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Gender contribution to income inequality

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HIGHLIGHTS

- Determine the contribution of gender to wage inequality from the Shapley approach.
- Decompose inequality by considering gender as an income source.
- Measure gender inequality in the light of all the wage distribution.
- A decomposition applicable regardless of the index used to measure inequality.

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ABSTRACT

This note suggests a new way of determining the contribution of gender to wage inequality as part of the framework based on the Shapley approach. The proposed methodology is illustrated using French data over the period 1970–2003.

1. Introduction

OECD (2012) emphasizes that the trends in the median wage gap between men and women during the last decade are flat, or downwards, for all OECD members. During the same period, a significant increase in higher incomes, and the stagnation or decrease of low incomes in most OECD countries has substantially changed income distribution, inducing a rise of income inequality (OECD, 2011). This pattern prompts the question of whether there is a modeling framework for gender inequality that can account for the wage gap at all levels of the distribution, and not only at the median level.

The decomposition of inequality measures appears to be an attractive way at appraising gender inequality, which can be defined as the contribution of gender to overall wage inequality. Among decomposition methods, those inspired by the Shapley value are particularly interesting,[1] since they allow the contribution of the various income sources or the contribution of different sub-populations to overall inequality, to be explained. However, the Shapley decomposition methods developed so far do not permit the estimation of the share of overall wage inequality due to gender. In fact, if the two sub-populations are made up of men and women respectively, the results of the decomposition make it possible to demonstrate that, if for instance, the contribution of men to inequality is 55%, then in this case a policy aimed at equalizing the incomes of men would reduce by 55% total income inequality. Hence the way in which the Shapley approach to decomposition has been generally used makes it impossible to determine the income inequality between men and women. This impossibility raises the question whether there is an alternative method that

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[1] Chantreuil and Trannoy (2011, 2013), and Shorrocks (2013) used the Shapley value (Shapley, 1953) to determine the exact contribution of different income sources to overall inequality.

would be capable, as part of the Shapley decomposition framework, at considering the issue of gender inequality.

To give a proper answer to this question we propose a new way of determining the contribution of gender to wage inequality as part of the framework based on the Shapley approach. We propose a solution assimilating the different dimensions of the status of individuals to a particular wage source in order to assess the contribution of each status. The wage received by an individual can be considered as the sum of several elements: an element determined by degree of career advancement, one related to gender and an element specific to the individual. The decomposition of inequality according to these elements will allow us answer the question concerning the contribution of each of the three elements to overall wage inequality. The proposed methodology is presented in Section 2, and then illustrated using French FQP[2] data over the period 1970–2003 (Section 3).

2. Gender decomposition

To decompose wage inequality by gender we consider the diverse dimensions of the status of an individual in terms of wage sources. In other words, the characteristics of an individual (age, occupation, gender, etc.) are treated as different sources for the wage. Consequently, for a given wage distribution and a set of individual's characteristics, the decomposition of the overall wage inequality can be effected using the Shapley approach. The contribution of a characteristic j to the overall wage inequality can be defined by the following formula:

$$Sh_j = \sum_{S \subset K, j \in S} \frac{(s-1)!(k-s)!}{k!} [I(Y(S)) - I(Y(S - \{j\}))] \tag{1}$$

where I is the chosen inequality measure (Gini and Theil in our following illustration), K is the set of individual's characteristics, k the cardinality of K, S a subset of individual's characteristics, s the cardinality of S, and $Y(S)$ the distribution of wage among wage sources obtained, equalizing the wage from the complementary source $N - S$ for all individuals. This distribution is defined by $Y(\emptyset) = 0$, and for all $S \in 2^K$, $S \neq \emptyset$,

$$Y(S) = \left(\sum_{j \in S} y_1^j + \sum_{j \notin S} \mu(y^j), \ldots, \sum_{j \in S} y_n^j + \sum_{j \notin S} \mu(y^j) \right) \tag{2}$$

where $\mu(y^j)$ is the average wage from wage source/characteristic j.

To match the illustration proposed in the following section, the definition of the wage distribution Y is defined for a population within which the individual's wage is the resultant of three characteristics—age, gender and a third variable that includes all other individual characteristics. In other words, we consider these three dimensions of the individual's status as different sources for her/his income. Income is thus divided into three parts: one age-specific part for the agent; one which is possibly gender-specific; plus a residual which is explained by neither of the two previous characteristics. As an example, let us consider an individual i of age a and gender g. Her/his total remuneration, $w_{i,a,g}$, can be written as follows:

$$w_{i,a,g} = w_a + (w_{a,g} - w_a) + r_{i,a,g}. \tag{3}$$

The total wage of this individual comprises the average wage of the agents of the same age of the subpopulation (of size n_a) considered:

$$w_a = \sum_{i=1}^{n_a} \frac{w_{i,a}}{n_a} \tag{4}$$

the difference between this average wage and those of the women/men of the same age (in number $n_{a,g}$) of the subpopulation considered:

$$w_{a,g} - w_a = \sum_{i=1}^{n_{a,g}} \frac{w_{i,a,g}}{n_{a,g}} - w_a \tag{5}$$

and a part specific to this woman/man i:

$$r_{i,a,g} = w_{i,a,g} - w_{a,g} \tag{6}$$

where $a \in [\underline{a}, \overline{a}]$ and $g = f, m$.

The first element of the wage described by Eq. (3) takes a strictly positive value. The second element is positive or negative according to whether the women/men of age a earned on average more or less than the agents of the same age in the subpopulation considered. The third element can be positive or negative according to whether agent i gains more or less than the average of the women/men of her/his age pertaining to the same subpopulation.

The wage sources being defined, we apply the Shapley decomposition method presented previously (Eq. (1)), which allows us to determine the contribution of age (considered as a proxy of career stage); gender; and the third variable which represents all other characteristics arising from the total wage inequality for a given population.

Other observable characteristics, like the diploma or the activity sector, can be used to group individuals into more homogeneous sub-populations. The decomposition of inequality into these more homogeneous sub-populations allows to better specify the part attributable to gender by omitting the structural effects which can arise if men and women have different characteristics.

3. An illustration on French data

In this section we assess the contribution of gender to employees' wage inequality. Using Gini (1921) and Theil (1967) indices as income inequality indicators, the proposed decomposition method is illustrated using French FQP data over the period 1970–2003. This household survey, conducted at irregular intervals by INSEE, is particularly interesting because it has contained since the beginning of the 1970s individual wage. From the surveys completed during this period (FQP, 1970, 1977, 1985, 1993 and 2003), we can measure the level and the evolution of wage gender inequality between different sub-groups. As an example, we compare gender inequality in the equivalent full-time wage for the public sector and for the private sector.

The measurement of wage inequality with Gini index (Table 1) shows a parallel evolution in both sectors. In each, the inequality in equivalent full-time wages decreases from the beginning of the 1970s to the mid-1980s and then stagnates until the beginning of the 2000s. In each survey wage inequality is always stronger in the private sector than in the public one. The decrease of income inequality over the considered period is in line with previous research works which computed the Gini index on large period (see for example Verdugo, 2014, Koubi et al., 2005 and Fougère and Kramarz, 2001). Analyzing the trend of income inequality over the period 1976–2000, Koubi et al. show that inequality measured by the Gini index decreases from 0.322 in 1976 to 0.296 in 1999 which represents a smaller decrease compared to the one we obtain. Our results are more in line with those obtained by Fougère and Kramarz (2001) and Verdugo (2014), who also point

[2] FQP (Formation Qualification Professionnelle) is the French database on Education–Training-Occupation.