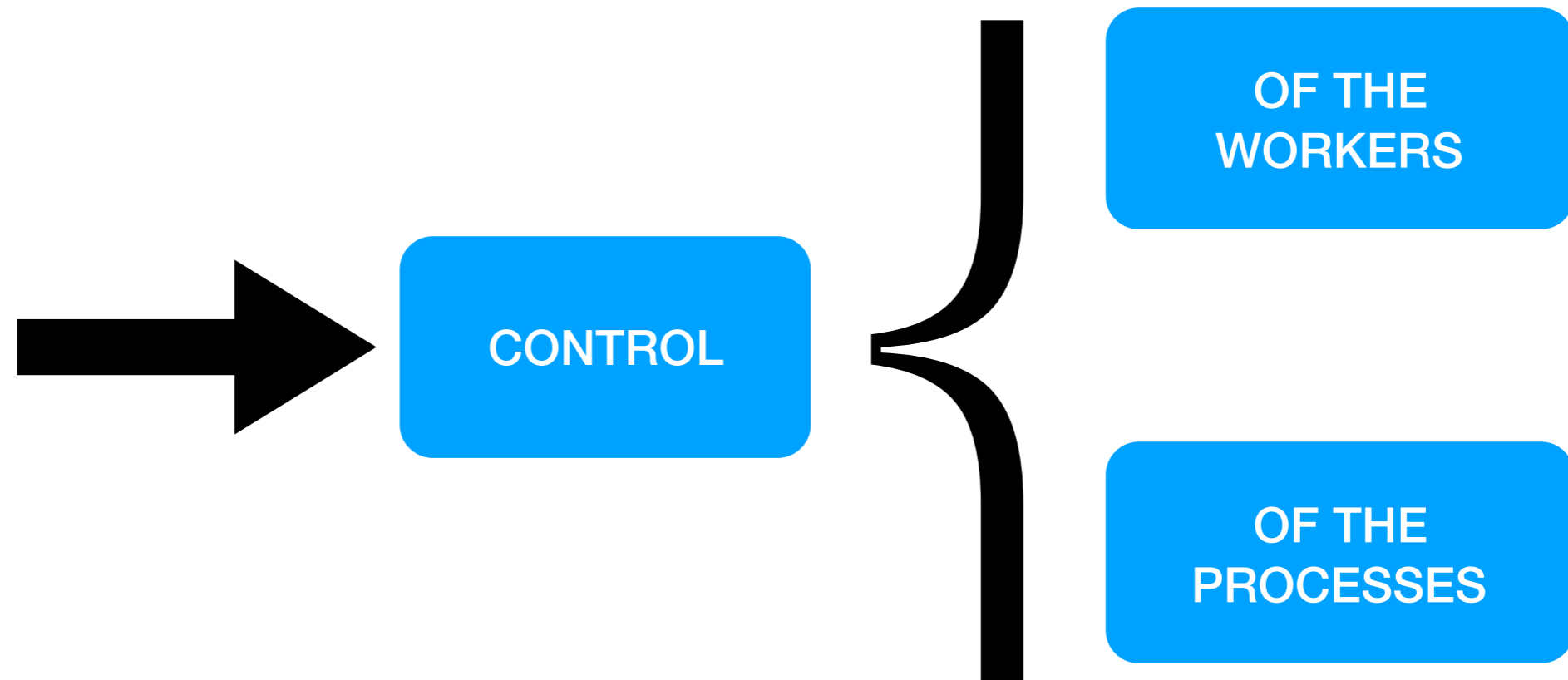
Digital skills are differently distributed across occupational groups. However, the average level of ICT knowledge and ICT complex knowledge required is very low, even in the more specialised occupations (2 and 3).

WORK ORGANISATION*

* Ó Riain and Healy (2018), Holm et al. (2010); Lorenz and Valeyre (2005)



WORK ORGANISATION



Control, and more specifically **control of the workers**, can be seen as a **dimension of power**, following the definition of Dosi and Marengo (2015, p.4) according to which power:

1. “is the ability of ruler to determine the set of actions available to the other agents (the “ruled”)”;
2. “involves the possibility of the authority to veto the decisions or intentions of the ruled ones.”
3. “relates to the ability of the authority to influence or command the choice within the “allowed” choice set (i.e. the span of control of the “ruled”), according to the deliberations of the ruler himself”

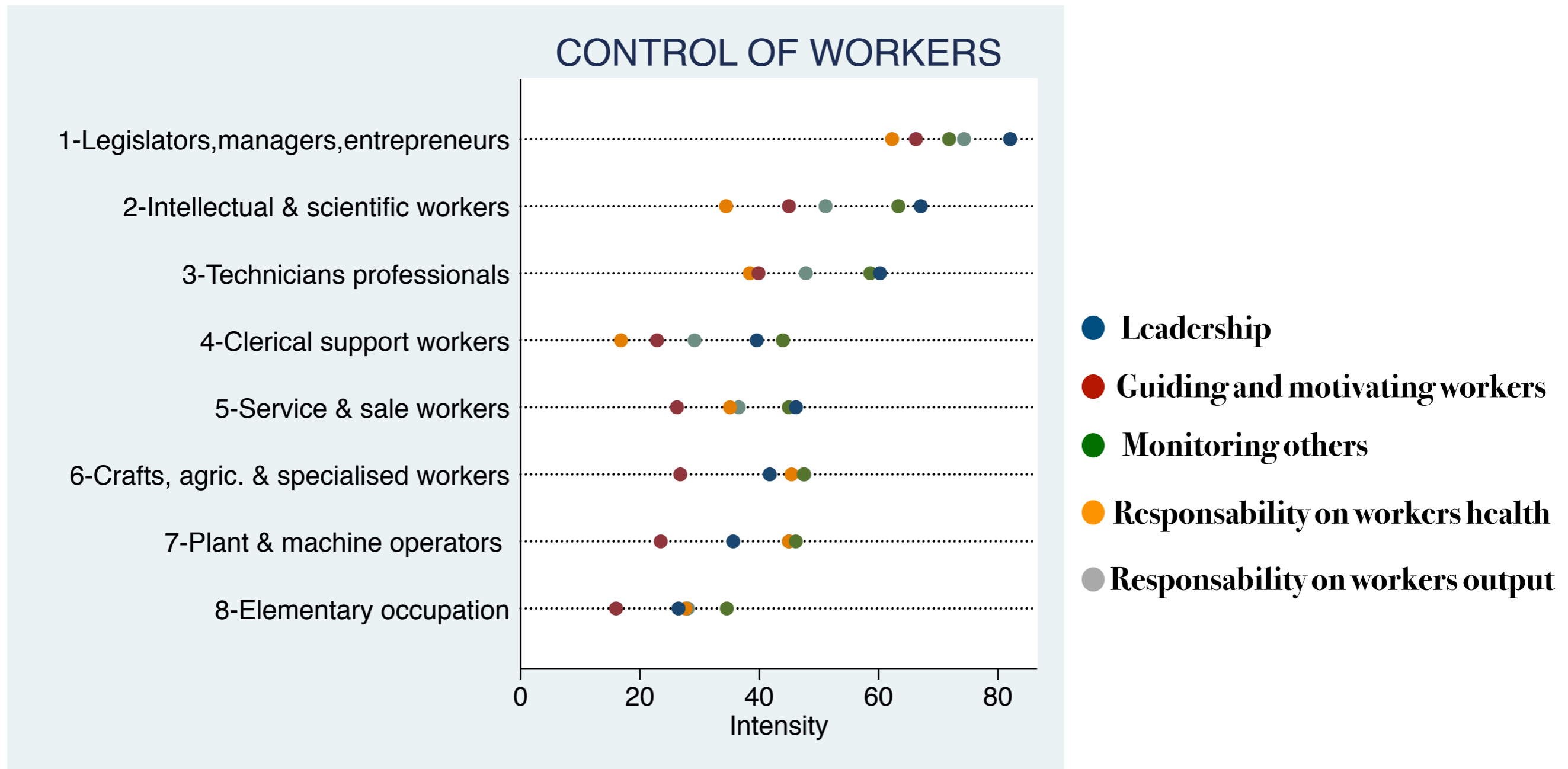
WORK ORGANISATION

Control of other workers

	Median wage	Tech innovation	Org innovation	Leadership	Guiding others	Guiding others (complexity)	Monitoring other workers	Monitoring other workers (complexity)	Responsibility on others health	Responsibility on others output
Median wage	1.0000									
Tech innovation	0.1480*	1.0000								
Org innovation	0.3605*	0.3283*	1.0000							
Leadership	0.6133*	0.2019*	0.4764*	1.0000						
Guiding and motivating others	0.6528*	0.2048*	0.4557*	0.8676*	1.0000					
Guiding others (complexity)	0.6807*	0.2074*	0.4656*	0.8641*	0.9778*	1.0000				
Monitoring other workers	0.5536*	0.2348*	0.4411*	0.8195*	0.8370*	0.8169*	1.0000			
Monitoring other workers (complexity)	0.5998*	0.2390*	0.4568*	0.8382*	0.8315*	0.8534*	0.9326*	1.0000		
Responsibility on others health	0.3040*	0.0796*	0.0701*	0.4122*	0.5468*	0.4973*	0.4128*	0.3501*	1.0000	
Responsibility on others output	0.4986*	0.2084*	0.2764*	0.6501*	0.8136*	0.7887*	0.6571*	0.6303*	0.7528*	1.0000

Being leader, monitoring other workers and being responsible of other workers output, are all positively correlated with innovation and the median wage in the profession. No variable shows a negative correlation.

CONTROL OF WORKERS ACROSS OCCUPATION GROUPS



Strongly different degrees of control over workers can be observed across the groups, with the highest values of managers (leadership around 90/100) and the lowest values observed in the elementary occupation group.

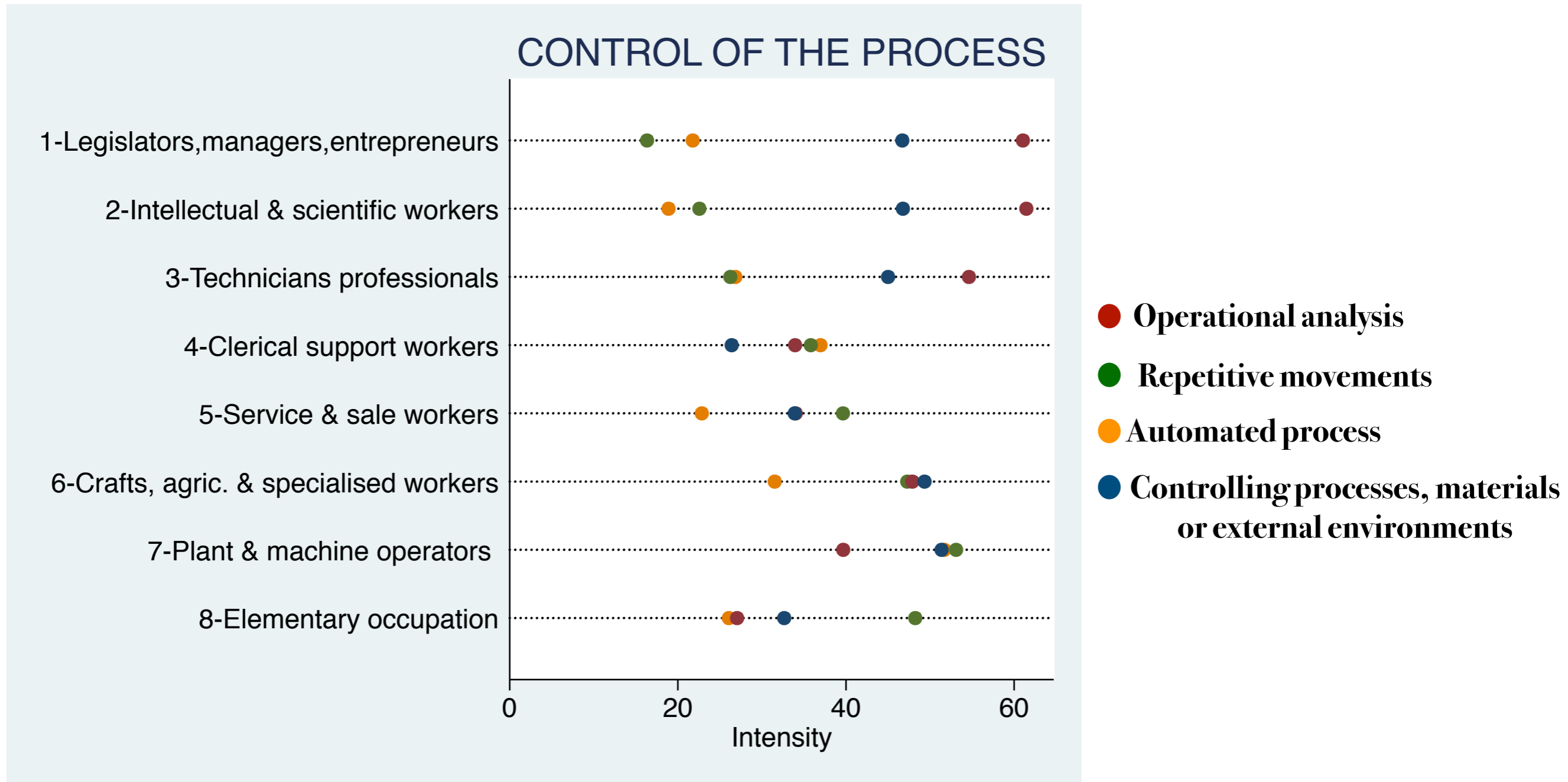
WORK ORGANISATION

Control of the process

	median wage	tech innovation	Org innovation	Controlling process and materials	Controlling process and materials(complexity)	Operational analysis	Operational analysis(complexity)	Repetitiveness	Degree of automatisisation
median wage	1.0000								
Tech innovation	0.1480*	1.0000							
Org innovation	0.3605*	0.3283*	1.0000						
Controlling process and materials	0.1996*	0.1104*	0.0897*	1.0000					
Controlling process and materials(complexity)	0.2734*	0.1263*	0.1564*	0.9362*	1.0000				
Operational analysis	0.4499*	0.2351*	0.3416*	0.5867*	0.6575*	1.0000			
Operational analysis(complexity)	0.5086*	0.2480*	0.3591*	0.5124*	0.6366*	0.9547*	1.0000		
Repetitiveness	-0.5110*	-0.1744*	-0.4584*	-0.0747*	-0.1640*	-0.4677*	-0.5243*	1.0000	
Degree of automatisisation	-0.1718*	0.1584*	-0.1489*	0.1454*	0.0803*	-0.1625*	-0.1799*	0.4661*	1.0000

Occupations requiring operational analysis and control of processes show positive correlation with innovation and median wage. Occupations characterised by frequent repetitive movements and automatic processes are negatively correlated with innovation and wages .

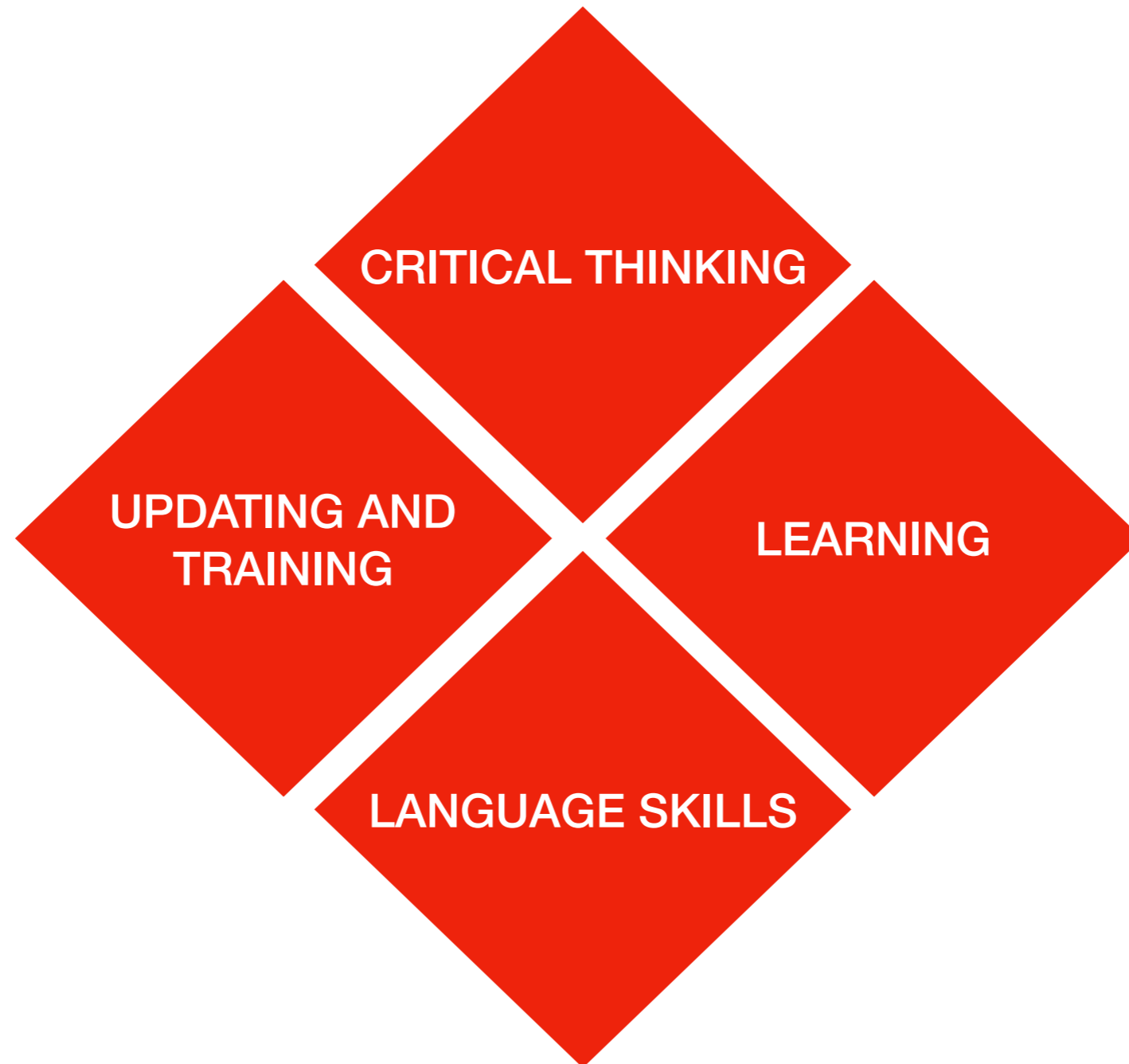
CONTROL OF THE PROCESS ACROSS OCCUPATION GROUPS



Doing repetitive movements and working in automated processes is more frequent for plant and machine operators and very less likely for intellectual and scientific workers.

KNOWLEDGE AND LEARNING*

*On the role of knowledge and learning see Dosi (1988), Lundvall (1992), Freeman and Soete (1997)

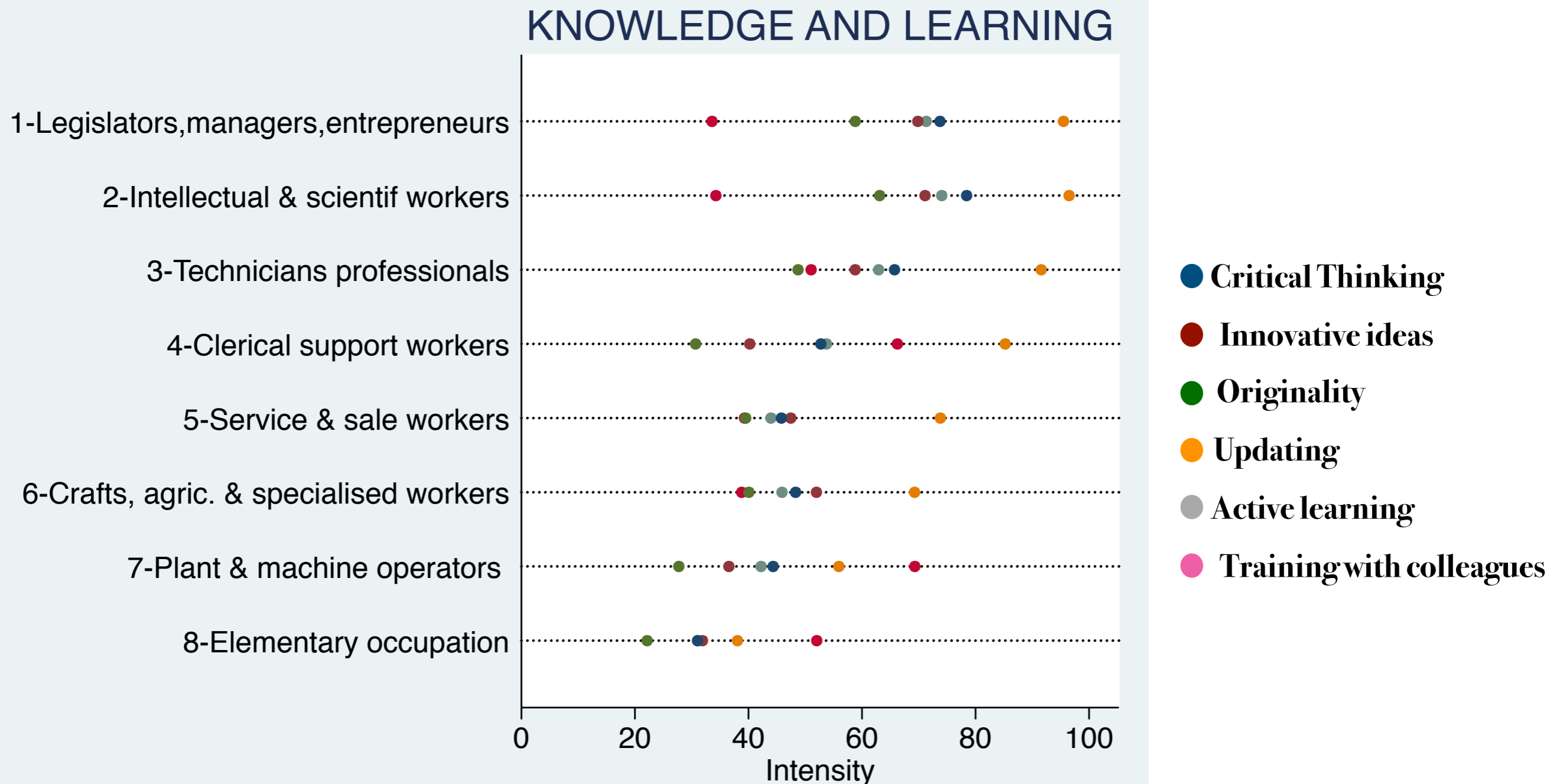


Correlation matrix (*significant at 1%)

	median wage	tech innovation	org innovation	Critical thinking	Innovative ideas	Originality	Updating required	Active learning	Entry training with colleagues
median wage	1.0000								
tech innovation	0.1480*	1.0000							
org innovation	0.3605*	0.3283*	1.0000						
Critical thinking	0.5536*	0.2350*	0.4633*	1.0000					
Innovative ideas	0.4065*	0.1762*	0.3688*	0.7093*	1.0000				
Originality	0.3326*	0.1051*	0.2975*	0.6618*	0.8829*	1.0000			
Updating required	0.4082*	0.3182*	0.4205*	0.7001*	0.5983*	0.5096*	1.0000		
Active learning	0.5545*	0.2801*	0.4887*	0.9225*	0.7010*	0.6378*	0.6996*	1.0000	
Entry training with colleagues	-0.0231	0.1845*	0.0047	-0.0615*	-0.3750*	-0.3816*	-0.2100*	-0.0709*	1.0000

All variables show a positive correlation with wages and innovation, except for entry training with colleagues.

KNOWLEDGE AND LEARNING ACROSS OCCUPATION GROUPS



Being original and having innovative ideas is not very high, even in intellectual professions (max 60/100) . Training with colleagues is more intense for operators and clerks, whereas a continuous updating is required for legislators, managers and intellectuals.

SOME VERY PRELIMINARY CONSIDERATIONS

1. Knowledge, digital skills and work organisation show strong heterogeneity across occupational groups. These factors may all play a role in the relation between innovation and wages.
2. In the future, we will perform a two steps analysis with an aggregate study of the main groups (PCA-FA) and a case study on some specific occupations within each group to map the occupational structure in Italy.

REGRESSION MODEL

$$\text{Log (median wage)}_{i,t} = \beta_0 + \beta_1 \text{RTI}_j + \beta_3 \text{Z}_{j,t} + \beta_4 \text{DS}_j + \beta_6 \text{C}_j + \beta_6 \text{K\&L}_j + \varepsilon_{j,t}$$

a very preliminary econometric exploration of the relative role of routinarity, work organisation and knowledge on wage differentials across occupations.

OLS regressions on median wages

	(1)	(2)	(3)	(4)	(5)	(6)
RTI	-0.00867*** (-28.54)	-0.00282*** (-8.33)	-0.00342*** (-10.68)	-0.00200*** (-5.12)	0.00206*** (5.04)	0.00245*** (5.92)
Tertiary Education (%)		0.534*** (25.12)	0.511*** (24.99)	0.446*** (20.08)	0.425*** (19.97)	0.444*** (20.19)
Women (%)		-0.428*** (-24.31)	-0.440*** (-24.69)	-0.430*** (-24.73)	-0.328*** (-18.22)	-0.347*** (-18.60)
Young Workers (%)		-0.674*** (-17.14)	-0.626*** (-15.38)	-0.633*** (-15.63)	-0.549*** (-14.19)	-0.555*** (-14.60)
Indeterminate Contracts (%)			0.138*** (6.61)	0.108*** (4.86)	0.0805*** (3.85)	0.0894*** (4.26)
Southern workers (%)			-0.197*** (-5.76)	-0.151*** (-4.27)	-0.117*** (-3.50)	-0.125*** (-3.74)
DS - Use of PC (Intensity)				0.00211*** (10.27)	0.00180*** (9.41)	0.00200*** (10.42)
K&L - Innovative ideas (Intensity)				0.000728* (1.99)	0.0000960 (0.28)	0.00119** (2.90)
C- Guiding and Motivating (Intensity)					0.00683*** (18.06)	0.00753*** (18.41)
C- Controlling processes (Intensity)						-0.00237*** (-4.64)
_cons	7.626*** (458.59)	7.518*** (323.04)	7.506*** (236.54)	7.333*** (154.93)	6.925*** (145.21)	6.921*** (144.96)
N	2996	2996	2996	2996	2996	2996
t statistics in parentheses						
* p<0.05, ** p<0.01, *** p<0.001						

SOME VERY PRELIMINARY CONSIDERATIONS

1. Knowledge, digital skills and work organisation show strong heterogeneity across occupational groups. These factors may all play a role in the relation between innovation and wages.
2. We will perform a two steps analysis with an aggregate study of the main groups (PCA-FA) and a case study on some specific occupations within each group to map the occupational structure in Italy.
3. **Not new:** Knowledge and digital skills always correlate positively with innovation and wages.
4. **?:** The role of RTI is partly downsized.
5. **New:** The higher is the control over other workers, the higher seems to be the correlation with wages and organisational innovation.

SOME VERY PRELIMINARY CONSIDERATIONS

1. Knowledge, digital skills and work organisation show strong heterogeneity across occupational groups. These factors may all play a role in the relation between innovation and wages.
2. We will perform a two steps analysis with an aggregate study of the main groups (PCA-FA) and a case study on some specific occupations within each group to map the occupational structure in Italy.
3. Knowledge and digital skills always correlate positively with innovation and wages.
4. ?: The role of RTI is partly downsized.
5. **New:** The higher is the control over other workers, the higher seems to be the correlation with wages (and organisational innovation).
6. The role of organisation cannot be neglected. In particular studying the role of control (see Braveman, 1974) is fundamental to investigate the direction and the content of technological and organisational change within jobs, and ultimately, the distribution of wages across occupations.

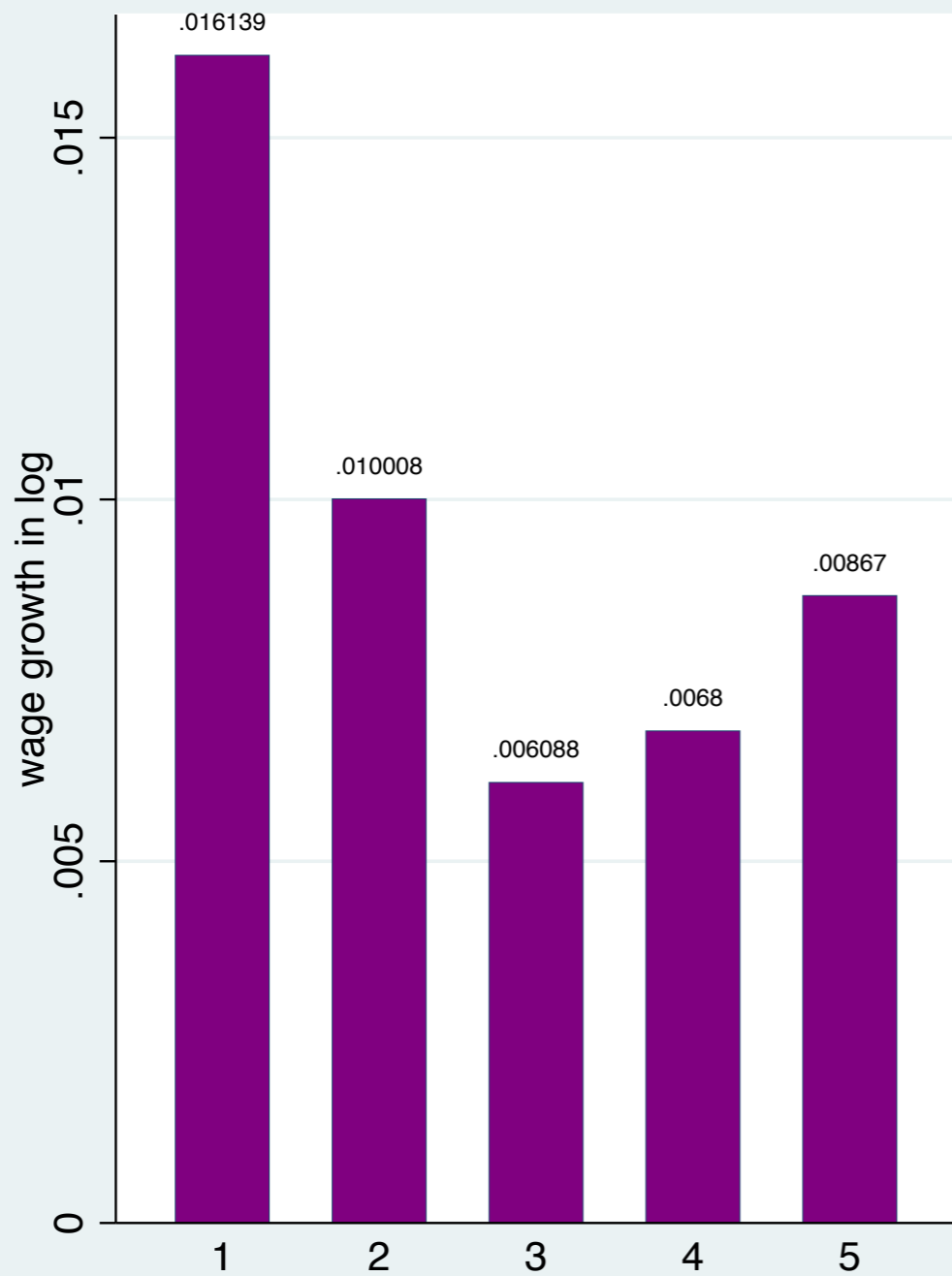
“The problem can be fruitfully attacked, it seems to me, only by way of concrete and historically specific analysis of technology and machinery on the one side and social relations on the other, and of the manner in which these two come together in existing societies.

Such an analysis could well start with the possibility that the present mode of the organization and control of labor arose in capitalist society for reasons specific to that society...”

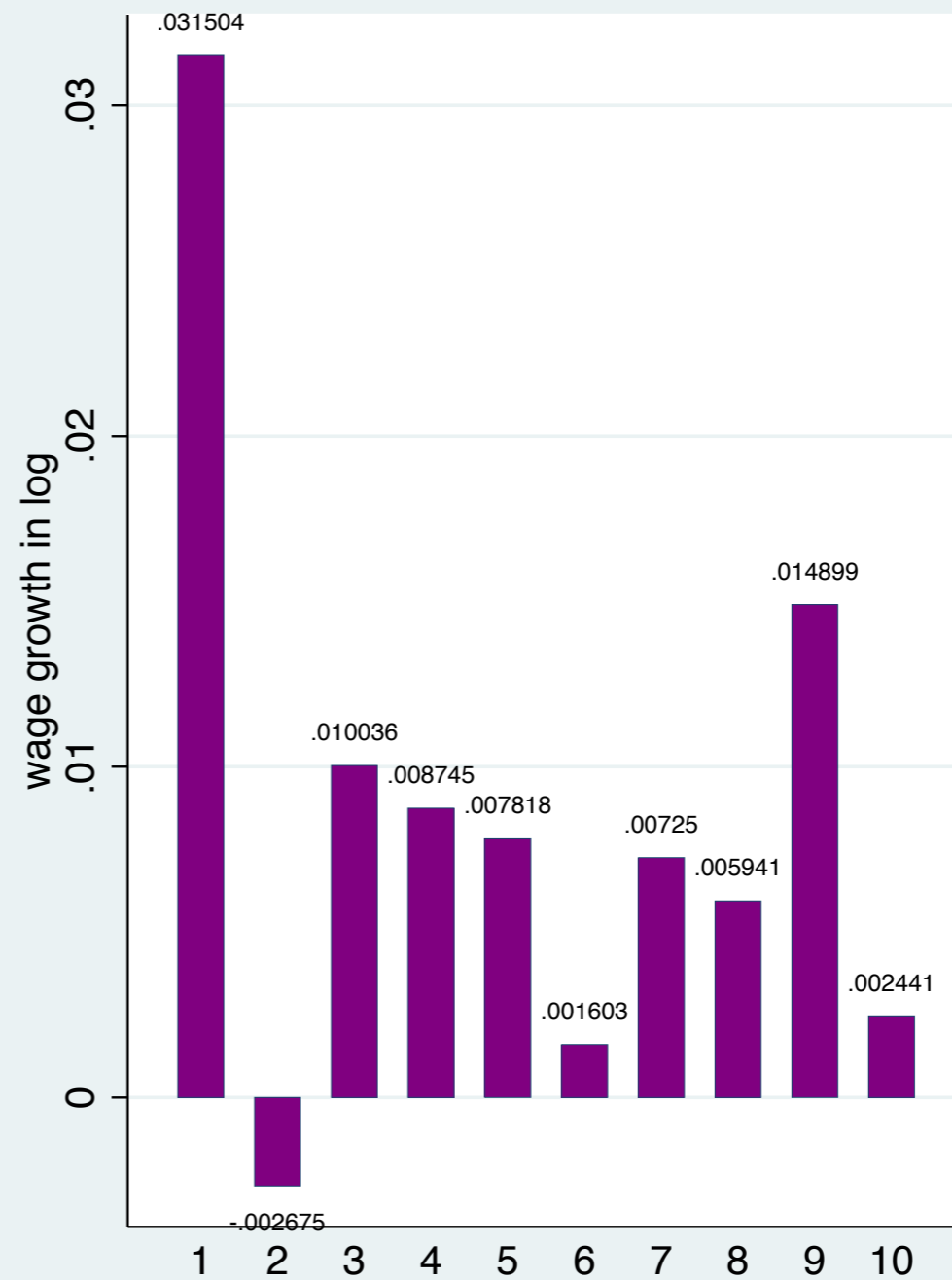
Harry Braverman (1998, p. 12, 1st ed. 1974)

Additional material

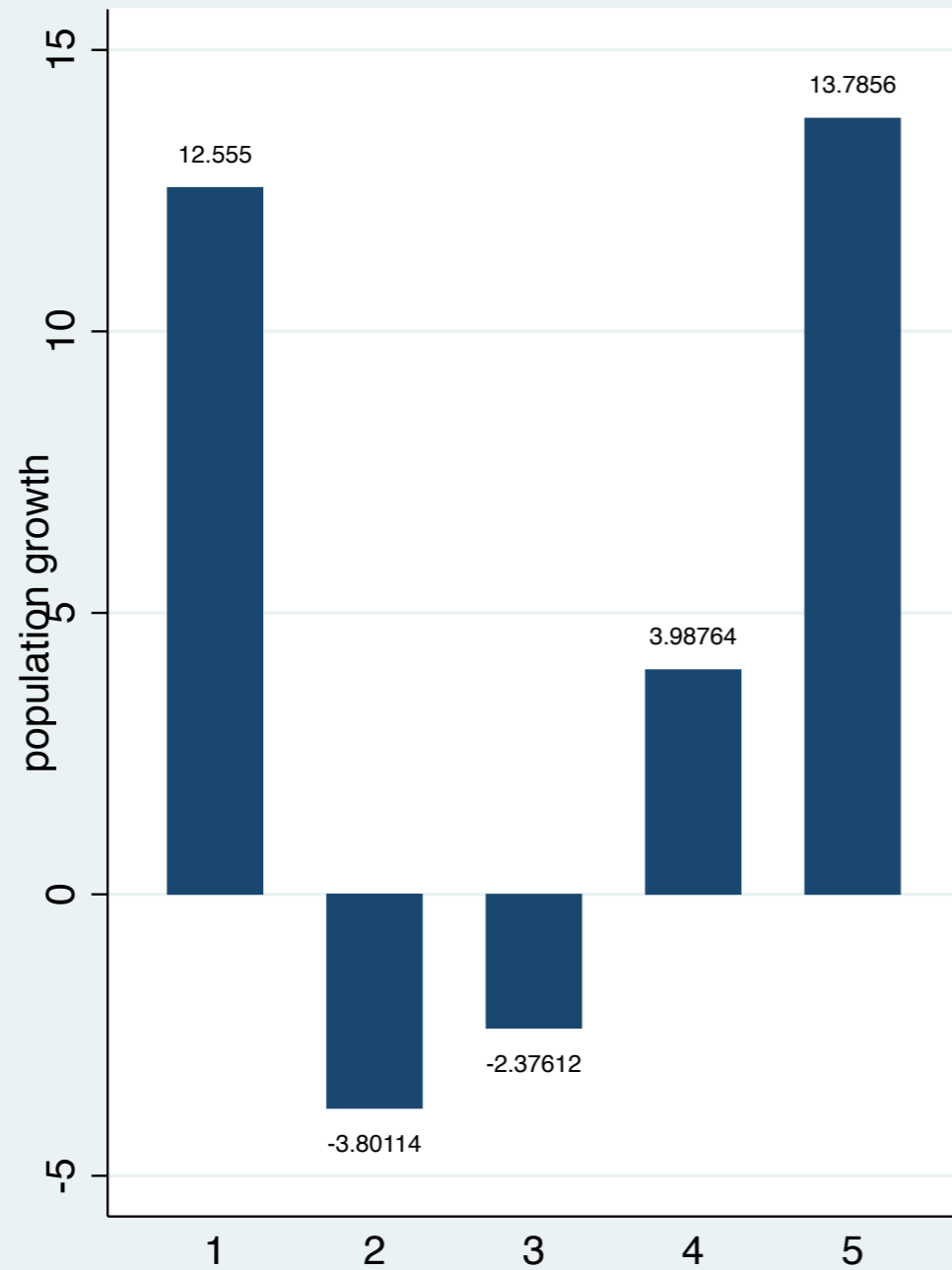
Wage growth over wage quintiles 2011-2016



Wage growth wage deciles 2011-2016



Population growth over wage quintiles
2011-2016



Population growth over wage deciles
2011-2016

