Nierówności Społeczne a Wzrost Gospodarczy, nr 63 (3/2020)
Social Inequalities and Economic Growth, no. 63 (3/2020)
DOI: 10.15584/nsawg.2020.3.10 ISSN 1898-5084, eISSN 2658-0780

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Gender differences in income distributions in Poland

Introduction

Gender differences manifest themselves in a variety of economic phenomena, with the persistence of disparities between distributions of income earned by women and men being one of the most expressive and widely discussed issues.

A growing amount of literature investigates gender-based income inequality, its causes and consequences. A greater interest in this area over the last decades was brought about by the increasing number of women entering the labour market, their greater financial independence, the emergence of a substantial gender pay gap in many countries and the observation that lower earnings of women together with their shorter working lives reduce their pension entitlements, which translates into a greater risk of poverty (Gregory, 2009). This is a vital issue, especially if wage reflects not only the individual's education and previous professional experience, but also expected labour market participation in the future (Goldin, 2014), as well as stronger or weaker gender identity norms, such as an aversion to situations when wives earn more than their husbands (cf. Bertand et al., 2015; Hederos Eriksson, Stendberg, 2015). Besides, even gender differences in the attitude toward competition and remuneration schemes are likely to include discriminatory effects (Heinz et al., 2016).

The relationship between economic growth and gender income inequalities is dynamic and was found to exhibit an inverted-U shape, in the form of a Kuznets' curve (Lantican et al., 1996). The decline in inequality at a certain stage of economic development can be attributed to the narrowing that occurs in such dimensions like labour force participation, paid hours of work (both out of home and at home) or education (Goldin, 2014). Another important process contributing to the decline in

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gender income inequalities is associated with globalisation. Competition through trade reduces costly discrimination against women in the labour market (Black, Brainerd, 2004). Long run trends in gender income inequality have been discussed much more often than the changes occurring within a business cycle, even though positive and negative shocks to the economy do not have the same impact on different groups of individuals, e.g. those belonging to different income quintiles (Hoover et al., 2009; see also Barlevy, Tsiddon, 2006). For instance, fluctuations in the unemployment rate may translate through different channels to the wages of women and men (O'Neill, 1985; Kandil, Woods, 2002; Razzu, Singleton, 2016; Bonhomme, Hospido, 2017). In particular, Bonhomme and Hospido (2017) demonstrate that male earning inequality is strongly countercyclical and follows the changes in the unemployment rate, while the results for women are different (the evidence for countercyclicality is much weaker). Interestingly, the global financial crisis affected female employment less than male employment; however, the austerity measures had a greater impact on women (Périvier, 2018).

In general, there are two approaches to measuring the gender aspects of income inequalities. The more restrictive form compares hourly wage when performing exactly the same job (preferably controlling for age, education, years of experience etc.) (e.g. Goraus et al., 2017). The less restrictive form is based not only on wages and salaries, but also other sources of income such as investments, pensions and other benefits. This paper adopts the less restrictive approach and analyses gender differences in net individual income. The emphasis is put on whole distributions, because the problem of gender inequalities cannot be reduced to differences in average or median incomes. Income distributions of women and men overlap and are strongly skewed, which precludes the reliance on mean-based methods in the analyses (Costa, 2019).

Naturally, data on individual net monthly income do not illustrate consumption possibilities nor the welfare of a given individual, due to the more or less equal pooling of resources within households or families. However, such an approach may lead to neglecting or underestimating gender income inequalities. Besides, a certain individual level of income can be regarded as a social right (Fritzell, 1999).

The aim of this paper is twofold. Firstly, it attempts to demonstrate structural differences and similarities between income distributions among women and men in Poland. The second objective is to present the evolution of income distributions over time in order to indicate business cycle issues which are still scarcely discussed in the literature on gender income inequality. The analysis is conducted first for whole income distributions, and then its scope is restricted to top income inequality.

The special focus on top income inequality is justified by the fact that it is the upper end of income distribution that is likely to contribute most to the existing inequalities. Furthermore, gender inequality at the top of the income distribution has started to attract the attention of a growing number of researchers (e.g. Boschini et al., 2017; Atkinson et al., 2018; Piketty et al., 2018; Ravaska, 2018; Bobilev et al., 2020; Yavorsky et al., 2019). However, so far no such analyses have been conducted for Poland.

In this paper income distribution is understood as an ordered vector of individual incomes for the population as a whole or for subpopulations of women and men. The analysis employs the dataset developed under the Social Diagnosis project, which was based on the panel research conducted biannually up to 2015 by the Council for Social Monitoring (2019)[2]. During the years 2003–2015, the survey included a question on individual net monthly income over the past three months. Not all respondents reported their income and in some waves there are no records with zero income in the database. Therefore, the analysis is conducted only for individuals who declared their actual value of income and whose income was greater than zero. Furthermore, in order to reduce differences associated with the age of entering and exiting the labour market on declared income levels (especially pensions), the calculations include only women and men aged 25–60 years.

The added value of the paper lies in the methods adopted and the scope of analysis. Firstly, the analysis goes beyond the standard summary statistics and employs kernel density estimates (for static comparisons) and simultaneous quantile regressions (for dynamic comparisons). This is also the first paper to discuss the gender aspects of top income inequality in Poland.

The paper is organised as follows. The following section presents detailed income distributions for women and men in Poland. In the next section the focus is on the top tail of the income distribution for both women and men. The final section contains conclusions.

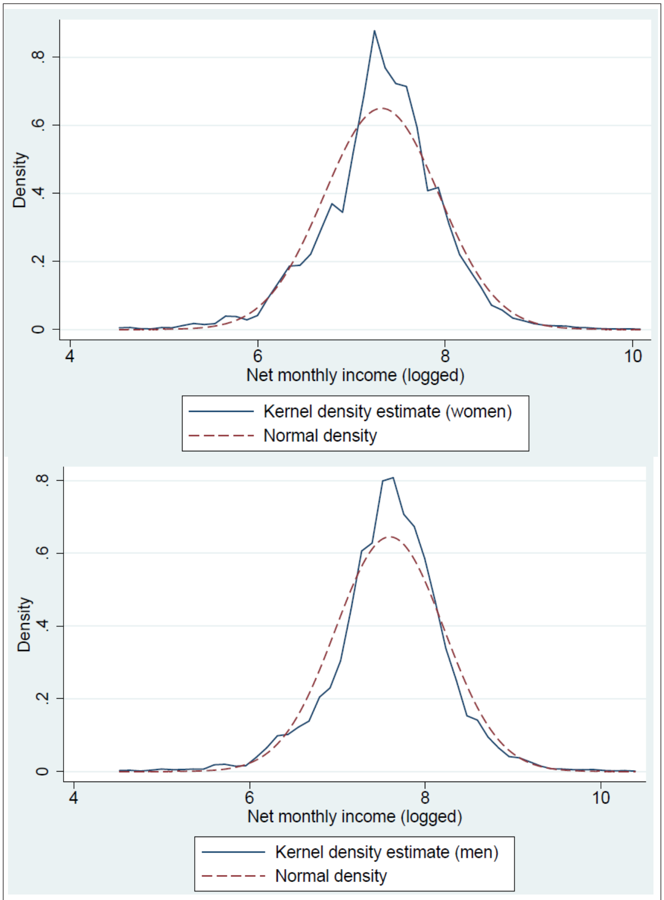
Comparison of income distributions of women and men for the whole sample

Static perspective

The starting point for the analysis of income distributions of women and men in Poland is based on standard measures such as mean income, median income and related measures, as well as the Gini coefficient, Theil index and entropy index. Their values calculated on the basis of seven waves of the panel research conducted by the Council for Social Monitoring for the whole sample and subsamples of women and men are presented in Appendix 1.

[2] Even though the data from the Social Diagnosis project were extensively described in a series of reports, the issue of gender differences in income was just mentioned (e.g. Czapiński, 2015) or presented from the point of view of the extent of wage discrimination when controlling for age, occupational status and education (e.g. Panek, Czapiński, 2015).

On average, women in Poland received a lower income than men, and their incomes were characterised by a lower dispersion in absolute and relative terms. This can be illustrated in detail with kernel density estimates (Appendix 2). For both selected years (2003 and 2015), the values of the kernel density for women are concentrated around the lower values of income and exhibit a peak that is higher than that for men. Shaikh *et al.* (2014) noted that despite these significant differences, both distributions are similar and close to exponential (lognormal). Figure 1 presents kernel density estimates for logarithms of net monthly income received by women and men in 2015.



Note: the sample includes only individuals aged 25–60 years that declared their actual value of income to be greater than zero.

Figure 1. Kernel density estimates for logarithms of net monthly income received by women (upper panel) and men (lower panel) in Poland in 2015

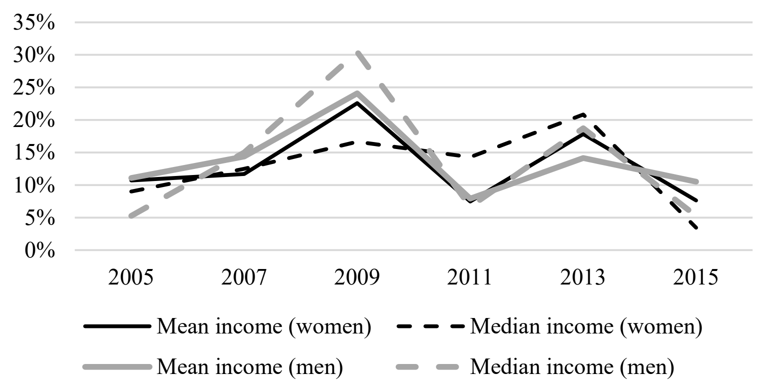
Source: own study based on the Council for Social Monitoring data (2019).

Figure 1 shows that both distributions of logged income seem to be close to normal, but the hypothesis that logged incomes are normally distributed can be rejected on the basis of the Shapiro-Francia test.

Inspecting basic summary statistics of distributions of logged incomes, one can see that in 2015 the greatest difference between women and men referred to the mean (and median), while variance, skewness and kurtosis were on a comparable level. Both distributions were slightly leptokurtic with a negative skewness close to zero.

DYNAMIC PERSPECTIVE

The fact that the mean and median incomes are behind the differentiation of the income distributions of women and men motivates the analysis of their dynamics. Over the 2003–2005 period, the mean income increased by 118% and the median income by 110.5% for men, while the mean (median) income increased only by 106.6% (104.4%) for women. However, the pace of growth of these values was not uniform over time (Figure 2).



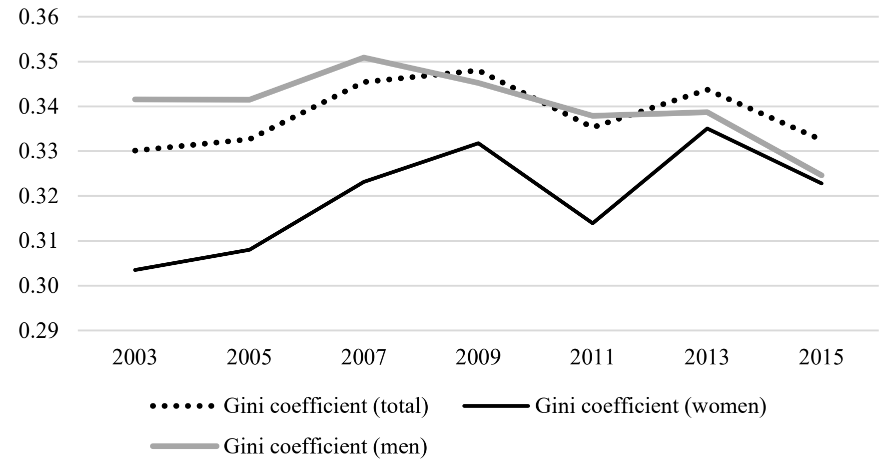
Note: The sample includes only individuals aged 25–60 years that declared their actual value of income to be greater than zero.

Figure 2. Dynamics of mean and median incomes of women and men in Poland over 2003–2015 (biannual rate of growth)

Source: own study based on the Council for Social Monitoring data (2019).

The fastest growth of all measures, except the median income for women, was observed in 2009 with a subsequent slowdown and boost – all consistent with the course of the business cycle.

As far as the inequality measures are concerned, a convergence in terms of all analysed measures could be observed (see Appendix 1 and Figure 3).



Note: The sample includes only individuals aged 25–60 years that declared their actual value of income to be greater than zero.

Figure 3. Evolution of the Gini coefficient calculated upon net monthly income in Poland over 2003–2015

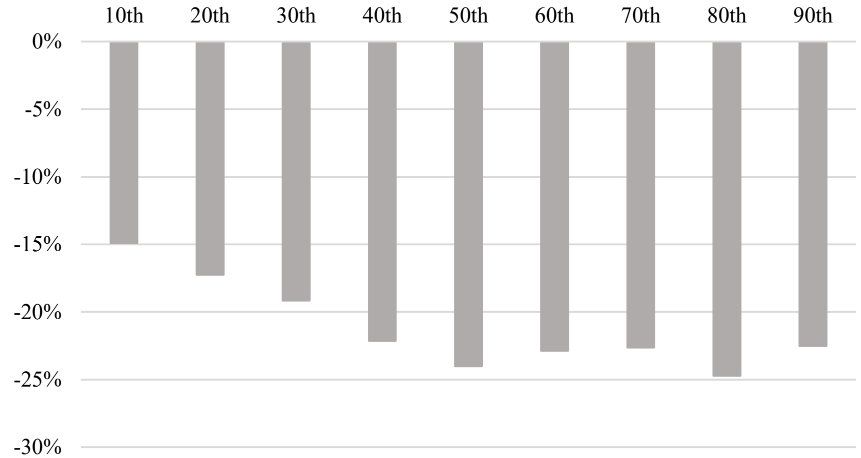
Source: own study based on the Council for Social Monitoring data (2019).

In particular, not only did the values of the Gini coefficient calculated for women converge on those of men (as exhibited in Figure 3), but a convergence of the Lorenz curves also took place (see Appendix 3)[3].

For the whole sample, the greatest inequality was observed in 2009 (only the entropy index was higher in 2015). The situation was similar for a subsample of women (however, the Gini coefficient and the entropy index were the highest in 2013). Among men, the inequality was the highest in 2007. As a matter of fact, during the years 2003–2007 the inequality among men was significantly higher than in the whole population, and it thus contributed to overall inequality. The differences concerning the timing of the occurrence of greatest inequality among the analysed subsamples provide support for including business cycle considerations in the analysis of income inequalities (even though the period of analysis was relatively short and the frequency of the data was low).

In order to show how the situation of women and men in particular income percentiles changed over time, simultaneous quantile regressions were run (with income as a dependent variable and gender as an independent variable) (see Appendix 4 and Figures 4–5).

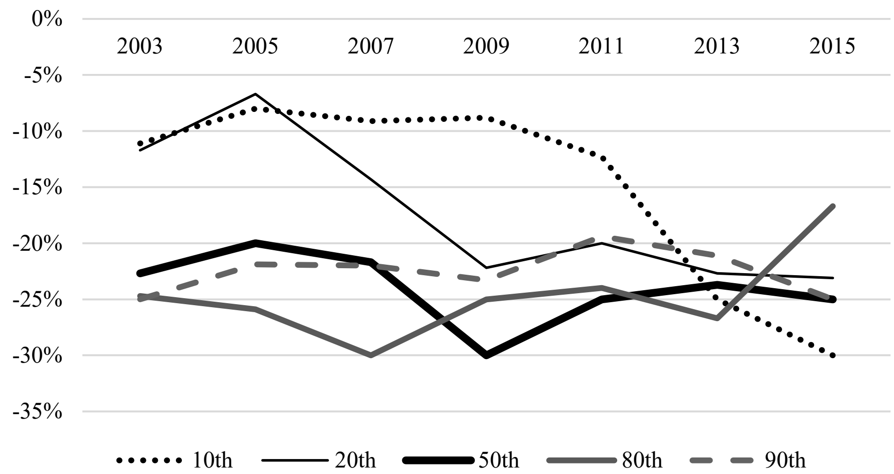
[3] Equality of the Gini coefficients does not imply coincidence of the Lorenz curves (see e.g. Włodarczyk, 2013).



Note: The sample includes only individuals aged 25–60 years that declared their actual value of income to be greater than zero.

Figure 4. Average difference between female and male incomes for selected percentiles in Poland over 2003–2015 (in percentage)

Source: own study based on the Council for Social Monitoring data (2019).



Note: The sample includes only individuals aged 25–60 years that declared their actual value of income to be greater than zero.

Figure 5. Relative differences between female and male incomes for selected percentiles in Poland over 2003–2015

Source: own study based on the Council for Social Monitoring data (2019).

Previous research has shown that the differences between women and men are most pronounced at higher earnings, to the disadvantage of women, and that the gap is usually wider at the 90th percentile than at the median (Gregory, 2009). In general, the results obtained from simultaneous quintile regressions confirm these findings, but not for the whole analysed period. During the years 2003–2007, at the 90th percentile, the relative difference between the incomes of women and men was greater than at the median, but during the period of 2009–2013, greater differences were observed around the median. In 2015, the difference was the same for both percentiles. Until 2011 the smallest differences were observed for the lowest income group (or the second in 2005). Since 2009 the difference for the lowest income group has steadily grown, which means that incomes of women did not catch up with those of men. This might have been caused either by the already mentioned not synchronized cyclical changes in income, the exceptional impact of the global financial crisis, or other factors such as different sources of net monthly income.

Gender aspects of top income inequality

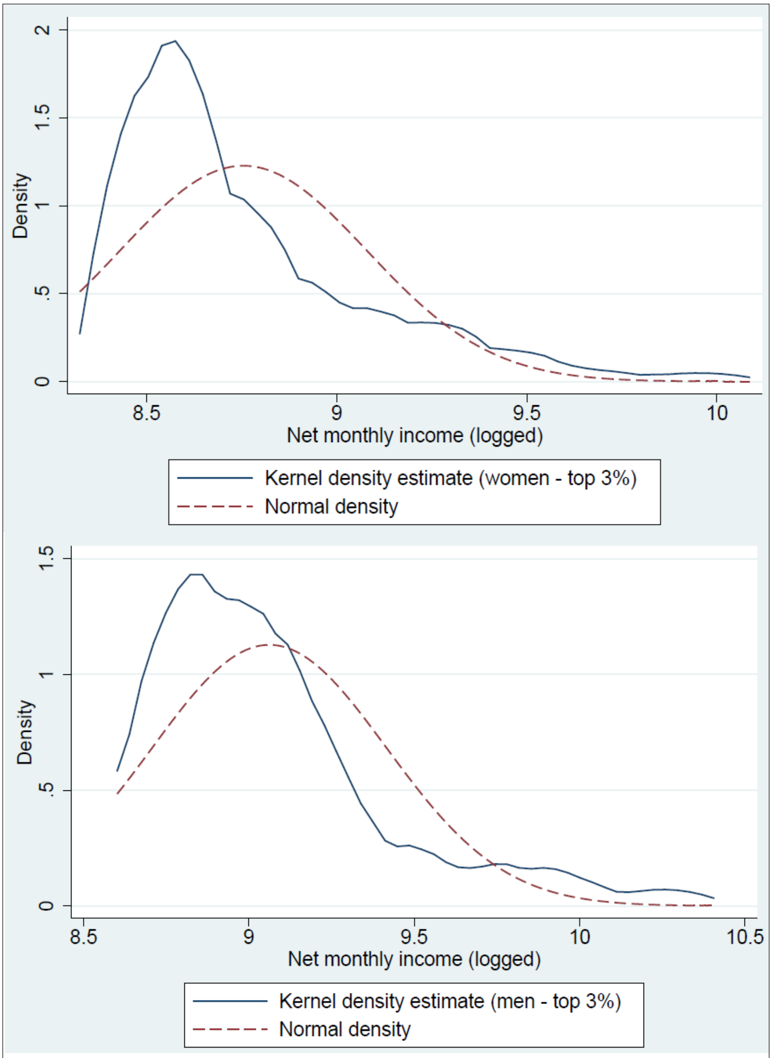
Static perspective

In this paper, top income inequality refers to the top 3% of the income distribution. The selected threshold corresponds to empirical works providing evidence that income distribution can be shown to be a composite of Pareto distribution for the 3% of population with the highest income, and Boltzmann-Gibbs distribution for the rest (for a review, see Włodarczyk, 2013). This mixture of distributions is a result of market incompleteness (Fiaschi, Marsili, 2012) and the coexistence of two distinct processes associated with income generation – one on the labour market (bottom tail) and the other on the capital market (top tail)[4].

A first look at the standard descriptive statistics calculated for the top 3% of both income distributions (presented in Appendix 5) confirms that at the top women

[4] Low-income individuals receive income mostly in the form of wages and salaries. As the changes in their income do not depend on their previous income, the process of income generation has an additive character, which results in an exponential (Boltzmann-Gibbs) income distribution. For individuals with the highest income, labour income is not as important as capital gains. Because of the multiplicative character of the generation of their income, the upper tail of income distribution follows the power law (Pareto) distribution (cf. Yakovenko, Rosser, 2009). In fact, Jagielski and Kutner (2013) demonstrated that there is yet another income class in the economy corresponding to a fraction of less than 0.2% of population with the highest income characterised by income distribution following the Zipf law; however, the available dataset precludes such an analysis. Nevertheless, they confirmed that in the European Union countries Boltzmann-Gibbs distribution refers to roughly 97% of the population.

in Poland received lower income than men and their incomes were characterised by a lower absolute dispersion. However, the top tail of both distributions exhibits a greater deviation from lognormal distribution than the income distribution encompassing the whole sample (Figure 6).



Note: The sample includes only individuals aged 25–60 years that declared their actual value of income to be greater than zero.

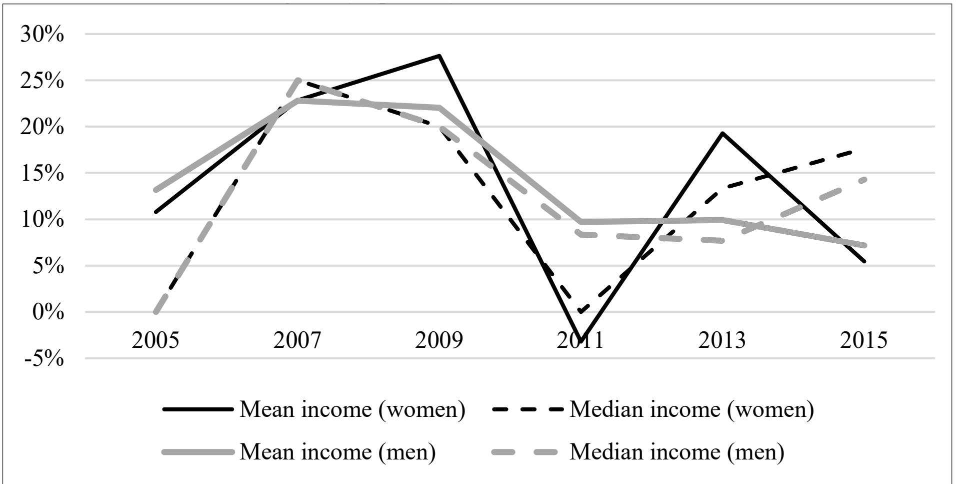
Figure 6. Kernel density estimates for logarithms of net monthly income received by the top 3% of women (upper panel) and men (lower panel) in Poland in 2015

Source: own study based on the Council for Social Monitoring data (2019).

Apart from the higher mean, the distributions displayed in Figure 6 are characterised by lower variance, positive skewness and slightly higher kurtosis as compared with the distributions presented in Figure 1.

Dynamic perspective

Throughout the analysed period, the median income of respondents with an income higher than the 97th percentile in each subpopulation rose by 100% both for women and men; however, the mean income rose by 119.2% for men and only 111.5% for women (compound rate of growth in nominal terms). As with the data presented in Figure 2, the pace of growth in these values followed the course of the business cycle (Figure 7).



Note: The sample includes only individuals aged 25–60 years that declared their actual value of income to be greater than zero.

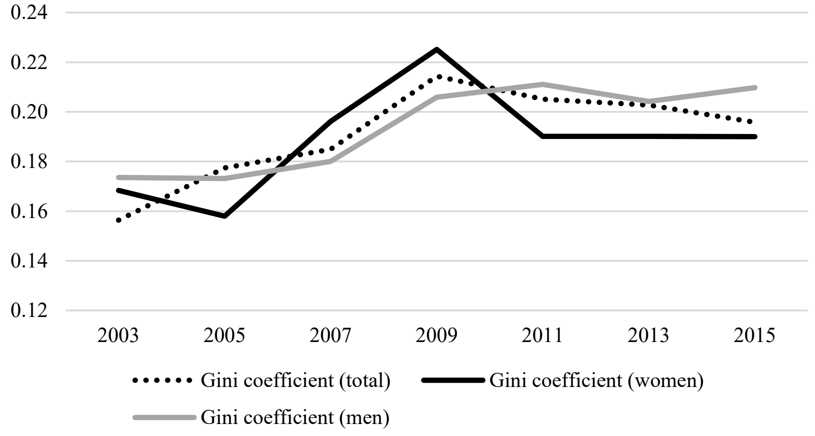
Figure 7. Dynamics of mean and median income of women and men in Poland from the top 3% over 2003–2015 (biannual rate of growth)

Source: own study based on the Council for Social Monitoring data (2019).

The most conspicuous feature of the data presented in Figure 7 is the variability of rates of growth of the mean and median incomes received by women, with the greatest collapse occurring between 2009 and 2011.

In terms of income inequality, the year 2009 was characterised by greatest disparities between women and men (see data in Appendix 5 and Figure 8).

As exhibited in Figure 8 and in Appendix 5, higher inequality was observed among women twice (in 2007 and 2009), while for men it was five times with 2011 characterised by the highest inequality.

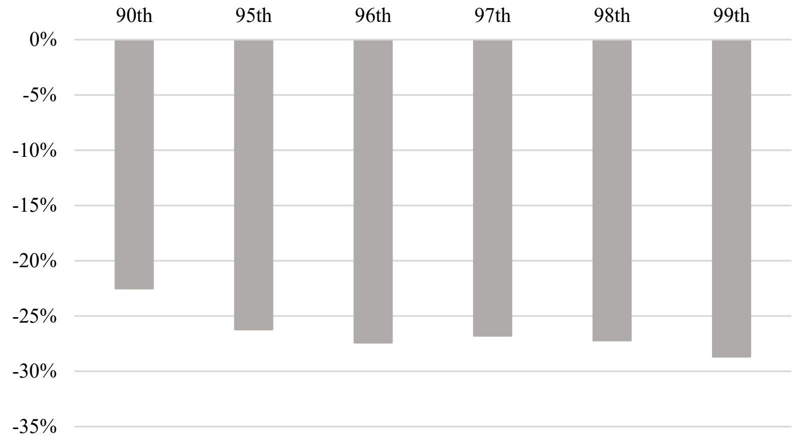


Note: The sample includes only individuals aged 25–60 years that declared their actual value of income to be greater than zero.

Figure 8. Evolution of the Gini coefficient calculated upon net monthly income of women and men from the top 3% in Poland over 2003–2015

Source: own study based on the Council for Social Monitoring data (2019).

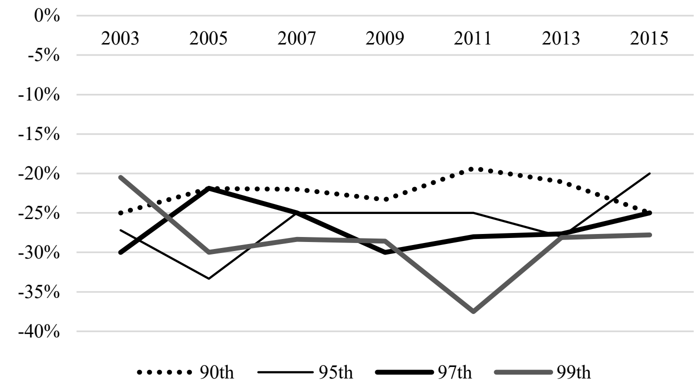
Similarly to the previous section, this analysis is supplemented with simultaneous quantile regressions with income as the dependent variable and gender as the independent variable (see Appendix 6 and Figures 9–10).



Note: The sample includes only individuals aged 25–60 years that declared their actual value of income to be greater than zero.

Figure 9. Average difference between incomes for women and men for selected top percentiles in Poland over 2003–2015 (in percentage)

Source: own study based on the Council for Social Monitoring data (2019).



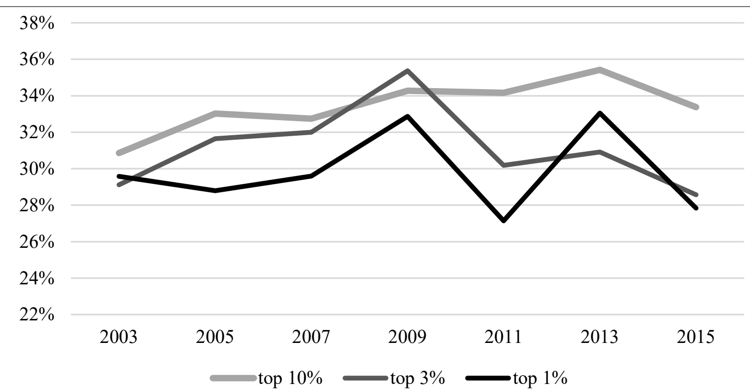
Note: The sample includes only individuals aged 25–60 years that declared their actual value of income to be greater than zero.

Figure 10. Relative differences between incomes for women and men for selected top percentiles in Poland over 2003–2015

Source: own study based on the Council for Social Monitoring data (2019).

On average, the difference between women and men was most pronounced at higher percentiles to the disadvantage of women, and was by several percentage points greater than in case of the percentiles displayed in Figures 4 and 5. This phenomenon partially explains overall gender income inequality.

Finally, an important indicator of gender differences at the top of the distribution (treated as a whole) is the share of women calculated for the top percentiles (see Figure 11).



Note: The sample includes only individuals aged 25–60 years that declared their actual value of income to be greater than zero.

Figure 11. Share of women among the top income earners

Source: own study based on the Council for Social Monitoring data (2019).

The share of women in the top 10% was the highest (with an average of 33.4% in the analysed period), the most stable and it exhibited a gradual increase over the years. The share of women in the top 3% and top 1% was lower (31.1% and 29.8%, respectively), much more variable and without a clear trend.

The observation that the share of women is decreasing for higher income groups is consistent with previous research (e.g. Boschini et al., 2017; Atkinson et al., 2018; Piketty et al., 2018; Ravaska, 2018; Bobilev et al., 2020). Most of these studies documented an increasing share of women among the top percentiles. However, a significant cross-country heterogeneity is observed. For instance, the share of women in the top 10% varies from around 15% in Switzerland to more than 40% in Slovenia (Bobilev et al., 2020).

CONCLUDING REMARKS

This paper investigated gender differences in income distribution in Poland on the basis of survey data available for the years 2003–2015[5]. The sample included only women and men aged 25–60 years who declared their income to be greater than zero. Despite many shortcomings associated with the quality of the data (e.g. low frequency and possible non-representativeness), the analysis confirmed that the main difference in income distribution between women and men is the lower mean and median income received by women and that at higher percentiles the disadvantage of women is on average greater. Nevertheless, there are many similarities referring to the variance, skewness and kurtosis of the distributions, which imply that both for women and men income distribution is close to a lognormal distribution for all observations or exhibit similar deviations from the lognormal distribution for the top 3% of earners in both subpopulations.

The analysis revealed slightly different dynamics in the incomes of women and men that may result from structural and cyclical aspects of inequality. For instance, the proportion of women and men among different branches is not homogeneous and their situation over the business cycle may fluctuate differently. Also, concentrating on full-time earnings makes it impossible to capture the situation where, due to a recession for example, members of one subpopulation (men or women) are forced to quit full employment and need to resort to part-time jobs, while the other subpopulation is disproportionately less afflicted.

This requires further research, preferably based on longer time series, with data of higher frequency and covering a greater number of individuals (which is especially important when top incomes are investigated). Following the observations by Bakker and Creedy (2000), who found that the unemployment rate has a significant impact on income distribution for men in New Zealand, future research could investigate

[5] Unfortunately, the Social Diagnosis project ceased to be funded after 2015, which makes it impossible to analyse the impact of programmes like "Family 500+" (introduced in April 2016) on the income distributions of women and men in Poland.

in greater detail the relationships between the parameters characterising income distributions for women and men where the macroeconomic variables change over the business cycle. Such analyses should include both labour and capital market developments and their impact on their male and female participants.

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Summary

The paper presents results of a descriptive analysis of income distributions as well as top income inequality among women and men in Poland. The analysis is based on the dataset provided by the Council for Social Monitoring (2019). Throughout 2003–2015 their panel survey included, for example, a question on individual net monthly income in the past three months. In order to reduce differences associated with the age of entering and exiting the labour market on declared income levels (especially pensions), the calculations include only women and men aged 25–60 years. The analysis of income distributions of women and men in Poland is based on standard measures such as mean income, median income and related measures, as well as the Gini coefficient, Theil index and entropy index. It is supplemented by kernel density estimates and results of simultaneous quantile regressions that demonstrate differences between women and men across income groups. The analysis of top income inequality includes comparisons of subsamples consisting of top 3% earners in each group. The share of women in the top percentiles is then calculated and discussed. The analysis shows different dynamics related to the incomes of women and men, which provides support for including business cycle considerations in the analysis of income inequalities and their gender aspects.

Keywords: income inequality, gender inequality.

Różnice w rozkładach dochodów kobiet i mężczyzn w Polsce

Streszczenie

W artykule przedstawiono wyniki analizy opisowej rozkładów dochodów kobiet i mężczyzn w Polsce ze szczególnym uwzględnieniem nierówności w grupie osób o najwyższych dochodach. Analizę oparto o bazę danych opracowaną przez Radę Monitoringu Społecznego (w ramach projektu Diagnoza Społeczna). W latach 2003–2015 jedno z pytań zadawanych respondentom dotyczyło indywidualnego miesięcznego dochodu netto z ostatnich trzech miesięcy. W celu zmniejszenia wpływu różnic związanych z momentem wchodzenia na rynek pracy i przechodzenia na emeryturę analizę ograniczono do osób w wieku 25–60 lat.

W analizie rozkładów dochodów kobiet i mężczyzn w Polsce wykorzystano m.in. standardowe miary, takie jak średni dochód lub mediana dochodu oraz wskaźniki oparte na tych miarach, jak również współczynniki Giniego, Theila oraz entropii. Poza tym wykorzystano jądrowe estymatory gęstości i przedstawiono wyniki estymacji regresji kwantylowej pokazującej różnice dochodowe między kobietami i mężczyznami w różnych grupach dochodowych. Następnie dokonano porównania między podpróbami kobiet i mężczyzn uzyskujących najwyższe dochody (przyjęto próg 3% dla każdej płci). Przedstawiono również udział kobiet w grupie osób o najwyższych dochodach. Przeprowadzona analiza ujawniła m.in. zróżnicowanie dynamiki dochodów kobiet i mężczyzn, co stanowi argument za uwzględnieniem w analizie nierówności dochodowych także czynników cyklicznych, które mogą odmiennie oddziaływać na obie płci.

Słowa kluczowe: nierówności dochodowe, nierówność płci.

JEL: D31, J16.

APPENDIX 1

Descriptive statistics of income distributions in Poland (2003–2015): a) whole sample, b) women, c) men.

a) Whole sample							
1	*2*	*3*	*4*	*5*	*6*	*7*	*8*
Year	2003	2005	2007	2009	2011	2013	2015
N	6987	6498	9701	19635	19777	11653	9612
Mean income	995.3249	1105.211	1245.667	1534.892	1651.672	1924.185	2104.944
Standard deviation	731.4435	819.2094	992.9986	1315.349	1306.365	1541.374	1591.217
Minimum income	41	100	100	100	100	100	100
Maximum income	14500	15000	20000	50000	30000	50000	30000
Median income	800	900	1000	1200	1400	1600	1800
CV	0.73488	0.74122	0.79716	0.85696	0.79094	0.80105	0.75594
Gini coefficient	0.33013	0.33265	0.34541	0.34802	0.33533	0.34376	0.33255
Theil index	0.19626	0.19843	0.21919	0.22610	0.20870	0.21581	0.20203
Entropy index	0.25043	0.23363	0.25260	0.25243	0.24451	0.28211	0.25986
GIG based on mean income	21.5%	21.8%	23.6%	24.5%	24.9%	22.4%	24.4%
GIG based on median income	22.7%	20.0%	21.7%	30.0%	25.0%	23.7%	20.0%
b) Women							
Year	2003	2005	2007	2009	2011	2013	2015
N	3672	3381	5188	10596	10734	6085	4956
Mean income	880.7372	975.0799	1088.98	1334.943	1434.648	1690.513	1819.939
Standard deviation	600.6849	674.6011	823.9445	1143.372	1026.723	1274.5	1301.496
Minimum income	41	100	100	100	100	100	100
Maximum income	13500	15000	16000	44000	16000	30000	22000
Median income	734	800	900	1050	1200	1450	1500
CV	0.68203	0.69184	0.75662	0.85649	0.71566	0.75391	0.71513
Gini coefficient	0.30350	0.30803	0.32313	0.33180	0.31389	0.33506	0.32284
Theil index	0.16827	0.17256	0.19584	0.21266	0.18098	0.20216	0.18820
Entropy index	0.20207	0.19690	0.21605	0.22108	0.20685	0.26837	0.24145
c) Men							
Year	2003	2005	2007	2009	2011	2013	2015
N	3315	3117	4513	9039	9043	5568	4656
Mean income	1122.253	1246.363	1425.789	1769.283	1909.278	2179.554	2408.312
Standard deviation	835.1396	931.3078	1130.795	1457.465	1535.885	1752.89	1801.686
Minimum income	43	100	100	100	100	100	100

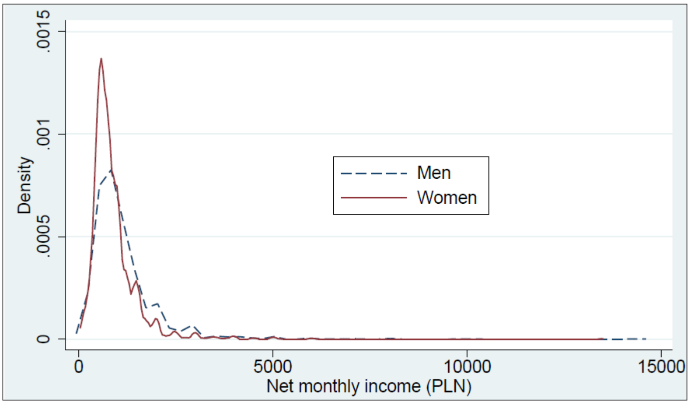
1	*2*	*3*	*4*	*5*	*6*	*7*	*8*
Maximum ncome	14500	15000	20000	50000	30000	50000	30000
Median income	950	1000	1150	1500	1600	1900	2000
CV	0.74416	0.74722	0.79310	0.82376	0.80443	0.80424	0.74811
Gini coefficient	0.34153	0.34152	0.35088	0.34519	0.33790	0.33868	0.32462
Theil index	0.20690	0.20650	0.22266	0.21933	0.21413	0.21250	0.19555
Entropy index	0.29246	0.25849	0.27395	0.26377	0.26559	0.27145	0.25039

Note: *N* represents the number of individuals aged 25–60 years that declared their actual value of income to be greater than zero. Income is expressed in current prices in PLN and is not corrected for inflation. *CV* stands for the coefficient of variation. Theil index and entropy index belong to the groups of generalised entropy indices[6]. GIG (gender income gap) is calculated as a difference between mean (median) income of women and men expressed as a percentage of men's mean (median) income.

Source: own study based on the Council for Social Monitoring data (2019).

Appendix 2

Kernel density estimates for income distributions of women and men in Poland: a) 2003, b) 2015.



a)

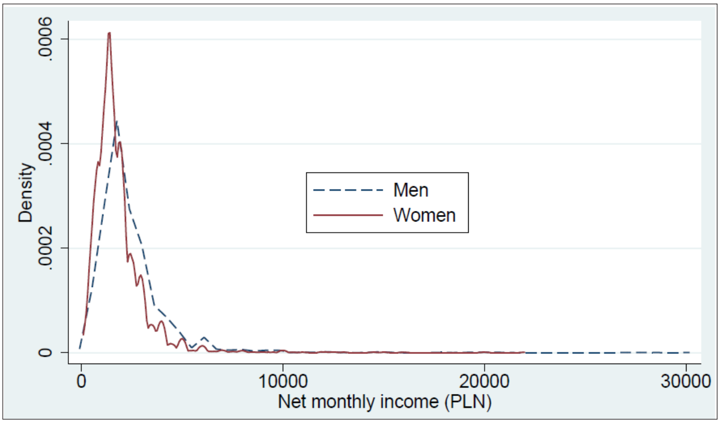
[6] Generalised entropy indices are calculated according to the following formula:

$$GE(\alpha) = \frac{1}{\alpha(\alpha-1)}\left[\frac{1}{N}\sum_{i=1}^{N}\left(\frac{y_i}{\bar{y}}\right)^{\alpha} - 1\right], \alpha \neq 0, \alpha \neq 1, \quad (1)$$

where N represents the number of individuals, y_i is the income of the individual i, $\bar{y}$ is the mean income, and α is the parameter depicting sensitivity of the index to changes in particular segments of the distribution. Generalised entropy indices are more sensitive to changes in the lower tail of the income distribution for lower values of α, while for higher values of α they are more sensitive to changes in the upper tail (Litchfield, 1999).

The entropy index is calculated with the formula above for α = –1, while for Theil index α = 1, so it is calculated as:

$$Theil\ index = GE(1) = \frac{1}{N}\sum_{i=1}^{N}\left(\frac{y_i}{\bar{y}}\right) ln\left(\frac{y_i}{\bar{y}}\right) \quad (2)$$

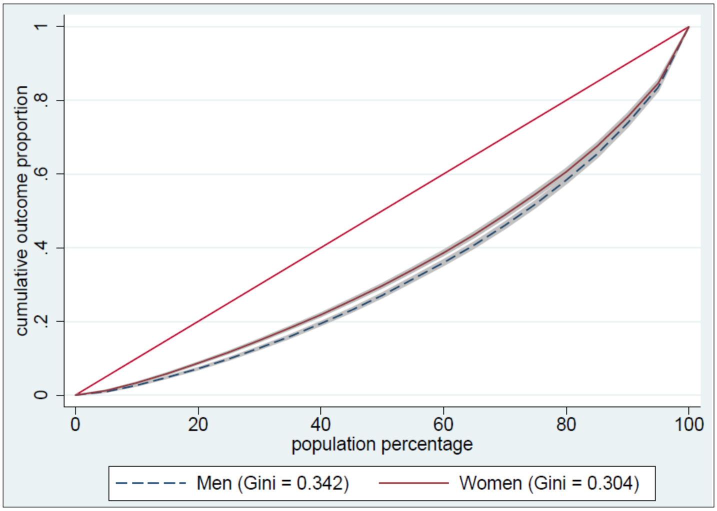


b)

Source: own study based on the Council for Social Monitoring data (2019).

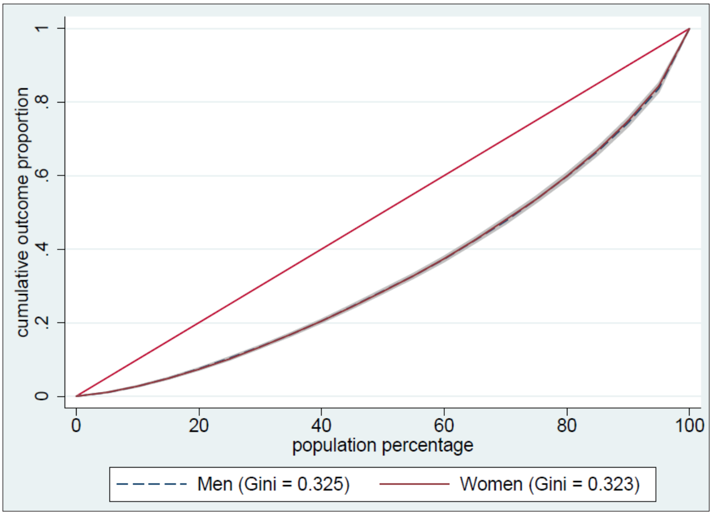
APPENDIX 3

Lorenz curves for income distributions of women and men in Poland: a) 2003, b) 2015.



a)

b)



Source: own study based on the Council for Social Monitoring data (2019).

Appendix 4

Gender differences in income across selected percentiles. Results of simultaneous quantile regressions.

P	10th	20th	30th	40th	50th	60th	70th	80th	90th
2003									
F	-50*** (13.14)	-66*** (15.77)	-100*** (6.054)	-150*** (7.701)	-216*** (35.04)	-200*** (26.30)	-200*** (28.01)	-370*** (41.83)	-500*** (0)
Const.	450*** (12.74)	566*** (15.77)	700*** (4.994)	800*** (0)	950*** (29.01)	1000*** (19.36)	1200*** (27.09)	1500*** (0)	2000*** (0)
Diff.	11.1%	11.7%	14.3%	18.8%	22.7%	20.0%	16.7%	24.7%	25.0%
2005									
F	-40** (15.96)	-40*** (11.81)	-160*** (32.09)	-200*** (13.59)	-200*** (2.227)	-284*** (23.73)	-400*** (45.72)	-440*** (57.53)	-460*** (89.35)
Const.	500*** (5.340)	600*** (6.931)	780*** (27.58)	900*** (11.77)	1000*** (0)	1200*** (9.361)	1400*** (42.55)	1700*** (42.12)	2100*** (73.85)
Diff.	8.0%	6.7%	20.5%	22.2%	20.0%	23.7%	28.6%	25.9%	21.9%
2007									
F	-50*** (13.24)	-100*** (0.600)	-160*** (24.25)	-200*** (0)	-250*** (44.65)	-300*** (23.53)	-300*** (36.21)	-600*** (50.19)	-550*** (51.81)
Const.	550*** (12.86)	700*** (0.600)	860*** (24.25)	1000*** (0)	1150*** (44.58)	1300*** (23.53)	1500*** (30.56)	2000*** (34.28)	2500*** (0)
Diff.	9.1%	14.3%	18.6%	20.0%	21.7%	23.1%	20.0%	30.0%	22.0%

2009									
F	-56*** (14.54)	-200*** (3.561)	-210*** (34.60)	-240*** (31.84)	-450*** (22.54)	-500*** (24.33)	-500*** (26.98)	-600*** (53.19)	-700*** (61.05)
Const.	636*** (10.70)	900*** (3.433)	1050*** (32.39)	1240*** (31.08)	1500*** (0)	1700*** (24.33)	2000*** (0)	2400*** (45.33)	3000*** (0)
Diff.	8.8%	22.2%	20.0%	19.4%	30.0%	29.4%	25.0%	25.0%	23.3%
2011									
F	-86*** (12.97)	-200*** (0)	-232*** (11.82)	-364*** (22.18)	-400*** (30.25)	-400*** (25.52)	-500*** (21.58)	-600*** (31.67)	-600*** (92.58)
Const.	700*** (8.741)	1000*** (0)	1200*** (0)	1400*** (13.08)	1600*** (30.25)	1800*** (15.91)	2000*** (0)	2500*** (0)	3100*** (93.17)
Diff.	12.3%	20.0%	19.3%	26.0%	25.0%	22.2%	25.0%	24.0%	19.4%
2013									
F	-200*** (8.056)	-250*** (40.26)	-300*** (29.45)	-400*** (27.74)	-450*** (63.61)	-400*** (9.443)	-500*** (36.71)	-800*** (47.00)	-800*** (149.2)
Const.	800*** (7.929)	1100*** (22.78)	1400*** (16.72)	1600*** (23.64)	1900*** (46.32)	2000*** (0)	2500*** (27.14)	3000*** (0)	3800*** (149.2)
Diff.	25.0%	22.7%	21.4%	25.0%	23.7%	20.0%	20.0%	26.7%	21.1%
2015									
F	-300*** (31.08)	-300*** (14.07)	-300*** (11.49)	-424*** (36.10)	-500*** (6.305)	-500*** (59.60)	-600*** (51.10)	-500*** (29.30)	-1000*** (14.95)
Const.	1000*** (30.43)	1300*** (8.572)	1500*** (11.49)	1800*** (17.28)	2000*** (0)	2300*** (55.54)	2600*** (51.10)	3000*** (0)	4000*** (0)
Diff.	30.0%	23.1%	20.0%	23.6%	25.0%	21.7%	23.1%	16.7%	25.0%

Note: Standard errors in parentheses (estimated with 100 bootstrap replications). *** denotes that all coefficients are statistically significant (p<0.01). *P* stands for percentile. Constant represents the median for group coded zero (men), while the coefficient of the variable *F* (female) depicts the absolute difference in medians between women and men. *Diff.* denotes the relative difference between women and men for selected percentiles.

Source: own study based on the Council for Social Monitoring data (2019).

Appendix 5

Descriptive statistics for the top 3% of earners in Poland (2003–2015): a) whole subsample, b) women, c) men.

a) Total							
year	2003	2005	2007	2009	2011	2013	2015
N	210	195	291	589	593	350	288
Mean income	3811.976	4189.487	5195.601	6422.711	6703.997	7608.434	8201.76
Standard deviation	1480.335	1737.712	2101.537	3782.318	3270.388	4079.668	3713.083
Minimum income	2800	3000	3500	4000	4350	5000	5500
Maximum income	14500	15000	20000	50000	30000	50000	30000
Median income	3200	3600	4500	5000	5800	6200	7000
CV	0.38834	0.41478	0.40448	0.58890	0.48783	0.53620	0.45272
Gini coefficient	0.15636	0.17747	0.18489	0.21438	0.20512	0.20274	0.19581
Theil index	0.05613	0.06540	0.06556	0.10884	0.08793	0.09463	0.07902
Entropy index	0.04071	0.04950	0.05262	0.07216	0.06517	0.06449	0.05997
GIG based on mean income	24.7%	26.3%	26.2%	22.9%	31.9%	26.2%	27.3%
GIG based on median income	25.0%	25.0%	25.0%	25.0%	30.8%	27.1%	25.0%
b) Women							
year	2003	2005	2007	2009	2011	2013	2015
N	110	101	156	318	322	183	149
Mean income	3188.755	3532.832	4340.256	5539.585	5362.062	6395.055	6743.94
Standard deviation	1311.671	1471.606	1864.082	3566.512	2364.916	3095.309	2854.352
Minimum income	2100	2500	3000	3500	3600	4340	4500
Maximum income	13500	15000	16000	44000	16000	30000	22000
Median income	3000	3000	3750	4500	4500	5100	6000
CV	0.41134	0.41655	0.42949	0.64382	0.44105	0.48402	0.42325
Gini coefficient	0.16838	0.15797	0.19609	0.22515	0.19016	0.19009	0.19004
Theil index	0.06058	0.05970	0.07351	0.12500	0.07579	0.08184	0.07138
Entropy index	0.04481	0.04119	0.05912	0.07947	0.05707	0.05738	0.05619
c) Men							
year	2003	2005	2007	2009	2011	2013	2015
N	99	94	135	271	271	167	140
Mean income	4234.495	4792.021	5884.815	7181.103	7877.166	8659.563	9280.714
Standard deviation	1666.983	1850.186	2298.542	3995.798	3903.826	4810.747	4351.546
Minimum income	3000	3200	4000	5000	5000	6000	6000
Maximum income	14500	15000	20000	50000	30000	50000	30000
Median income	4000	4000	5000	6000	6500	7000	8000
CV	0.39367	0.38610	0.39059	0.55643	0.49559	0.55554	0.46888
Gini coefficient	0.17358	0.17315	0.18007	0.20589	0.21107	0.20421	0.20971
Theil index	0.06038	0.05912	0.06154	0.09859	0.09129	0.09983	0.08603
Entropy index	0.04731	0.04669	0.05007	0.06666	0.06861	0.06609	0.06742

Note: see the note below table in Appendix 1.

Source: own study based on the Council for Social Monitoring data (2019).

APPENDIX 6

Gender differences in income across selected top percentiles. Results of simultaneous quantile regressions.

P	90th	95th	96th	97th	98th	99th
			2003			
F	-500*** (0)	-680*** (130.0)	-1000*** (91.79)	-900*** (125.4)	-1000*** (264.7)	-820** (341.0)
Const.	2000*** (0)	2500*** (119.0)	3000*** (90.53)	3000*** (0)	3500*** (236.5)	4000*** (284.4)
Diff.	-25.0%	-27.2%	-33.3%	-30.0%	-28.6%	-20.5%
			2005			
F	-460*** (90.44)	-1000*** (96.74)	-800*** (104.5)	-700*** (228.1)	-1000*** (239.1)	-1500*** (325.6)
Const.	2100*** (71.72)	3000*** (85.82)	3000*** (0)	3200*** (200.4)	4000*** (220.8)	5000*** (232.8)
Diff.	-21.9%	-33.3%	-26.7%	-21.9%	-25.0%	-30.0%
			2007			
F	-550*** (63.22)	-800*** (182.2)	-940*** (142.7)	-1000*** (131.0)	-1300*** (336.8)	-1700*** (460.9)
Const.	2500*** (14.07)	3200*** (164.7)	3500*** (106.1)	4000*** (83.33)	4500*** (229.9)	6000*** (303.8)
Diff.	-22.0%	-25.0%	-26.9%	-25.0%	-28.9%	-28.3%
			2009			
F	-700*** (61.46)	-1000*** (6.37e-11)	-1000*** (187.7)	-1500*** (128.1)	-1200*** (289.4)	-2000*** (240.2)
Const.	3000*** (10.70)	4000*** (3.433)	4000*** (32.39)	5000*** (31.08)	5200*** (0)	7000*** (24.33)
Diff.	-23.3%	-25.0%	-25.0%	-30.0%	-23.1%	-28.6%
			2011			
F	-600*** (90.73)	-1000*** (95.95)	-1200*** (210.7)	-1400*** (94.62)	-2000*** (61.38)	-3000*** (311.4)
Const.	3100*** (92.23)	4000*** (95.95)	4500*** (178.1)	5000*** (10)	6000*** (53.66)	8000*** (271.0)
Diff.	-19.4%	-25.0%	-26.7%	-28.0%	-33.3%	-37.5%
			2013			
F	-800*** (139.7)	-1400*** (148.7)	-1000*** (143.6)	-1660*** (241.2)	-1500*** (327.6)	-2347*** (559.4)
Const.	3800*** (139.7)	5000*** (94.38)	5000*** (143.0)	6000*** (151.9)	6500*** (334.2)	8347*** (462.5)
Diff.	-21.1%	-28.0%	-20.0%	-27.7%	-23.1%	-28.1%
			2015			
F	-1000*** (16.09)	-1000*** (136.8)	-2000*** (221.4)	-1500*** (182.2)	-2000*** (413.9)	-2500*** (622.6)
Const.	4000*** (0)	5000*** (134.3)	6000*** (221.3)	6000*** (42.21)	7000*** (418.0)	9000*** (512.4)
Diff.	-25.0%	-20.0%	-33.3%	-25.0%	-28.6%	-27.8%

Note: see the note below table in Appendix 4.

Source: own study based on the Council for Social Monitoring data (2019).