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IDENTIFYING THE ENVELOPE WAGES PHENOMENON BASED ON LFS AND SES DATA SETS – EVIDENCE FROM POLAND

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ABSTRACT. This paper deals with the problem of identifying envelope wages based on the Labour Force Survey (LFS) and the Structure of Earnings Survey (SES). The research samples have been adjusted so that the distribution of individuals in both databases is the same. The maximum likelihood method is used and the parameters of multilevel models that explain wages are estimated. Theoretical wages for selected workers groups are calculated. Based on differences between the theoretical wages of individuals from the LFS and SES databases, a measure associated with envelope wages is calculated. The novelty of this study lies in providing a new method for evaluating the phenomenon of envelope wages. The analysis indicates that various features of the employees and enterprises significantly affect the propensity to receive an envelope wage. This propensity is also strongly determined by affiliation to a NACE section. Regional differentiation of the propensity to receive envelope wages was also identified. This problem is urgent in light of the negative demographic tendencies in Poland and similar countries of the Central and Eastern Europe that lead to an intensified competition for employees. However, cost competition does not allow for significant increases of labour costs. Therefore, fiscal authorities in Poland and similar countries should rethink their taxation policies.

JEL Classification: C50, J01, C21

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Introduction

Illegitimate wage practices are frequently encountered in developing and catching-up countries. In Europe, this problem applies, in particular, to countries located in the central-eastern part of the continent, namely Poland (Tafenau et al., 2010; Arendt et al., 2020; Adair, 2021). These countries transformed from a socialist to a market economy, and are characterized by low productivity (Williams, 2009b; Williams & Padmore, 2013). Illegitimate wage practices may be related to, among other things, the tax wedge. The higher the wedge, the greater the difference between what employers pay and what employees earn, which in turn encourages circumvention of the rules (Arsić et al., 2015). When there is low productivity, businesses

cannot raise wages significantly to be competitive. Meanwhile, people earn little and are aware that wages in other countries are significantly higher. Employees want to get more while businesses want to pay less. Therefore, both parties agree to envelope wages.

Envelope (i.e., illegitimate, informal, underground, undeclared, or hidden) wages is a term strongly related to the shadow economy. The latter can be defined as "all currently unregistered economic activities that contribute to the officially calculated Gross National Product" (Schneider, 2011b, p. 2). The size of the shadow economy varies depending on the region of the world, from below 20% of official GDP in OECD countries to approximately 40%, on average, in Latin America and Sub-Saharan Africa (Medina & Schneider, 2019). The size of the shadow economy may be calculated based on direct (e.g., surveys or auditing methods) or indirect (e.g., transactions approach, currency demand approach, the discrepancy between national expenditure and income statistics, the discrepancy between official and actual labor force, electricity consumption) approaches (Schneider & Buehn, 2018). This paper focuses on shadow economy aspects that are strongly related to wage levels. Identifying envelope wages, explained as the discrepancy between wages declared by employees and reported by employers, may also be helpful in searching for and detecting unregistered activities.

The phenomenon of envelope wages has been studied in different countries, including European Union (EU) (Williams & Padmore, 2013; Williams, 2014) and Baltic (Meriküll & Staehr, 2010; Williams & Horodnic, 2015b) countries, and individual countries, e.g., Croatia (Stefanov et al., 2017), Bulgaria (Di Nola et al., 2018), and Turkey (Pelek & Uysal, 2018). Research on envelope wages in the literature typically uses a direct measurement approach based on survey data, while assessments are usually based on statistical analysis (e.g., Williams 2008, 2009a, 2009b, 2014; Stefanov et al., 2017), and less often on estimating the parameters of econometric models (e.g., Meriküll & Staehr, 2010; Williams & Padmore, 2013; Pelek & Uysal, 2018).

The importance of studying envelope wages in Poland stems from the unfavorable labor market conditions in Poland at the beginning of the transition period (the 1990s). Massive unemployment was a serious social problem in the period preceding the country's accession to the EU. The outdated employment structure resulted in low labor productivity. Therefore, the bargaining power of Polish employees was very weak, and employers could enforce illegal payroll practices. Due to low labor productivity and relatively high non-wage costs, employers could offer non-standard types of contracts. Meanwhile, the scale of temporary employment in Poland has been large for many years. Since joining the EU, the share of temporary workers has been much higher than the EU and euro area average. As Lewandowski and Magda (2018) showed, between 2002 and 2016, the number of temporary workers in Poland increased from 1.5 million to 3.5 million. Eighty percent of vacancies created in the analyzed period in Poland offered temporary jobs. Since temporary employment is usually linked to the secondary labor market segment, a high ratio of temporary workers exacerbates illegal payroll practices. The results of empirical studies indicate that in the Polish economy, the problem of undeclared work, as well as illegal payroll practices, is not negligible (e.g., Arendt et al., 2020). Therefore, analyzing the problem of envelope wages in a country characterized by a large ratio of temporary employment to total employment is pertinent.

In this paper, an alternative approach to identifying envelope wages is proposed. Data on wages from the Structure of Earnings Survey (SES) and the Labour Force Survey (LFS) is used. Using data reported by employers (SES) and employees (LFS) allowed to identify the discrepancies between wages from both data sets. The aim of the study is to identify the groups of enterprises and workers that are most likely to experience the phenomenon of envelope wage. The article identifies the characteristics of the company and the employee that make these

discrepancies significant and explain where they may arise. The paper's contribution is both methodological and empirical. Though some studies were devoted to analyzing the differences between wages reported in the LFS and SES (e.g., Strawiński, 2015; Grabowski & Korczak, 2020), to the best of the authors' knowledge, this is the first to use these differences to assess the problem of envelope wages. The differences between wages reported by individuals and accounting departments are analyzed in terms of employee features and features associated with the enterprise's business environment. Additionally, determinants of the propensity to receive envelope wages are identified.

In this paper, three hypotheses are proposed. The hypotheses are based on a literature review concerning the impact of various factors on envelope wages and differences in wages between Poland and neighbouring countries. The first hypothesis considers the fact that wages in German border regions are higher than wages in Polish border regions. Therefore, it is expected that employers in Polish West regions are forced to offer something more for employees in order to retain workers. In this context, the following hypothesis is set: the phenomenon of an envelope wage is more often observable in regions located close to the German border (H1). Moreover, two hypotheses concerning the relationships between the propensity to receive envelope wage and the level of skills are formulated. First, there exists a negative impact of the level of education on one's propensity to obtain envelope wage (H2). Second, more experienced workers are less likely to accept envelope wages (H3).

The paper is structured as follows. The second section provides a literature review of the microeconometric determinants of wages, while the third section describes the data preparation and research methods and formulates hypotheses. The results and a discussion are provided in section 4. The final section offers concluding remarks.

1. Literature review

1.1. Determinants of envelope wages

The problem of envelope wages has been known in the literature for a long time. It can contribute to a variety of outcomes that vary across countries over time (Meriküll & Staehr, 2010; Williams & Horodnic, 2015a; Williams & Krasniqi, 2021).

The literature mentions determinants of envelope wages related to the functioning of formal institutions, formal and legal regulations, as well as the level of development of the country. They are associated with, inter alia, tax and social security contribution burdens (Buehn & Schneider, 2012), labor market regulations or trade barriers (Schneider, 2011a), tax morality (Williams & Horodnic, 2015b), a lack of trust in the legal system and formal institutions (Stefanov et al., 2017), or low-quality public institutions (Dell'Anno, 2010). By contrast, Williams (2014) points out that in more developed and equal societies, with higher taxation and social protection levels, as well as a better policy to protect workers from poverty, envelope wages are less common. A recent country-level analysis confirms this finding (Williams & Krasniqi, 2021).

Another group of determinants of envelope wages is socio-economic factors. Research in this area is generally based on data from questionnaire surveys. Most often, they are public opinion polls, such as Eurobarometer (e.g., Williams 2008, 2009a, 2009b, 2009c, 2014; Williams & Horodnic, 2015a, 2015b; Williams & Krasniqi, 2021), and less often, the Structure of Earnings Survey or the Labour Force Survey (Pelek & Uysal, 2018). Among them, we can distinguish two main groups of factors – individual (e.g. gender, education) and enterprise characteristics (e.g. location, firm size).

Pelek and Uysal (2018) provided estimates of underreporting in wages and the associated tax losses. Their paper is close to ours in terms of the set of independent variables, including some individual (gender, age, education) and enterprise (public/private sector, NACE section, firm size) characteristics; and data collected at the firm (SES) and household (Household LFS - HLFS) level. On the other hand, what distinguishes our study is the inclusion of additional independent variables (experience of workers, indefinite work period, region of the country), the use of a different country, where there may be other conditions of envelope wages (e.g., the distance from border with country offering significantly higher wages), and the analysis of this phenomena in several consecutive periods.

These three countries are relatively small and underdeveloped in terms of their geographical size and population, geopolitical importance, market size and aggregate demand, production, investment, export, and technological potential. According to many non-economic indicators (political stability, democratization, liberalization and institutionalization of society, law, infrastructure development, safety, security, investment, compliance with environmental and social standards, efficiency of the legal system, human rights respect, etc.), as well as economic indicators (purchasing power, rate of economic growth, foreign trade balance, current account deficit, public debt, inflation rate, unemployment rate, public expenditure, investments, etc.), they are characterized by a long-term transitional crisis of structural type.

1.2. Determinants of wages

Our evaluation of the problem of envelope wages is based on estimating the parameters of the wage equation based on the SES and LFS data. It is necessary to identify wage determinants in order to estimate the parameters of the appropriate model. Therefore, a summary of the empirical approaches to explaining wages based on micro-data is vital. A justification for the use of the explanatory variables is provided in *Table 1*.

Apart from traditional regressors of wages, differences in wage levels may be explained in the framework of the Routinization-Biased Technical Change (RBTC) theory (see: Autor et al., 2003). According to the RBTC theory, individuals' wages depend on the task contents of their jobs. It means that differences between the wages of workers from different occupational groups should be controlled. As Arendt and Grabowski (2019) suggested, individuals assigned to the same 4-digit code occupational group should have similar wage levels, ceteris paribus. If there are large differences between the wages of workers from the same 4-digit code occupational group, those with lower wages may quit and start working for firms offering higher wages. For workers from the same 3-digit code occupational group, differences may be slightly larger, but it is expected that the between-group variation exceeds the within-group variation. Such an approach was considered by Grabowski and Korczak (2020).

2. Methodological approach

2.1. Data preparation

LFS and SES data sets were used. Both data sets are conducted in all current and candidate EU Member States and members of the European Free Trade Association (EFTA). Data on Polish individuals were taken into account. The data are reported from employees (LFS) and employers (SES). The LFS contains quarterly data, while the SES contains bi-annual data with wages for October. For data consistency, data from the fourth quarter from the LFS were used. Moreover, the LFS data set was limited to employed people only. The data set contains data from 2010, 2012, 2014, 2016 and 2018.

2.2. Method

In this paper, an original method of identifying envelope wages is proposed. This method is based on estimating the parameters of the models that explain wages based on the SES and LFS data for years 2010, 2012, 2014, 2016 and 2018. *Table 1* consists of the names and definitions of the explanatory variables in the model that explains wages, as well as justification for using these variables.

Table 1. Independent variables used in the model

Variable	Definition of variable	Justification for the use of consecutive variables
FEMALE	Binary variable taking a value of 1 for females and 0 for males	The extensive economic literature indicates the problem of the gender wage gap in developed and developing countries (Jones et al., 2018). Several studies devoted to the problem have been conducted by, among others, Majchrowska and Strawiński (2016, 2018). Meanwhile, Kompa and Witkowska (2018) indicated that Polish women earn less than their male counterparts who work in the same industry and region.
EXPERIENCE	Experience of worker (number of years) in all enterprises he/she had worked before the poll was conducted	Mincer (1974) argued that individual wages grow with experience. Therefore, experience is very often considered to be a determinant of wages.
EDU1	Dummy variable taking a value 1 for workers with a basic level of education	According to the Mincerian framework, there is a positive relationship between education level and wages (Mincer, 1974). The validity of these results was confirmed for the Polish economy by, among others, Grabowski (2019). Meanwhile, Strawiński et al. (2018) and Parteka (2018) pointed out the decreasing role of tertiary education attainment and the increasing role of vocational education attainment in recent years.
EDU2	Dummy variable taking a value 1 for workers with a vocational education	
EDU3	Dummy variable taking a value 1 for workers with secondary general education	
EDU4	Dummy variable taking a value 1 for workers with secondary technical education	
EDU5	Dummy variable taking a value 1 for workers with tertiary education	
IND	Dummy variable taking a value of 1 if a respondent is employed for an indefinite period and 0 otherwise	As Aleksynska (2018) indicated, workers with permanent contracts have a stronger position within an enterprise. Therefore, it is appropriate to include a dummy variable indicating whether a respondent is employed for an indefinite period or not.
REG^k	Dummy variable taking a value of 1 for workers from region *k:* Dolnośląskie (DLN); Kujawsko-Pomorskie (KP); Lubelskie (LUBE); Lubuskie (LUBU); Łódzkie (LODZ); Małopolskie (MAL); Mazowieckie	The New Economic Geography approach states that there is a correlation between a region's economic potential and the wages in the enterprises located there. Therefore, including regional

	(MAZ); Opolskie (OPOL); Podkarpackie (PODK); Podlaskie (PODL); Pomorskie (POM); Śląskie (SL); Świętokrzyskie (SW); Warmińsko-Mazurskie (WM); Wielkopolskie (WIEL); Zachodniopomorskie (ZACH)	dummies in the model explaining wages is valid.
SEC^s	Dummy variable taking a value of 1 in for enterprises from NACE section *s:* Agriculture, forestry and fishing (A); Mining and quarrying (B); Manufacturing (C); Electricity, gas, steam and air conditioning supply (D); Water supply; sewerage, waste management and remediation activities (E); Construction (F); Wholesale and retail trade; repair of motor vehicles, including motorcycles (G); Transportation and storage (H); Accommodation and food service activities (I); Information and communication (J); Financial and insurance activities (K); Real estate activities (L); Professional, scientific and technical activities (M); Administrative and support service activities (N); Public administration and defense; compulsory social security (O); Education (P); Human health and social work activities (Q); Arts, entertainment and recreation (R); Other service activities (S)	As different industries are characterized by different productivity levels and the strength of trade unions may also differ across industries (Emilio et al., 2012), including section dummies is justified.
SIZE1	Dummy variable taking a value of 1 for individuals employed in enterprises with no more than 49 workers	Enterprise size may also have an impact on wages. As Idson and Oi (1999) argued, big firms pay efficiency wages to prevent shrinking.
SIZE2	Dummy variable taking a value of 1 for individuals employed in enterprises with 50-249 workers	
SIZE3	Dummy variable taking a value of 1 for individuals employed in enterprises with more than 250 workers	
SECTOR	Dummy variable taking on a value of 1 for individuals employed in enterprises from the public sector	Public and private sector jobs differ in several dimensions, which may be explained by the hedonic theory of wages (Emilio et al., 2012). Thus, the dummy variable associated with the sector should be included as an explanatory variable in an empirical investigation.

Source: *own elaboration*

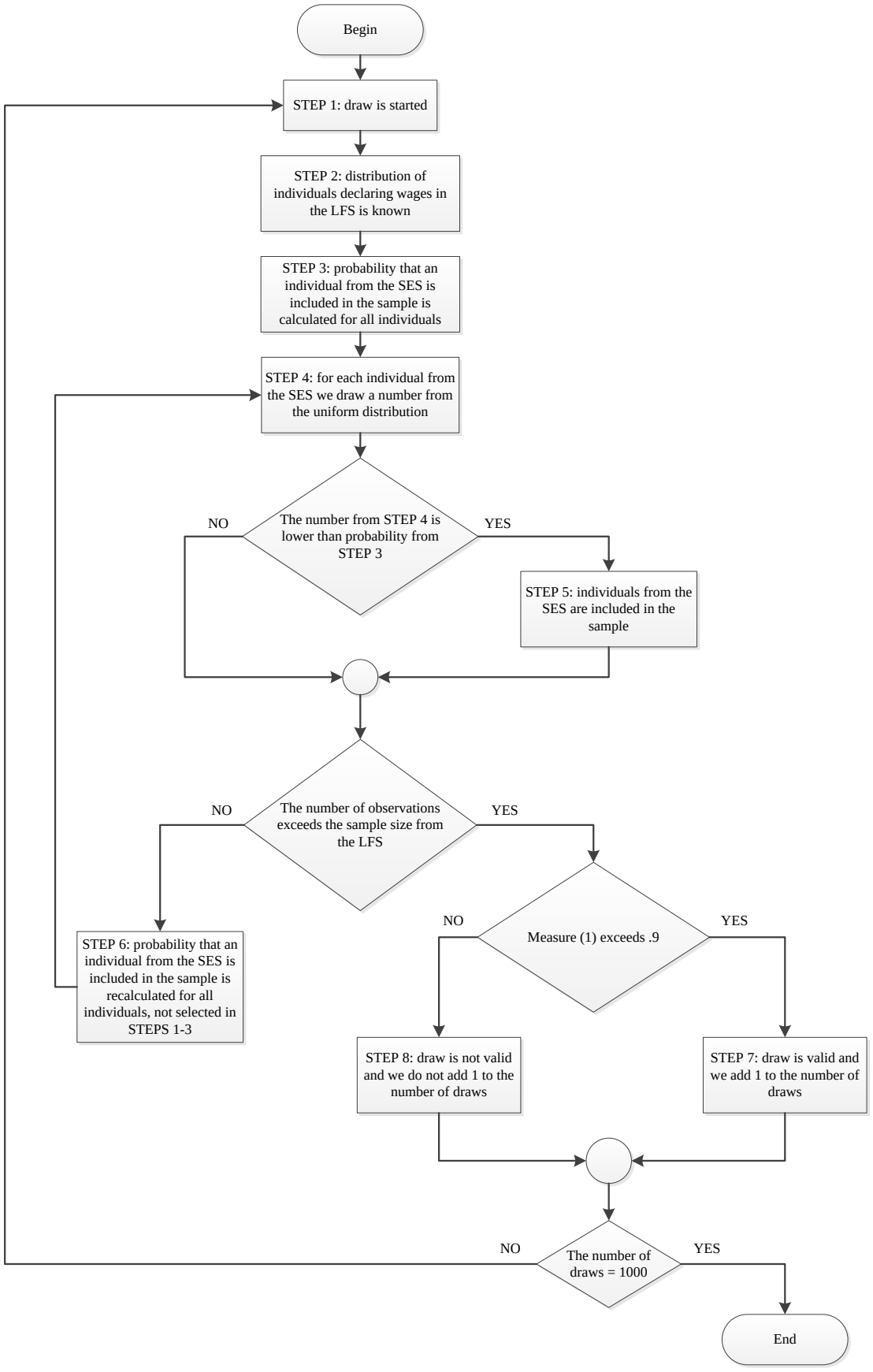
In the first step, we analyze the distribution of individuals from the LFS regarding wage levels across gender, experience (we divide the whole sample of workers into the following

groups: less than 5 years, 5-10 years, 10-15 years, more than 15 years), educational attainment, type of employment contract, enterprise location (NUTS-2 region), and enterprise section, size, and sector. In order to have comparable data, we draw individuals from the SES characterized by the same distribution. In order to ensure the consistency of structures of distribution of individuals from the LFS and SES, the appropriate measure of consistency of structures was used. The following index of consistency of structures for all features was applied:

$$ICS_f = \frac{\sum_{kf=1}^{Kf} min\left(w_{kf}^{LFS}, w_{kf}^{SES}\right)}{\sum_{kf=1}^{Kf} max\left(w_{kf}^{LFS}, w_{kf}^{SES}\right)}, \quad (1)$$

where w_{kf}^{LFS} and w_{kf}^{SES} denote fraction of individuals from the *k*-th group according to feature *f* in the LFS and SES respectively.

Based on the distribution of individuals from the LFS who report wage levels, we calculate the probability that an individual from the SES with specific features should be included in the sample. A random number from uniform [0,1] distribution is drawn. If this number is lower than the calculated probability, an individual from the SES is included in the sample. Otherwise, he/she is not included in the sample. The same procedure is conducted for all individuals from the SES database. After the first round, we compare the distribution of samples from the SES with the "desired" structure based on the LFS. Next, we modify the probabilities of including an employee based on the difference between the "desired" structure and the empirical structure. Next, similar draws are carried out for the units that were not included in the first round. We continue this procedure until the SES sample size exceeds the LFS sample size. To verify whether the big draw (all individuals drawn from the SES) is valid, we compare the fractions of individuals with specific features in the SES sample with an analogous fraction in the LFS sample. If the quantity (1) exceeds .9, this big draw is treated as valid. Such a value is deemed satisfactory in works devoted to compliance of structures (Kądziołka, 2022). For each year, the big draw from the SES is conducted 1000 times (only valid draws are counted). Graph 1 presents the algorithm of drawing samples from the SES. It should be added that we address the problem of sample selection and we do not have to use the Heckman-type estimator (see Pelek & Uysal, 2018), since distributions of individuals in the SES and LFS databases are consistent. The consistency is measured based on comparison of the quantity (1) with .9.



Graph 1. The algorithm of drawing samples from the SES
Source: *own elaboration*

Next, based on theories that point out the determinants of wages in the microeconometric model, the following multilevel models for individuals from the SES and LFS data sets are proposed:

$$log(wage_i) = \boldsymbol{x}_i\boldsymbol{\beta} + \sum_j z1_i^j\, u1^j + \sum_k z2_i^k\, u2^k + \sum_k z3_i^l\, u3^l + \sum_m z4_i^m\, u4^m + \varepsilon_i. \quad (2)$$

In model (2), vector $\mathbf{x}_i$ consists of variables included in *Table 1*; $u1^j$, $u2^k$, $u3^l$ and $u4^m$ denote random effects associated with the 1-digit code, 2-digit code, 3-digit code and 4-digit code occupational groups, respectively. The letters *j, k, l,* and *m* index 1-, 2-, 3- and 4-digit occupational groups. It is assumed that random effects follow a normal distribution with means $E(u1^j)$, $E(u2^k)$, $E(u3^l)$, $E(u4^m)$ and standard deviations $\sqrt{Var(u1^j)}$, $\sqrt{Var(u2^k)}$, $\sqrt{Var(u3^l)}$ and $\sqrt{Var(u4^m)}$. Variable $z1_i^j$ is equal to 1 if the *i-th* employee belongs to the *j-th* 1-digit code occupational group, and 0 if he/she belongs to another group. Variable $z2_i^k$ is equal to 1 if an employee belongs to the *k-th* 2-digit code occupational group, and 0 if he/she belongs to another group. Variable $z3_i^l$ is equal to 1 if an employee belongs to the *l-th* 3-digit code occupational group, and 0 if he/she belongs to another group. Variable $z4_i^m$ is equal to 1 if an employee belongs to the m-th 4-digit code occupational group, and 0 if he/she belongs to another group. It is assumed that the error term ε_i follows a standard normal distribution with zero mean and constant variance.

In order to estimate parameters of the model (2), the likelihood function is constructed. When the likelihood function is derived, the assumptions about the normality of distribution of error term ε_i and random effects $u1^j$, $u2^k$, $u3^l$, $u4^m$ are made. Next, the likelihood function is maximized with the use of the BHHH (The Berndt–Hall–Hall–Hausman) numerical algorithm (Greene, 2003). It means that the maximum likelihood method is used to find estimates of the parameters of the model (2), as well as means and standard deviations for fixed and random effects.

Next, we calculate the theoretical wages for individuals from the LFS and SES based on the estimates of the parameters of model (2). In particular, we concentrate on the following quantities:

$E_{LFS} = E\big(log(wage_{LFS})\big)$ – average theoretical wage of an individual from the LFS,
$E_{SES} = E\big(log(wage_{SES})\big)$ – average theoretical wage of an individual from the SES,
$E_{LFS}^g = E\left(log\big(wage_{LFS}^g\big)\right)$ – average theoretical wage of an individual belonging to group g from the LFS (groups are associated with dummy variables and base categories. Four earlier defined groups according to experience are considered),
$E_{SES}^g = E\left(log\big(wage_{SES}^g\big)\right)$ – average theoretical wage of an individual belonging to group g from the SES (groups are associated with dummy variables and base categories. Four earlier defined groups according to experience are considered).

Next, we calculate the following ratios:

$$R_{LFS}^g = \frac{E_{LFS}^g}{E_{LFS}}, \quad (3)$$

$$R_{SES}^g = \frac{E_{SES}^g}{E_{SES}}, \quad (4)$$

$$RR^g = \frac{R_{LFS}^g}{R_{SES}^g}. \quad (5)$$

Measure (3) informs us about the relationship between the average wage in a given group and the average wage in the sample of all workers in the LFS. Measure (4) analogously informs us about the relationship between the average wage in a given group and the average wage in the whole sample from the SES. Due to differences in wages reported by workers and human resources departments (HR departments provide information about gross wages, while households provide information about net wages), the relative wages for selected groups are calculated. Measure (5) shows the relationship between measures (3) and (4). If value (3) is significantly larger than value (4), it may be interpreted as workers reporting significantly higher wages compared to the HR departments. Large values of measure (5) show that the remuneration reported by individuals in the LFS is relatively large compared to the remuneration reported by HR departments. It may mean that workers from specific groups receive more money than is officially reported, and some of this money constitutes an envelope wage. Therefore, analyzing the performance of measure (5) across different groups may reveal which workers are more likely to receive an envelope wage. Based on measure (5), we create a measure of the percentage difference between the relative wage reported in the LFS and the relative wage reported in the SES:

$$EW^g = (RR^g - 1) * 100. \quad (6)$$

Since measures (3)-(6) are calculated based on 1000 draws, bootstrap confidence intervals are constructed. Statistical inference makes it possible to verify the following hypothesis:

$$H_0: EW^g = 0\ , \quad (7)$$

$$H_1: EW^g \neq 0\ .$$

2.3. Hypotheses

Sometimes employees and employers agree to non-standard remuneration methods, which is broadly studied in economic literature (Arendt et al., 2020). This phenomenon can be explained by the tax wedge. As Dolenz and Laporsek (2010) indicate, the level of the tax wedge (the difference between cost for employer and revenue for employee) has a negative impact on employment. Moreover, when the tax wedge increases, employers and employees search for such types of contracts that reduce the difference in question (Biro et al., 2022). Non-standard remuneration methods enable employees to increase their wealth and help enterprises reduce labor costs. Therefore, sometimes they are chosen by both parts of the contract.

Before the empirical study is conducted, the hypotheses are set. The first hypothesis is associated with regional differentiation of envelope wages. Wages in Poland are much lower than in Germany. *Table 2* compares minimum hourly wages in Poland and Germany in years 2017 and 2018 (the EUR/PLN exchange rate from the end of year is used for conversion). Only in these years (from the analyzed period 2010-2018) minimum hourly wages were in force in both countries. Results from this table indicate that those individuals who live close to the German border and have some command of German can take the opportunity to cross the border and, thus, earn more. Polish entrepreneurs from the regions in the west of Poland are aware of differences in wages between Poland and Germany. However, if they want to be competitive, they cannot pay more than their counterparts from other Polish regions. Fixing the official minimum wage and offering an additional envelope wage seems to be the best solution to improve competitiveness and retain workers. The relatively low distance between the regions in the west of Poland and the old member states of the European Union resulted in locating

subsidiaries from Western Europe close to the German border. *Table 3* indicates that the number of foreign capital enterprises is relatively large in the Dolnośląskie, Zachodniopomorskie, and Lubuskie regions, which border with Germany. However, these enterprises are very often warehouses of e-commerce corporations that hire mainly blue-collar personnel. They are very often active in industries characterized by low wages (e.g., the furniture industry). An analysis of transnational corporations indicates that they very often locate production sites in less developed, cheaper countries and development centers in the most developed countries (Kordos & Vojtovic, 2016). An analysis of the location of subsidiaries of large European companies indicates that research and development centers are in the most developed countries, while production sites are in cheaper destinations. However, the citizens from these regions can earn money abroad. Therefore, employers must offer additional money on top of regular wages to convince workers not to leave the enterprises. The large number of foreign-capital enterprises indicates that the number of job offers is large, and that unemployment rates are low in these regions. In general, the western regions of Poland are characterized by a larger number of foreign capital enterprises, a greater number of newly created jobs, and a greater number of job offers per unemployed. These categories are mutually correlated, which is confirmed by results of many empirical studies (see *Table 3*). The conclusion concerning the positive relationship between investments of foreign capital enterprises and number of job offers is based on findings from empirical research conducted by Klimek (2017). In this study, positive effects of foreign direct investments on economic development in Polish regions were identified. Relatively large numbers of job offer (in relation to the number of unemployed) positively affect the probability of leaving unemployment and shall result in a lower unemployment rate, which is in line with the results obtained by Nickell (1979). However, dominant industries, mainly in Lubuskie and Zachodniopomorskie, are not associated with well-paid jobs (e.g., in Lubuskie, the furniture industry plays an important role). Employees want to earn more, but employers want to reduce costs. Therefore, both parties agree to non-standard remuneration methods. Based on these considerations, we propose the following hypothesis:

Hypothesis 1: The problem of an envelope wage is more often observable in regions located close to the German border.

Table 2. Means end standard deviation

Year	Poland	Germany
2017	3.11	8.84
2018	3.19	8.84

Source: *own elaboration based on official governmental data*

Table 3. Data concerning number of newly created jobs, foreign-capital enterprises, and number of unemployed per job offer in the period 2010-2018

Region	Number of newly created jobs in years 2010-2018 per 10 000 inhabitants	Number of foreign-capital enterprises per 10 000 inhabitants (average for years 2010-2018)	Number of unemployed per one job offer (average for years 2010-2018)
Dolnośląskie	1.40	7.9	29.94
Kujawsko-Pomorskie	.98	2.7	69.57
Lubelskie	.94	2.0	102.54
Lubuskie	1.92	6.9	37.33
Łódzkie	1.34	4.1	67.77
Małopolskie	1.44	5.2	51.04
Mazowieckie	2.17	18.3	69.27
Opolskie	1.17	4.6	42.16
Podkarpackie	1.04	2.3	97.96
Podlaskie	.91	1.6	130.77
Pomorskie	1.32	5.9	47.77
Śląskie	1.39	5.1	25.77
Świętokrzyskie	1.09	1.5	120.35
Warmińsko-Mazurskie	1.20	2.0	114.70
Wielkopolskie	1.50	6.4	37.97
Zachodniopomorskie	1.09	8.3	57.91

Source: *own elaboration on the basis of the Polish Statistical Government data*

The next hypotheses, which are going to be formulated are associated with individual features. They concern the relationship between educational attainment and the propensity to receive envelope wage and the relationship between experience and propensity to receive envelope wage. Well-educated and more experienced employees have better bargaining power and can better negotiate official wages. In the case of more experienced employees, replacing them with other workers is more difficult than in the case of less experienced ones. Therefore, the bargaining power of employees shall increase with their work experience. As indicated by Dumont et al. (2012), bargaining position of high-skilled employees is much better than bargaining position of low-skilled employees. Job experience and level of education are related to the level of skills, since numerous studies indicate that these variables significantly affect wages (Psacharopoulos & Ng, 1994; Grabowski, 2019). Therefore, it is expected that the propensity to receive an envelope wage decreases as experience increases, and it is lower for better-educated employees. The proposed hypotheses are as follows:
Hypothesis 2: The propensity to receive envelope wage decreases as experience increases.

Hypothesis 3: The propensity to receive envelope wage is lower for better-educated employees.

3. Results and discussion

3.1. The results of the estimation of the parameters of the model

Tables 4.a-4.c present the results of the estimation of the parameters of the model (2) based on the LFS data, as well as average estimates of parameters for 1000 draws from the SES data.

Table 4a. Results of estimating the parameters for variables associated with features of workers and enterprises

Variable	2010		2012		2014		2016		2018	
	SES	LFS	SES	LFS	SES	LFS	SES	LFS	SES	LFS
FEMALE	-.101***	-.108***	-.104***	-.134***	-.102***	-.128***	-.098***	-.135***	-.088***	-.133***
EDU5	.176***	.158***	.166***	.164***	.170***	.159***	.163***	.182***	.163***	.125***
EDU4	.008***	.014	.011***	.019**	.010***	.006	.004**	-.025*	-.008***	-.025***
EDU2	-.053***	-.077***	-.046***	-.095***	-.041***	-.073***	-.050***	-.135***	-.070***	-.084***
EDU1	-.062***	-.199***	-.054***	-.198***	-.039***	-.177***	-.047***	-.234***	-.072***	-.170***
IND	.149***	.072***	.162***	.096***	.160***	.147***	.146***	.085	.224***	.109***
PRIVATE_SECTOR	.003**	.012*	-.024***	-.067***	-.025***	.025**	-.034***	-.087	-.039***	.025***
EXPERIENCE	.007***	.006***	.007***	.005***	.006***	.004***	.006***	.005***	.007***	.003***
SIZE2	.169***	.123***	.153***	.063***	.180***	.113***	.183***	.056	.233***	.132***
SIZE3	.306***	.212***	.267***	.160***	.295***	.202***	.300***	.133***	.320***	.202***
cons	7.668***	7.663***	7.823***	7.715***	7.847***	7.759***	7.975***	7.884***	7.484***	8.036***

Source: *own elaboration*

Table 4b. Results of estimating the parameters for regional dummies

Region	2010		2012		2014		2016		2018	
	SES	LFS	SES	LFS	SES	LFS	SES	LFS	SES	LFS
KP	-.064***	-.047***	-.065***	-.038***	-.080***	-.072***	-.094***	-.073***	-.068***	-.009
LUBE	-.082***	-.103***	-.099***	-.106***	-.084***	-.080***	-.111***	-.190***	-.113***	-.052***
LUBU	-.042***	-.069***	-.037***	-.001	-.042***	-.046**	-.026***	-.021	-.022***	.033**
LODZ	-.032***	-.051***	-.044***	-.030***	-.038***	-.022	-.063***	-.043	-.082***	-.007
MAL	-.028***	-.004	-.035***	.020	-.028***	-.023	-.047***	-.009	-.055***	.004
MAZ	.111***	.065***	.083***	.053***	.072***	.040***	.059***	-.066	.044***	.070***
OPOL	-.031***	-.050***	-.052***	-.014	-.052***	.014	-.066***	-.011	-.060***	-.062***
PODK	-.100***	-.122***	-.108***	-.079***	-.103***	-.116***	-.117***	-.097***	-.134***	-.083***
PODL	-.029***	-.078***	-.097***	-.116***	-.066***	-.087***	-.080***	-.190***	-.072***	-.039***
POM	.011***	.018*	.007***	.013	-.008***	.018	-.023***	-.048*	.001	.015
SL	-.013***	-.029***	-.014***	.029**	-.027***	-.039**	-.044***	-.114***	-.038***	-.011
SW	-.059***	-.112***	-.084***	-.097***	-.078***	-.082***	-.101***	-.136***	-.120***	-.101***
WM	-.056***	-.031***	-.050***	-.059***	-.073***	-.043***	-.059***	-.158***	-.045***	-.055***
WIEL	-.024***	-.064***	-.026***	-.030***	-.020***	-.049***	-.029***	-.048***	-.035***	-.014
ZACH	-.030***	-.011	-.008***	.006	-.025***	-.022	-.023***	.032	-.018***	-.002

Source: *own elaboration*

Table 4c. Results of estimating the parameters for section dummies

NACE group	2010		2012		2014		2016		2018	
	SES	LFS	SES	LFS	SES	LFS	SES	LFS	SES	LFS
A	.001	-.076***	.046***	.068***	.026***	.016	.036***	.116**	.068***	.007
B	.249***	.160***	.204***	.144***	.162***	.214***	.114***	.234***	.181***	.203***
D	.164***	.163***	.157***	.082***	.160***	.122***	.172***	.081*	.090***	.087***
E	.044***	-.017	.001	-.054**	.001	-.012	-.008**	-.046	-.059***	.020
F	-.046***	.059***	-.061***	.058***	-.072***	.037*	-.056***	.059***	-.030***	.026
G	-.014***	-.026***	-.047***	-.021**	-.026***	.002	-.028***	-.023	-.042***	-.007
H	-.037***	.048***	-.055***	.019	-.044***	.035*	-.045***	.068***	-.094***	.051***
I	-.031***	-.036**	-.111***	-.022	-.091***	-.026	-.086***	-.037	-.137***	-.017
J	.136***	.066***	.096***	.102***	.067***	.139***	.083***	.110***	.104***	.163***
K	.188***	.124***	.105***	.141***	.060***	.152***	.116***	.139***	-.155***	.130***
L	.024***	.039**	-.038***	.020	-.021***	.024	-.022***	-.025	-.089***	-.038
M	.037***	-.018	.057***	.016	.047***	.025	.048***	-.000	.025***	.035*
N	-.203***	-.091***	-.156***	-.144***	-.128***	-.080***	-.127***	-.061**	-.209***	-.026
O	-.021***	.006	-.097***	-.025	-.114***	.039*	-.136***	-.108*	-.202***	.004
P	-.114***	-.051***	-.185***	-.111***	-.141***	-.034	-.163***	-.160***	-.307***	-.023
Q	-.088***	-.074***	-.153***	-.141***	-.152***	-.052**	-.178***	-.162***	-.225***	-.091***
R	-.039***	-.000	-.124***	-.046*	-.108***	-.001	-.097***	-.100	-.173***	-.042
S	-.147***	-.075***	-.044***	-.124***	-.048***	-.023	-.060***	-.117***	-.149***	-.103***

Source: *own elaboration*

The results from *Tables 4.a-4.c* confirm the occurrence of the gender wage gap (Majchrowska & Strawiński, 2016, 2018; Kompa & Witkowska, 2018) in the Polish economy. In 2010, female wages turned out to be about 10% lower than male wages, "ceteris paribus". This difference fluctuated between 8.8% and 10.4% in the case of employees from the SES database and between 10.8% and 13.4% in the case of employees from the LFS database. The positive relationship between education level and wages (Tamborini et al., 2015) was identified too. Individuals with basic education level turned out to have significantly lower wages than individuals with secondary general education level, ceteris paribus. This difference fluctuated between 3.9% and 7.2% for individuals from the SES database and between 17.0% and 23.4% for individuals from the LFS database. On the other hand, wages of workers with tertiary education turned out to be significantly higher than wages of employees with secondary education. The difference fluctuated between 16.3% and 17.6% in the case of individuals from the SES database and between 12.5% and 18.2% in the case of employees from the LFS database. It can also be observed that wages grow with the worker's experience (Mincer, 1974) and the size of the enterprise (Zimermanová, 2010). 10 years of additional experience resulted in an increase of wages by 3%-7%, ceteris paribus. Working under an open-ended contract also results in higher wages. An analysis of employees from the SES database indicates that working under an open-ended contract results in wages higher by 14.6-22.4%, ceteris paribus. In the case of employees from the LFS database this difference fluctuated between 7.2% and 14.7%. This result is in line with findings of other studies (see e.g., Aleksynska, 2018). The results indicate that wages vary across regions, which may be associated with the economic potential of the region (Cieślik & Rokicki, 2016, 2022). Significant estimates of parameters for regional dummies for all years indicate that regional differences exist. An example of such a region is the Mazowieckie voivodship, where the Warsaw (the capital of Poland) agglomeration is located. Results of the empirical investigation also indicate that larger (than in other regions) wages are observable in Pomorskie and Dolnośląskie regions, where large agglomerations (Tricity and Wroclaw) are located. On the other hand, for example in Warmińsko-Mazurskie region, with much smaller capital city, wages turned out to be significantly lower than in Dolnośląskie region, ceteris paribus. The difference fluctuated between 4.5% and 7.3% in the case of employees from the SES database and between 3.1% and 15.8% in the case of individuals from the LFS database.

The results for the NACE section dummies show that the highest wages occurred in: Agriculture, forestry and fishing (section A); Mining and quarrying (section B); Manufacturing (section C); Electricity, gas, steam, and air conditioning supply (section D), Information and communication (section J); and Professional, scientific and technical activities (section M). In particular, in section B, wages turned out to be significantly larger than in the manufacturing section, ceteris paribus. In the case of employees from the SES database the difference fluctuated between 11.4% and 24.9% and between 14.4% and 23.4% in the case of individuals from the LFS database.

3.2. Calculating values estimating the propensity to receive envelope wages

In the next step, theoretical wages are calculated based on the estimation of the multilevel model parameters. Later, values of measure (6) are calculated for different groups, as shown in *Tables 5.a-5.c*. This measure is interpreted as the percentage difference between the relative wage reported in the LFS and the relative wage reported in the SES. High and positive values of this measure inform that employees receive higher wages than is reported by HR departments. Negative values of this measure may be explained by strong bargaining position and capabilities of receiving high official wages without additional component

(envelope wage). Moreover, negative values may be associated with the fact that some workers (with very good bargaining position) receive additional benefits, which are reported by HR departments and not reported by individuals, when they inform about wages. It means that an envelope wage may partly explain the difference between the relative wage reported in the LFS and the relative wage reported in the SES.

Moreover, a comparison between the relative wages reported by individuals and relative wages reported by HR departments is compliant with bottom-up methods used for estimating the PIT (personal income tax) and SSC (social security contributions) gap (Guyton et al., 2021). For example, Baldini et al. (2009) used econometric techniques to compare the reported income based on tax returns with the income reported in surveys and identified substantial discrepancies. Analogously, Benedek and Lelkes (2011) used a combination of household budget survey data covering the years from 2006 to 2007 and administrative tax records to evaluate the extent of income underreporting. Therefore, the measure (6) is very significant in the context of the study.

Table 5a. Values of measure (6), which indicate the propensity to receive envelope wages in different groups

Group	2010	2012	2014	2016	2018
Males	**-1.82**	**-1.92**	**-1.58**	-1.05	**-1.81**
Females	**1.28**	**.82**	**.77**	.22	**.48**
Basic education	**-19.32**	**-9.30**	**-11.40**	**-1.90**	**-7.91**
Vocational education	**5.45**	**4.32**	**3.78**	**4.55**	**5.17**
Secondary general education	1.02	.89	.75	.67	1.04
Secondary technical education	**6.27**	**5.45**	**4.49**	**5.58**	**4.31**
Higher education	.98	-.23	-.21	.75	.46
Not more than 49 employees	**12.01**	**12.98**	**13.35**	**11.15**	**4.98**
50-249 employees	**7.37**	**8.65**	**9.21**	**6.67**	**2.03**
250 and more employees	**-13.31**	**-14.17**	**-16.26**	**-13.25**	**-6.71**
Employed for indefinite period	**-4.31**	**-3.01**	**-2.57**	**-2.89**	**-5.76**
Employed for definite period	**12.21**	**9.22**	**7.15**	**8.02**	**15.74**
Private enterprise	**4.92**	**2.86**	**3.14**	.93	**1.55**
Public enterprise	**-3.78**	**-2.56**	**-3.57**	-.86	**-1.71**
Experience less than 5 years	**-3.87**	**-1.19**	**-3.12**	-.23	**-1.93**
Experience between 5 and 10 years	**4.82**	**2.30**	**3.00**	.18	**2.63**
Experience between 10 and 15 years	**7.89**	1.13	**2.33**	1.21	**1.35**
Experience longer than 15 years	**-5.11**	**-2.39**	**-4.54**	**-1.98**	**-2.12**

Note: Bold values indicate the significance of measure (6) at the .05 level of significance
Source: *own elaboration*

Table 5b. Values of measure (6), which indicate the propensity to receive envelope wages in different regions

Region	2010	2012	2014	2016	2018
Dolnośląskie	**3.16**	**4.09**	**4.57**	4.80	**1.85**
Kujawsko-Pomorskie	**4.73**	**6.83**	**4.46**	9.04	**6.82**
Lubelskie	.02	-.03	-.11	.05	-.06
Lubuskie	**-.52**	**9.13**	**5.76**	**6.74**	**7.14**
Łódzkie	**-2.31**	**-1.39**	**-1.56**	**-2.01**	**-2.15**
Małopolskie	**8.46**	**4.99**	**3.44**	**7.55**	**8.61**
Mazowieckie	**-5.65**	**-4.45**	**-4.79**	**-4.77**	**-5.02**
Opolskie	**-2.15**	**-2.89**	**-1.98**	**-2.03**	**-2.43**
Podkarpackie	-.06	-.14	.12	.09	.07
Podlaskie	**-1.27**	**-1.65**	**-1.82**	**-1.75**	**-2.03**
Pomorskie	**12.45**	**4.33**	**5.49**	**5.55**	**.47**

Śląskie	**-.37**	-.28	-.31	-.35	-.06
Świętokrzyskie	**-1.82**	**-1.11**	**-1.44**	**-1.62**	**-1.87**
Warmińsko-Mazurskie	-.11	.07	.03	-.04	-.07
Wielkopolskie	**-4.24**	**-3.57**	**-3.73**	**-4.01**	**-4.11**
Zachodniopomorskie	**5.23**	**6.14**	**6.79**	**1.97**	**3.81**

Note: Bold values indicate the significance of measure (6) at the .05 level of significance

Source: *own elaboration*

Table 5c. Values of measure (6), which indicate the propensity to receive envelope wage in different NACE sections

Section	**2010**	**2012**	**2014**	**2016**	**2018**
Agriculture, forestry, fishing	-.13	-.78	-.54	-1.23	-1.09
Mining and quarrying	-1.45	**-2.34**	-1.35	-1.67	**-2.01**
Manufacturing	**4.21**	**5.12**	**4.58**	**4.72**	**4.91**
Electricity, Gas, Steam and Air Conditioning Supply	-.32	-.45	-.89	-.45	-.61
Water supply; sewerage, waste management and remediation activities	.12	.15	-.04	.34	.54
Construction	**5.76**	**7.61**	**9.46**	**8.37**	.43
Wholesale and retail trade; repair of motor vehicles, including motorcycles	.21	.26	.19	.17	.12
Transportation and storage	**4.78**	**6.21**	**5.13**	**5.67**	**5.12**
Accommodation and food service activities	**2.37**	**1.99**	**2.03**	**2.45**	**2.11**
Information and communication	.12	.15	.02	.03	-.05
Financial and insurance activities	-.34	-.21	-.27	-.29	-.13
Real estate activities	**1.76**	**1.98**	**1.67**	**1.55**	**1.89**
Professional, scientific and technical activity	-.23	-.19	-.29	-.34	-.21
Administrative and support service activities	**1.89**	**1.71**	**2.03**	**1.65**	**1.78**
Public administration and defense; compulsory social security	**-2.35**	**-2.76**	**-2.31**	**-2.56**	**-2.78**
Education	**-2.81**	**-2.09**	**-2.45**	**-2.36**	**-2.57**
Human Health and Social Work Activities	-.27	-.21	-.05	-.32	-.17
Arts, entertainment and recreation	**5.57**	**7.92**	**1.27**	**7.90**	**2.17**
Other service activities	-.31	-.43	-.21	-.38	-.45

Note: Bold values indicate the significance of measure (6) at the .05 level of significance

Source: *own elaboration*

3.3. Discussion

The differences in the expected wages calculated using data from the LFS and SES data sets are especially observable in selected groups of workers (*Table 5.a*). For females, relative wages reported in the LFS were greater than those reported in the SES. The difference fluctuated between .22% and 1.28%. However, this result does not show that the propensity for women to receive envelope wages is larger than that for men. This may be because most management positions are filled by men (Ezzedeen et al., 2015). These workers very often receive additional benefits, which are reported by human resources departments but not reported by individuals when disclosing information about wages. In the case of education, the greatest differences were for vocational and secondary technical levels of education. In the case of employees with vocational education the difference fluctuated between 3.78% and 5.75%, while in the case of individuals with secondary technical education the difference fluctuated

between 4.31% and 6.27%. Larger propensity to receive envelope wage in the case of individuals with vocational education confirms findings obtained by Arendt et. al. (2020) for the Central Region of Poland. This is generally in line with expectations that employees with fewer years in formal education are more likely to receive envelope wages (e.g., Williams, 2009a; Williams & Horodnic, 2015b). The results confirm the validity of hypothesis 3. Employees with vocational and secondary technical education often have a specialist profession and hence higher wage requirements. As Parteka (2018) and Strawiński et al. (2018) indicate, the bargaining position of employees with vocational and secondary technical education level increases due to decreasing supply of workers with such qualifications and capabilities. Companies know that they must pay more individuals with vocational and secondary technical education to retain valuable workers. However, these enterprises try to avoid the tax wedge. Increasing the share of non-wage labor costs in total labor costs reduces the official demand for labor, which in turn may increase employment in the shadow economy (see, e.g., Arsić et al., 2015).

Results of the empirical study indicate that strong linkages between the size of an enterprise and the propensity to obtain envelope wages may be present. In the case of individuals from enterprises with less than 250 employees, relative wages declared by workers turned out to be significantly larger than relative wages reported by HR departments. On the other hand, HR departments reported larger wages than individuals employed in firms with at least 250 workers. The difference fluctuated between 6.71% and 16.26%. The obtained results confirm the findings of Franic and Cichocki (2022), who identified a smaller inclination to envelope wages in the group of workers of large enterprises.

Another example of differences in expected wages concerns fixed-term employment. Employees on a fixed-term contract turned out to declare significantly larger wages than was reported by HR departments. The difference fluctuated between 7.15% and 15.74%. This finding may be related to informal subsidies for employees with lower qualifications who are employed for a trial period. Employees on an indefinite employment contract have a greater bargaining position, so they receive higher official wages than individuals employed for a definite period. In the case of professional experience, it can be assumed that the likelihood of receiving envelope wages is associated with medium experience. Values from *table 5.a* indicate that the difference between the relative wage reported in the LFS and the relative wage reported in the SES fluctuated between .18% and 4.82% in the case of individuals with experience between 5 and 10 years. In the case of employees with experience between 10 and 15 years, the difference between the relative wage reported in the LFS and the relative wage reported in SES fluctuated between 1.13% and 7.89%. In the case of individuals with experience below 5 years and employees with experience above 15 years, the relative wage reported in the SES turned out to be larger than the relative wage reported in the SES. For the least experienced workers, their bargaining power is weak, so they accept low wages without an envelope wage. Those with between 5 and 15 years' experience have stronger bargaining power. However, companies try to avoid the tax wedge, so they pay such workers low wages and an additional envelope wage. The bargaining power of the most experienced workers is the greatest, and they receive higher official wages without an envelope wage. Moreover, some individuals with experience above 15 years receive additional benefits, which are reported by human resources departments but not reported by individuals when disclosing information about wages. Therefore, the higher level of the relative wages reported in the SES than in the LFS seems to be justified. This result is in line with findings obtained by Franic and Cichocki (2022), who have found that the propensity to accept envelope wages lessens with age. It means that the validity of hypothesis 2 is only partly confirmed. Regarding enterprise size, the differences in expected wages are

found not only among smaller enterprises (e.g., Williams & Horodnic, 2015a) but also among larger companies employing more than 50 employees.

In order to understand differences in the value of measure (6) across regions (*Table 5.b*), map has been produced that distinguishes regions that are significantly positive, significantly negative and not significantly different from the 0 value of this measure. *Figure 1* shows the dominating sign of the value of measure (6). It turns out that relative wages reported in the LFS were significantly larger than those reported in the SES in regions located close to the German border, as well as in tourist regions. The result confirms the validity of hypothesis 1. This result is not surprising, since enterprises located in Germany offer higher wages than Polish enterprises. Moreover, numerous e-commerce enterprises have located their warehouses in western Poland due to lower labor costs (compared to old EU members) and lower transportation costs (compared to those from eastern Poland). Most jobs offered in these enterprises are appropriate for blue-collar workers with low and medium qualifications. Therefore, the official wages offered in these enterprises are low. However, employees have stronger bargaining power since they can quit and work in other firms located in Germany. This positive difference between the relative wage received according to the LFS and SES may be associated with envelope wages. Employees working in enterprises located close to the German border may receive low official wages and an additional envelope wage. Relative LFS wages in tourist regions were significantly larger than the relative SES wages. This may be associated with the fact that, in general, the accommodation and food service activities section is characterized by low wages and opportunities to receive envelope wages. This result is in line with Williams and Padmore (2013). Moreover, the costs of accommodation for workers of enterprises located in touristic regions are very high. In order to retain workers, hospitality sector entrepreneurs add additional envelope wages to official low wages.

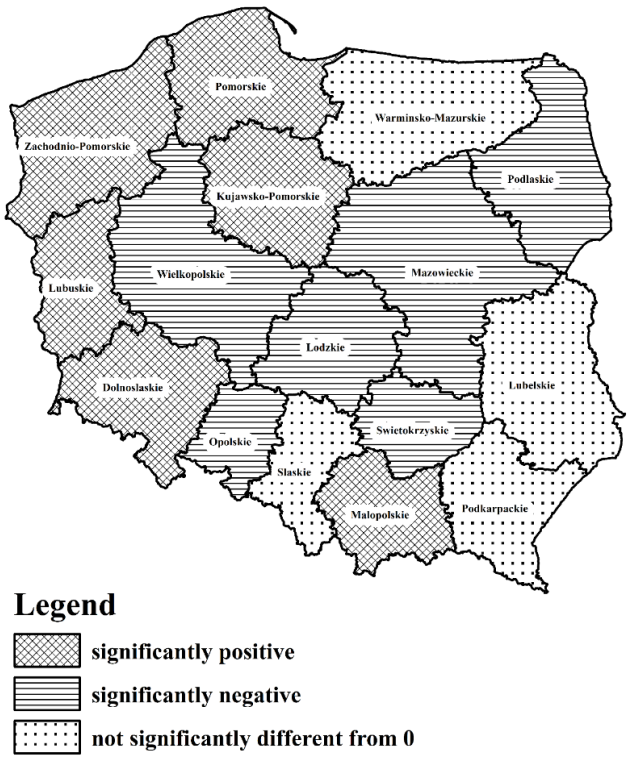


Figure 1. The differences between wages reported in the LFS and SES data sets
Source: *own elaboration*

When looking at expected wages by industry (*Table 5.c*), we can see that the greatest differences are for Manufacturing, Construction, Transportation and storage, Accommodation and food service activities, as well as Arts, entertainment and recreation. In general, propensity to receive envelope wages seems to be larger in the case of sections characterized by lower labour productivity. This result is in line with findings obtained by Di Nola et al. (2019) and indicates that there exists negative a correlation between labour productivity and the tendency to avoid paying taxes. In the case of Manufacturing, the difference between the relative wages reported by the LFS and relative wages reported by the SES fluctuated between 4.12% and 5.12%. In the case of the Construction, the difference between the relative wages reported by the LFS and relative wages reported by the SES fluctuated between .43% and 9.46%. In the case of Transportation and Storage, the difference between the relative wages reported by the LFS and relative wages reported by the SES fluctuated between 4.78% and 6.21%. These results confirm findings concerning the impact of educational attainment on the propensity to obtain an envelope wage. In the case of the analyzed sections, the percentage of workers with vocational and secondary technical education levels is larger than in other sections, while the results of the empirical research indicate that employees with these education levels are characterized by a larger propensity to receive an envelope wage. Significant and positive differences between relative wages reported in the SES and relative wages reported in the LFS are also observed in the case of Accommodation and Food Service Activities, as well as Arts, Entertainment and Recreation. The difference fluctuated between 1.99% and 2.45% in the case of Accommodation and Food Service Activities and between 2.17% and 10.27% in the case of Arts, Entertainment and Recreation. These sections are characterized by the greatest opportunities for employees to receive envelope wages. Most jobs in these sections are characterized by great (or at least seasonal) demand for workers. Significant and negative differences between the relative wages reported in the LFS and relative wages reported in the SES were found in the case of such sections as Public Administration and Defense, Compulsory Social Security, as well as Education. Enterprises in these sections very often represent the public sector and offering envelope wages is not possible. Moreover, workers in these sections often receive additional benefits, which are reported by human resources departments but not reported by individuals when disclosing information about wages. Therefore, the negative differences for these sections are in line with expectations.

Conclusions, policy recommendations and limitations

In this paper, a new approach to identifying envelope wages was proposed. The approach is based on comparing average wages in selected workers groups as reported by employees and human resources departments. Due to the problem of missing data on wages in the LFS, a sample of workers from the SES was drawn (from the same distribution as those reporting in the LFS), and parameters of the multilevel model explaining wages were estimated. Relative average wages for selected groups were compared.

The results of the analysis indicate that employee and enterprise features affect the propensity to receive envelope wages. Envelope wages are more popular in private firms, as well as small and medium enterprises, in comparison with public companies and large firms. This result indicates that there is a significant relationship between competitiveness and the propensity to give employees envelope wages. Small and medium-sized private enterprises operate in a more competitive environment; therefore, reducing costs by offering employees low official wages and an additional envelope wage may be treated as an element of their strategy. Moreover, in general, smaller firms have a worse financial situation, and offering a high official wage may make it hard for them to survive.

Some supply factors are also important. The propensity to offer low/high official wages, as well as envelope wages, depends on the employees' bargaining power. The least experienced workers have the lowest bargaining power, so they are often offered low official wages without envelope wages. In the case of employees with 5-15 years of general experience, they have greater bargaining power since their greater experience allows them to receive a larger number of job offers. However, their bargaining power is not large enough to receive a high official wage. Therefore, employees with a medium level of job experience very often receive low official wages plus an additional envelope wage. For the most experienced workers, their position in enterprises, as well as the many possibilities of finding another job, result in them having great bargaining power. These workers receive envelope wages less often since they can negotiate a high official wage. Another supply factor that affects the propensity to receive an envelope wage is associated with the level of education. Employees with vocational and secondary technical educational attainment possess rare skills, which helps them in negotiations. Due to the relatively low level of productivity in Polish enterprises, employers do not want to offer high wages to blue-collar workers. Therefore, employers often offer low official wages plus additional envelope wages.

Regional differences in the propensity to receive envelope wages have also been identified. However, these differences do not depend on historical or cultural factors but are associated with proximity to the German border, as well as the attractiveness of the region to tourists. Differences in the propensity to receive an envelope wage across NACE sections were also important. Envelope wages are popular in sections characterized by great (or at least seasonal) demand for workers and a low supply of workers with specific qualifications.

The results of the analysis were similar in five surveys (2010, 2012, 2014, 2016, and 2018), which demonstrates their robustness. The finding may be generalized to analyze the problem of envelope wages in a post-transition economy characterized by relatively low productivity. Repeating the research for the period that takes into account the processes observed during the COVID-19 pandemic or high inflation in 2022 would be an interesting complement to the analysis. In order to analyze the impact of the COVID-19 pandemic or high inflation on the problem of envelope wages, models including data for 2010-2018, as well as 2020 and 2022 will be estimated and the significance of differences of parameters for different years will be evaluated.

Based on the results obtained in this study, the following policy recommendations can be formulated. The problem of large differences between the amount of money paid by employers and received by employees is solved in a such way that employers offer extra money in addition to what is covered in the contract. An analysis of the differences between relative wages reported by individuals and HR departments indicates that in the case of some groups of workers, the problem may be serious. Therefore, it seems that some regulations leading to lower tax wedge and providing more flexibility in contracts between employees and employers could be beneficial for both sides of the contract, as well as state and local budget revenues. Moreover, recommendations concerning regionalization of minimal wages which are present in economic press could be considered based on distribution of wages and results of the analysis devoted to the problem of envelope wages. The results of this study also provide recommendations for fiscal control institutions. Based on the results of the estimation of parameters of the wage equation for individuals from the LFS and SES database, one can predict in which regions, sections, and groups of workers the propensity to receive an envelope wage is significantly larger.

This paper also has important limitations. It is assumed that respondents are honest and provide true information about wages that they receive. It should be stressed that the phenomenon of envelope wages only partly explains the differences between relative wages

reported by individuals and human resources departments. One can only assume that relatively larger wages in the LFS database than in the SES database in some groups provide information about the groups of workers characterized by a larger propensity to receive envelope wages. However, in some groups of workers larger wages in the SES database are recorded. This can be interpreted not only as a lower propensity to obtain envelope wage but the fact of receiving additional benefits, which are reported by human resource departments and not reported by individuals in the Labour Force Survey. One important feature associated with the population of town/city, where an individual lives or works, is not considered in this study. The results of the study indicate that agglomeration effects exist and individuals from regions with metropolitan areas receive larger wages, ceteris paribus. However, employees may live and work in the center of a metropolitan area, as well as in smaller towns located 100 km from Warsaw, Krakow, Tricity, etc. Another pattern of obtaining envelope wages may concern workers from villages, small towns, and centers of metropolitan areas. Unfortunately, the lack of data concerning the size of a town/city in the SES database makes such analyses impossible. Similar limitations concern regions located close to the German border. In the case of enterprises located a few kilometers from the German border, entrepreneurs face great challenge to retain valuable workers. However, some town and cities in the border regions (Dolnośląskie, Lubuskie, Zachodniopomorskie) are located 100 kilometers from the German border. Everyday commuting is very difficult. Entrepreneurs have better bargaining positions since candidates for employees must consider difficulties associated with commuting.

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