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ORIGINAL ARTICLE

A sectoral growth-income inequality nexus in Indonesia

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Abstract

This paper provides evidence of strong associational effects between economic growth in the manufacturing, agriculture, mining and services sectors and income inequality, measured by an income equality variable, using panel data for Indonesian districts and cities over the period 2000 to 2010. The results show a significantly positive impact of both manufacturing and services shares of GDP on income inequality. The share of agriculture in GDP, however, shows a significantly negative impact on income inequality. The effects are robust to the incorporation of control variables, making a case for considering sectoral differences in policy targeting for achieving inclusive growth.

KEYWORDS

Asia, development, economic growth, inclusive, income equality

1 | INTRODUCTION

The world is experiencing a double reversal, with decreases in between-country inequality accompanied by increases in within-country inequality. While global inequality levels have declined by more than 5% over the last decade, associated with the rapid development of emerging economies, within-country income inequality has risen sharply in almost every country (Bastagli, Coady, & Gupta, 2012; Bourguignon, 2015). Even accounting for population size, an IMF study found that for the period 1990–2010 inequality increased by 11% within emerging economies (Ostry, Berg, & Tsangarides, 2014).

Indonesia, with an average annual growth of 5% during the 2000s, is among countries experiencing a high increase in income inequality (World Bank, 2014a). A depiction of the sectoral growth composition in the country

TABLE 1 Sectoral growth composition in Indonesia, 2000–2010

	Sectoral GDP share (in %)		Average annual GDP growth
	2000	2010	2000–2010
Agriculture	15.60	15.29	3.46
- Farm foodcrops	8.08	7.48	3.03
- Estate crops	2.34	2.11	3.79
- Other agriculture	5.18	5.69	3.96
Mining	12.07	11.16	1.10
- Crude petroleum and gas	8.43	4.51	−1.96
- Other mining	3.64	6.66	6.06
Manufacturing	27.75	24.80	4.47
- Oil and gas refinery	3.91	3.33	−1.39
- Other manufacturing	23.84	21.48	5.20
Services	49.26	49.30	7.74
- Electricity, gas and water supply	0.60	0.76	7.96
- Construction	5.51	10.25	6.96
- Trade, hotel and restaurant	16.15	13.69	5.96
- Transport and communication	4.68	6.56	12.86
Transport	3.36	3.37	6.20
Communication	1.31	3.19	21.94
- Banking, leasing & business	8.31	7.24	6.71
- Other services	9.34	10.24	5.32
GDP (IDR trillion)	1,389.77	6,446.85	5.23

Source: BPS (2015).

shows that the services sector (including utilities, trade, hotel and restaurant) has been the main driver for Indonesian economic growth during the 2000s (see Table 1). The construction sector experienced an accelerated growth for the later years, allowing it to double its contribution to GDP during the analysed decade. Associated with an initial recovery prioritization of the financial sector after the Asian Financial Crisis, the construction sector gained strength during the last years, also boosted by mining-related construction activities including roads, ports, railways, among other coal-mining infrastructure (Burke & Resosudarmo, 2012).

Meanwhile, the agriculture, mining and manufacturing sectors grew by less than the national average. The slow growth in the mining and manufacturing sectors is related to a decline in the oil, gas mining and refinery industries. Despite the slow overall growth of the mining sector, 'other mining activities' such as coal mining doubled its share of GDP with a faster annual growth rate than the Indonesian average. The latter is associated with the mining boom, particularly coal mining, that Indonesia experienced from 2000 until 2012 (Burke & Resosudarmo, 2012). The manufacturing sector, when excluding oil and gas refineries, has grown relatively close to the national average. In general, hence, it is suggested that sectoral growth in Indonesia has varied[1] considerably during the 2000s, with the services sector playing a greater role and agriculture, mining and manufacturing a lesser one.

[1]Despite an apparent small change in the composition of each economy sector during the period of study at the national level, this paper shows that the between-district variation is large enough to obtain consistent results (see Section 4). The dynamics that affect growth in each sector and their nexus with the income distribution are best analysed at a very disaggregated, district-level. Appendix Table A2 provides statistical evidence of the significant variation between-districts, that suggests the use of Between-Effects rather than Fixed-Effects models.

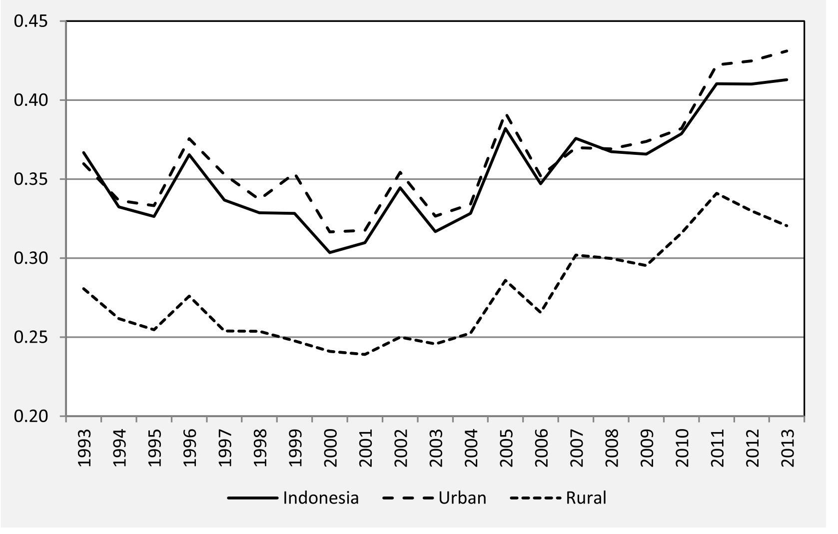

FIGURE 1 Gini coefficient in urban and rural areas, 1993–2013
Source: Yusuf et al. (2014).

Figure 1 shows that inequality in Indonesia, measured by a Gini coefficient, was relatively stable before the 1997–1998 crisis, but has since increased significantly (Yusuf, Sumner, & Rum, 2014). The World Bank (2014b) also showed that, between 2003 and 2010, consumption only grew by 1.3% per annum for the bottom 40% of Indonesian households, whereas for the top 20% it grew by 5.9%. The bottom 40% of households accounted for just 19% of the total income in 2010, as opposed to the 44% in the hands of the top 20%. The World Bank further argued that if Indonesia aspires to generate prosperity and avoid the middle-income trap, it must address economic growth and tackle inequality (World Bank, 2014a). In particular, poverty-reduction policies in Indonesia should consider the impacts of growth on inequality, as the trickle down effect of economic growth appears to be weak for the bottom 20% of Indonesian households (de Silva & Sumarto, 2013, 2014a). Modelling sources of inequality can inform Indonesian policy-makers on how best to tackle inequality and poverty, thereby making Indonesian society fairer and its economy stronger.

By estimating between-effects and instrumental variables regressions using a panel dataset for the 431 Indonesian districts and cities over the period 2000–2010, this study examines the impact of compositional changes in GDP on income inequality, measured by an income equality variable, in Indonesia.[2] The results show a positive and statistically significant impact of the manufacturing and services share of GDP on income inequality. The share of agriculture in GDP, however, shows a negative impact on income inequality, while no impact is shown for the mining share of GDP. The effects are robust to the incorporation of education, employment, government spending and credit covariates as control variables. The results, hence, indicate that growth in the agriculture sector has been more inclusive than in the manufacturing and services sectors, making a case for paying attention to sectoral differences in policy targeting for achieving inclusive growth.

The rest of the paper proceeds as follows. Section 2 provides a literature analysis, attempting to cover from the earliest developments to the latest and most controversial empirical studies relating to economic growth and inequality. Section 3 describes the basic models, the construction of variables to be applied in the models and data sources. Section 4 explains the estimation strategies applied in this paper, while Section 5 summarizes the key results as well as interpreting and analysing the findings. Section 6 concludes and suggests implications for better policy practice.

[2]This is detailed and justified in Sections 3 and 4 of this paper.

2 | LITERATURE REVIEW

Early theoretical development approaches by Lewis (1954) and Kuznets (1955) showed a trade-off between economic growth and income inequality. Kuznets (1955) hypothesized an inverted U-shaped relationship between the two variables, where early stages of development are positively related with increasing levels of income inequality, while advanced stages are expected to present low inequality levels. Following this initial effort, some authors cast doubt on the inverted-U hypothesis, including Anand and Kanbur (1993), Deininge and Squire (1996) and Ravallion and Chen (1997), who broadened the empirical research by adding larger samples and more robust estimators. Other authors, including Alesina and Rodrik (1994) and Perotti (1996) found that income inequality has detrimental effects on growth due to credit-market imperfections, exacerbated by income inequality, while Barro (2000), Lopez (2003) and Knowles (2005) found no significant relation. The former, however, found that when only a sample of developing countries is considered, inequality of expenditure presents a significant negative correlation with economic growth.

Beyond this theoretical and empirical disagreement, there is a tentative consensus. Kanbur (2012), UNDP (2013) and Royuela, Veneri, and Ramos (2014) showed that more than the quantity, it is the nature of economic growth which matters in explaining changes in the income distribution within countries. Moreover, Galbraith (2009) and Beddoes (2012) suggested the possibility of an augmented Kuznets curve, with increasing inequality in the last segment of the curve.[3] Galbraith (2011) proposed that this increasing section of the curve relates to the highest income sectors in the economy, as these benefit disproportionally during economic booms.

Within-country studies in Indonesia, applying province-level data, also present mixed empirical evidence. Akita, Lukman, and Yamada (1999), Timmer (2007) and Hartono and Irawan (2008) found no statistically significant correlation between economic growth and income inequality, whereas Leigh and van der Eng (2009) and Tadjoeddin (2013), found a statistically significant negative correlation. Moreover, Resosudarmo and Vidyattama (2006), Akita, Kurniawan, and Miyata (2011), Sagala, Akita, and Yusuf (2013) and Bhattacharyya and Resosudarmo (2015) only found a positive and statistically significant relation between mining GDP and inequality, without a significant correlation for non-mining GDP. Consequently, there is a lack of empirical consensus regarding the nexus between economic growth and income inequality, both worldwide and in Indonesia. Also, the most disaggregated level of analysis that these studies present is at province-level. The main contribution of this paper is to directly address the nexus between economic growth and income inequality in Indonesia, using district level data.

3 | BASIC MODEL AND DATA SOURCES

This paper estimates the effects of sectoral GDP on income inequality, measuring an income equality variable, in district *i* at time *t*. The estimated model can be summarized as:

$$B_{it} = \tau_t + \delta_{it} + \beta Y_{jit} + \varphi X_{it} + \varepsilon_{it}. \quad (1)$$

The model incorporates an income equality indicator (B_{it}), time-varying shocks that affect each region (τ_t), a variable to account for district split over time (δ_{it}), a vector composed by the contribution of the *j*th GDP sector (Y_{jit}) for district *i* at time *t*, and a vector of additional covariates (X_{it}). Consequently, the independent variables of interest are Y_{Mit}, Y_{Sit}, Y_{Ait} and Y_{Nit} which stand for manufacturing, services, agriculture and mining sectors, respectively, measured as shares of total GDP. Also, following the between-region inequality decomposition performed by Akita et al. (2011), time-varying shocks are added to the models with year-dummy variables, from 2000 to 2010, and four regions: Sumatra, Java-Bali, Kalimantan and Eastern Indonesia. Year and region fixed effect controls can be added to the models, to control common shocks for all districts across time, for example, national anti-poverty policy programs (Bhattacharyya & Resosudarmo, 2015). District split dummy variables allow control of splitting districts (δ_{it}= 1) and

[3]Paul Krugman (2014) also denoted the increasing segment of the N-curve as a “great U-shaped arc” referring to the large (and increasing) income disparities in the United States, previously exposed by Thomas Piketty's (2014) findings.

non-splitting districts (δ_{it}= 0), during 2000 and 2010.[4] The latter minimizes potential double-counting of district information. This paper approximates the growth in each GDP sector as the increase in its share of GDP, supported by statistically significant correlations (see Appendix Table A1). The estimated coefficient β determines the marginal effect of a percentage point increase in an economy sector Y_{jit} on B_{it}. The error term is ε_{it}.

The vector of additional covariates X_{it} is composed of five variables: expenditure on education ($educexp_{it}$), employment ($emppop_{it}$), government spending ($gexpGDP_{it}$) and a proxy variable for credit ($credGDP_{it}$). The first covariate, is household expenditure on education *per capita*, as a proportion of the household total expenditure *per capita*. The second covariate is an employment-to-population ratio, as a measure of labour market conditions (Censky, 2012). Government spending is expressed as a proportion of GDP, to account for the relative size of this expenditure in each district.

The World Bank (2015) database does not provide data on credit availability at district level. However, to account for the size of the financial sector in each district and approximate credit availability, a covariate of the financial sector's GDP per financial sector workers is applied in this paper. The use of this covariate is based on the idea that the relative size and contribution of the financial sector in each district should be represented by more people working in this sector. This proxy variable can also account for the labour productivity in the financial sector and its influence over credit availability along the business cycles (Zandvakil, 2016).

The ratio between the average household expenditure *per capita* of the bottom 20% and the average household expenditure *per capita* for each district or city (expenditure ratio of the bottom 20%) is the income equality indicator (B_{it}) applied as the dependent variable in this paper. This B_{it} is applied as an alternative indicator of inequality to the Gini coefficient, for the following reasons. First, district level Gini coefficients are not yet available at the time of writing this paper. The World Bank (2015) dataset does not provide a Gini coefficient at district-level, nor the levels of consumption or income for each population quintile that would enable its construction.[5] However, the dataset does provide a unique variable for the consumption of the bottom 20% of households, which allows the construction of B_{it}. Second, there is an empirical justification for the use of B_{it}, related to its high statistically-significant correlation with the Gini coefficient. Third, the use of an alternative inequality indicator is also justified by theory.

The empirical justification is based on the statistical properties of B_{it} and its significant correlation with the Gini coefficient. First, B_{it} tends to follow a normal probability distribution. A Kernel probability density function and a skewness-kurtosis test confirmation of this variable show that there is no statistically significant skewness or kurtosis in this equality variable. This condition is expected to produce normally-distributed regression residuals, from the correlations between each sectoral GDP and B_{it} analysed in this paper. The normality of the regression residuals is of prime importance for the validity of significance tests in the estimation results of Equation (1), since an asymptotically-consistent coefficient requires an asymptotically-normal distribution of the regression residuals (Wooldridge, 2013). Second, a maximum-likelihood (MLE)[6] random-effects regression between B_{it} and the Gini coefficient at the provincial level in Indonesia shows a statistically-significant negative correlation between both indicators of income

[4]The number of districts and cities in Indonesia is increasing over time. During the writing of this paper there were 415 districts and 99 cities in Indonesia. Using INDO-DAPOER (World Bank, 2015) data, this paper reconstructed the districts such as they were in 2000 and built a district split binary vector with information up to 2010. This dummy variable takes the value of one from the year that the district split and zero otherwise. With this addition, and excluding outlier observations for the variable of interest, the dataset applied in this paper comprehends 431 districts and cities. The outlier observations, representing B_{it} values greater than 0.6, were excluded from the sample because they belong to several districts outside the Java-Bali-Sumatra islands, which are hardly representative in the Indonesian National Socioeconomic Survey (SUSENAS) sample (BPS, 2014). Finally, due to missing values in the dataset, some regressions may show fewer than 431 districts.

[5]An apparently-deliberate omission of the income (or expenditure) distribution data may be related to the fact that some district level surveys may incur in small sampling or sampling bias due to intern conflict (World Bank, 2014c), and thus may not be statistically representative.

[6]For a less disaggregated level of data, such as income inequality (the Gini coefficient) at provincial level, a MLE regression fully maximizes the likelihood of a random-effects estimator, obtaining a minimum variance of the regression estimates, i.e. asymptotically-efficient estimators (Greene, 2012). The random-effects MLE regression performed in Table 2 also holds statistically-significant when controlling for time-varying shocks per region, suggesting consistent validity of the equality indicator (B_{it}).

TABLE 2 Correlation between the expenditure ratio of the bottom 20% and the Gini coefficient (provincial level), period 2000–2010

	Dependent variable: expenditure ratio of the bottom 20% (B_{it})		
	MLE random-effects estimation	z statistic	p-value
Gini coefficient	−0.510*** (0.052)	−9.81	0.000
Observations	1631		
Districts	423		
LR chi^2	92.51		
p-value	0.000		

Note: ***p < 0.01; **p < 0.05; *p < 0.10.

distribution (Table 2). This relationship can also be seen in Figure 2. Consequently, this alternative equality indicator can be applied as a proxy for other common inequality indicators such as the Gini.

Finally, applying inequality indicators that focus on the bottom 20% of the income distribution allows attention to be focused on an extreme section of income distribution that is overlooked by conventional inequality indicators such as the Gini. As the Gini coefficient accounts for averages in the dispersion of incomes of individuals (Deaton, 2013), it lacks sensitivity in the extreme sections and may bias the inequality estimation downwards, as Krozer (2015) found in Mexico. Meanwhile, B_{it} measures direct changes to the well-being of the least-advantaged in income distribution; i.e. the bottom 20%. They are less able to invest in education, health and nutrition for themselves and their children (Ostry et al., 2014; UNDP, 2013), which in turn perpetuates intergenerational income inequality and inequality of opportunity (UNDP, 2013). Therefore, theoretically, B_{it} may pose a better equality estimator than the Gini.

The data set for this paper was obtained from two principal sources: The World Bank (2015) Indonesia Database for Policy and Economic Research (INDO-DAPOER) and a Statistics Indonesia (BPS, 2013) database. A panel dataset covering 431 Indonesian districts and cities over the period 2000–2010 is built for this paper.

4 | ESTIMATION STRATEGY

Applying a fixed effects (FE) model for within-variation or a between effects (BE) model for between-variation to reduce or eliminate the endogeneity problem embedded in a panel data model has been a common practice (Wooldridge, 2009). This paper argues that performing a BE model yields more precise and efficient coefficients than an FE model. The use of a FE model, which is based on within-region differences, would discard all information about

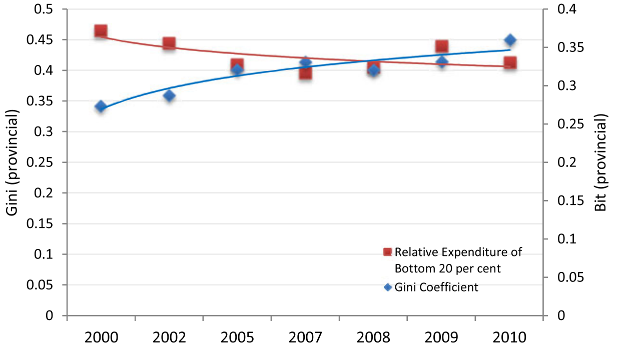

FIGURE 2 Evolution of the average expenditure ratio of the bottom 20% and the average Gini coefficient at the provincial level in Indonesia
Source: SUSENAS (BPS, 2014) and World Bank (2015).

between-region differences. If explanatory variables have significant variation across regions but have little variation over time, then applying an FE model will lead to imprecise estimators with large standard errors (Williams, 2015). This is the case for this paper, as robust tests for equality of variances show that manufacturing, services and agriculture shares of GDP present a statistically significant difference in variance between regions, but almost no significant difference across time (Appendix Table A2).

The next estimation strategy, since the data set is an unbalanced one, is to check whether an ordinary least squares regression (OLS) or a weighted least squares method (WLS) should be applied to the BE model to produce a stabilized variance that would ensure precise and efficient estimates (StataCorp, 2015; Williams, 2015; Wooldridge, 2009). White's test in Appendix Table A3 shows that applying OLS regressions yields heteroscedasticity problems for the effects of all GDP sectors. Hence, WLS regressions should be applied to address heteroscedasticity problems presented in manufacturing, services, agriculture and mining.

However, measuring the effects of the agricultural sector can still present endogeneity[7] problems, as reverse causality may be latent in its estimation. High income inequality in certain districts could cause lower bargaining power and lower relative wages for Indonesian farmers, bringing about a higher investment in agriculture in these districts (Sabates-Wheeler, 2005; Stiglitz, 2012). For this reason, this paper also applies an instrumental variables (IV) model. Variables $Precipitation_{it}$ and $Temperature_{it}$, measured as average precipitation per year and average temperature per year, respectively, are used as instruments to predict the agriculture share of GDP (Y_{Ait}). The use of these variables is justified because precipitation and temperature are exogenous geography-based instruments correlated with Y_{Ait} and are unlikely to affect inequality through channels other than GDP, as is also argued by Bhattacharyya and Resosudarmo (2015). A Durbin–Wu–Hausman specification test is applied to identify the best estimator, suggesting that the estimated coefficient of the IV regression between Y_{Ait} and B_{it} is statistically different to an alternative OLS estimator (Appendix Table A4).

5 | RESULTS AND DISCUSSION

Table 3 reports results from the between effects and instrumental variable estimations. This table shows statistically-significant negative correlations between the manufacturing share of GDP and B_{it}, as well as between the services share of GDP and this equality indicator. The slightly larger marginal effect that manufacturing shows compared to services (column (1)) is reverted once the heteroscedasticity problems are corrected by applying WLS regressions (column (2)). These findings imply that, on average, a one percentage point increase in the manufacturing share of GDP of an Indonesian district would decrease the relative expenditure of the poorest 20% of households of that district by 0.24 percentage points, all else being equal. Meanwhile, the mining share of GDP does not show a statistically significant correlation with the equality indicator. These three coefficients were estimated with between effects estimations. These regressions, as well as the instrumental variable estimations applied for agriculture, are controlled for time varying shocks per region δ_t to avoid possible endogeneity problems arising from common shocks that can affect all districts.

The agriculture sector, on the contrary, presents a positive correlation with the equality indicator. The OLS and WLS between effects estimations, presented in columns (1) and (2) in Table 3, suggest that an increase in the agriculture share of GDP is associated with an increase in the relative expenditure of the bottom 20% of Indonesian households. Moreover, considering the possibility of reverse causation from equality to agriculture, the IV estimation in Column 3 (Table 3), which instrumented the agriculture share of GDP with $Precipitation_{it}$ and $Temperature_{it}$, shows

[7]As it is shown in the results section of this paper, there is evidence that the IV estimation contributes to reduce the endogeneity problems in the Agriculture sector. Also, by including time varying shocks per region and additional covariates in the robustness analysis, without significant changes in the main results of any GDP sector, it is suggested that the models are correctly specified and endogeneity is not present in the estimation of any sector.

TABLE 3 Effects of sectoral GDP growth on inequality

Dependent variable: expenditure ratio of bottom 20% (B_{it})		BE-OLS (1)	BE-WLS (2)	IV (3)	Districts and cities	Observations
Manufacturing share of GDP (Y_{Mit})	Coefficient	−0.237***	−0.208***		420	2456
	Standard Error	(0.042)	(0.038)			
	F-Statistic	2.81	3.05			
	Adjusted R^2	0.147	0.164			
Services share of GDP (Y_{Sit})	Coefficient	−0.214***	−0.217***		421	2458
	Standard Error	(0.051)	(0.046)			
	F-Statistic	2.43	2.84			
	Adjusted R^2	0.120	0.149			
Agriculture share of GDP (Y_{Ait})	Coefficient	0.462***	0.472***	0.506***	421	2458
	Standard Error	(0.028)	(0.027)	(0.073)		
	F-Stat or Wald Chi^2	9.96	11.76	320.12		
	Adjusted R^2	0.461	0.506	0.356		
Mining share of GDP (Y_{Nit})	Coefficient	−0.048	−0.023		400	2274
	Standard Error	(0.041)	(0.036)			
	F-Stat	2.11	2.25			
	Adjusted R^2	0.100	0.112			
Time varying shocks per region		YES	YES	YES		
District split		YES	YES	YES		
Instruments		NO	NO	Precipitation and temperature		

Notes: BE-WLS means that a WLS regression is applied to a BE model, and BE-OLS means that an OLS regression is applied to a BE model. IV means an IV model. The BE regressions present F-Stat values, while the IV regressions present Wald Chi^2 values. District split dummy variables were added to the models, controlling for splitting and non-splitting districts to avoid double counting. Time-varying shocks added to the models with year-dummy variables, from 2000 to 2010, and four regions: Sumatra, Java-Bali, Kalimantan and Eastern Indonesia.

***$p < 0.01$; **$p < 0.05$; *$p < 0.10$.

an stronger relation with the equality indicator and a substantial decrease in the adjusted r-squared of the IV regression, suggesting that the potential endogeneity problem for this GDP sector could have been addressed.

To reinforce the relations found in these estimations, this study checked the robustness of the estimations between each of the GDP sectors and the equality indicator, in the presence of additional covariates. The controls applied were education ($educexp_{it}$), employment ($emppop_{it}$), government spending ($gexpGDP_{it}$), and a proxy variable for credit ($credGDP_{it}$). Table 4 reports these results. The results in Table 4 are relatively consistent with the ones presented in Table 3. Moreover, this study performed multiple cross-comparison estimations between sectors (and control variables) to reduce the scope for model misspecification and omitted variable bias. These estimations, as reported in Appendix Table A5, are also relatively consistent with the main results in Table 3. This paper acknowledges that the results in Table 3 might still suffer from an issue of unobserved heterogeneity bias. However, the relatively consistent results between the aforementioned tables, as well as the WLS and IV estimations, should produce relatively white random errors. It can therefore be argued that the main results in Table 3 are robust enough.

The IV regression between the agriculture share of GDP and the equality indicator, including each covariate, also showed robust and statistically-significant coefficients in all cases. Conditional on the additional covariates, the coefficient on agriculture moved up from 0.506 to 0.677 percentage points on average, showing an increase of 0.171 percentage points, or a 34% increase in the value of the coefficient, corresponding to a one percentage point increase in the agriculture share of GDP on equality. This includes the presence of the education covariate, which is a variable with important influence in determining skills, household income and the relative expenditure of the poorest 20%.

TABLE 4 Robustness check with additional covariates

Dependent variable: expenditure ratio of Bottom 20% (B_{it})				
	BE-WLS models for Y_{it}^M, Y_{it}^S and Y_{it}^N IV models for Y_{it}^A			
	(4)	(5)	(6)	(7)
Manufacturing share of GDP (Y_{Mit})	−0.121*** (0.036)	−0.154** (0.062)	−0.205*** (0.039)	−0.199*** (0.062)
Services share of GDP (Y_{Sit})	−0.097*** (0.043)	−0.180*** (0.062)	−0.195*** (0.048)	−0.205*** (0.066)
Agriculture share of GDP (Y_{Ait})	0.606*** (0.099)	0.780*** (0.170)	0.507*** (0.114)	0.816*** (0.128)
Mining share of GDP (Y_{Nit})	−0.044 (0.032)	−0.069 (0.055)	0.022 (0.038)	−0.071 (0.057)
Time varying shocks per region	YES	YES	YES	YES
District split	YES	YES	YES	YES
Additional controls	Expenditure on Education ($educexp_{it}$)	Employment *per capita* ($emppop_{it}$)	Government spending per GDP ($gexpGDP_{it}$)	Credit per GDP ($credGDP_{it}$)
Observations	2456	899	1660	867

Notes: The models include district split dummy variables. Time-varying shocks added to the models with year-dummy variables, from 2000 to 2010, and four regions: Sumatra, Java-Bali, Kalimantan and Eastern Indonesia.

***p < 0.01; **p < 0.05; *p < 0.10.

Having controlled for the abovementioned covariates and common shocks for all districts and cities across time, while performing robust consistency and significance tests, on a panel setting at the district and city level, it can be concluded that the manufacturing and services shares of GDP show a strong and positive associational effect with income inequality, while the agriculture share of GDP shows a negative one. There is no relation between the mining share of GDP and inequality.

There are both empirical and theoretical elements found in literature that support these findings. The findings of this paper are more or less consistent with the work of de Silva and Sumarto (2014b). They argue that despite its rapid economic growth, particularly in the manufacturing and services sectors, Indonesia is simultaneously experiencing a slowdown in poverty reduction and a speeding up in inequality.

This paper's findings are also consistent with the work of Akita et al. (2011) who provided evidence for a positive correlation between economic growth in the Indonesian manufacturing and services sectors and a regional inequality indicator. They find that the high industrialization and export orientation of regions such as Sumatra and Kalimantan tend to increase inequality, and that globalization, trade and financial liberalization have also increased inequality in the Java-Bali region. These endogenous and exogenous factors, which are worth taking into consideration when formulating policy, could be driving non-inclusive growth in the manufacturing and services sectors.

The result of this paper, however, contradicts the findings of Foster and Rosenzweig (2004), where growth in the rural manufacturing sector reduced local and spatial income inequality. However, their findings were based on a simple computable general equilibrium model with low empirical credibility (Suryahadi, Suryadarma, Sumarto, & Molyneux, 2006).

Finally, the strong positive effect of the agriculture share of GDP and equality found in this paper could be the most novel (or even surprising) finding, which could not have been foreseen without a detailed and disaggregated study at district-level. A possible explanation could be conjectured from agricultural productivity. Warr (2016) found that higher rates of agricultural productivity growth in Indonesia presented highly significant effects on poverty reduction. This paper validates Warr's (2014) findings of the positive effects of agricultural liberalization reducing poverty and inequality in Indonesia and Thailand. Likewise, Suryahadi, Suryadarma, and Sumarto (2009) found that rural agricultural growth could drastically reduce poverty, while Suryadarma, Artha, Suryahadi, and Sumarto (2005)

TABLE 5 Correlation between labour productivity in agriculture and the equality indicator in Indonesia, period 2000–2010

	Dependent variable: expenditure ratio of the bottom 20% (B_{it})		
	IV estimation	**z statistic**	**p-value**
Labour productivity in the agriculture sector (lpY_{Ait})	1.41*** (0.388)	3.63	0.000
District split	Yes		
Time varying shocks per region	Yes		
Instruments	Precipitation and temperature		
Wald Chi^2	30.33		
Observations	901		

Notes: Agriculture labour productivity (lpY_{Ait}) constructed as the ratio between the number of people in the agriculture sector and the GDP in agriculture, in IDR constant prices. The model includes district split dummy variables. Time-varying shocks added to the model with year-dummy variables, from 2000 to 2010, and four regions: Sumatra, Java-Bali, Kalimantan and Eastern Indonesia.

***$p < 0.01$; ** $p < 0.05$; *$p < 0.10$.

found a statistically significant relation between poverty reduction and low inequality in Indonesia. This study can also provide some evidence of the effects of agricultural productivity on income inequality, applying the same district-level data. Following a parallel theoretical and empirical justification such as the one previously applied in this study, an IV estimation shows a positive and statistically-significant correlation between labour productivity in the agricultural sector and income equality, which also controls for time-varying shocks per region and precipitation and temperature instruments (see Table 5).

6 | CONCLUSION

Despite its remarkable economic performance, Indonesia's GDP growth after the 1997–1998 crisis has been accompanied by rising rates of income inequality, which could hurt the sustainability of Indonesian economic growth. Policy-makers, therefore, require disaggregated information for targeted interventions. The positive nexus of growth and inequality at initial stages of development could be partially explained by a Kuznets relation. Economic theory, however, cannot help understand the sectoral growth patterns that are skewing the country's income distribution. Therefore, it is important to detect sectoral differences of growth-inequality nexus to reveal the drivers of the types of growth that are significantly increasing inequality in Indonesia.

This paper investigates the effects of economic growth in the manufacturing, agriculture, mining and services sectors on income inequality in Indonesia, applying a panel dataset of 431 Indonesian districts and cities over the period 2000–2010. Inner characteristics of key variables determined that between effects (BE) and instrumental variables (IV) estimations were required to analyse these effects. The results indicate a negative and statistically-significant impact of the manufacturing and services shares of GDP on the income equality indicator applied in this paper. At the same time, a statistically-significant positive impact of the agriculture share of GDP on income equality was found, while no statistically-significant impact was found for the mining sector. These outcomes are robust to the inclusion of time-varying shocks per region, as well as controlling for education, employment, government spending and credit covariates, suggesting strong relations.

This paper hence helps to reduce the empirical uncertainty regarding the types of economic growth that affect income inequality in Indonesia. Its main conclusion is that growth in the agriculture sector has been more inclusive than in the mining, manufacturing and services sectors.

Two main policy implications can be drawn from the findings of this paper. First, the finding that growth in the manufacturing and services sectors *per se* is not inclusive means that, while pursuing policies allowing growth in the manufacturing and service sectors, targeted interventions are required in both sectors to achieve inclusive growth and ensure long-term prosperity. The timely development of strong and appropriate social safety net policies during the industrialization periods is an example of the necessary targeted interventions.

The second policy implication relates to the finding that growth in the agricultural sector is likely to have a positive effect on the country's income distribution. This does not mean the agricultural sector share should be increased, but rather that reforms and improvements are required to increase agricultural productivity and opportunities for smallholders to increase their income, thus alleviating the inequality problem.

Indonesia should focus on policies related to technological and human capacity improvements in agro-processing and input supply channels, increasing their productivity. Otsuka (2013) suggests the adoption of large-scale mechanization in Asia to produce scale economies that guarantee food security while increasing income equality. Likewise, Otsuka and Runge (2011) provided statistical evidence for adaptation of agricultural technology and innovations in favour of the production factor with the largest relative availability as the best strategy to promote rapid growth in output, productivity as well as income equality in developing countries. For Indonesia, a labour intensive economy, a strategy aligned with mechanical innovations and capacity-building, more than biological innovations, would increase agricultural labour productivity, levelling their incomes with respect to higher income earners in other sectors and decreasing income inequality (Otsuka & Runge, 2011). According to El Benni and Finger (2013), these market support policies can have more direct and more efficient enhancements than agricultural growth, while decreasing income inequality, as the authors found in Switzerland.

Agrarian reform policies should also be considered. According to the World Bank (2003), agrarian reforms can perform as powerful catalysts for social and economic change, reducing poverty, alleviating inequality and improving efficiency of smallholder agriculture, by establishing favourable incentives and environments that nurture investment and productivity enhancements. Strong land reforms in Vietnam have proven successful for increasing rice production and lifting millions of people out of poverty (Kompas, Che, Nguyen, & Nguyen, 2012).

Further studies however need to be done to understand the effectiveness of a social safety net, technological and human capacity improvement, and agrarian reform policies in reducing inequality. Also, the heterogeneity limitation within the services sector, with regards to the types of occupations and associated skills, could be overcome with supplementary studies that decompose the services and manufacturing sectors, perhaps within clusters. This decomposition could help further understand the subsectors and components that are causing the strong and positive nexus of the services and manufacturing shares of GDP with inequality. The formulation of the targeted policies required to enhance productivity and overcome income inequality in each sector, like the design of appropriate safety net programmes, are beyond the scope of this paper.

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APPENDIX

TABLE A1 Correlation between economic growth and shares of GDP in Indonesia, period 2000–2010

	GDP growth on manufacturing sector	GDP growth on services sector	GDP growth on agriculture sector
Dependent variables:	**BE-OLS estimation**	**BE-OLS estimation**	**BE-OLS estimation**
Growth in manufacturing share of GDP $g\ (Y_{it}{}^{M})$	2.901*** (0.102)		
Growth in services share of GDP $g\ (Y_{it}{}^{S})$		0.427*** (0.079)	
Growth in agriculture share of GDP $g\ (Y_{it}{}^{A})$			0.241*** (0.047)
Time varying shocks per region	Yes	Yes	Yes
F-Stat or Wald Chi^2	26.85	3.44	2.63
Districts	409	410	410
Observations	2090	2091	2091
Adjusted R^2	0.68	0.17	0.12

Notes: Time-varying shocks added to the models with year-dummy variables, from 2000 to 2010, and four regions: Sumatra, Java-Bali, Kalimantan and Eastern Indonesia. The estimation method applied, between effects regressions with time-varying regional controls, is the same method applied in the rest of the paper, and its carefully explained in Section 4.

***$p < 0.01$; **$p < 0.05$; *$p < 0.10$.

TABLE A2 Robust tests for equality of variances

	Manufacturing Share of GDP (in %)			**Services Share of GDP (in %)**			**Agriculture Share of GDP (in %)**		
Region	Mean	Std. Dev.	Freq.	Mean	Std. Dev.	Freq.	Mean	Std. Dev.	Freq.
Eastern	0.0798	0.1003	136	0.3499	0.1457	136	0.3466	0.1647	136
JavaBali	0.2066	0.1865	834	0.3902	0.1184	834	0.2528	0.1615	834
Kalimantan	0.1085	0.123	636	0.3187	0.1336	636	0.3324	0.1858	636
Sumatra	0.1322	0.1218	730	0.3188	0.1383	730	0.3129	0.1898	730
Total	0.1493	0.154	2336	0.3461	0.1348	2336	0.2987	0.1811	2336
	W0 = 78.5993	df (3, 2332)	Pr > F = 0.0000	W0 = 6.5066	df (3, 2332)	Pr > F = 0.0002	W0 = 11.4645	df (3, 2332)	Pr > F = 0.0000
	W50 = 58.7317	df (3, 2332)	Pr > F = 0.0000	W50 = 6.1547	df (3, 2332)	Pr > F = 0.0003	W50 = 10.1129	df (3, 2332)	Pr > F = 0.0000
	W10 = 64.8866	df (3, 2332)	Pr > F = 0.0000	W10 = 6.4813	df (3, 2332)	Pr > F = 0.0002	W10 = 11.2351	df (3, 2332)	Pr > F = 0.0000
	Manufacturing Share of GDP (in %)			Services Share of GDP (in %)			Agriculture Share of GDP (in %)		
Year	Mean	Std. Dev	Freq.	Mean	Std. Dev.	Freq.	Mean	Std. Dev.	Freq.
2000	0.1539	0.1498	177	0.3484	0.1306	177	0.3099	0.1935	177
2001	0.1611	0.1652	218	0.3373	0.1367	218	0.3063	0.1926	218
2002	0.1647	0.1647	214	0.3379	0.132	214	0.2989	0.1836	214
2003	0.1531	0.1509	191	0.3454	0.1345	191	0.301	0.1789	191
2004	0.1588	0.161	205	0.3472	0.1296	205	0.3044	0.1782	205
2005	0.1561	0.1535	241	0.3421	0.13	241	0.307	0.178	241
2006	0.1545	0.1521	200	0.3483	0.133	200	0.2948	0.1774	200
2007	0.1427	0.1558	252	0.3412	0.1465	252	0.2834	0.1866	252
2009	0.1358	0.1496	296	0.3525	0.1375	296	0.2904	0.1765	296
2010	0.1304	0.1421	342	0.3547	0.1348	342	0.2984	0.1728	342
Total	0.1493	0.154	2336	0.3461	0.1348	2336	0.2987	0.181	2336
	W0 = 0.9042	df (9,2326)	Pr > F = 0.5204	W0 = 0.7712	df (9,2326)	Pr > F = 0.6432	W0 = 1.359	df (9, 2326)	Pr > F = 0.2012
	W50 = 0.6837	df (9,2326)	Pr > F = 0.7243	W50 = 0.7621	df (9,2326)	Pr > F = 0.6517	W50 = 1.2463	df (9, 2326)	Pr > F = 0.2617
	W10 = 0.8558	df (9,2326)	Pr > F = 0.5645	W10 = 0.7753	df (9,2326)	Pr > F = 0.6393	W10 = 1.3898	df (9, 2326)	Pr > F = 0.1868

Notes: Levene's robust test statistics (W0). for the equality of variances between the groups. Brown and Forsythe. (1974). test statistics with more robust estimators, replacing Levene's mean with the median (W50). or with the 10% trimmed mean (W10).

TABLE A3 White's heteroscedasticity test

		White's test	Cameron and Trivedi's decomposition		
			Skewness	Kurtosis	Total
Manufacturing Share of GDP (in%)	chi2	21.35	114.35	9.12	144.82
	p-value	0.0003	0.000	0.0025	0.000
	df	4	2	1	7
Services Share of GDP (in%)	chi2	18.34	118.73	17.86	154.93
	p-value	0.0011	0.0000	0.0000	0.000
	df	4	2	1	7
Agriculture Share of GDP (in%)	chi2	18.79	38.25	1.65	58.69
	p-value	0.0009	0.0000	0.1991	0.000
	df	4	2	1	7
Mining Share of GDP (in%)	chi2	25.55	110.69	1.96	138.20
	p-value	0.0000	0.0000	0.1618	0.000
	df	4	2	1	7

Notes: White's test for Ho: homoskedasticity, against Ha: unrestricted heteroscedasticity, for OLS regressions between each GDP share and the equality indicator. Cameron and Trivedi's decomposition performs an information matrix test for the regression model and an orthogonal decomposition into tests for heteroscedasticity, skewness, and kurtosis (StataCorp, 2015).

TABLE A4 Durbin–Wu–Hausman specification test for consistency of the IV estimator

	Dependent variable: Expenditure ratio of Bottom 20% (B_{it})		
	OLS estimation	t statistic	p-value
e_hat	0.997*** (0.0139)	71.61	0.000
Time varying shocks per region	Yes		
Instruments	No		
Observations	2336		
F-Stat	146.31		
R^2	0.7131		
Adjusted R^2	0.7082		

Notes: The Durbin–Wu–Hausman specification test departs from e_hat, the residuals generated from the IV regression between the GDP share in agriculture and the relative expenditure of the bottom 20% (B_{it}), applying precipitation and temperature as instruments. Using an OLS estimation, these residuals are regressed against the equality indicator Bit, to evaluate the consistency of the IV estimation. The coefficient is statistically significant at a one% level of significance; therefore the null hypothesis can be rejected in favour of the alternative. This implies that the estimated coefficients of the IV and OLS regressions are significantly different, and an IV regression can be applied for estimating the causal effects of the agriculture share of GDP and the equality indicator.

***$p < 0.01$; **$p < 0.05$; *$p < 0.10$.

TABLE A5 Cross-comparison estimations between Shares of GDP and covariates

Dependent variable: Expenditure ratio of Bottom 20% (B_{it})					
	BE-WLS models for Y_{it}^{M} and Y_{it}^{S} IV models for Y_{it}^{A}				
	Mining (Y_{Nit}) (9)	Expenditure on Education (*educexp*$_{it}$) (10)	Employment *per capita* (*emppop*$_{it}$) (11)	Government spending per GDP (*gexpGDP*$_{it}$) (12)	Credit per GDP (*credGDP*$_{it}$) (13)
Manufacturing (Y_{Mit})	−0.352*** (0.038)	−0.197*** (0.040)	−0.252*** (0.066)	−0.342*** (0.042)	−0.323*** (0.064)
Services (Y_{Sit})	−0.436*** (0.054)	−0.298*** (0.057)	−0.317*** (0.076)	−0.431*** (0.057)	−0.338*** (0.078)
Adjusted R^2	0.31	0.37	0.213	0.287	0.19
F-Statistic	5.26	6.37	6.97	5.24	5.88
Observations	2272	2272	838	1556	806
Agriculture (Y_{Ait})	0.498*** (0.1109)	0.661*** (0.138)	0.550*** (0.242)	0.699*** (0.143)	0.627*** (0.171)
Adjusted R^2	0.35	0.33	0.33	0.29	0.34
Wald Chi^2	354.12	424.45	154.9	286.91	95.87
Observations	2274	2274	840	1556	806
Time varying shocks per region	YES	YES	YES	YES	YES
District split	YES	YES	YES	YES	YES

Notes: The BE-WLS regressions simultaneously include Manufacturing, Services and Mining shares of GDP. The IV regression simultaneously includes Agriculture and Mining shares of GDP. All the models include district split dummy variables. Time-varying shocks added to the models with year-dummy variables, from 2000 to 2010, and four regions: Sumatra, Java-Bali, Kalimantan and Eastern Indonesia.

***p < 0.01; **p < 0.05; *p < 0.10.

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Resumen. Este artículo proporciona evidencia de los fuertes efectos asociativos entre el crecimiento económico en los sectores manufacturero, agrícola, minero y de servicios y la desigualdad de ingresos, medida por una variable de igualdad de ingresos, para lo cual usa datos de panel de distritos y ciudades de Indonesia durante el período 2000 a 2010. Los resultados muestran un impacto positivo significativo de la contribución del sector manufacturero y el de servicios en el PIB en la desigualdad de ingresos. Sin embargo, la contribución de la agricultura al PIB muestra un impacto negativo significativo en la desigualdad de ingresos. Los efectos se muestran robustos ante la incorporación de variables de control, lo que justifica que se consideren las diferencias sectoriales en la orientación de las políticas para lograr un crecimiento inclusivo.

抄録: 本稿では、2000年～2010年のインドネシアのdistrictとcityのパネルデータを使用して、製造業、農業、鉱業、サービスセクターの経済成長と、所得平等変数で測定した所得不平等との強い因果関係を示すエビデンスを提示する。結果から、GDPの製造業とサービスが占める割合は、所得不平等に有意に正のインパクトを与えることが示されるが、GDPに占める農業の割合は所得不平等に対し、有意に負のインパクトを与えることも示された。この因果関係は、制御変数を代入した場合も頑健であることから、インクルーシブ・グロース（包摂的成長）を実現するための政策目標の設定がセクターによって異なることを考慮することが正しいことが示される。