DECOMPOSING WEALTH INEQUALITY IN THE EU COUNTRIES

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Abstract

This study explores a range of advanced statistical decomposition techniques to analyse the structure and determinants of wealth across selected EU countries, using data from the Household Finance and Consumption Survey (HFCS). Specifically, it applies the Kitagawa-Oaxaca-Blinder decomposition, the Machado-Mata decomposition, and the Juhn-Murphy-Pierce decomposition to disentangle the contributions of various economic, demographic, and social factors to overall wealth inequality. These methods allow for a nuanced examination of the extent to which disparities in wealth can be explained by observable characteristics, such as education, income, employment status, and household composition, as well as unobservable or residual differences related to gender, age, or regional disparities. By comparing the outcomes of these decomposition techniques, the study highlights their respective strengths and limitations in identifying and quantifying the drivers of inequality. The findings provide critical insights into the relative explanatory power of each method and help determine the most appropriate approach for analysing wealth distribution. Furthermore, based on the empirical results, the study offers evidence-based recommendations aimed at reducing wealth inequality and promoting a more equitable distribution of economic resources within and across EU countries.

Key words: decomposition, method, wealth

JEL Code: D31, G51, D61

Introduction

Wealth inequality is a major social and economic challenge, affecting both individual well-being and broader economic stability. Gender and age are key factors influencing how wealth accumulates, as caregiving roles and life-cycle stages impact wealth patterns differently for men and women, and for those in productive versus non-productive age groups.

This paper uses decomposition methods to separate wealth gaps into explained parts—based on observable characteristics—and unexplained parts, reflecting deeper structural

inequalities. Focusing on Slovakia and the Czech Republic, which share similar socio-economic histories, the study examines gender-based wealth disparities across age groups to answer:

Despite more than two decades of independent development, the Slovak and the Czech Republic remain closely aligned. The main objective of this paper is to examine wealth disparities between men and women across both productive and non-productive age groups in the Slovak and in the Czech Republic using decomposition methods. The paper aims to answer the following research question:

'What are the explained and unexplained components of gender-based wealth inequality across age groups in the Czech Republic and Slovakia, as identified through decomposition methods?'

1 Literature review

The Wealth inequality persisting in society is more unequal than income inequality. Despite the traditionally received smaller attention in the literature, several authors focus on the wealth-related aspects in their publications, such as Piketty (2014), Zucman (2014), and Atkinson (2015).

The concept of wealth has evolved over decades to encompass all forms of ownership and societal assets. Wealth is commonly understood as surplus and well-being (Semyonov & Lewin-Epstein, 2013). In modern economic theory, wealth is defined as a stock variable, representing the total value of accumulated tangible and intangible assets at a given point in time (Chancel et al., 2022). However, due to challenges in measurement and individual variability, most empirical studies limit their scope to material forms of wealth (Grabka, 2013; Hauser & Stein, 2004). More precisely, wealth is often defined as the net value of financial and non-financial assets minus liabilities (Piketty, 2014).

The disparity reflects heterogeneity, unevenness, or inequality. While inequality is not inherently problematic - especially when it results from fair processes and individual effort -it becomes a concern when persistent disparities undermine long-term economic sustainability and contribute to dissatisfaction in society (Giddens, 2000).

The distribution of wealth across demographic groups, particularly by age and gender, has been analysed in recent publications such as those by the World Economic Forum (2022) and Cordova et al. (2022). In addition, the distribution of wealth is persistent across generations, making its analysis critical for understanding long-term structural inequalities. Therefore, age is a crucial factor in wealth dynamics.

Young adults struggle with wealth creation due to high housing prices and problems related to entering the labour market. When entering the post-productive age, the decumulation occurs. These processes are strongly influenced by consumption and propensity to save. Additional impacts apart from income, consumption, and savings influencing wealth vary significantly depending on inheritance, education level, and health (Attanasio & Hoynes, 2000; Wolff, 2017).

In Central Europe, local researchers have adapted wealth measures and examined wealth inequalities. Despite the political separation following the dissolution of Czechoslovakia, labor market conditions, social structures, and demographic trends have remained relatively similar in Slovakia and the Czech Republic for several decades (Fessler & Tzamourani, 2020).

To quantify and analyze wealth disparities, decomposition methods—commonly used in wage inequality studies—have increasingly been applied to wealth inequality research. Notable studies by Brzezinski & Salach (2020) and Leitner (2018) have leveraged datasets such as the Household Finance and Consumption Survey (HFCS) to examine wealth gaps in depth.

Despite the growing body of literature, empirical analyses focusing specifically on wealth inequality by gender and age within the Czech and Slovak contexts using diverse decomposition techniques remain limited. This paper aims to fill that empirical and methodological gap by providing a comparative analysis of wealth inequality in these two countries, utilizing high-quality HFCS data.

2 Data and Methodology

This paper uses microdata from the Household Finance and Consumption Survey (HFCS), conducted on a regular three-year basis is regarded as one of the most suitable datasets for wealth-related analysis. The paper focuses on the latest Wave 4 data from 2021, examining the Czech Republic and the Slovak Republic due to their shared socio-economic history and comparable economic structures (European Central Bank, 2021). The access to the microdata is granted for academic and scientific purposes.

All monetary wealth-related variables are aggregated and adjusted by the ECB, and these adjusted variables are included in the imputations. The analysed dataset consists of 5 imputations of variables listed in 5 separate data files. This paper does not consider the replicate and household weights for this survey. The analysis is performed on the answers of 6 730 respondents from the Czech Republic and 4 939 respondents from the Slovak Republic (European Central Bank, 2021).

Tab. 1 Overview of the variables included the analysis

Variable ID	Name of the variable	Variable type	Inclusion into the analysis
DN3001	Net wealth, excl. Public and occupational pensions	Numerical value	Dependent variable analyzed in the paper
DA3001	Total assets 1, excl. public and occupational pension plans	Numerical value	Explanatory variable included in the decomposition, the sum of real and financial assets, levels of the assets are the most crucial parts contributing to the wealth level
DI2000	Total household gross income 2, including interest payments	Numerical value	Explanatory variable included in the decomposition, the level of income represents the method of accumulation of wealth through savings and determines the level of consumption
DOCOGOOD	Amount spent on consumer goods and services, annual	Numerical value	Explanatory variable included in the decomposition, consumption influences the wealth level as part of the income, and wealth is consumed to satisfy the needs
RA0200	Gender Gender of the survey respondent	Binary variable - 1 - Male, 2 - Female Reclassified - 0 - Female, 1 - Male	Gender-related aspects are considered, as for each gender, there are different wealth levels
RA0300	Age	Numerical variable	Age-related aspects are considered, as for each age, there are different wealth levels
RA0300_B	Age in brackets Where the bracket value is the lower bound of each age group	Numerical value - Age in brackets: 0-6=>0, 7-13=>7, 14-15=>14, 16-19=>16, 20-24 =>20, 25-29 =>25, 30-34 =>30, 35-39 =>35, 40-44 =>40, 45-49 =>45, 50-54 =>50, 55-59 =>55, 60-64 =>60, 65-69 =>65, 70-74 =>70, 75-79 =>75, 80-84 =>80, 85+ =>85 Reclassified - 0 - Non-productive age: 0–14 and 65+ years, 1 - Productive age: 15–64 years	

Source: Author's own work according to ECB (2021)

The paper study applies three complementary decomposition methods - Oaxaca-Blinder, Machado-Mata, and John-Murphy-Pierce - to analyse the observed wealth gaps between men and women. These methods account for the quantification of differences by attributing them to observable characteristics. All of the calculations were performed in R on data, for Oaxaca-Blinder method using package *oaxaca* and for Machado-Mata and Juhn-Murphy-Pierce methods, the calculations were performed manually (Hlaváč, 2022). Analyses were performed separately for each multiple imputation dataset, with results pooled according to Rubin's rules.

The **Oaxaca-Blinder** (1973) decomposition method focused on mean gaps and inequality. It decomposes the difference in average outcomes, in our case net wealth, between two groups—such as men and women into two parts.

Average values for A – men and B – women (Hlaváč, 2014):

$$\bar{Y}_A = \hat{\beta}_A \bar{X}'_A \tag{1.1}$$

$$\bar{Y}_B = \hat{\beta}_B \bar{X}'_B \tag{1.2}$$

$\bar{Y}_A, \bar{Y}_B$ – average outcome (i.e. net wealth level) for men, respectively for women

$\hat{\beta}_A, \hat{\beta}_B$ – estimated regression coefficient for group men, respectively for women

$\bar{X}'_A, \bar{X}'_B$ – a vector of average characteristics for men, respectively for women

Then, the difference in average outcomes is rewritten as followed (pooled) (Hlaváč, 2014):

$$\Delta\bar{Y} = \bar{X}'_A\hat{\beta}_A - \bar{X}'_B\hat{\beta}_B \tag{1.3}$$

$$\Delta\bar{Y} = (\bar{X}_A - \bar{X}_B)'\hat{\beta}_R + \bar{X}'_A(\hat{\beta}_A - \hat{\beta}_R) + \bar{X}'_B(\hat{\beta}_R - \hat{\beta}_B) \tag{1.4}$$

- Explained component: Attributes explained by group differences in observable characteristics (Hlaváč, 2014) (first term)
- Unexplained component: Attributes explained by differences in the returns to these characteristics (Hlaváč, 2014) (second and third term)

The decomposition is based on linear regression models estimated separately for each group. The method is applied in the paper with bootstrapping (R = 100) and robust standard errors to ensure statistical validity.

The **Machado-Mata** (2005) decomposition method extends the Oaxaca-Blinder framework by incorporating distributional decomposition using quantile regression techniques. Instead of focusing solely on the mean difference when compared to the Oaxaca-Blinder decomposition, the Machado-Mata allows the analysis of differences across the entire distribution of wealth in each quantile. The method allows to reflect the lower and upper tails of the wealth distribution,

which include extreme values. The method includes reweighting one group's covariates using the other group's coefficient estimates (Machado & Mata, 2005).

Estimated quantile regressions for each group separately – now $\beta^A(\tau)$ for men and simulate for $i \epsilon B$ the function as followed:

$$Y_i^{Counter} = X_i^B . \beta^A(u_i) \quad (1.5)$$

- β^A - quantile-specific coefficient for men
- X - vector of explanatory variables
- u_i – random quantile

Decomposed to:

$$F^B(Y) - F^A(Y) = F^B(Y) - F^{B|A}(Y) + F^{B|A}(Y) - F^A(Y) \quad (1.6)$$

- $F^A(Y)$ - distribution of men
- $F^B(Y)$ - distribution of women
- $F^{B|A}(Y)$ - counterfactual distribution meaning women's covariates with men's coefficients (Machado & Mata, 2005)

The **Juhn-Murphy-Pierce** (1993) decomposition method is a simplified method focused on the decomposition of the total outcome difference into differences in coefficients and interaction effects. Primarily applied to wage inequality, extending the Oaxaca-Blinder decomposition and points to residuals (Juhn, Murphy & Pierce, 1993):

$$Y_i = X_i\beta + R_i \quad (1.7)$$

- Y_i - the outcome variable (i.e. net wealth),
- X_i - vector of observed characteristics,
- β – vector of estimated coefficients
- R_i – the residual (Juhn, Murphy & Pierce, 1993)

Then, the equation is rewritten to for group A, respectively for group B:

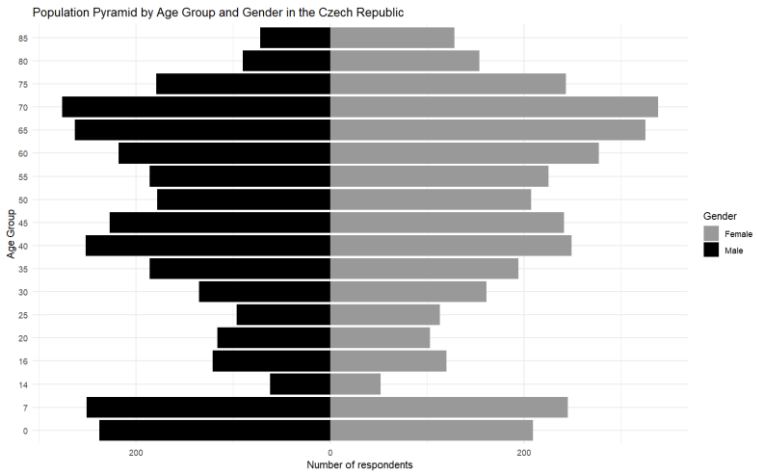
$$(\bar{Y}^A - \bar{Y}^B) = (\bar{X}^A - \bar{X}^B)\hat{\beta}^B + \bar{X}^A(\hat{\beta}^A - \hat{\beta}^B) + (\bar{R}^A - \bar{R}^B) \quad (1.8)$$

- Composition effect: Change due to observable characteristics (first term)
- Coefficient effect: Change due to returns to characteristics (second term)
- Unexplained inequality: Change in residuals (third term) (Juhn, Murphy & Pierce, 1993)

3 Results and Discussion

This section presents empirical results focused on net wealth based on HFCS Wave 4 microdata (2021) for the Czech and Slovak Republic. Fig. 1 and 2 show age-gender distribution pyramids for both countries, illustrating population structures by age group and gender.

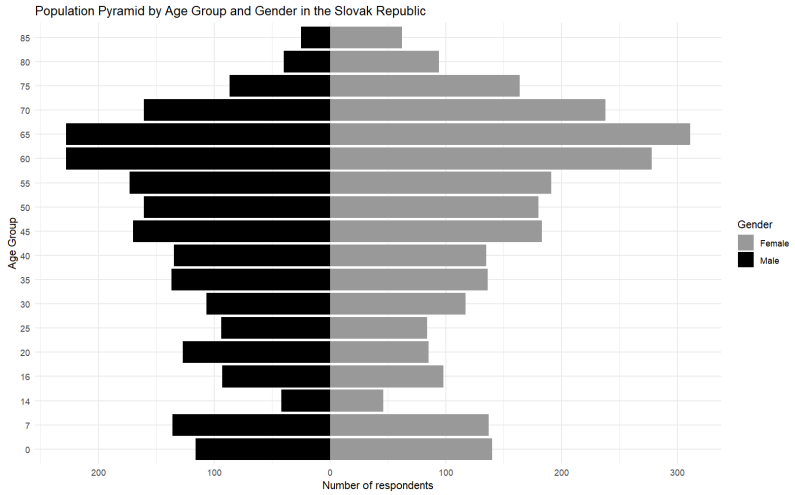
Fig. 1 Distribution of age groups and gender in the Czech Republic



Source: Author's own work

In both countries, most respondents belong to the productive (working) age group, with a balanced gender distribution across ages. The Slovak sample has fewer respondents in non-productive age groups (youth and elderly) compared to the Czech sample, though all age segments are represented.

Fig. 2 Distribution of age groups and gender in the Slovak Republic



Source: Author's own work

We analyse gender-based wealth inequality across productive and non-productive age groups using three decomposition methods. The model includes net wealth as the dependent variable, with total assets (DA3001), gross income (DI2000), and consumption (DOCOGOOD) as explanatory variables, grouped by age (RA0300_B) and gender (RA0200). Detailed results are in Tab. 2.

Tab. 2 Results of decomposition methods

Oaxaca-Blinder decomposition method				
Country	Group (Mean values)	Explained component	Unexplained component	Total difference
CZ	Productive age	-7 159	541	-6 618
	Non-productive age	-16 908	770	-16 138
SK	Productive age	-2 947	-639	-3 586
	Non-productive age	-13 178	2 178	-11 000
Machado-Mata decomposition method				
Country	Group (50th quantile)	Explained component	Unexplained component	Total difference
CZ	Productive age	11 343	-131	11 212
	Non-productive age	24 286	164	24 450
SK	Productive age	4 996	-358	4 638
	Non-productive age	17 498	-556	16 942
Juhn-Murphy-Pierce decomposition method				
Country	Group (Distribution)	Explained component	Unexplained component	Total difference
CZ	Productive age	21 426.	-98	21 328
	Non-productive age	11 388	202	11 590
SK	Productive age	11 180	-603	10 577
	Non-productive age	11 373	-801	10 572

Source: Author's own work

Using the Oaxaca-Blinder decomposition, the average wealth gap was broken down by observable characteristics. Non-productive age groups in both countries show larger gender wealth disadvantages than productive-age groups. Explained components dominate, meaning differences in variables largely account for the gap. The unexplained component for non-productive Slovaks is positive and relatively high, possibly due to intergenerational transfers, subsidies, or hidden factors. Among productive-age groups, differences are smaller, with unexplained components suggesting fewer gender constraints.

The Machado-Mata method decomposition was analyzed on the 50th quantile of population instead of mean. Therefore, it must be considered when comparing the results between the methods. Men and women in non-productive age groups again show larger total differences. The explained component dominates, similarly to the previously mentioned Oaxaca-Blinder method. Explanatory variables with their characteristics explain the noted gaps. The unexplained components are relatively small and even negative in the majority age groups. Respondents from the non-productive groups in both countries have higher positive explained components. This can be explained by accumulation efforts related to total assets and income and the limitation of consumption by women.

The Juhn-Murphy-Pierce decomposition included the changes in the distribution of residuals. In this model, productive-aged men and women in the Czech Republic have the highest total value of difference explained by considered explanatory factors. Unexplained components are small and mostly negative in the case of the Slovak Republic, pointing to the minor but still present negative role of structural disadvantages in the case of women. Both productive and non-productive groups in Slovakia show similar total differences, suggesting a wealth distribution that is differently shaped than that of the Czech Republic.

In the case of the Oaxaca-Blinder decomposition, based on our calculations, most of the observed differences in the wealth gap were explained using the explanatory variables. The Machado-Mata method confirmed higher disparities in the 50th quantile in the case of non-productive age groups in both countries. Juhn-Murphy-Pierce points to structural differences being important, especially in the Slovak Republic.

All applied methods confirmed the wealth gender gap in productive and non-productive age groups. Findings show that a large part of the disparity is due to observable factors such as income, education, and employment (explained component). However, significant unexplained differences—especially among older women—point to structural inequalities likely tied to gender norms, labour market dynamics, and cumulative disadvantage. Positive unexplained values mostly present in the Oaxaca-Blinder decomposition method suggest advantages and the presence of mitigation factors. Negative unexplained components in the Machado-Mata and Juhn-Murphy-Price decomposition methods suggest persistent structural issues and deserve further and more detailed analyses.

Conclusion

This paper examined gender and age-based wealth inequality in Slovakia and the Czech Republic, focusing on productive and non-productive age groups. Using Oaxaca-Blinder, Machado-Mata, and Juhn-Murphy-Pierce decomposition methods, we identified both explained and unexplained components of the wealth gap.

In some cases, women outperformed expectations, suggesting that policy measures have had a mitigating effect. Still, persistent gaps, particularly in the non-productive age group, highlight the need for more targeted interventions. The use of multiple decomposition methods confirmed the robustness of the results. The decomposition results summarise the present disadvantages faced mainly by women. However, positive unexplained components in suggest that advantages or supportive systems are present.

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