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The sources of income inequality in Indonesia: A regression-based inequality decomposition

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THE SOURCES OF INCOME INEQUALITY IN INDONESIA: A REGRESSION-BASED INEQUALITY DECOMPOSITION

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Abstract

Growing inequality is one important problem for a developing country, and Indonesia is no exception. Narrowing the gap between those at the top and the bottom of income distribution has become one of the government's main concerns. To achieve this goal, the sources of income inequality must be identified appropriately. Given the availability of household level data in Indonesia (Indonesia Family Life Survey), we are motivated to investigate the source of income inequality in Indonesia. The approach employed in this study is regression-based inequality decomposition using the Shapley value decomposition framework. The results show that education, wealth, as well as the employment sector are significant contributors to income inequality in Indonesia. These findings suggest that any policy aimed at reducing unequal access to education and finance is important to improve income inequality in the future.

JEL Classification: D31, D63, O53

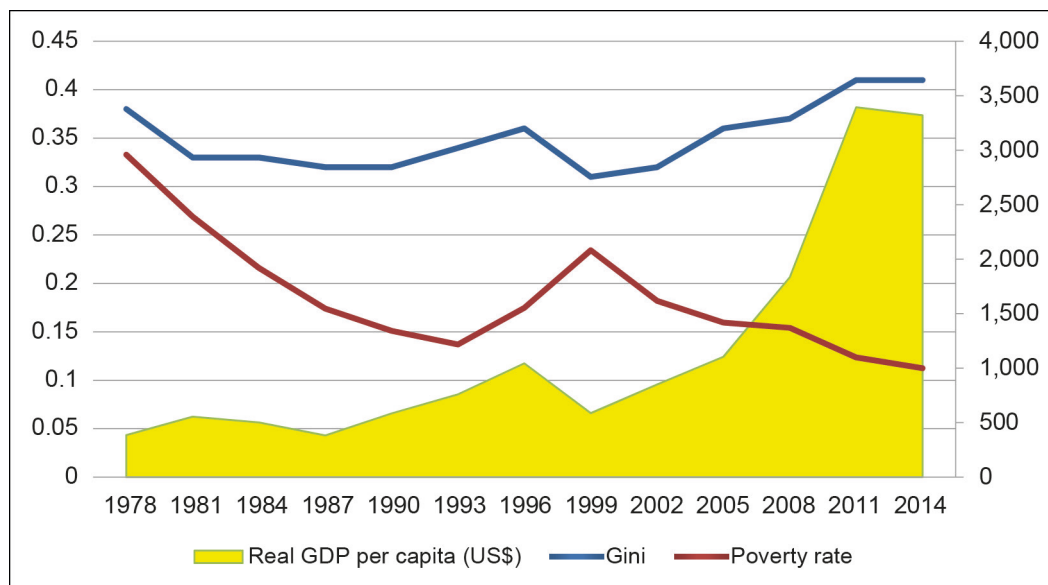
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1. BACKGROUND

Given abundant reserves of natural resources as well as a large labor force, Indonesia has successfully achieved decent economic growth in the recent decade. In 2008, Indonesia became a member of G20, making it one of the world's major economies. It has also been predicted that by 2030 it would be one of the top seven countries in terms of economy size, if it can maintain its rapid growth (Mc Kinsey Global Institute 2012). Furthermore, its decent economic condition has enabled the country to address the high poverty rate typical for a developing country. Nevertheless, another problem arises as the country grows: inequality has increased sharply in the last decade. Figure 1 shows how economic indicators have evolved overtime. In 1978, almost one-third of Indonesia's population lived below the poverty line. Twenty years later, as gross domestic product (GDP) per capita grew moderately, the poverty rate decreased significantly to around 15% right before the currency crisis hit Southeast Asia.

Figure 1: Poverty, Inequality, and GDP per Capita in Indonesia



GDP = gross domestic product.

Source: Indonesia Central Statistics Agency, the World Bank.

Indonesia has managed to recover quickly from the crisis as shown by the higher growth in GDP per capita after 2000. Poverty rate, which was adversely impacted by the crisis, eventually improved over time. On the other hand, higher growth seems to have negative consequence on income distribution as shown by the Gini index, which increased sharply during the last decade. The income gap between those at the bottom decile and those at the top widened as shown by the Gini index, which reached 0.41 in 2014. The 10 percentage point increase in the Gini index over 10 years was considered high among other developing countries. It is also the highest increase for a country in South Asia.

At some point, inequality is necessary to give a sort of incentive for the economy to continually grow faster. However, a persistent gap in income distribution will also affect economic performance later (Stiglitz 2016). Therefore, the widening gap in income distribution has been one of the concerns for the government. In medium-term development, one of the government's targets is to reduce the Gini index by 2019. In order to address the growing inequality in Indonesia, one must be aware of the sources of income inequality. Once the sources of inequality are identified, the best policies can then be formulated to close the gap in income distribution.

The rich literature on income inequality can help elaborate more on the root of the inequality problem in Indonesia. A most interesting study on the sources of income inequality has been conducted using household level data in many countries. The availability of household level data makes it possible to conduct the same study in Indonesia. By employing micro data, we can actually look for the characteristics that determine what is contributing to the higher inequality measure. Moreover, household level data allow us to decompose the inequality measures into some important contributing factors.

Income inequality decomposition can be conducted by using several methods. The most popular method is by employing either population subgroup or factor components decomposition (Shorrocks 1980, 1982, 1984; Bourguignon 1979). The example of population subgroup decomposition includes those that employ gender, age, and race differences in decomposition analysis. Despite its popularity, this method cannot control the contribution of other factors, thus undermining the contribution of other factors such as education and experience (Shorrocks and Wan 2004). In a factor-component decomposition, we can attribute income inequality by the source of income such as wage income, investment income, and other income. Nevertheless, this method cannot explain the fundamental factors that contribute to the difference in income such as education, wealth, and other personal or family characteristics.

Fortunately, the other analytical framework—regression-based decomposition—makes it possible to overcome the limitation of the former. This framework was initiated by Oaxaca (1973) and Blinder (1973), and was then developed by Juhn et al. (1998) and Wan and Zhou (2004). By employing this method we can control the contribution of several factors simultaneously as well as identify the contribution of fundamental factors in explaining inequality.

In this study we will investigate the source of income inequality by decomposing the inequality measure, i.e., Gini index, into factors that significantly contribute to those measures. The regression-based inequality decomposition will be employed in this study. In order to decompose the source of income inequality, the Shapley value decomposition framework proposed by Shorrocks (1999) and the method employed by Wan (2002) will be utilized in this study. By doing so, it is expected that we can contribute more to literature concerning income inequality as well as give some relevant feedback to policy makers.

2. LITERATURE REVIEW

Earlier studies on income inequality have found several factors that contribute significantly to income inequality. Most studies found education to be an important factor that creates wider income gap between the poor and the rich (Chongvilaivan and Kim 2015; Contreras et al. 2009; De Silva and Sumarto 2013; Dos Santos and da Cruz Vieira 2013; Morduch and Sicular 2002; and Sapelli 2011). Some studies also find that access to finance matters in explaining income inequality (Wan and Zhou 2004; Bae,

Han, and Son 2012). According to the more recent study by the World Bank (2016), there are several main causes of income inequality in Indonesia: (i) unequal opportunity, (ii) unequal jobs, (iii) high wealth concentration, and (iv) low resiliency. Unequal access to education can give rise to inequality in the future since those who are less educated tend to engage in low-wage jobs, which are typically in the informal sector. Differences in wealth accumulation also matters in determining access to both education and health services, which in turn affect the potential earning of household members in the future. These findings have motivated us to investigate whether these factors make significant contribution in explaining income inequality in Indonesia.

Regarding the approach applied in this inequality study, several earlier studies were focused on the decomposition of income inequality, which included those using population subgroup decomposition and those employing regression-based decomposition approach. The former was particularly aimed to answer the sources of inequality in a subgroup of population by decomposing them into between-group and within-group components of inequality. Using this approach for Indonesian data, Chongvilaivan and Kim (2015) find that education, as well as regional characteristics matters in explaining income inequality. Nevertheless, this approach has some limitations, since it cannot control the contribution of other variables as well as fundamental determinants in income inequality (Shorrocks and Wan 2004). Furthermore, according to Morduch and Sicular (2002), this method can only explain the decomposition based on discrete variables, and the inclusion of multiple factors would give some constraint since the number of groups will increase in line with the number of categories.

Meanwhile, the latter is a more appealing approach since it allows us to decompose the inequality measures using multiple contributing factors simultaneously to deal with the limitation of the former. This approach has gained attention since the works of Oaxaca (1973) and Blinder (1973). The more recent studies using that method were carried out to determine income as a source of inequality in rural People's Republic of China (Morduch and Sicular 2002; Wan and Zhou 2004). In Indonesia, the same approach was employed by de Silva and Sumarto (2013). Despite the same approach using regression-based inequality, the two studies were different in terms of their treatment on contributing factors other than the proposed explaining variables, i.e., the contribution of constant and residuals. Morduch and Sicular (2002) determined the contribution of each factor as the inequality measured over the income prediction made by each contributing factor. The main flaw of this method was the nontrivial contribution made by the constant as well as residuals. Wan (2002) noticed the pitfall and proposed a new method of decomposing contribution using the Shapley value decomposition as discussed in Shorrocks (1999). Under this method, we can disentangle the contribution made by constant and residuals and focus on the contribution made by the factors being examined.

The following explanation can give a picture of how this method works. Suppose that the measured inequality using, say Gini index, is $I(Y)$. This index can be decomposed using the income generation function obtained from the regression of income (Y) on the explaining variables such as age, education, wealth, etc. The fitted value of income (\hat{Y}) can be used to measure the inequality contributed by the factors plus constant and residuals ($I(\hat{Y})$). The contribution of residuals (CO_e) can be measured as $I(Y) - I(\hat{Y})$. Furthermore, the constant contribution can be netted out by measuring the inequality given the constant (C) equals to zero. Therefore, we can get $Y^* = (\hat{Y}|C = 0)$ to measure the net contribution of factors being examined for income inequality. Finally, the inequality measure associated with contributing factors is $I(Y^*)$, which is subject to decompose further.

In order to determine the contribution of each factor, the Shapley value decomposition is employed. This decomposition framework was adopted from the game theory field to determine the net contribution of each player in a game. Each contributing factor is an analogy of a player in that game, for which contribution can be calculated using the Shapley value.

3. DATA AND METHODOLOGY

This study utilizes datasets obtained from the Indonesia Family Life Survey (IFLS). It is a household and community longitudinal survey conducted by RAND, for which the first wave was conducted in 1993. Currently, five waves of IFLS data are available, which includes the surveys conducted in 1993, 1997, 2000, 2007, and 2014. IFLS is a rich dataset consisting of a wide array of household and community characteristics, i.e., household structure, education, income, health, etc. Even though only 13 of 34 provinces are covered in this survey, it represents 83% of Indonesia's population, with at least 7,000 households and around 30,000 individuals surveyed.

Income inequality decomposition is carried out with the following procedure. First, we determine the inequality measure, $I(Y)$, based on household income. Second, a regression of income=generating function is employed to obtain the income equation that can be used to predict income based on each household characteristic. A semi-log income-generation function is applied in this study. Third, the exponential of fitted value of income is used to determine the new inequality measure, $I(\hat{Y})$, with which the residual's contribution (COe) can be netted out from $I(Y)$. Fourth, the Shapley value decomposition method is employed to determine net contribution of each factor to income inequality.

The income equation employed in this study is as follows:

$$\ln(y) = \alpha + X\beta + \varepsilon \quad (1)$$

$\ln(y)$ is the natural log of per capita annual household income, while $X\beta$ is vector of the independent variables explaining household income. The explanatory variables are as follows:

1. Head of household's gender
2. Household size
3. Head of household's age
4. Head of household's age squared
5. Head of household's years of education
6. Head of household's years of education squared
7. Household's wealth per capita
8. Proportion of household members who are wage earners
9. Dummy variable for rural location
10. Dummy variable for eastern Indonesia

Gender is included in the income equation to account for discrimination in labor participation between males and females, which may have an impact on income. Age and education are included since these covariates can represent productivity and knowledge, which can create correlation between them and income. Furthermore,

household wealth is included in the income-generating function since the accumulation of wealth can have an impact on inequality since it can determine how well the access to education is, as well as health service, which in turn influences income inequality. Moreover, it also can have a positive correlation with household income since additional income can be generated from that wealth. The proportion of wage earners over the number of household members is also included in the function to account for the impact of labor market outcome on income inequality. In order to account for regional disparity, a dummy for rural and eastern Indonesia is also included in the income equation.

The summary statistics of those variables is presented in Table 1. This study includes only the three latest waves of IFLS: IFLS 3 (2000), IFLS 4 (2007), and IFLS 5 (2014). By including these three waves, it is expected that the change in source of inequality over time can be analyzed to determine whether such changes are significant. Based on summary statistics, it can be inferred that the average number of years of education in Indonesia is still low (around 6 to 8 years). Nevertheless, it shows progress since the average year of education increases over time. The average accumulation of wealth also shows a significant increase over time, in line with the high growth between 2000 and 2014. The average proportion of wage earners is one-fifth and it is quite stable over time. The proportion of households living in urban areas shows an increasing trend, which in 2014 was only around 40% of households living in rural areas. The mean other explanatory variables are quite stable over time.

Table 1: Summary Statistics of the Variables

Variable	2000		2007		2014	
	Mean	Std. Dev.	Mean	Std. Dev.	Mean	Std. Dev.
Log of per capita income	13.69	1.26	14.56	1.23	15.33	1.29
Male-headed	0.85	0.36	0.86	0.35	0.86	0.35
Household size	4.55	1.97	4.22	1.81	4.02	1.71
Age	48.57	12.95	49.75	12.62	47.73	12.57
Age squared	2,526.50	1,327.76	2,634.31	1,315.21	2,436.22	1,275.79
Education	6.11	4.63	6.84	4.77	7.97	4.70
Education squared	58.82	69.94	69.51	76.17	85.62	79.02
Wealth	1.02E+07	2.82E+07	2.23E+07	4.70E+07	4.95E+07	9.57E+07
Wage earners	0.21	0.24	0.17	0.23	0.20	0.25
Rural	0.55	0.50	0.50	0.50	0.42	0.49
Eastern Indonesia	0.11	0.31	0.11	0.31	0.12	0.32
Observations	6,407		6,720		8,337	

After the fitted value of income per capita is predicted and the contribution of residuals has been netted out, the Shapley value decomposition is applied to determine the contribution of each income source. The following explanation will describe how the decomposition works. Suppose that there are k factors of variables in the income-generation function so that:

$$Y = F(X) + e \quad (2)$$

$$Y = \hat{Y} + e \quad (3)$$

Therefore, we can decompose inequality and disentangle the contribution of residuals as follows:

$$I(Y) = I(\hat{Y}|X_1, X_2, \dots, X_k) + CO_e \quad (4)$$

Where $I(Y)$ is income inequality measured on actual income, $I(\hat{Y}|X_1, X_2, \dots, X_k)$ is income inequality measured on predicted income, and CO_e is the contribution of residuals. Since we employ a semi-log income equation, we can ignore the contribution of a constant on income inequality.

The contribution of each factor is then described as follows:

$$I(\hat{Y}|X_1, X_2, \dots, X_k) = C_1 + C_2 + \dots + C_k \quad (5)$$

where C_1 is the contribution of X_1 in income inequality. The contribution of each factor is determined as the impact on income inequality if a factor is removed by replacing it either with its means value or zero. In this method we use the means value as the replacement. The contribution of each factor is then determined as follows:

$$C_j = \frac{1}{k!} \sum_{\pi \in \Pi_k} [I(\hat{Y})|B(\pi, X_j) \cup \{X_j\}) - I(\hat{Y})|B(\pi, X_j)] \quad (6)$$

where $I(\hat{Y}|X)$ is the inequality measured on predicted income, and Π_k is the set of all possible permutations of the k variables. $B(\pi, X_j)$ is the set of variables ahead of X_j in the ordering π .

The share of each factor contribution in income inequality (S_j) then can be determined as follows:

$$S_j = C_j / (I(Y)) \quad (7)$$

This method does require extensive calculation because as more factors are included in the income equation, the possible permutation from the set of variables increases as well.

4. RESULTS AND DISCUSSIONS

The obtained income-generation function is presented in Table 2. The sign of the coefficients is as expected with most of them significant at 1% level of significance. The number of male household heads is positively correlated with per capita income, which suggests that different patterns of participation between genders exist in Indonesia's labor market. Age is negatively correlated with per capita income, which implies that productivity may decrease as age goes up, thus leading to lower per capita income. Household size also has a negative relationship with per capita income. This finding is consistent since more household members will lower per capita income. Meanwhile, education is found to have a positive relationship with per capita income. This finding is also consistent, since the more educated a person is the more knowledge he or she possesses, thus leading to greater income per capita. Wealth is also found to have positive impact on per capita income. Households with more wealth can generate more income using the wealth owned. The proportion of wage earners also positively correlated with income per capita. Furthermore, regional disparity also matters in determining the per capita income. Households in rural areas tend to have lower per capita income compared with those living in urban areas. Moreover, households

in eastern Indonesia generate less per capita income compared with those living in western Indonesia.

Table 2: The Estimated Income-Generating Function

Variables	(1) Coefficient	(2) Coefficient	(3) Coefficient
Male-headed	0.2122*** (0.040)	0.2635*** (0.038)	0.2737*** (0.036)
Household size	-0.0507*** (0.007)	-0.0683*** (0.007)	-0.0220*** (0.007)
Age	0.0591*** (0.008)	0.0512*** (0.007)	0.0472*** (0.007)
Age squared	-0.0006*** (0.000)	-0.0005*** (0.000)	-0.0005*** (0.000)
Education	0.0401*** (0.009)	0.0338*** (0.009)	-0.0032 (0.009)
Education squared	0.0023*** (0.001)	0.0018*** (0.001)	0.0035*** (0.001)
Wealth	0.0000*** (0.000)	0.0000*** (0.000)	0.0000*** (0.000)
Wage earners	0.9346*** (0.059)	1.3448*** (0.060)	1.4010*** (0.052)
Rural	-0.2811*** (0.030)	-0.1923*** (0.028)	-0.1964*** (0.026)
Eastern Indonesia	-0.1708*** (0.044)	-0.2105*** (0.041)	-0.1511*** (0.038)
Constant	11.9547*** (0.192)	12.8603*** (0.186)	13.5750*** (0.176)
Observations	6,407	6,720	8,337
R-squared	0.261	0.295	0.253

Standard errors in parentheses: *** p<0.01, ** p<0.05, * p<0.1.

After income generation is specified, the Shapley value decomposition is employed to determine each factor's contribution in income inequality. In this study, we use the Gini index as measure of income inequality. The result of the decomposition is presented in Table 3.

In this decomposition, we use the Gini index as the main measure of inequality. In 2000, education is the most significant contributor to income inequality. One-fifth of income inequality is caused by different levels in education. This finding is also in line with earlier studies, which conclude that education matters in explaining income inequality in Indonesia (Chongvilaivan and Kim 2015; De Silva and Sumarto 2013). This finding implies that unequal access to education significantly affects income inequality in Indonesia. More equal access can increase human capital, which can have better impact on inequality through higher wages because those who are more educated can acquire more skill, thus influencing the labor market outcome later. The importance of education in determining income was also discovered by Duflo (2000), who found that greater access to education significantly improves the education level as well as wages in Indonesia.

Table 3: Decomposition Results, 2000

No	Variables	Gini	Theil L	Atkinson
		%	%	%
1	Male-headed	1.02	0.47	0.53
2	Household size	2.95	1.88	1.97
3	Age	15.48	1.11	5.97
4	Education	20.99	15.34	16.65
5	Wealth	19.07	19.40	21.92
6	Wage earners	8.29	4.22	4.84
7	Rural	5.89	3.98	4.30
8	Eastern Indonesia	0.89	0.53	0.57
All variables		74.63	46.93	56.75
Residuals		25.37	53.07	43.25
Total		100.00	100.00	100.00

Source: Authors' calculation.

Wealth comes second in determining income inequality, which is just below education contribution. This finding implies that asset accumulation by household can give better access to education as well as health services either through inheritance or more income generated from the ownership of assets. This finding suggests the importance of wealth in dealing with income inequality. The emergence of wealth contribution to income inequality is also found in Manna and Regoli (2012).

Age comes third in explaining income inequality. This finding along with earlier findings suggests that individual qualification, especially experience, matters in determining income. Wage earners account for about 8% of income inequality. Regional disparity in rural areas explains for about 6% of income inequality. Interestingly, being situated in eastern Indonesia only accounted for less than 1% of income inequality. In geographic area, the difference between rural and urban areas determines more income inequality. It can be associated with unequal development between rural and urban areas, especially related to infrastructure development, which is very important to stimulate economic activity.

In order to observe the pattern of this contribution over time, we also present the results of the decomposition for 2007 and 2014 in Table 4 and Table 5, accordingly. For 2007, there is no significant change in the contribution of each factor to income inequality, except for wage earners. Wealth and education are still significant contributors to income inequality, in which both contribute to about 40% of income inequality. One noticeable change is the contribution of wage earners in determining income inequality. The share of wage earners significantly increases from 4% in 2000 to 21% in 2007 and becomes the largest contributor as well. The rise in wage earners' contribution can be attributed by the skill difference as a result of unequal access to education. Those who are less educated tend to engage in low-wage informal sector work with more fluctuation in earning. Meanwhile, those with more education work in the formal sector, which gives them stable income. Moreover, the recent strength of the labor union in Indonesia also contributes to the difference in wages since the union can negotiate regional minimum wage every year. The contribution of rural areas to income inequality is also lower in 2007. This finding can be associated with the progress on decentralization, which was begun in Indonesia in early 2000.

Table 4: Decomposition Results, 2007

No	Variables	Gini	Theil L	Atkinson
		%	%	%
1	Male-headed	0.37	−0.72	−0.58
2	Household size	4.51	3.43	3.47
3	Age	16.04	2.50	6.53
4	Education	19.24	15.62	16.04
5	Wealth	19.70	20.70	22.28
6	Wage earners	21.27	17.72	18.90
7	Rural	4.03	2.90	2.96
8	Eastern Indonesia	1.18	0.77	0.80
All variables		86.35	62.93	70.40
Residuals		13.65	37.07	29.60
Total		100.00	100.00	100.00

Source: Authors' calculation.

In 2014, wage earners and wealth were the largest contributors of income inequality, with each of them explaining one-fifth of income inequality. The contribution of education decreases moderately, showing progress on equalizing the access to education by the government through increased allocation of expenditure on education. Meanwhile, the change in regional disparity contribution decreases by a negligible amount.

As an alternative to the Gini index, Theil L as well as the Atkinson index is used as another measure of income inequality and a similar pattern is found. So far, the decomposition results using both measures are consistent with the above explanation. The noticeable difference when using both measures is the higher contribution of residuals, which is also found in Wan and Zhou (2004), as well as Dos Santos and da Cruz Vieira (2013).

Table 5: Decomposition Results, 2014

No	Variables	Gini	Theil L	Atkinson
		%	%	%
1	Male-headed	0.87	−0.03	0.04
2	Household size	1.32	0.88	0.91
3	Age	14.68	3.60	4.74
4	Education	16.70	11.63	12.84
5	Wealth	19.20	18.02	20.33
6	Wage earners	20.22	13.47	15.11
7	Rural	3.74	2.31	2.48
8	Eastern Indonesia	0.61	0.15	0.18
All variables		77.32	48.04	57.82
Residuals		22.68	51.96	42.18
Total		100.00	100.00	100.00

Source: Authors' calculation.

In sum, based on our findings, the sources of income inequality in Indonesia is quite similar to those in the other developing countries in the world. Unequal access to education has an adverse impact on income distribution. This problem can be persistent in the future since those with higher income can provide a better education for their children while those who live in low-income families will be less educated, thus worsening inequality for the next generation.

Regarding education policy, the Government of Indonesia has allocated a significant amount of budget for education (one-fifth of government spending) since 2009. Given the significant impact of education on income inequality and the large amount spent on education programs, it has to be assured that the money goes into effective education improvement programs. It should be noted that quality of education must be preserved while increasing school participation rate.

Wealth also matters in explaining income inequality in Indonesia. The contribution of wealth is quite stable over time. The accumulation of wealth can be associated with greater access to finance, which can also determine one's opportunity toward better education and health services. Furthermore, intergenerational wealth transfer also influences access to education, which in turn determines income inequality in the future. The significant contribution of wealth implies that equal access to finance can narrow the gap between the poor and the rich. The development of an efficient credit market can broaden the access to finance for the poor. To do that, the basic problems in a credit market (asymmetric information) must be addressed since those problems can hinder low-income people from getting access to credit (de Aghion and Morduch 2004).

The employment sector is also found to have significant impact on the widening gap in income distribution. The contribution of wage earners rises significantly during the first two periods of observation before it becomes stable during the last two observations. Again, this finding can be attributed to unequal access to education in the early life, which can create a divergence in skill accumulation and eventually influences labor market outcome as well as income inequality. Last, equal development between urban and rural areas can have better impact on inequality since that development, especially infrastructure development, is important to spur economic growth in areas that were considered left behind in terms of infrastructure.

5. CONCLUSION

This study employs the Shapley value decomposition framework and regression-based inequality decomposition approach to determine the main sources of inequality in Indonesia. Three waves of household survey data are utilized in this study, which represent the data for the years 2000, 2007, and 2014. Education, wealth, and the employment sector are the main determinants of income inequality. The combination of these factors can explain almost 60% of income inequality. Furthermore, the interconnection between these factors can explain why inequality grew significantly in the last decade. Wealth can determine the length of education as well as skill accumulation, which in turn determines the employment status and labor market outcome. These findings suggest that in order to improve the inequality measure, more efforts should be aimed at reducing unequal access to education as well as finance. Last, more equal development between rural and urban areas is also important in reducing income inequality in Indonesia.

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