DETERMINANTS OF HOURLY EARNINGS AND EARNINGS INEQUALITY: ANALYSES ON ITALIAN DATA FROM THE STRUCTURE OF EARNINGS SURVEY[1]

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Abstract. The study examines the differences in hourly earnings among employees, which can contribute to an unequal distribution of income with implications for equity and social cohesion. The analyses apply a log-linear regression model to data from the Structure of Earnings Survey (SES). The method allows highlighting whether and to what extent certain categories of employees are disadvantaged compared to others. The findings reveal substantial and persistent wage differentials associated with gender, education, occupation, contract type, firm size and geographical location. In particular, women earn significantly less than men even after controlling for observable factors, and higher educational attainment is strongly rewarded, though unevenly across sectors. Territorial gaps also remain pronounced, especially between the North-West and the South. These results underscore the importance of targeted labour market policies aimed at reducing structural disparities and improving wage equity across demographic groups and regions.

1. Introduction

Earnings gaps are one of the most evident expressions of inequality in modern labour markets. These disparities extend beyond mere pay comparisons, reflecting deeper structural dynamics influenced by individual, institutional, and geographic factors. Understanding the factors influencing earnings is essential for informing policies that promote fairness and social cohesion. Hourly earnings differentials, in particular, provide a clearer perspective on the relative advantages and disadvantages experienced by different groups of employees. These gaps can persist even among individuals with similar roles or contractual conditions, revealing subtle forms of labour market segmentation. In countries like Italy, which are characterised by significant territorial disparities and varied employment structures, analysing earnings differences is particularly important. Harmonised data sources, such as the Structure of Earnings Survey, allow for rigorous analysis of earnings inequality within a statistically robust and comparative framework.

This paper provides an empirical contribution by supplying updated evidence for 2022 and comparisons with 2018, and a methodological contribution by using a

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[1] The article is the result of the joint work of the authors. §1 and §2 are attributed to Francesca Ceccato, §3 is attributed to Paola Conigliaro, §4, §5 and §6 are attributed to Marilena Ciarallo.

harmonised set of covariates that deepens our understanding of the structural drivers of earnings inequality.

2. Measuring hourly earnings according to the Structure of Earnings Survey

2.1. Data source and methodology

This paper relies on data from the Structure of Earnings Survey (SES) for the 2018 and 2022 editions related to Italy. In line with Regulation (EC) No 530/1999, the SES provides harmonised statistics every four years in each EU country. The target population comprises all enterprises and institutions in the private and public sectors with at least ten employees, engaged in industrial, construction and service activities (excluding the activities of households as employers and extra-territorial organisations and bodies) (NACE Rev. 2, sections B to S). Italy also covers public administration and defence, compulsory social security (section O), but these are still considered optional. The indicators released by Eurostat do not include section O, allowing for comparisons between Member States.

The statistical processes for the private and public sectors differ considerably. In the private sector, data from direct statistical survey are combined with data drawn from ad hoc processing on the Istat private-sector labour register (LR-Priv). The register supports all major phases of the process, such as sampling, variable pre-filling, editing and imputation and final estimates. In the Public sector, on the other hand, data completely derive from administrative and register data as the Istat public-sector labour register (LR-Pubb). Due to the recent development of its framework, it is worth spending some words describing LR-Pubb. In order to ensure a comprehensive coverage of public sector institutional units, their employees and all statistical variables on employment, earnings and social security contributions, it is necessary to integrate several administrative sources. With regards to economic units in the public sector, the frame list is compiled from the Register of Public Institutions (ISTAT, 2021). The target population of employees was drawn from these units and the statistical variables of interest are constructed from administrative variables, metadata and, in some cases, auxiliary sources. This process is complex and leads to the attribution to each reference unit of information on the characteristics of the job position (contractual qualification, professional qualification, etc.), labour input, working time (number of paid days, ordinary paid hours, etc.), earnings and contributions (for more details ISTAT, 2025).

2.2 Survey Scope and Focus of the Analysis

Employees who received remuneration for the reference month of the year are covered (October is conventionally used as it is characterised by low seasonality).

Of the approximately 11.698 million employees in the total population, about 268 thousand were selected for the sample. Of these, 59% belong to the private sector, which represents 71% of the target population.

This paper focuses on average hourly earnings in the reference month, which is one of the indicators derived from the SES. These are calculated using the arithmetic mean of the ratio of the remuneration received by employees in October (excluding remuneration in kind and non-regular components but including remuneration for overtime) to the hours paid by the employer (including ordinary and overtime hours worked, as well as paid and unpaid holiday hours, public holidays and employer-paid sick leave). As required by EU regulations, the indicators are calculated with reference to a specific month that is not exposed to seasonality. Furthermore thedata is limited to enterprises and institutions with at least ten employees. Itt incorporates both the limits of representativeness relating to a population unbalanced towards large units (not faithful to the economic reality of the country) and the limits common to almost all surveys, linked to the information collected that fail to capture informality, relevant in our economic system. These, however, are common features of all the strategies for collecting these data adopted across EU countries., Starting from SES 2026 edition, according to the new regulation on Business Statistics, the sample will be expanded to enterprises under ten employees, significantly improving representativeness.

The richness of the sources allows however to produce comparable analyses of the relationships between remuneration levels and employee and employer characteristics. The survey collects information on economic units characteristics: sector of economic activity, geographical macro-area of the economic unit's location, size of the unit and form of economic and financial control. It also detects job characteristics, such as occupation, type of employment contract, contractual working time and length of service in the enterprise, as well as on personal characteristics of the employee, mainly sex, age and educational attainment. The following sections provide a detailed analysis of mean hourly earnings, combining all these aspects through descriptive and regression analyses.

3. Preliminary Analyses

Before introducing the multivariate analysis, it is useful to present main differences in hourly earnings resulting in SES 2022 survey, following a descriptive approach. Overall, data resulting from 2022 edition confirm the articulate landscape in term of average hourly earnings, as observed in previous editions. Gender difference in earnings remain evident, even considering average hourly earnings: in 2022 women earn on average 0.9 euro less than men (15.9 and 16.8 euro per hour respectively). Also the strong relationship between earnings and educational attainment is widely confirmed: the average hourly earnings is 12.4 euro for

employees with, at most, lower secondary education (G1), 15.0 euro for those with a upper secondary degree (G2), 16.5 euro in case of tertiary education with not more than 4 years (G3), and 24.2 euro for employees with the highest educational levels (G4). Furthermore, at any educational level, women earn less than men, with more pronounced differences for the highest levels (Table 1).

Part-time workers tend to have lower hourly earnings (12.0 euro) than full-time workers (17.3). The same happens for those with atypical contracts, e.g. employees on fixed-term contracts earn 24.6% less than those on indefinite duration contracts.

Table 1– *Average hourly earnings (€) by macro-section of economic activity, educational attainment and sex.*

ECONOMIC ACTIVITIES	Educational attainment				
	Basic	Secondary	Tertiary	Tertiary+	Total
Industry except construction (B-E)	12.9	15.1	17.0	23.1	15.4
Construction (F)	12.9	13.5	14.7	20.3	13.7
Services of the business economy (G-N)	11.2	13.8	15.1	22.3	14.6
Other Services (O-S)	14.3	16.9	17.3	25.6	19.6
SEX					
Female	11.1	14.0	15.5	22.3	15.9
Male	13.1	15.7	18.0	26.7	16.8
Total	12.4	15.0	16.5	24.2	16.4

Source: Istat, Structure of earnings survey, 2022

Company size and sector of economic activity also play relevant roles: the average hourly earnings is 12.8 euro in enterprises with 10 to 49 employees, while it amounts to 19.2 euro in those with at least 1,000 employees. In addition, certain sectors tend to offer higher earnings than others. Differences span from Accommodation and food services activities (10.9 euro per hour) to Financial and insurance activities (25.9 euro). Differences are evident also at macro sector level (Table 1). In units under private control average hourly earnings are lower (14.4 euro) than in units under public control (20.4 euro).[2]

Although the table clearly illustrates the well-known correlation between educational attainment and earnings, a closer look at the details reveals additional significant information, about the intertwining between educational attainment and other factors, as macro sector of activity or sex. It is, in fact, possible to observe that women with G3 level earn on average less than men with G2 and that the hourly

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[2] For more detailed information, see ISTAT, 2025

earnings vary on a narrower range according to educational level in sector F (Construction) than in the other macro sectors.

A study applied to SES 2018 dataset, focusing on the gender pay gap (Ceccato *et al*, 2022), highlighted how differences in hourly earnings are strengthened or weakened according to the combined effect of multiple characteristics. This effect is commonly defined composition effect. Main foundational studies on wage discrimination (e.g. Blinder, 1973, Mincer, 1974) as well as on evolution on wages structure (Lemieux, 2006) devoted their attention on it. One of the goals of these studies is to ascribe the contribution of a character (usually gender) in determining earnings, by isolating it as much as possible from the effects attributable to other characteristics. They apply advanced methods to decompose earnings differences amongs subpopulations according to the main factors determining earnings.

It should also be noted that the average value of an indicator is determined by the frequency with which a combination of characteristics occurs in the target population (i.e. the relative number of units holding those characteristics). Figure 1 aims to clarify this statement: in the left side, it depicts the average hourly earnings in euro by sector of economic activity and sex, while in the right one it reports the share of employees by section and sex out of the total number of employees.

Figure 1 – *Average hourly earnings by section and sex, and GPG (left chart). Share of employees on total employees by section and sex (right chart).*
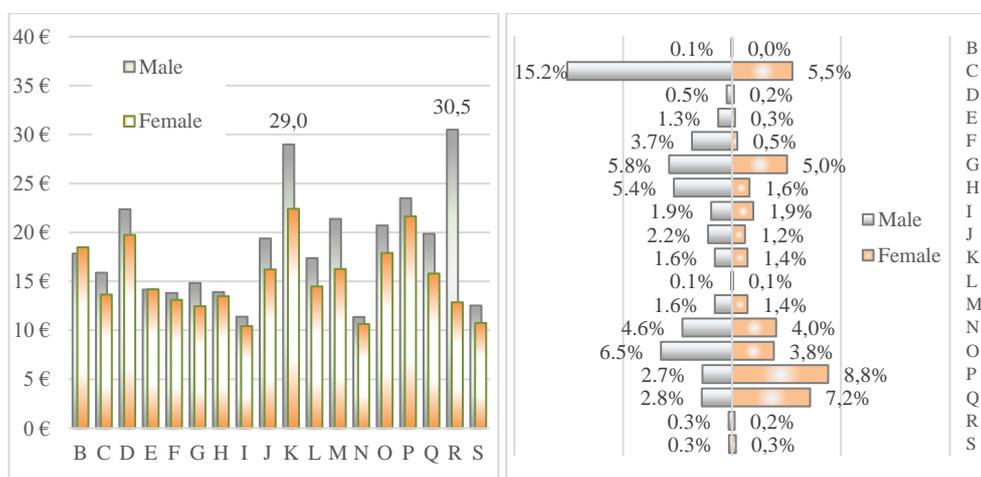
Legend axis: B - Mining and quarrying; C – Manufacturing; D - Electricity, gas, steam and air conditioning supply; E - Water supply; sewerage, waste management and remediation activities; F – Construction; G - Wholesale and retail trade; repair of motor vehicles and motorcycles; H - Transportation and storage; I - Accommodation and food service activities; J - Information and communication; K - Financial and insurance activities; L - Real estate activities; M - Professional, scientific and technical activities; N - Administrative and support service activities; O - Public administration and defence; compulsory social security; P – Education; Q - Human health and social work activities; R - Arts, entertainment and recreation; S - Other service activities

It is evident that working in Section R (Arts, entertainment and recreation) is very remunerative for men, that earn on average 30.5 euro per hour, while it is not for women (12.8 euros), resulting in a *Gender Pay Gap* (GPG) jumping to 57.8%. Also in section K (Financial and insurance activities), the hourly earnings are on average high, but the differences between men (29.0 euro) and women (22.4) are smaller (GPG 22.7%). However, what happens in these two sections has little influence on average hourly earnings and overall GPG, since only 3.5% of employees work in them (right chart).

The right chart also shows the gender composition of each sector of economic activity. In Section C (Manufacturing), collecting over 20% of employees (within SES target population), three out of four are men, and average hourly earnings are not particularly high neither for men (15.9 euro), nor for women (13.7). Among 11.6% of employees working in Section P (Education), three quarter are women (over 20% of female employees).

The examples demonstrate that, while mean values are indeed substantial, they have a tendency to hide disparities in earnings among employees. Therefore, in order to explore the intensity of the disparities, it is necessary to identify the contribution of each relevant characteristic in determining the average value. In summary, it is imperative to explore the combined effect of any characteristic by applying multivariate analysis.

4. Methodological approach

Although the descriptive analysis conducted in the first part of the paper allows us to highlight some regularities in the distribution of hourly earnings, it is not sufficient to clearly identify the mechanisms underlying earnings formation. Indeed, univariate and bivariate statistics may reflect spurious correlations or overlaps between compositional and structural effects, without isolating the specific impact of each factor. To overcome these limitations and estimate the partial effects of different individual and job characteristics, a log-linear regression model is therefore used, an established approach in labour economics. As Mincer (1974) noted, "*the earnings function summarizes the net effects of various human capital investments on earnings*". Specifically, the dependent variable is the natural logarithm of the hourly earnings, a functional transformation commonly used in the literature to smooth the skewness of the earnings distribution and allow for "*a straightforward interpretation of regression coefficients as approximate percentage change*s" (Blau & Kahn, 2017, p. 791). The multivariate model adopted allows controlling simultaneously for multiple covariates, returning a more accurate and robust representation of earnings determinants in the Italian labour market. The set of

explanatory variables includes both individual and job-related characteristics. These comprise age and length of service in enterprise (both entered as linear and squared terms), educational attainment (four levels from lower secondary to advanced tertiary, (Becker, 1964), gender, type of employment contract (permanent, temporary, apprenticeship), and working time arrangement (full-time vs. part-time). We also control for firm size, occupational category (ISCO classification), economic sector (NACE codes), ownership (public vs. private), and geographic macro-region (NUTS-1 level). As Wooldridge (2010, p. 135) emphasizes, "*using dummy variables with appropriate base categories is essential to avoid perfect multicollinearity and ensure meaningful interpretation of coefficients*." Specifically, the reference groups are: upper secondary education, male, full-time employees, permanent contracts, clerks, firms with 10–49 employees, public sector, and the North-West macro-region. The model can be formally specified as follows: $\mathbf{log(w_i) = \beta_0 + \Sigma\ \beta_k \cdot X_{ik} + \varepsilon_i}$, where $\log(w_i)$ is the natural logarithm of hourly earnings for individual i, X_{ik} is the vector of explanatory variables, and ε_i is the error term.

5. Results

5.1. Model fit

The regression model explains approximately 56.7% of the variance in hourly earnings (adjusted $R^2 = 0.567$). This value is in line with similar earnings models in the literature (Lemieux, 2006) and confirms that the chosen specification captures the main determinants of wage differentials. While cross-sectional and not causal, the model offers a robust descriptive framework to analyze earnings structures and disparities in the Italian labor market. As Blau and Kahn (2017) argue, "*descriptive analyses of gender pay gaps and labor market inequalities remain crucial for informed policy responses*". The main results are reported and interpreted in Section 5.2.

5.2. Regression results

Table 2 reports the estimated coefficients from the log-linear regression model of hourly earnings. All coefficients are interpreted in semi-elasticity terms, that is the approximate percentage change in earnings associated with a one-unit change in the covariate controlling for all other variables. Several factors show a strong and statistically significant association with earnings levels. In particular, higher educational attainment and professional occupational status are positively correlated with higher hourly earnings. Firm size and geographic location also contribute to earnings differences, with workers in larger firms and in certain territories earning more on average.

Table 2 – *Main regression results on Hourly Earnings Determinants (Year 2022).*

| Parameter	Estimate	StdErr	95% Confidence Interval		ChiSq	p-value
Intercept	2,211	0,009	2,194	2,228	66183	<.0001
Higher Level of education and training						
G1: Lower Secondary	-0,051	0,002	-0,054	-0,048	1018	<.0001
G3:Tertiary(up to 4 years)	0,053	0,002	0,049	0,058	521	<.0001
G4:Tertiary (more than 4 years)	0,185	0,002	0,181	0,189	10485	<.0001
Sex						
Female	-0,110	0,001	-0,113	-0,107	6763	<.0001
Contractual Working Time						
Part Time	-0,077	0,002	-0,080	-0,073	1984	<.0001
Occupation						
Armed forces	0,405	0,004	0,396	0,414	8455	<.0001
Craft and related trades workers	-0,048	0,003	-0,053	-0,043	347	<.0001
Elementary occupations	-0,133	0,002	-0,138	-0,128	3121	<.0001
Managers	0,828	0,005	0,818	0,838	25062	<.0001
Service workers and shop and market sales workers	-0,009	0,002	-0,013	-0,004	12	0,0004
Plant and machine operators and assemblers	-0,027	0,003	-0,032	-0,022	97	<.0001
Professionals	0,371	0,002	0,366	0,375	26202	<.0001
Skilled agricultural and fishery workers	-0,038	0,014	-0,066	-0,010	7	0,0078
Technicians and associate professionals	0,139	0,002	0,135	0,143	4509	<.0001
Size class of the enterprise						
1000+	0,121	0,002	0,117	0,125	3920	<.0001
500-999	0,088	0,003	0,083	0,093	1047	<.0001
250-499	0,075	0,003	0,070	0,080	869	<.0001
50-249	0,048	0,002	0,044	0,051	720	<.0001
Geographic macro-area NUTS-1						
Center	-0,042	0,002	-0,045	-0,039	669	<.0001
Island	-0,061	0,003	-0,066	-0,057	615	<.0001
Northeast	-0,007	0,002	-0,010	-0,004	20	<.0001
South	-0,074	0,002	-0,078	-0,070	1602	<.0001
Effects of experience and length of service						
Age	0,010	0,000	0,009	0,011	596	<.0001
Agesquared	0,000	0,000	0,000	0,000	140	<.0001
Lenght of service	0,009	0,000	0,009	0,009	1956	<.0001
Lenght of service sq	0,000	0,000	0,000	0,000	276	<.0001

Note: Estimates are derived from a log-linear regression model bases on Structure of earnings data for Italy (Year 2022) . All categorical variables are included as dummy variables; reference categories are described in Section 5.1.

Moreover, contractual arrangements (e.g., part-time work) and individual characteristics such as age and length of service in the enterprise play a measurable role. Specifically, the inclusion of quadratic terms highlights a non-linear

relationship: earnings tend to increase with age and length of service, but at a decreasing rate. This pattern is consistent with human capital theory, according to which earnings rise with accumulated experience (Becker, 1964), but also reflects potential mechanisms of deferred compensation within enterprises. The significant and independent effects of both variables suggest that general labour market experience and firm-specific seniority contribute distinctly to earnings differentials.

Results for economic activity sections are not shown in the table but will be presented in the next paragraph. Compared to the reference category (Manufacturing), hourly earnings are notably higher in Financial Services and Energy, and lower in Hospitality and Administrative Support (Figure 2). A pronounced and statistically significant gender pay gap is also evident: women earn approximately 10.4% less than men, after controlling for all other characteristics.

Figure 2 – *Predicted Hourly Earnings by Economic Activity (Year 2022).*
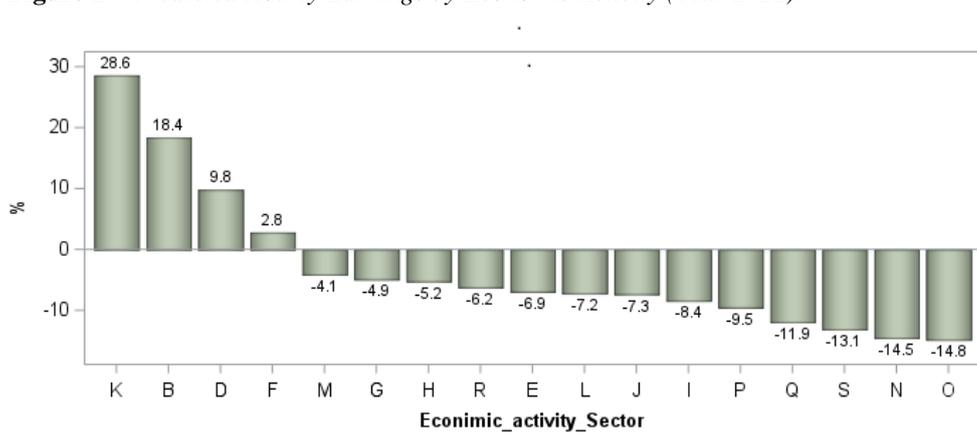
Legend x-axis: B - Mining and quarrying; C – Manufacturing; D - Electricity, gas, steam and air conditioning supply; E - Water supply; sewerage, waste management and remediation activities; F – Construction; G - Wholesale and retail trade; repair of motor vehicles and motorcycles; H - Transportation and storage; I - Accommodation and food service activities; J - Information and communication; K - Financial and insurance activities; L - Real estate activities; M - Professional, scientific and technical activities; N - Administrative and support service activities; O - Public administration and defence; compulsory social security; P – Education; Q - Human health and social work activities; R - Arts, entertainment and recreation; S - Other service activities

Source: Istat, Elaboration based on Structure of earnings survey, 2022

As for occupational category, the reference group (clerks) is associated with mid-range earnings. Higher occupational levels—such as managers and professionals are linked to substantial "wage premiums" (+49.9% and +44.9%, respectively), while manual and elementary occupations show negative and significant earnings differentials, down to –13% for elementary occupations.

Firm size is also positively correlated with earnings. Employees in larger firms (250–499 and 500–999 employees) earn roughly 7.5% and 9.3% more, respectively, than those in smaller firms (10–49 employees).

Finally, territorial disparities are evident: all macro-areas show lower earnings compared to the North-West (reference area). The earnings gap is particularly pronounced in the South (–6.1%) and Islands (–7%), confirming long-standing territorial imbalances in the Italian labour market.

5.3. Comparative Analysis: 2022 vs. 2018

An increase in hourly earnings is observed across all educational groups between 2018 and 2022. The highest earnings are recorded among individuals with tertiary education longer than 4 years (G4), whose average hourly earnings rises from €21.4 in 2018 to €22.0 in 2022. The largest increase is seen among those with tertiary education up to 4 years (G3), with a gain of €0.8 (from €15.0 to €15.8). In contrast, individuals with upper secondary education (G2) experienced the smallest increase, of just €0.2 (from €14.0 to €14.2). The earnings gap between education levels remains wide, confirming the strong positive association between educational attainment and earnings levels. However, the relatively modest earnings growth suggests that returns to education, while persistent, have not substantially increased over the period considered.

Figure 3 – *Predicted Hourly Earnings by Education Level (Year 2022 vs 2018) and Hourly Earnings Difference by Education Level (Relative to Upper Secondary Level %).*
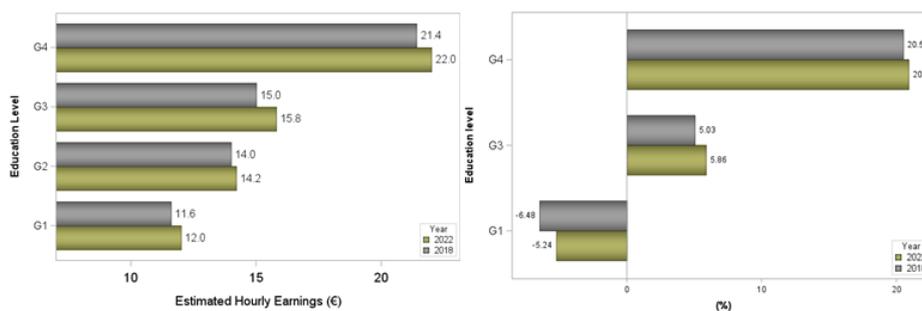
Source: Istat, Elaboration based on Structure of earnings survey, 2022

The estimated effects of education level on hourly earnings in 2022, using Upper Secondary education (G2) as the reference category are shown in the right of the Figure 3. Results show that individuals with tertiary education earn significantly more than those with upper secondary education. In particular, those with more than four years of tertiary education (G4) have the highest earnings premium (+20.9%),

followed by individuals with up to four years of tertiary education (G3, +5.86%). Conversely, individuals with lower secondary education (G1) earn approximately 5.24% less than the reference group. The interaction effects, though relatively modest, suggest that the earnings advantage associated with tertiary education slightly increased in 2022 compared to 2018. Interestingly, the smallest increase over time is observed for the highest education level (G4: +0.39%), while the largest relative improvement is found among workers with lower secondary education (G1: +1.24%). All coefficients are statistically significant at the 1% level.

These findings are consistent with previous research suggesting that the increase in earnings inequality is not evenly distributed across the earnings spectrum, but rather disproportionately concentrated at the top. In particular, studies such as Mincer (1997) highlight that the earnings–education relationship has become increasingly convex, with higher education levels yielding proportionally greater returns.

The persistence of sizeable earnings gaps across education levels between 2018 and 2022 indicates that returns to education remain a stable feature of the wage structure. Despite significant macroeconomic disruptions during this period, including the COVID-19 shock, relative wage advantages by education level changed only marginally. This suggests that short-term shocks primarily affected overall wage growth rather than the underlying education-related wage hierarchy. Institutional factors such as wage rigidities, collective bargaining, and rising inflation may help explain the modest temporal variation observed.

6. Conclusions

The proposed multivariate analysis of hourly earnings, using a log-linear regression provides robust empirical evidence of the main factors associated with differences in earnings, highlighting the relevance of both individual and job-related characteristics. Results confirm persistent earnings gaps by educational attainment, with higher returns to tertiary education, and a significant gender pay gap of around 10.4%. Temporal comparisons between 2018 and 2022 show modest overall wage growth, with slight increases in relative earnings advantages for some groups, while structural differentials remain largely unchanged. The analysis is based on a structural four-yearly survey, which, while rich in cross-sectional detail, does not allow for tracking individual earnings over time or establishing causal mechanisms. Therefore, the findings should be interpreted as descriptive associations rather than causal effects..

Looking ahead, further advancement of Labour Register and its integration with survey data, could support the analysis of dynamic phenomena such as earnings persistence, career mobility, and contract transitions.

In addition, the forthcoming revision of the statistical regulation governing the 2026 edition of the Structure of earnings survey, will extend the coverage to enterprises with fewer than ten employees. This expansion of the observation field is expected to improve the representativeness of the dataset and provide a stronger basis for targeted policy interventions, including measures to reduce gender wage gaps, address territorial disparities, and tackle contract segmentation.

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