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# ECONOMETRIC MODELS OF PAY AND JOB SATISFACTION: THE CASE OF RUSSIA

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# 1. OVERVIEW OF THE DISSERTATION RESEARCH

**Motivation**

The exploration of job and wage satisfaction constitutes a pivotal endeavor within the paradigm of Russian economy. In recent decades, Russia has undergone profound economic and social transformations that have significantly reshaped the labor market, employment structure, and the social welfare of the workforce. Within this milieu, the scrutiny of job satisfaction emerges as indispensable for elucidating the intricacies of labor relations, the motivational underpinnings of employees, and the determinants of their professional conduct.

Job and wage satisfaction are intricately linked to the efficacy of work performance, the impetus behind employee motivation, and the sustainability of career trajectories. In Russia, as in other nations, the degree of job satisfaction exerts a direct influence on labor productivity, the caliber of work executed, and the depth of employee engagement in the occupational milieu. Discontentment with working conditions or remuneration may precipitate elevated employee turnover, increased absenteeism, and a diminution in motivation and engagement. Such outcomes inevitably impinge upon the overall operational efficacy of organizations and their economic outputs.

Within the Russian context, marked by pronounced disparities in wage levels and working conditions across diverse regions and sectors, the investigation of the factors underpinning job satisfaction assumes heightened significance. The analysis of these factors enables the discernment of the principal sources of employee dissatisfaction, which, in turn, equips employers and policymakers with the insights necessary to devise more efficacious strategies for ameliorating working conditions and augmenting employee satisfaction. Moreover, the examination of job satisfaction in Russia affords a critical assessment of the social and economic ramifications of labor market reforms, thereby gauging the alignment of contemporary employment policies with the aspirations and exigencies of the workforce.

Thus, the study of job and wage satisfaction in Russia is pertinent for the formulation of scientifically substantiated recommendations aimed at enhancing working conditions, invigorating employee motivation, and fortifying social stability within the nation.

**Previous studies**

There are two methodological approaches to studying relationship between pay and pay satisfaction that can be found in literature. One is the 'justice model', the other is the 'self-interest model' (Younts, Mueller, 2001). Self-interest model shows that an individual always considers financial remuneration, that is, pay, positively, so that the higher is the pay, the more positive is the individual's attitude to the pay (Randall, Mueller, 1995). If pay satisfaction is a function of the pay

level, the observed dynamics would resemble the function of utility with diminishing marginal utility (Clark, 1997; Clark, 2001). In the case of pay increase, it would mean that each additional unit of increase will have less positive effect on pay satisfaction. At the same time, this relationship will never be negative.

According to the justice model (Mussweiler, 2003), an individual mostly evaluates her own pay against other people's pay. The starting point of the model is some fair pay level for a particular person who possesses particular characteristics. Relationship between satisfaction and pay level is direct. But as soon as pay level reaches the predetermined 'fair pay' value, the relationship becomes opposite. Any additional increase of pay level becomes associated with extra burden of responsibility. Thus, if an individual considers his pay level to be lower than 'fair pay', his pay satisfaction is declining. But at the same time, an individual whose pay is above the 'fair pay' level also gets frustrated, feeling guilty for having unfair pay increase (Adams, 1965; Adams, Freedman, 1976, pp. 43–90; Walster et al., 1978).

When pay level is lower than an average level, both models show that pay satisfaction declines. When pay level is above the average level, a person's reaction gets more complicated. The effect can be controversial (Peters et al., 2008): on the positive side, a person may feel good about a larger amount of money, while on the negative side, she may feel also frustrated considering the pay increase as an unfair benefit.

For those employees who are paid below the average level, the vector of both efects will be the same. For those who are paid above the average level, the vectors of both effects will have different directions. Thus, it makes sense to conclude that the latter category of workers is less likely to be influenced by the change in pay level, in what concerns the overall pay satisfaction.

Job satisfaction, as a broader concept, has been in the focus of the researchers since the mid-20th century, starting with Frederick Herzberg, a psychologist who studied motivation of employees. Quite often, research interest in job satisfaction is motivated by its relationship with labour productivity, workers' turnover, absenteeism and labour mobility (Freeman, 1978; Warr, 1999). Meanwhile, job satisfaction is important per se, as it is an essential component of the overall life satisfaction among the working-age population.

Numerous empirical studies have investigated the connection between individual and professional characteristics and job satisfaction (Ahn, Garcia, 2004; Sweeney, McFarlin, 2004; Clark, 2005; Clark, Senik, 2005). Those papers are mostly based on the assumption that individuals evaluate the job as a whole. However, other studies show that job satisfaction is also linked to some internal and external aspects of work (Warr, 1999). Internal aspects refer, for example, to the level of

independency in performing the tasks, opportunity to apply one's skills, variety of tasks assigned, supportive managers and communication culture in the workplace. External aspects refer to the factors related to the external environment and working conditions that influence employees' job satisfaction: remuneration, working conditions, corporate policies and procedures, work schedule, job security, and other aspects of employment (Warr, 1999). Hence, just as other subjective judgements, job satisfaction is a result of assessment of a number of internal and external aspects of job, including working conditions, pay level, job loss risks, autonomy in the workplace and so on. Overall job satisfaction can be regarded as a weighted result of assessment of each aspect or component of work. Such approach reflects Lancaster's theory of consumer behavior (Lancaster, 1971), where utility derived from consumption of particular goods depends on the utilities linked to the parameters of these goods. In the framework of this dissertation research, it is assumed that individuals do not assess the job as a whole, but rather refer to a combination of various job aspects which shape overall job satisfaction.

More often, factors influencing the overall job satisfaction include satisfaction with the job duties and responsibilities, working conditions, wage, security of employment and working hours (Skalli et al., 2008; Tarvid, 2015; Sloane, 2011; Ahn, García, 2004). Impact of each factor varies depending on the combination of the selected factors, geography of the research and the methodology applied. Quite limited are studies conducted in Russia and focusing on the contribution of various components of job satisfaction into the overall job satisfaction. These works are covered in the literature review in Chapter 1 of the dissertation. Russian scholarship is rather scarce in terms of the job satisfaction research, although such studies have high practical value: job satisfaction level is one of the key factors determining an employee's intention to leave. Therefore, better understanding of how job satisfaction is shaped by its different components can help employers hire and retain their workers more efficiently.

**Subject and object of the research**

The subject of the research is employed people aged 18–65.

The object of the research is individuals' job satisfaction in general, and pay satisfaction, in particular.

**Purpose and objectives of the research**

The purpose of the research is to develop, test, and evaluate econometric models of pay satisfaction and job satisfaction that are applicable to the available Russian data.

Objectives of the research:

1. to develop a pay satisfaction model that would allow to consider the contribution of

various job aspects into overall satisfaction, including:

    a. an average pay level of the individual's reference group;

    b. the deviation of one's pay from the reference level;

    c. reveal differences in pay satisfaction between relatively rich and relatively poor individuals, that is those with income level higher or lower than the reference group wages;

2. develop an econometric model linking the following factors to overall job satisfaction:

    a. pay satisfaction;

    b. working conditions satisfaction;

    c. career opportunities satisfaction;

3. to study the contribution dynamics of the above factors on a year-to-year basis in the period 2002–2022.

**Methodology and methods**

To achieve the identified purpose of the research, the dissertation thesis employs one-dimensional and multi-dimensional models of multiple order selection, which are estimated using the method of full and limited information maximum likelihood (FIML, LIML).

**Data**

This research relies on two sources of data:

1. "Russia Longitudinal Monitoring survey, RLMS-HSE»[1], conducted by Higher School of Economics and ZAO "Demoscope" together with Carolina Population Center, University of North Carolina at Chapel Hill and the Institute of Sociology RAS. For the purposes of the dissertation research, the data of 11th–30th waves of the survey were used, covering the period of 2002–2022.

2. Federal State Statistics Service (Rosstat). Average Monthly Nominal Wages by Regions of the Russian Federation for 2000–2023 (Rosstat, 2023).

**Scientific contribution of the research**

Scientific contribution of the dissertation is the following:

1. For the first time, using data for Russia, the author quantified the contribution of the reference group's income to pay satisfaction.
2. For the first time, using the data for Russia, the author quantified separately the effects of positive and negative deviations of actual wage from the income of the reference group on the overall pay satisfaction.

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[1]https://rlms-hse.cpc.unc.edu, http://www.hse.ru/org/hse/rlms

3. For the first time in Russian labor economic research, the author introduced a multivariate model of job satisfaction and its facets that accounts for the satisfaction measurement errors.

**Key findings**

1. Findings concerning pay satisfaction:
    a. In Russia, deviation of actual wage from expected wage plays a greater role for an individual's pay satisfaction than the pay itself.
    b. The ratio of the contributions of the expected wage and the deviation of the actual wage from the expected one was approximately 1:2 over the period from 2002 to 2022.
    c. When a positive deviation from the expected level occurs, it results in higher satisfaction, other conditions being equal. This effect is more significant compared to the contribution in case of negative deviation.

2. Findings concerning job satisfaction:
    a. A multivariate job satisfaction model is introduced that accounts for the satisfaction measurement errors that are typically being overlooked in Russian labor economics.
    b. Two methods for estimating a multivariate job satisfaction model were tested: full information maximum likelihood and limited information maximum likelihood. Applying the method of limited information maximum likelihood (in contrast to the method of full information maximum likelihood) to estimate the models with ordinal parameters in general and multivariate ordered probit regression models, in particular, allows to accelerate the estimation procedure significantly, while, at the same time, minimizing estimation quality loss.
    c. Working conditions satisfaction [not pay satisfaction] contributes the most to the overall job satisfaction.
    d. Pay satisfaction and career prospects satisfaction make nearly equal contribution to the overall job satisfaction, but significance of these factors is much lower compared to the working conditions.

3. Findings concerning the dynamics of the impact on pay satisfaction and job satisfaction:
    a. The ratio of the impact of expected wage and the deviation of the actual pay from this expected value to pay satisfaction remains relatively stable over the period from 2002 to 2022.
    b. Over time, the impact of the working conditions satisfaction tends to increase, while the contribution of pay satisfaction and career prospects is gradually decreasing.

**Theoretical and practical relevance of the research findings**

For the first time in Russian labor economics, a multivariate model of job satisfaction and its aspects was utilized, allowing for the consideration of measurement errors in levels of satisfaction. Additionally, for the first time using Russian data, a pay satisfaction model was developed that allows for consideration of measurement errors in the reference group wage.

The dissertation research illustrates that using limited information maximum likelihood model (LIML) for estimating multidimensional order probit regression is more appropriate. With LIML, estimation procedure takes much less time and ensures minimum quality loss, compared to the full information maximum likelihood model (FIML).

In terms of labor economics, the results of the dissertation research indicate that in Russia, non-material benefits of job are more important for an individual than financial gains. Therefore, employers can position themselves better by focusing on intangible benefits offered to prospective employees. Moreover, such an approach could help reduce employee turnover and increase work engagement, leading to more productive work.

The findings provide a fresh perspective on the research concerning the returns on education. Economic perspective on the returns to education is often limited to financial gain, overlooking other benefits (Becker, 1964; Shultz, 1961; Mincer, 1974; Borisov, 2017). Meanwhile, in practice, a person considers numerous factors when making career choices, so that financial gain may be of secondary importance. Hence, conventional studies on returns to education should be revised to get a more comprehensive picture.

The results of this dissertation research were used as educational material at the advanced training course 'Analysis of panel and qualitative data', conducted for the staff of the Tyumen State University in 2023.

**Structure of the dissertation thesis**

Dissertation thesis consists of an introduction, three chapters, a conclusion, a list of references and an appendix.

Chapter 1 offers detailed overview of the literature on the subject under study.

Chapter 2 explores the relationship between pay satisfaction and pay level considering both absolute pay and relative pay (relative to the expected pay level for an individual with particular characteristics). Additionally, Chapter 2 compares quantitative estimates of pay level contribution to the overall pay satisfaction of relatively 'poor' workers and relatively 'rich' employees, that is for people who have labour income below and above the expected level of pay.

Chapter 3 studies the relationship between job satisfaction and satisfaction with various aspects

of job, while also explaining the constrains associated with the usage of FIML method and justifying the usage of LIML as an alternative method.

**Approbation of the research findings**

The findings of the dissertation research were presented and discussed at the following conferences:

- in 2023:
  - Fifth Russian Economic Congress, Yekaterinburg, September 11–15, 2023. Presentation title: 'Factors of job satisfaction in Russia.'
  - 5th Conference 'Applied Econometrics', organized by the Faculty of Economics, National Research Institute — Higher School of Economics, Moscow, April 21–22, 2023. Presentation title: 'Factors of job satisfaction in Russia'.
  - Workshop of the Central Economic Mathematical Institute of the Russian Academy of Sciences, Moscow, February 22, 2023. Presentation title: 'Factors of job satisfaction in Russia'.
- in 2022:
  - International Academic School-workshop named after academician S.S. Shatalin, 'System modeling of socio-economic processes', Krasnovidovo village, Mozhaisky district, Moscow region, October 3–9, 2022. Presentation title: 'Relative labor income as a determinant of wage satisfaction in Russia.'
- in 2021:
  - VII International Conference Modern Econometric Tools and Applications, Moscow, September 23–25, 2021. Presentation title: 'Who is satisfied with the salary? What do the RLMS data say?'.

The findings of the dissertation research were published as three papers, 3.6. printed sheets in total (the author's contribution is 2.4 printed sheets), in Russian peer-reviewed scientific journals recommended by the Higher Attestation Committee under the Ministry of Education and Science of the Russian Federation.

## 2. MAIN POINTS OF THE DISSERTATION

**Introduction** explains the relevance of the subject of the dissertation research, formulates research purpose and objectives, describes scientific contribution, theoretical and practical value of the findings, approbation of the results.

**Chapter 1** presents a literature review covering also the definition of pay satisfaction,

evolution of theoretical approaches used to identify the determinants of pay satisfaction, a more detailed discussion of the relationship between relative pay and overall pay satisfaction, as well as job satisfaction factors.

*Section 1.1.* traces the evolution of theoretical approaches to the factors influencing pay satisfaction. From the economic perspective, wage has been considered a key factor. Those who supported 'scientific management' paradigm, at the end of 19th and beginning of the 20th centuries, indicated that wage is among the most effective motivation tool for employees. However, when exploring the issue further, many behaviorists concluded that wage is of secondary importance. Later, the relationship between pay level and a person's attitude towards it became of more interest to the researchers, because firm managers could succeed more if they knew exactly how the factors of pay satisfaction relate to each other.

Pay satisfaction is interpreted as a general subjective perception of an individual about his pay (Heneman, 1985).

The early theoretical perspectives in pay satisfaction research were rooted in the assumption that salary is a meaningful factor of workers' motivation. For example, the theory of inequity (Adams, 1963) stipulates that an individual would compare his level of wellbeing against other people, so called reference group. This theory was developed further by Lawler into a theory of motivation (Lawler, 1971), that serves the theoretical basis of this dissertation research.

In accordance with the Lawler's theory of motivation, pay satisfaction level is the discrepancy between actual salary of an individual and the pay level that this individual considers to be appropriate for the work he performs. If discrepancy is small, a person feels satisfied with pay; if discrepancy is significant, the individual feels underpaid and gets dissatisfied. At the same time, many scholars underline that if discrepancy is significant but reverse — that is, when an individual's salary is above his expectations — than he also feels dissatisfied, although for other reasons, linked to the perceptions of unfairness and guilt. In this dissertation research, fair pay is interpreted as an individual's expected pay based on a specific combination of his socio-demographic characteristics, because a person tends to treat his work pay 'fair' when it is almost equal to the average wage of reference group, that is people with similar characteristics (level of education age, gender, etc.) (Chen et al., 2002; Hegtvedt, Markovsky 1995, pp. 257–280).

*Section 1.2.* studies relationship between a relative pay and pay satisfaction in more detail. A relative pay is the difference between the pay of the reference group (a group of people with which an individual compares himself) and the actual pay of an individual. This relationship can be either positive or negative. Negative relationship emerges when an individual feels envious of higher wages of people

from the reference group, considering it as a situation of unfair pay, dishonest competition, and vulnerability (Easterlin, 1995; Falk, Knell, 2004; Smith, 1880. C. 466). Positive relationship emerges if an individual feels sure that his salary will be at the level of the reference group in the future (Hirschman, Rothschild, 1973). It is important to note that both effects are simultaneous, and the one which dominates, will determine the overall impact of relative pay on the individual's pay satisfaction (Card et al., 2012; Clark et al., 2009; Mumford, Smith, 2015).

Russian scholarship addressing the relationship between pay satisfaction ad relative pay is scarce. As a rule, when researchers do study the determinants of individual pay satisfaction, they ignore the role of relative pay (Ankudinov et al., 2013; Kleimenova, Prokhoda, 2014). Other papers investigate job satisfaction and/or life satisfaction, but not pay satisfaction (Linz, 2003; Frijters et al., 2006; Smirnych, 2009; Linz, Semykina, 2012; Bartolucci et al., 2017; Veredyuk, 2020). Gordievskaya and Ustinova's (2019) work is most closely related to the issue of relationship between pay satisfaction and relative pay, as it analyses how an individual assesses the fairness of the ratio between his work input and salary. However, these authors did not analyse the impact of the reference group income. Hence, there is an obvious gap in the Russian literature in what concerns the impact of relative pay on pay satisfaction.

*Section 1.3.* describes the factors that influence job satisfaction. In economic research, a most often used characteristic of job is salary. However, in practice, a person considers and compares simultaneously numerous parameters of the job, all of which impact his decisions, including salary. Thus, Russian researchers have not studied thoroughly many aspects influencing individual's job satisfaction, have not compared contribution of those aspects to pay satisfaction against the contribution of pay level. Meanwhile, understanding the impact of various factors is of great practical relevance: it was found that people satisfied with their job, are more active and responsible employees, more loyal to their organization, tend to strengthen its image in the labour market, and are more disciplined (Sanchez-Beaskoetxea, Coca Garcia, 2015; Kalleberg, 1977; Clark, 2015; Lannoo, Verhofstadt, 2016).

Based on the existing literature, the key factors influencing job satisfaction, are the following:

1. 'Content of work', which refers to the social impact of the job, opportunity to ensure autonomy for an individual, and connection between personal interests of an employee and his job.
2. Pay level (Jung, Suh, 2019; Sainju et al., 2021; Stamolampros et al., 2019; Kotyrlo, 2023).
3. Professional development opportunities, career promotion (Stamolampros et al., 2019; Iverson, Maguire, 2000).
4. Working conditions (Zamfir, 1983; Sainju et al., 2021; Tarvid, 2015; Fetai et al., 2015).

Apart from those, other factors influencing job satisfaction may include reliability of the employer (Gardner, Oswald, 2002; Clark, 2005; Sainju et al., 2021), relationships with managers and coworkers (Crossman, Abou-Zaki, 2003; Zamfir, 1983) and others.

The research assessing the contribution of various factors to the overall job satisfaction is diverse. For example, Ahn and Garcia (2004) studied the contribution of various factors to overall job satisfaction using the data on 14 European countries for the period 1994–2001 and ranked the factors under study in the following way, starting from the most influential to the least influential: (a) content of work; (b) pay level; (c) working conditions; (d) security of employment.

Some country-specific peculiarities have been detected: factors (a) and (c) were more important for the countries of Central and Northern Europe, while factors (b) and (d) — for Mediterranean Europe. The authors highlight that the pay level contributes much less to the overall job satisfaction compared to an individual's health status and correlation between his professional qualification and actual work performed.

Similar findings were obtained by Leontaridi and Sloane (2004, p.87–140) using the data on the United Kingdom for the period 1991-1997: most influential factors appeared to be the content of work and an individual's autonomy in the workplace.

In Russia, job satisfaction was studied by Ustinova and Gordievskaya (2019). Their research was based on the data of the survey monitoring the qualitative state of the labor potential of the population of the Vologda region conducted in 2016. The research explores how job satisfaction is related to such factors as security of employment, additional guarantees, and fair pay. The results showed that pay level plays a key role in job satisfaction. Similar findings were also obtained by Smirnykh (2009): when changing the job, the salary and working conditions play much greater role for an individual's satisfaction with the new job, compared to the presence of higher education, the form of ownership of the company, the number of subordinates, etc.

The study of Osipov and Trushina (2021), based on the RLMS-HSE data for the period 2006–2018, is very closely related to the subject of this dissertation research. Osipov and Trushina studied job satisfaction of educational institutions' employees and researchers. The authors modeled job satisfaction as composed of numerous factors and used correlation analysis to measure relationship between those factors and overall job satisfaction. The results of the analysis showed that the most important factors were (in descending order of importance) working conditions, career opportunities, and pay level. However, these three factors could not be included in the regression models simultaneously, due to high multicollinearity.

Thus, Russian scholarship is quite scarce in terms of research focusing on modeling job

satisfaction as being determined by satisfaction with various aspects of job. Meanwhile, when understanding better what makes job satisfaction and which factors contribute to higher job satisfaction, employers can be more effective in hiring and retaining qualified employees, which is highly relevant with current labour shortages in the Russian labour market. These considerations constitute the motivation of this dissertation research.

In **Chapter 2**, pay satisfaction model is developed. *Section 2.3.* offers a basic pay satisfaction model which is further developed in *Section 2.4* into an expanded model.

*Section 2.2.* describes the data set used for the analysis, that is survey data of the RLMS-HSE for the period 2002–2022, for individuals aged 18–65, who gave responses to the question about their job satisfaction: 'Please, tell me, to what extent you feel satisfied or not satisfied with your salary:

1. Fully satisfied

7. Difficult to say

2. Rather satisfied

8. Refused to answer'.

3. Satisfied and not satisfied at the same time

4. Not very much satisfied

5. Not satisfied at all

It is worth noting that the question concerns only the individual's main job, since, moving to the 'Occupation' section of the questionnaire, the interviewer informs the respondent: 'Let us talk about your main occupation at the moment...'. The data on individuals' second and subsequent jobs was not used in the dissertation research.

Observations used for the analysis included responses ranging from 1 (fully satisfied) to 5 (not satisfied at all). At the beginning of the period under study, the sample is biased towards answers 'rather not satisfied' and 'not satisfied at all', but over time, the share of the 'satisfied' respondents is growing. The sample is gender-balanced.

*In Section 2.3.,* in the base pay satisfaction model, pay satisfaction is defined as:

1) the average salary of individuals with similar characteristics

2) deviation of pay from the average salary

The base model is a system of equations for each year:

$$\begin{cases} \ln w_i = x_i'\beta + \varepsilon_i \\ S_i^* = \alpha_1 E(\ln w_i) + \alpha_2 \big(\ln w_i - E(\ln w_i)\big) + v_i \end{cases} \tag{1}$$

The first line in the system of equations (1) is wage equation. Here $i$ is an individual in the sample, $\varepsilon_i$ is a random error having a normal distribution with zero mean and variance $\sigma^2$, $x_i'$ is a row vector of individual's characteristics, and $\beta$ is a column vector of the corresponding coefficients, so that

$$x_i'\beta = \beta_0 + \beta_1 age_i + \beta_2 age_i^2 + \beta_3 female_i + \beta_4 tenure_i + \beta_5 manager_i +$$
$$\beta_6 secondary\_education_i + \beta_7 higher\_education_i + \beta_8 \ln \_average\_wages_i +$$
$$\beta_9 regional\_center_i + \beta_{10} city_i + \beta_{11} Moscow_i + \beta_{12} St\_Petersburg_i \qquad (2)$$

Individuals' characteristics used in the wage equation (2) are listed in Table 1.1.

Table 1.1. — Individuals' characteristics used in the wage equation in the model (1)

| Pay satisfaction | $S_i$ | = 1 if fully satisfied<br>= 2 if rather satisfied<br>= 3 if both satisfied and not satisfied<br>= 4 if not really satisfied<br>= 5 if absolutely not satisfied |
|---|---|---|
| Wage | $\ln w_i$ | Logarithm of the average wage in the last 12 months |
| Age | $age_i$ | Age (years) |
| Female | $female_i$ | = 1 if female<br>= 0 otherwise |
| Length of service at the current job | $tenure_i$ | Length of service at the current job (years) |
| Having subordinates at work | $manager_i$ | = 1 if a respondent has subordinates<br>= 0 otherwise |
| Vocational education | $secondary\_education_i$ | = 1 if a respondent has vocational or technical education<br>= 0 otherwise |
| Higher education | $higher\_education_i$ | = 1 if a respondent has completed higher educational institution, any modality<br>= 0 otherwise |
| Average monthly wage in the region | $\ln \_average\_wages_i$ | Logarithm of the accrued average monthly wage in the region according to Rosstat data for the corresponding year |
| Regional centre | $regional\_center_i$ | = 1 if a respondent's place of residence in a regional centre, but not in Moscow or St. Petersburg<br>= 0 otherwise |
| City | $city_i$ | = 1 if a respondent's place of residence is in a city<br>= 0 otherwise |
| Moscow | $Moscow_i$ | = 1 if a respondent lives in Moscow<br>= 0 otherwise |
| St. Petersburg | $St\_Petersburg_i$ | = 1 if a respondent lives in St. Petersburg<br>= 0 otherwise |

*Source: (Dubnovitskaya, 2021)*

The control variables include a set of socio-demographic parameters often used in the wage-related research based on the data from RLMS-HSE (Oshchepkov, 2006; Lukyanova, 2009; Egorov,

2015; Ovchinnikov, Malkina, 2009), such as gender, age, education level, length of service at the current workplace, the fact of having subordinates as a dummy-variable to indicate a managerial position, average monthly wage (both the individual's wage and average wage in the corresponding region), type of the administrative-territorial unit where a respondent resides, specifying if it is Moscow or St. Petersburg.

The second line of the equation system (1) is the pay satisfaction equation, where $S_i^*$ is the unobservable level of pay satisfaction, $\alpha_1$, $\alpha_2$ are the estimated parameters, $E(\ln w_i)$ is the expected value of pay level for an individual with given characteristics $x_i'$, $v_i$ is a random error that has a logistic distribution. The value $\alpha_1 E(\ln w_i)$ would be named *the contribution of the typical* (average for the reference group) *wage into the pay satisfaction* of an employee $i$, and the value $\alpha_2(\ln w_i - E(\ln w_i))$ is the *contribution of the atypical wage into the pay satisfaction.* The value $\frac{\alpha_2}{\alpha_1}$ shows how many times higher satisfaction results from a percentage change in the atypical wage compared to a similar percentage change in the typical wage. In other words, this value reflects the importance of social comparison as a determinant of pay satisfaction.

The pay satisfaction equation is fully consistent with an ordered logit regression with the only difference being that the explanatory variables in this regression are not observable, because these include the value $E(\ln w_i)$. Therefore, instead of the standard procedure of the logit model estimation, the entire system of equations (1) is estimated. It is assumed that the observations are independent, and the random errors in the two equations are not influenced by each other, so the likelihood function is:

$$L = L^{(1)}(\ln w_i\,; x_i', \beta, \sigma^2) * L^{(2)}(S_i; x_i', \beta, \alpha_1, \alpha_2, \mu_1, \mu_2, \mu_3, \mu_4 | \ln w_i) \tag{3}$$

Here $L^{(1)}$ represents the first component of the likelihood function for the wage equation. It is assumed that the wage logarithm has a normal distribution with constant variance $\sigma^2$. Then $L^{(1)}$ represents the normal distribution density $\ln w_i$ with expected value $x_i'\beta$ and variance $\sigma^2$:

$$L^{(1)}(\ln w_i\,; x_i', \beta, \sigma^2) = \prod_{i=1}^{n} \frac{1}{\sqrt{2\pi\sigma^2}} e^{\frac{-(\ln w_i - x_i'\beta)^2}{2\sigma^2}} \tag{4}$$

The second component of the likelihood function $L^{(2)}$ corresponds to the ordered logit regression model. In accordance with the logit regression procedure, the range of all possible values of the latent satisfaction level $S_i^*$ is divided into intervals by threshold values $\mu_m$, so that specific interval of the unobserved variable $S_i^*$ would determine the value of the observed variable $S_i$ ranging from 1 to 5. Then the probability that for observation $i$, satisfaction $S_i$ will take the value $j$ , is:

$$p_{ij} = p(S_i = j) = p(\mu_{j-1} < S_i^* \leq \mu_j) = F(\mu_j - S_i^*) - F(\mu_{j-1} - S_i^*), \tag{5}$$

where $F(z)$ is the logit distribution function, $F(z) = \dfrac{e^z}{1+e^z}$ ; $S_i^*$ is a latent pay satisfaction level of an individual $i$, $S_i^* = \alpha_1 x_i' \beta + \alpha_2 (\ln w_i - x_i' \beta)$; $\mu_m$ is threshold values for $S_i^*$. Then, the component $L^{(2)}$ is:

$$L^{(2)}(S_i; x_i', \beta, \alpha_1, \alpha_2, \mu_1, \mu_2, \mu_3, \mu_4 | \ln w_i) = \prod_{S_i=1} F(\mu_1 - S_i^*) * \prod_{S_i=2} [F(\mu_2 - S_i^*) - F(\mu_1 - S_i^*)] *$$

$$\prod_{S_i=3} [F(\mu_3 - S_i^*) - F(\mu_2 - S_i^*)] * \prod_{S_i=4} [F(\mu_4 - S_i^*) - F(\mu_3 - S_i^*)] * \prod_{S_i=5} [1 - F(\mu_4 - S_i^*)] \quad (6)$$

General likelihood function $L$ consists of $L^{(1)}$, which is the contribution of the first equation to the likelihood value in observation $i$, and $L^{(2)}$ being the contribution of the second equation. Maximizing the logarithm of the likelihood function allows to obtain numerical values for the estimates of the coefficients in the system of equations (1).

The model was estimated using Stata software, separately for each year in the period 2002–2022, for the total sample, as well as separately for men and women. An original program was developed to simultaneously evaluate both expressions of model (1).

The expanded model of pay satisfaction in *Section 2.4* assumes that the reference group wage level may have a different impact on individuals depending on their own wage level. For example, somewhat low-paid employees are more likely to compare themselves to other people, and thus, will be more likely to assess their subjective well-being relative to the others' income level (Clark, Senik, 2010; Solnick, Hemenway, 1998). In contrast, pay satisfaction of the individuals with higher wages would be less affected by relative income (Clark et al., 2010). However, the findings of the studies on this issue are controversial, making the development of the expanded model based on the Russian data well-justified.

The expanded model of pay satisfaction is a system of two equations: wage equation and pay satisfaction equation. The difference from the base model is that in the pay satisfaction equation, two types of deviation of the actual wage from the expected one (the so-called atypical wage) — positive and negative deviation — appear as two separate regressors.

This dissertation research makes use of two modifications of the above equation system. In one ("short") version, the distribution of pay satisfaction level is influenced only by the expected value of the logarithm of the wage and the deviation of the actual wage logarithm from the expected wage:

$$\begin{cases} \ln w_i = x_i' \beta + \varepsilon_i & (7) \\ \ln \dfrac{P(S_i > j)}{P(S_i \le j)} = \alpha_1 E(\ln w_i) + \alpha_2 I_i^+ \big(\ln w_i - E(\ln w_i)\big) + \alpha_3 I_i^- \big(\ln w_i - E(\ln w_i)\big) & (8) \\ \qquad\qquad\qquad j = 1,2,3,4 \end{cases}$$

Here, $w_i$ is the wage of an employee $i$, paid out in the previous month.

$x_i^{'}$ is a row vector of explanatory variables representing an employee's characteristics and place of residence (identical to the base model from *Section 2.3*) in the wage equation;

$\beta$ is a vector of the explanatory variables' coefficients in the wage equation;

$\varepsilon_i$ is a random component;

$S_i$ is a response of an employee $i$ to the question about satisfaction with salary (1 is 'fully satisfied', 5 is 'not satisfied at all');

$I_i^+ = 1$, if $\ln w_i \geq E(\ln w_i)$, 0 otherwise;

$I_i^- = 1$, if $\ln w_i < E(\ln w_i)$, 0 otherwise.

$\alpha_1, \alpha_2, \alpha_3$ are the coefficients of the satisfaction equation.

Equation (8) allows representation through the unobservable level of satisfaction $S_i^*$, which is related to the explanatory variables as follows:

$$S_i^* = \alpha_1 E(\ln w_i) + \alpha_2 I_i^+ \big(\ln w_i - E(\ln w_i)\big) + \alpha_3 I_i^- \big(\ln w_i - E(\ln w_i)\big) + v_i \qquad (9)$$

where $v_i$ is a random error with a distribution function $F_v(z) = \exp(z)/(1+\exp(z))$, and the observed responses $S_i$ are obtained by discretization of the latent satisfaction level $S_i^*$. In such representation, the coefficients $\alpha_1$, $\alpha_2$, $\alpha_3$ can be easily interpreted as reflecting the contribution of a one-unit change in the value of explanatory variable to the pay satisfaction level.

In the second ('long') version of the model, the pay satisfaction equation includes an employee's characteristics and the place of residence:

$$\ln \frac{P(S_i > j)}{P(S_i \leq j)} = x_i' \gamma + \alpha_2 I_i^+ \big(\ln w_i - E(\ln w_i)\big) + \alpha_3 I_i^- \big(\ln w_i - E(\ln w_i)\big)$$
$$j = 1,2,3,4 \qquad (11)$$

Here $\gamma$ is the added vector of estimated coefficients for the characteristics of an individual (identical to the base model from *Section* 2.3). This option makes it possible to link satisfaction with an individual's characteristics, but does not allow to assess the contribution of 'typical' wage to dissatisfaction, since the term $\alpha_1 E(\ln w_i)$ is removed from the equation because the coefficient $\alpha_1$ is not identifiable due to the strict multicollinearity.

The method of full information maximum likelihood was chosen for estimating the expanded model represented in two versions. To account for possible gender differences in the studied context, the base model and expanded model were estimated separately for men and women. Models were also estimated for each year separately.

*Section* 2.5 contains the conclusions of Chapter 2.

**Chapter 3** of the dissertation research studies the relationship between job satisfaction and various aspects of job: pay satisfaction, working conditions, career prospects. In Chapter 2 it was shown that negative deviations of the actual wage from the average wage of an individual with similar characteristics has little impact on the overall pay satisfaction. This finding may indicate that for these employees, other aspects of professional activity have more impact on their overall attitude to the job: in this regard, Chapter 3 aims at finding out which aspects of job satisfaction play the key role.

*Section 3.2.* provides an overview of the data used for the analysis, describes job satisfaction model and explains the use of the limited information maximum likelihood method for the model estimation.

In Chapter 3 [just as in Chapter 2] the analysis relies on the survey data from RLMS-HSE for individuals aged 18–65, for the period 2002–2022, and, specifically, on their responses concerning job satisfaction, pay satisfaction, working conditions, and career prospects. Each variable has a discrete ordered value ranging from 1 to 5, where 1 means 'fully satisfied', and 5 corresponds to 'not satisfied at all'.

Modeling the relationship between job satisfaction and its components was based on the assumption used in the analysis of qualitative characteristics: for each answer on a five-point scale there is an unobservable continuous random variable, reduced to a discrete scale by grouping into intervals. Thus, the observed level of job satisfaction in general for the i-th respondent is related to the latent ("true") level of satisfaction as follows:

$$J_i = \begin{cases} 1, & \text{если } J_i^* < \alpha_1^J, \\ 2, & \text{если } \alpha_1^J < J_i^* < \alpha_2^J, \\ 3, & \text{если } \alpha_2^J < J_i^* < \alpha_3^J, \\ 4, & \text{если } \alpha_3^J < J_i^* < \alpha_4^J, \\ 5, & \text{если } \alpha_4^J < J_i^*. \end{cases} \tag{12}$$

where $\alpha_1^J, \dots, \alpha_4^J$ are the boundaries of class intervals.

Similarly, the variables of wage satisfaction ($W_i$), working conditions ($C_i$) and job promotion prospects ($P_i$) were linked to unobservable values $W_i^*, C_i^*, P_i^*$. The fourth component is the contribution of other factors.

It is assumed that the variables $J_i^*, W_i^*, C_i^*, P_i^*$ have a joint normal distribution with zero expected value, unit variances and an unknown correlation matrix:

$$\begin{pmatrix} J_i^* \\ W_i^* \\ C_i^* \\ P_i^* \end{pmatrix} \sim N\left( \begin{pmatrix} 0 \\ 0 \\ 0 \\ 0 \end{pmatrix}, \begin{pmatrix} 1 & \rho_{JW} & \rho_{JC} & \rho_{JP} \\ \rho_{WJ} & 1 & \rho_{WC} & \rho_{WP} \\ \rho_{CJ} & \rho_{CW} & 1 & \rho_{CP} \\ \rho_{PJ} & \rho_{PW} & \rho_{PC} & 1 \end{pmatrix} \right) \tag{13}$$

The model includes 22 estimated parameters: 6 are elements of the correlation matrix and 16 are boundaries of the class intervals of unobserved levels of satisfaction $\alpha_m^J, \alpha_m^W, \alpha_m^C, \alpha_m^P, \ m = 1, \ldots, 4$ . The parameters were estimated using the maximum likelihood method. The model represents a specific case of a multivariate ordered probit model, where all variables are included as endogenous. This methodology was chosen due to the peculiarities of the variables, which are all ordered discrete variables with a limited set of values.

It was not the estimated correlations that were of interest, but rather the parameters of representing the model in the form of a regression equation:

$$J_i^* = \beta_1 W_i^* + \beta_2 C_i^* + \beta_3 P_i^* + \varepsilon_i, \tag{14}$$

where $\beta_1, \beta_2, \beta_3$ are regression coefficients determined by the elements of the correlation matrix, $\varepsilon_i$ is a random component defined by the equation:

$$\varepsilon_i = J_i^* - \mathrm{E}\left( J_i^* \mid W_i^*, C_i^*, P_i^* \right) = J_i^* - \beta_1 W_i^* - \beta_2 C_i^* - \beta_3 P_i^*, \tag{15}$$

and not dependent on variables $W_i^*, C_i^*, P_i^*$ . Following the assumption of joint normality, the value $\varepsilon_i$ has a normal distribution, and the regression equation is linear, so that the coefficients are related to the correlation matrix of the values $J_i^*, W_i^*, C_i^*, P_i^*$ by the following relation:

$$\begin{pmatrix} \beta_1 \\ \beta_2 \\ \beta_3 \end{pmatrix} = \begin{pmatrix} 1 & \rho_{WC} & \rho_{WP} \\ \rho_{CW} & 1 & \rho_{CP} \\ \rho_{PW} & \rho_{PC} & 1 \end{pmatrix}^{-1} \begin{pmatrix} \rho_{WJ} \\ \rho_{CJ} \\ \rho_{PJ} \end{pmatrix} \tag{16}$$

The coefficients $\beta_1, \beta_2, \beta_3$ are standardized and can be used to compare the contribution of components to overall job satisfaction. The contribution of the fourth component (other factors) corresponds to the standard deviation of the random component $\varepsilon_i$:

$$\sigma_\varepsilon = \sqrt{\mathrm{D}\left( J_i^* - \beta_1 W_i^* - \beta_2 C_i^* - \beta_3 P_i^* \right)} \tag{17}$$

The estimations were carried out using data for the period 2002–2022, separately for each year, and, additionally, for subsamples of men and women applying the full information maximum likelihood method.

A computational problem arises when using full information maximum likelihood (FIML) method to estimate multivariate ordered probit regression if more than two equations are included into the model. This problem can be solved if evaluating not the entire correlation matrix $\Sigma$ at once, but by pairs - $(Y, X_1), (Y, X_2) \dots (X_{k-1}, X_k)$. This would be a variation of the *limited information maximum likelihood (LIML) method*. Further steps in calculating coefficient estimates and random error variance remain, but the estimation time is shortened significantly without a significant loss of the estimation quality.

To test the potential of LIML for estimating multivariate ordered probit regressions, the dissertation study estimated the job satisfaction model, first, using FIML, and then using LIML, and compared the results — for each year in the period of 2002–2022 within the joint sample, and separately for men and women. The difference in coefficient estimates and standard errors of model (14), estimated using FIML and LIML, does not seem large. The coefficient estimates differ by less than 0.02. However, the model estimation procedure is tens of times faster: to calculate coefficient estimates using FIML would take from 10 to 60 minutes, depending on the number of observations, while using LIML would take 15–120 seconds — implying a total of 15–120 seconds to estimate six correlation coefficients $(Y, X_1), (Y, X_2), (Y, X_3), (X_1, X_2), (X_1, X_3), (X_2, X_3)$.

The difference in estimation time is especially pronounced when more variables are included into the model. For the additional 2020 model which contains not three, but seven aspects of job satisfaction as regressors, the model estimation time difference was multiple: coefficients estimation took 360 minutes using FIML, and only 3 minutes using LIML.

*Section 3.3*. contains the conclusions of Chapter 3.

## 3. KEY RESULTS

The dissertation research analyzes certain factors affecting pay satisfaction and job satisfaction in Russia. Specifically, the study examined the influence of an individual's reference group wage on their pay satisfaction, as well as the impact of various facets of job satisfaction on the overall indicator based on data from the RLMS HSE 2002–2022.

Based on the study, comparing one's wage with the reference group wages plays a far more important role than one's own wage in assessing one's pay satisfaction. People compare their wages with the wages of other people with similar characteristics, and this comparison has a greater impact on their satisfaction than their absolute wage value. Moreover, if one divides individuals into relatively low-paid and high-paid, it turns out that satisfaction is more sensitive to the deviation of one's own wage from the reference group in a positive direction rather than a negative one, contrary to what can be found in the literature. In other words, the wages of others is more significant for individuals with

a relatively high income rather than for low-income individuals, despite the latter being more prone to comparing themselves with others, and their income having a greater impact on subjective well-being than that of the former (Clark, Senik, 2010; Solnick, Hemenway, 1998). These theses hold true throughout the entire period from 2002 to 2022 for both men and women, as no significant difference was found between them in this regard.

The underscored significance of comparison for subjective well-being entails several implications. In a world where comparisons exist, the argument that economic growth leads to increased happiness for everyone does not seem to hold. This is closely related to the Easterlin paradox (Easterlin, 1974, pp. 89–125), which posits that although individuals with higher incomes are typically happier than their less affluent counterparts at a given point in time, these higher incomes do not lead to increased happiness over time. Hence, it follows that a persistent orientation towards economic growth as a means of increasing happiness may prove to be an inadequate strategy. The issue lies in the fact that, *in comparison* to more developed countries or individuals with higher incomes, individuals may feel less satisfied, despite the overall economic growth. Turning to pay satisfaction, if the wages of a reference group majorly affect it through comparison, then it stands to reason to reconsider some established opinions on economic policy. Specifically, negative externalities associated with individuals' perceptions of their societal standing (Oswald, 1983) may imply that the societal cost of income inequality is substantially higher than conventionally believed, leading to corresponding implications for the optimal tax policy. Similarly, firm-offered wages may exhibit low variance if strong within-firm comparison effects are prevalent and may increase over time as workers compare their current wages to their own previous ones (Frank, Hutchens, 1993).

Regarding a broader concept of job satisfaction, the results of the dissertation research indicate that the greatest impact on it is made by the satisfaction with working conditions compared to the satisfaction with pay and opportunities for professional growth; with the impact having a noticeable margin over others, increasing over time, and again, without significant differences found between men and women in the studied context. The rising effect of satisfaction with work conditions on the overall job satisfaction is most likely explained by the fact that contemporary employees tend to value comfortable working conditions more than high remuneration or opportunities for professional growth. This phenomenon may be related to the shifting priorities and values among workers in modern Russia, where the pursuit of a work-life balance is becoming increasingly relevant.

The obtained results point to the necessity of paying a particular attention to improving working conditions within the organization. This implies the reorganization of workplaces, flexible/hybrid work schedules, fostering a favorable corporate culture, implementing new technologies, and other measures aimed at enhancing employee comfort. By emphasizing non-material benefits, employers

can distinguish themselves in the competitive landscape to attract potential employees, reduce turnover rates, and increase job engagement, all of which are intended to foster greater productivity. Considering the broader perspective, the significant role of non-material benefits in employment justifies the need to revise many studies on the returns to education. Conventional economic studies often limit themselves to the material compensation of employees while assigning secondary importance to, or entirely disregarding, other benefits (Shultz, 1961; Becker, 1964; Mincer, 1974; Borisov, 2017). This leads to a distorted assessment of the effectiveness of education since it is known that individuals consider multiple factors when making career decisions, and financial returns do not necessarily prevail. Therefore, it stands to reason to reconsider traditional research on the returns to education for a more comprehensive understanding of its implications.

From a methodological perspective, the dissertation research examines the feasibility of applying the limited information maximum likelihood method (in comparison to the full information one) for estimating multivariate ordered probit regressions and demonstrates its advantages in such cases. Even though in econometrics the limited information maximum likelihood method for linear regression has been known since the beginning of the last century, its application to probit models is not common; they are mostly estimated using the full information method. However, in case of regressions with multivariate ordinal variables, the latter can pose a computationally challenging task, potentially requiring significant time for solution. As shown in the dissertation, the limited information maximum likelihood method allows for a substantial reduction in the estimation time of such models without significant loss of quality, compared to the full information maximum likelihood method. Whenever one needs to carry out a mass of calculations (due to a large number of equations or observations), as in the present study, this advantage can be of fundamental importance. In addition, the potential for applying the limited information maximum likelihood method extends beyond probit regressions. It appears promising for analyzing any samples with multivariate ordinal features (for example, within the framework of component and factor analysis). The latter are quite widespread in research that is in demand by commercial companies, such as the study of consumer satisfaction with goods and services.

## 4. PUBLICATIONS ON THE TOPIC OF THE DISSERTATION

The studies published by the author in leading peer-reviewed scientific journals recommended by the Higher Attestation Commission of the Ministry of Education and Science of the Russian Federation are as follows:

1. Dubnovitskaya, Anastasia & Furmanov, Kirill, 2023. «Job satisfaction in Russia: Wages, working conditions and promotion opportunities». Applied Econometrics, Russian Presidential Academy of National Economy and Public Administration (RANEPA), vol.

72, pages 121–139.

2. Dubnovitskaya, Anastasia & Furmanov, Kirill, 2022. «Relative wage as a determinant of pay satisfaction in Russia». Applied Econometrics, Russian Presidential Academy of National Economy and Public Administration (RANEPA), vol. 66, pages 99–117.

3. Dubnovitskaya, Anastasia, 2021. «Who is satisfied with their pay? Evidence from the Russian Longitudinal Monitoring Survey». Applied Econometrics, Russian Presidential Academy of National Economy and Public Administration (RANEPA), vol. 64, pages 49–69.

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