



# The Decline and Levelling Off of Earnings Inequality: Boon or Bane for a Growing Economy?

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## Abstract

This paper investigates evidence on deficits in economic inclusion, focussing on the labour market in Indonesia. Increasing job polarization and an accompanying rise in earnings inequality on account of technological development and globalisation over the past few decades have augmented concerns about the attainability of governments' perennial objective of inclusive growth. However, there are circumstances in which declining or levelling earnings gaps may be more of a bane than a boon for a country's long-term economic health. Using the particularly interesting case of Indonesia, which has reduced and subsequently levelled off its earnings inequality in the midst of impressive growth, this paper studies how structural factors and labour market policies influence dynamics of inequality. The study finds evidence of a strong role of structural characteristics, which appears to indicate that reductions in earnings inequality may be more of a bane than a boon for Indonesia's long-term prosperity. The paper concludes with broader insights and a discussion on policy implications that extend beyond the Indonesian context.

**Keywords** Earnings inequality · Minimum wage · Quantile decomposition · Indonesia

## Résumé

Ce document examine les preuves de déficits en matière d'inclusion économique, en se concentrant sur le marché du travail en Indonésie. L'augmentation de la polarisation de l'emploi et une hausse concomitante de l'inégalité des revenus, en raison du développement technologique et de la mondialisation au cours des dernières décennies, ont augmenté les préoccupations concernant la possibilité d'atteindre l'objectif perpétuel des gouvernements, c'est-à-dire une croissance inclusive. Cependant, il existe des circonstances dans lesquelles la diminution ou la stabilisation des écarts

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de revenus peut être plutôt un fléau qu'un bénéfice pour la santé économique à long terme d'un pays. En utilisant le cas particulièrement intéressant de l'Indonésie, qui a réduit et par la suite stabilisé son inégalité de revenus au milieu d'une croissance impressionnante, ce document étudie comment les facteurs structurels et les politiques du marché du travail influencent les dynamiques de l'inégalité. L'étude trouve des preuves d'un rôle fort des caractéristiques structurelles, qui semble indiquer que les réductions de l'inégalité des revenus peuvent être plutôt un fléau qu'un bénéfice pour la prospérité à long terme de l'Indonésie. Le document se conclut par des perspectives plus larges et une discussion sur les implications politiques qui vont au-delà du contexte indonésien.

## Resumen

Este artículo investiga evidencias sobre déficits en la inclusión económica, centrándose en el mercado laboral en Indonesia. La creciente polarización laboral y un aumento acompañante en la desigualdad de ingresos, debido al desarrollo tecnológico y la globalización en las últimas décadas, han aumentado las preocupaciones sobre la posibilidad de alcanzar el objetivo perenne de los gobiernos de un crecimiento inclusivo. Sin embargo, existen circunstancias en las que la disminución o estabilización de las brechas salariales puede ser más un perjuicio que un beneficio para la salud económica de un país a largo plazo. Utilizando el caso particularmente interesante de Indonesia, que ha reducido y posteriormente estabilizado su desigualdad de ingresos en medio de un crecimiento impresionante, este artículo estudia cómo los factores estructurales y las políticas del mercado laboral influyen en la dinámica de la desigualdad. El estudio encuentra evidencia del fuerte papel de las características estructurales, que parece indicar que las reducciones en la desigualdad de ingresos pueden ser más un perjuicio que un beneficio para la prosperidad a largo plazo de Indonesia. El artículo concluye con ideas más amplias y una discusión sobre las implicaciones políticas que se extienden más allá del contexto indonesio.

**JEL Classification** C21 · J08 · J31

## Introduction

Inclusive growth has long been high on the agenda of both governments and inter-governmental organisations; the supposition is that growth by which the earnings of the non-poor rise faster than those of the poor is both dis-equalising and unfair and should hence be avoided (Klasen 2010). Developments over the past few decades in the domain of technological change and globalisation have raised concerns about the attainability of the perennial objective of inclusive growth. In more affluent parts of the world, one main concern has been technology-induced polarisation of the labour market into 'lousy' and 'lovely' jobs (Goos et al. 2014; Spence and Hlatshway 2012).

In emerging markets, analysts have been more preoccupied with the implications of premature deindustrialisation, which diminishes the ability of countries to benefit



from labour-intensive manufacturing in boosting growth and reducing inequalities in a Kuznets-type fashion (Rodrik 2015). According to World Income Database (WID) (2017) statistics, since the 1970s, the earnings share of the top 1% of earners in more affluent economies has been on the rise, while that of the rest of the population has stagnated. The trend has been similar in less developed countries. The top 10% of earners in India were found to account for slightly more than half of the national income, while the top 10% of earners in South Africa were found to account for two-thirds of the national income in 2014 (Alvaredo et al. 2018). Solt's (2016) Standardized World Income Inequality Database highlights Asia as one continent where the pre-1990s period witnessed a fall in earnings inequality, but the trend has since reversed.

But is rising earnings inequality always undesirable, and can the underlying reason for the bridging or levelling off of an earnings gap be a bane rather than a boon for long-term economic health and welfare? To answer this question, one needs to delve into the interplay of structural characteristics and government interventions in individual settings. Theoretically, earnings inequalities are not necessarily a negative outcome of surges in technology, globalisation and growth. As such, they may reflect either high returns to innovation (Aghion and Jaravel 2015) or a 'paradox of progress' whereby the supply of skills lags behind ever-rising demand, generating high returns to specific types of competencies and occupations, even if inequality of education is falling (Bourguignon et al. 2005: pp. 393–398). An issue with not only fairness and social cohesion, but also efficiency and long-term growth, emerges if individuals' ability to access high-growth niches in an economy is constrained by inequality of opportunity and low social mobility (Autor 2014).

Ironically, a relatively low level of earnings inequality can be equally counter-productive if it reflects low availability of high-quality and growth-enhancing job opportunities rather than inequality-reducing government policies (Dimova and Stephan 2016). In either case, the motivation of capable individuals—especially those in lower socio-economic strata—to acquire skills and produce effort is constrained. This, in turn, has detrimental implications for long-term economic development. Excluding members of disadvantaged groups from educational opportunities limits their productive capacity, thus negatively affecting per capita income and eventually increasing inequality (Lopez et al., 1998 in Thorbecke and Charumilind 2002).

Evidently, further investigation is needed to understand whether earnings inequality is a boon or a bane for long-term economic growth. The basis for such investigation is well captured within the two strands of literature, which focus on the relationship between inequality and growth and the socio-economic effects of inequality. Forbes (2008), as an example of the first, found that a rise in the country's level of inequality has a positive and significant effect on short- and medium-term growth. The second strand of literature on the socio-economic effects of inequality justifies studying socio-economic factors as a mechanism through which inequality affects growth. Thorbecke and Charumilind (2002) reviewed the empirical literature on the nexus of inequality and argued the importance of looking at social phenomena to explain the causal mechanisms between the two. The social factors include education, political stability, health, and the level of crime. Contrasting evidence demonstrates that each of these factors may



cause income inequality to affect growth either positively or negatively (Thomas et al. 2000 in Thorbecke and Charumilind 2002: p. 1487).

The focus in this paper is to investigate trends in earnings levels and inequality to better understand their role in long-term economic growth. Using state-of-the-art decomposition analysis, we examine these issues through the lens of a particularly interesting case of falling (and subsequently levelling off) earnings inequality in the midst of impressive growth. The focus is on structural characteristics and direct government interventions in the form of rising minimum wages to explain the dynamics of earnings inequality. We began with descriptive exercises to examine the trends in earnings levels and working characteristics, focussing on two periods: 2000–2007 and 2007–2014. We observed an initial decrease in earnings inequality which reversed itself in the second period. Changes in earnings levels and inequality can reflect changes in either of two factors: the dynamics of returns to skills and shifts in the distribution of workers' characteristics.

Next, we estimated the Mincerian equation of returns to skills on log of earnings (see section “[Evolution of returns to characteristics](#)”) by pooling the earnings data for 2000–2007 and 2007–2014. We found a continuous decline in returns to education since 2000, which is consistent with other studies. However, it is uncertain whether the returns to education represent the largest contributing factor to declining earnings inequality in Indonesia. We found a substantial mismatch between the supply of and demand for skills, which may also reflect a relatively low quality of education as a potential explanation of the rising inequality since 2007. As such, we determined it necessary to examine the interplay between returns to characteristics and changes in the workers' characteristics in setting wage levels and affecting the inequality trend. We addressed this challenge by performing unconditional quantile decomposition method.

The decomposition method allows us to decompose the total change in wage into two parts. The first part represents changes in the characteristics of workers (i.e. ‘composition effect’) and the second part represents changes in the returns associated with those characteristics (i.e. ‘wage structure effect’). It also allows us to quantify the contribution of each covariate to the overall changes in both wage level and inequality. We find that structural characteristics, which influenced the returns to skills and sectors of employment, had a dominant effect. Furthermore, the pattern of this influence appears to indicate more of a bane than a boon for Indonesia's long-term economic health.

This paper contributes to an enhanced understanding of the relative contribution of a set of covariates in setting wage levels and determining inequality across wage distribution. It provides a broad overview and highlights the key contributing factors towards changes in both wage level and inequality. It utilizes repeated cross-section data covering a period of almost two decades (from 2000 to 2014). In so doing, this paper offers recent and longer-term insights into the phenomenon under examination. Furthermore, it extends the focus of existing studies of earnings determinants in Indonesia from changes in average earnings to the gap across the earnings distribution. The results highlight the reason for the persistent concerns of the working poor as indicated in earlier studies (Priebe et al. 2014).



The remainder of this study is organised as follows. Section “[Economic and labour market trends in the Indonesian context](#)” provides some details on the Indonesian economy, which is used as a context for the analysis. Section “[Data and preliminary statistics](#)” describes the data and descriptive statistics. Section “[Empirical analysis](#)” outlines the empirical strategy and highlights the results. The last section offers conclusions.

## **Economic and Labour Market Trends in the Indonesian Context**

In a little more than a decade following the crisis of 1997–98, Indonesia transformed itself from a lower-middle-income country into a confident G20 member. Between 2001 and 2012, the gross domestic product (GDP) doubled from USD 580 billion to USD 1.1 trillion. During nearly the same period (between 1999 and 2012), poverty halved from 24 to 12% (World Bank 2014: p. 4). Despite these positive developments, Indonesia’s growth has been described as ‘jobless’; 65 million people have continued to hover around the national poverty line and vulnerability has remained high (Alatas and Newhouse 2010; World Bank 2014).

Indonesia aims to avoid a middle-income trap in an equitable manner but encounters several obstacles. The country has a massive demographic dividend, with forecasts suggesting its population will remain youthful until 2025–30. This demographic advantage positions Indonesia to compete with China in the low-skilled manufacturing sectors. However, since 2005–06, there is evidence that Indonesia has experienced deindustrialisation, largely on account of a commodity boom in sectors such as palm oil, coal, and gas (World Bank 2016:28). Indonesia’s manufacturing exports overshadowed by those of Vietnam—which was hardly present in global manufacturing in the 1990s—and Malaysia, whose manufacturing exports remained higher despite a certain decline. Moreover, the service sector’s expansion in Indonesia has also been sluggish compared to China, South Korea and India, with a concentration in lower as opposed to higher value-added niches (Alatas and Newhouse 2010; World Bank 2014: p. 36).

One of the key drivers of equitable growth is the specific mode of structural change a country undergoes, along with its implications for the health of an economy. The structure of Indonesia’s economy has seen fundamental changes over the years. Until the mid-1980s, the import substitution strategy and high complementarity between capital and labour led to a high proportion of skilled labour in both employment and the wage bill. However, after opening up to trade and investments, the country experienced the stylised comparative advantage effect. Specialisation in labour-intensive industries such as textiles, garments, footwear and wood reduced the share of manufacturing skilled labour in both employment and the wage bill. In other words, while the economic structure in the 1980s stimulated rising earnings inequalities, the opening of the economy in the 1990s created the conditions for the reversal of this trend. After the crisis of 1997–98, a reallocation of skilled labour moving towards more highly skilled industries took place, characterised by higher average wages. This was a consequence of the shifting structure of exports towards more highly skilled manufacturing sectors such as chemicals, machinery



and equipment (Di Gropello et al. 2011). It is not clear whether the above-mentioned resource-boom-driven deindustrialisation trend dominated that of the reorientation towards higher value niches across manufacturing and services, or how it influenced the structure of earnings. Theoretically, both trends could lead to increased earnings inequality.

However, the modality of this influence hinges not only on the structural characteristics, but also on the nature of skill generation and the equilibrium between the demand for and supply of skills. While a massive increase in education typically leads to lower skill premiums and decreased earnings inequality, there is a scenario where increased educational attainment might heighten earnings inequality. This can occur when the rise in education levels is met with stronger demand for those skills, thereby increasing the returns to education (Bourguignon et al. 2005; Campos-Vázquez et al. 2014). While little research on this subject has been performed in the Indonesian context, existing evidence suggests that the latter may not be the case here. Despite the massive increase in the volume of higher education, there is evidence of low skill quality and skill mismatch in the secondary and tertiary sectors (Di Gropello et al. 2011).

At the same time, the presence of more highly skilled niches in the manufacturing sector is low, with only 8.4% of manufacturing positions requiring university education, compared to 28.5% of positions requiring primary education. The demand for education in the service sector is significantly higher, with 57.8% of jobs requiring university education. However, the productivity in the manufacturing sector is almost five times higher, thus offering more substantial returns to higher skills (Di Gropello et al. 2011). Given the existing evidence of increased supply of education, skill mismatch, and relatively low availability of higher skill niches in substantially more productive sectors, it is not surprising that the few available estimations show falling returns to education in Indonesia (Purnastuti et al. 2013).

Our estimates from the Indonesian Family Life Survey (IFLS) indicate that since 2000, Indonesia has experienced falling and, subsequently, levelling off earnings inequality. Yet the structural changes discussed so far give an ambiguous interpretation of this pattern. It is possible that the trend was driven by the massive expansion of education over and above demand-side requirements, despite the healthy development of high-growth niches. However, it is equally possible that the skills supplied were not on a par with the demands of the changing environment, and that this resulted in a skill mismatch and falling returns to skills. A further explanation would be direct government interventions aimed at closing the earnings gap. The rising minimum wage was among the most prolifically researched government interventions in the post-2000 era in Indonesia. Since 2011, there has been a significant departure from the moderate pace of the minimum wage increases of the preceding decade. In 2012 alone, 25 provinces increased the minimum wage by an average of 30%, while Jakarta raised it by 44% (World Bank 2014, p. 38).

Research on the implications of raising minimum wages in Indonesia has also yielded ambiguous conclusions. Magruder (2013) considered whether rising minimum wages led to capable workers being attracted to the formal sector—according to the logic of efficiency wages—and a simultaneous decline in the informal sector. He found that, consistent with big push theory, formal employment in non-tradable



manufacturing industries with the potential for industrialisation increased, while informal employment in these industries decreased. Using economy-wide as opposed to sectoral-level data, Hohberg and Lay (2015) corroborated this finding. They showed that rising minimum wages had no negative impact on the probability of being formally employed, a positive effect on formal sector wages, and no spillover effect on informal wages.

However, delving more deeply into cross-sectoral dynamics, Magruder (2013) found that the effect of rising minimum wages was heterogeneous: although formalisation increased in those manufacturing industries with industrialisation potential, in the service sector (where the industrialisation potential is low), informal work expanded. Addressing broader welfare consequences, Yamada (2016) found rising minimum wages in Indonesia to be very limited in terms of improving living standards and reducing inequality.

In sum, more rigorous and detailed analysis is essential to unravel the key determinants of the falling and subsequent levelling off of earnings inequality in Indonesia in the midst of impressive growth. The observed narrowing of the earnings gap could suggest that the education system has become more inclusive, resulting in a supply of skills that not only meets but potentially exceeds demand. This situation, combined with substantial minimum wage increases, may have contributed to reducing income disparities among workers. However, it could also indicate that the effect of rising minimum wages is minimal, simply reflecting demand-side problems leading to low returns to higher skill levels. The dominance of one of these drivers of inter-temporal earnings inequality over the other would determine whether a falling and levelling off of the earnings gap is a boon or a bane for Indonesia's economic health, with crucial implications in the long term.

## Data and Preliminary Statistics

### Data

The empirical analysis is based on the Indonesian Family Life Survey (IFLS) during the period 2000–2014. The IFLS provides detailed information on a range of demographic, labour market and economic wellbeing-related characteristics of individuals, households and communities. It is a longitudinal survey, representative for approximately 83% of the population.<sup>1</sup>

Compared to other available data sets from Indonesia (such as SUSENAS and SAKERNAS, the National Labour Force Survey), the IFLS data set is particularly useful for the study of earnings inequality. One advantage is that it collects information on self-employed workers, who represent the great majority of informal workers in Indonesia. In addition, it collects longitudinal information on individuals' earnings.

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<sup>1</sup> Further details on the survey and the sampling techniques can be found in Frankenberg and Thomas (2000).



However, IFLS data have a few limitations that may necessitate careful interpretation of this study's findings. First, the IFLS dataset is only representative for up to 83% of the national population. This implies an inability to capture heterogeneity in the earnings structure due to geographical variations such as district-level market structure. We include geographical variables (e.g. urban/rural and provinces) and province-level minimum wage to respond to this challenge. Nevertheless, the results are not feasible for generalisation at the province or district level.

Second, information from the IFLS data tend to under-represent earnings levels at the tails of the earnings distribution. As in other household surveys in Indonesia (e.g. SUSENAS and SAKERNAS), it is very common for the top income and/or earnings to be under-reported. Initially, IFLS also covered only 13 of Indonesia's 16 provinces and included less coverage of relatively deprived and underdeveloped areas, particularly in the eastern region. IFLS has since launched *IFLS East*, another survey that collects socio-economic information representative of the country's eastern regions. However, the only available data are for the year 2012. Incorporating IFLS East in the present analysis would not serve this paper's objective of analysing individuals' earnings levels and inequality over a period spanning from 2000 to 2014. As a result, we may have captured an underestimated picture of earnings levels and inequality among workers in the country.

Another challenge arising from the use of longitudinal data is maintaining a low level of attrition. IFLS data consist of five waves performed in the years 1993, 1997, 2000, 2007, and 2014 and have a relatively low level of attrition. The re-contact rates of the initial IFLS households in the subsequent waves are high. They are 94.4%, 95.3%, 93.6% and 92% for IFLS 2, 3, 4 and 5 respectively (Strauss et al. 2016: p. 4). A total of 87.8% were interviewed in all five waves. This paper utilizes the latest three waves, which left out approximately 5–8% of the initial households from the respective waves. Attrition may affect the changes in the distribution of workers' characteristics observed in each of the periods covered. Nevertheless, this study applies an unconditional quantile decomposition method which enabled us to estimate the changes in individuals' earnings over time, regardless of changes to the workers' characteristics per se.

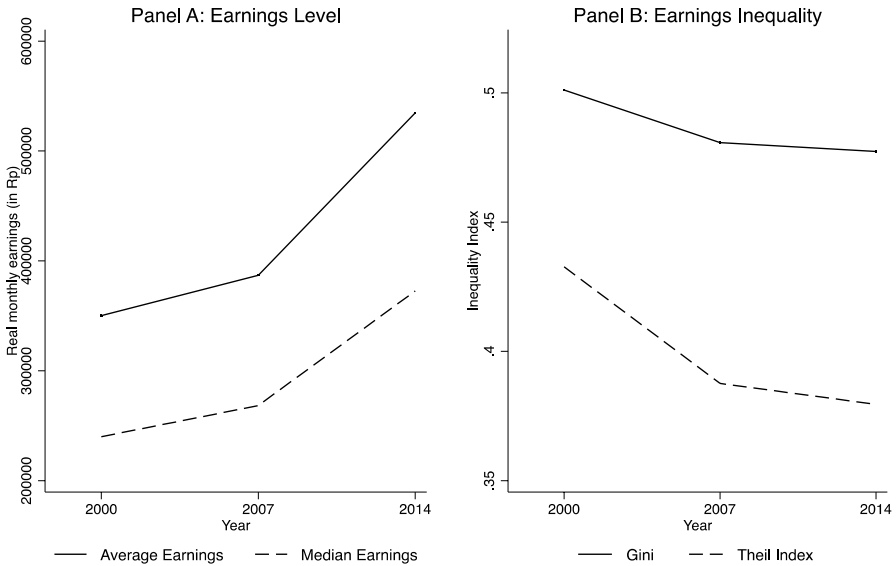
## Preliminary Statistics

As indicated above, our purpose is to study changes in individual earnings and earnings inequality. To this end, we restricted the sample to full-time working and paid individuals aged 18–64; we excluded non-paid family workers. Extreme monthly earnings values were also removed to lower the risk of measurement errors. We retained data only on individuals with information on all relevant key variables in all waves. After applying these sample restrictions, we were left with 12,754 observations from IFLS 3 (95% of the eligible sample), 14,757 observations from IFLS 4 (93% of the eligible sample) and 18,395 observations from IFLS 5 (93% of the eligible sample). The survey is known for its very low level of attrition (Yamada 2016).

Figure 1 highlights the trends in average and median monthly earnings (left-hand panel) and earnings inequality (right-hand panel) during the period 2000–2014. The







**Fig. 1** Earnings level and earnings inequality trends. Source: Author’s calculation based on IFLS rounds. Survey weight applied

trends are both highly interesting and consistent with developments in the Indonesian economy, as highlighted in Section “[Economic and labour market trends in the Indonesian context](#)”. While (real) mean and medium earnings remained stable and earnings inequality went down significantly from 2000 to 2007, during the 2007–2014 period, these trends were reversed: Real earnings rose, while earnings inequality levelled off.

Some of the descriptive statistics, as highlighted in Table 1, provide at least a partial explanation for these trends. For example, we observe that the proportion of salaried private sector jobs increased steadily over the years, while the proportion of self-employed workers—who account for the bulk of the informal sector—went down. As indicated earlier, this process went hand in hand with a steady rise in minimum wages, an accompanying formalisation of labour, and average wage increase (Hohberg and Lay 2015).

Furthermore, we see that the proportion of individuals with a primary education or less declined steadily from 2000 to 2014, while the proportion of those with either lower secondary or higher secondary education increased. The proportion of people with tertiary education remained very low (at below 1%), but it nevertheless increased from 0.0042 to 0.0050 from 2007 to 2014.

Whether increasing the supply of education lowers earnings inequality on account of lowering the returns to higher skills depends on the demand side of the market. Some of the evidence presented above suggests that Indonesia has been experiencing deindustrialisation since the mid-2000s. This observation is not entirely supported by our data; we see that the proportion of people holding manufacturing jobs increased from 22.4% in 2007 to 24% in 2014 (see Table 1). At the same time, the



**Table 1** Descriptive statistics

Year	2000		2007		2014	
	Mean	S.d	Mean	S.d	Mean	S.d
Log of monthly earnings	12.2627	1.0791	12.3981	1.0586	12.7141	1.0819
Less than primary	0.3173	0.4654	0.2571	0.4371	0.1982	0.3987
Primary	0.3236	0.4679	0.3324	0.4711	0.3142	0.4642
Lower secondary	0.1538	0.3607	0.1645	0.3707	0.1898	0.3921
Higher secondary	0.2007	0.4005	0.2418	0.4282	0.2929	0.4551
Tertiary	0.0047	0.0684	0.0042	0.0645	0.0049	0.0698
Female	0.3643	0.4812	0.3566	0.4790	0.3809	0.4856
Male	0.6357	0.4812	0.6434	0.4790	0.6191	0.4856
Agriculture	0.2819	0.4499	0.2700	0.4440	0.2249	0.4175
Manufacturing	0.2279	0.4195	0.2226	0.4160	0.2374	0.4255
Service	0.4902	0.4999	0.5074	0.5000	0.5377	0.4986
Government	0.0866	0.2813	0.0846	0.2783	0.0706	0.2561
Private	0.4544	0.4979	0.3478	0.4763	0.5297	0.4991
Self-employment	0.459	0.4983	0.4269	0.4946	0.3997	0.4899
Rural	0.5409	0.4983	0.5214	0.4996	0.4593	0.4984
Urban	0.4591	0.4983	0.4786	0.4996	0.5407	0.4984
Sumatera	0.1396	0.3466	0.1559	0.3628	0.1584	0.3651
Java and Bali	0.7837	0.4117	0.762	0.4259	0.7577	0.4285
Nusa Tenggara	0.0225	0.1482	0.0236	0.1516	0.0257	0.1582
Kalimantan	0.0291	0.1680	0.0312	0.1737	0.0298	0.1700
Sulawesi	0.0252	0.1566	0.0274	0.1632	0.0283	0.1659
Potential year of experience	25.9731	13.9272	26.672	14.1158	26.6497	13.9038
Minimum wage dummy	0.5277	0.4992	0.4719	0.4992	0.4557	0.498
N observations	12,754		14,757		18,395	

Source: Authors' calculation based on IFLS rounds. Survey weight applied

service sector remained the largest employment sector, providing about half of all jobs in all three periods. The implications of this pattern of inter-sectoral allocation of labour on earnings inequality would depend on the relative availability of high-skill niches across these sectors, which would thereafter affect the returns to skills attained in the labour market.

The statistics in Table 2 provide some insight into this question. We see that across the manufacturing and service sectors, the very low availability of jobs requiring a university education declined during the period examined, though it was higher in the service sector than in the manufacturing sector. The availability of jobs requiring a high school education increased in both sectors but was once again on average higher in the service sector. This is consistent with the distribution pattern of monthly wages across the sectors, as shown in Fig. 2.

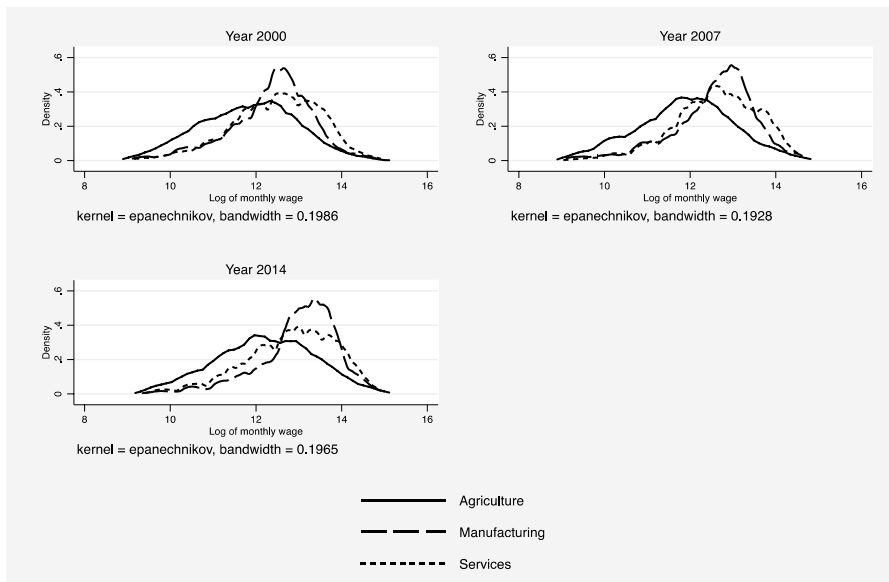
For 2000 and 2007, we observe a higher incidence of higher salaries in the service sector than in the manufacturing sector, though the range of salaries in the



**Table 2** Education levels by sector

Year		2000			2007			2014		
Sector	Education Level	%	Mean	s.d.	%	Mean	s.d.	%	mean	s.d.
Agriculture	<Primary	38.74	0.387	0.487	46.09	0.461	0.499	38.74	0.387	0.487
Agriculture	Primary	30.35	0.303	0.460	31.64	0.316	0.465	30.35	0.304	0.460
Agriculture	Lower secondary	17.35	0.174	0.379	13.47	0.135	0.341	17.35	0.174	0.379
Agriculture	Higher secondary	13.41	0.134	0.341	8.72	0.087	0.282	13.41	0.134	0.341
Agriculture	Tertiary	0.14	0.001	0.038	0.07	0.001	0.027	0.14	0.001	0.038
Manufacturing	<Primary	16.01	0.160	0.367	17.42	0.174	0.379	16.01	0.160	0.367
Manufacturing	Primary	26.40	0.264	0.441	32.38	0.324	0.468	26.4	0.264	0.441
Manufacturing	Lower secondary	23.82	0.238	0.426	20.63	0.206	0.405	23.82	0.238	0.426
Manufacturing	Higher secondary	33.64	0.336	0.473	29.25	0.293	0.455	33.64	0.336	0.473
Manufacturing	Tertiary	0.12	0.001	0.035	0.32	0.003	0.057	0.12	0.001	0.035
Service	<Primary	13.59	0.136	0.343	18.51	0.185	0.388	13.59	0.136	0.343
Service	Primary	34.08	0.341	0.474	34.47	0.345	0.475	34.08	0.341	0.474
Service	Lower secondary	17.52	0.175	0.380	16.20	0.162	0.369	17.52	0.175	0.380
Service	Higher secondary	34.02	0.340	0.474	30.17	0.302	0.459	34.02	0.340	0.474
Service	Tertiary	0.80	0.008	0.089	0.64	0.006	0.080	0.8	0.008	0.089

Source: Authors' calculation based on IFLS rounds. Survey weight applied



**Fig. 2** Kdensity of log of monthly earnings by sectors. Source: Author's calculation based on IFLS rounds. Survey weight applied

former is also greater. At the same time, by 2014, the average salaries in the two sectors had equalised somewhat. Overall, these statistics are consistent with some of



the literature highlighted at the outset of this paper, which showed Indonesia to have both low overall availability of jobs at the highest skill range and, at least during the first half of the 2000–2014 period, a greater incidence of higher skill job opportunities in the service sector than in the manufacturing sector (despite the greater potential of the latter to generate higher returns to skills). The relative equalisation of wages across the two sectors seen in 2014 is consistent with the observation made in Section “[Economic and labour market trends in the Indonesian context](#)” of gradual development of higher skill niches in the manufacturing sector. At the same time, these statistics are not sufficient to build strong evidence on the inter-temporal dynamics of returns to skills, which will be explored more rigorously in the following sections.

## Empirical Analysis

### Evolution of Returns to Characteristics

An important first step in disentangling the supply-side (related to supply of characteristics such as education) and demand-side drivers of earnings inequality is the assessment of the determinants of returns to skills acquired by labour market participants. For this purpose, we first estimate Mincer equation with the following specification:

$$\ln Y_{it} = \alpha_0 + \alpha_1 \text{Exp}_{it} + \alpha_2 \text{Exp}_{it}^2 + \sum_{j=1}^n \beta_j \text{Educ}_{it} + \sum_{j=1}^n \gamma_j \text{Controls}_{it} + \varepsilon_{it}, \quad (1)$$

where  $\ln Y_{it}$  is the natural logarithm of monthly earnings for individual  $i$  at time  $t$ ;  $\text{Exp}_{it}$  is the stylised measure of potential experience, namely age minus the years of education minus 5;  $\text{Educ}_{it}$  is a set of categorical education variables, including dummy variables for tertiary, higher secondary, lower secondary, and primary education and omitting less than primary education. Aside from the usual fixed effects, such as regional controls and whether the individual resides in an urban or a rural area, the control variable set  $\text{Controls}_{it}$  accounts for the sector of employment (manufacturing and service sectors, omitting the agricultural sector), and type of employment (government and private, omitting self-employment). Since, as argued earlier, it is important to account for the effect of changing minimum wages on earnings inequality. We also include a minimum wage variable, which takes the value of one if the respondent’s wage exceeds the minimum wage in the region. Note that minimum wages are provided on a monthly earnings basis, which is one of the key reasons for which we chose monthly earnings as a dependent variable in Eq. 1 (aside from complications with the correct assessment of hours of work which would have arisen had we chosen to use hourly wages). A description of the full set of variables used in the empirical specification is provided in Table 5 in the appendix.

Given the distinctive trends in earnings growth and earnings inequality between the 2000–2007 and 2007–2014 periods, we pooled the data across these two periods



**Table 3** Evolution of the returns to characteristics

Explanatory variables	2000–2007		2007–2014			
	Log of real monthly earnings		Log of real monthly earnings			
	Mean	S.e.	Mean	S.e.		
Primary	0.097	***	0.014	0.077	***	0.015
Lower secondary	0.15	***	0.016	0.0538	***	0.017
Upper secondary	0.15	***	0.016	0.12	***	0.016
Tertiary	0.303	***	0.05	0.188	***	0.053
Experience	0.017	***	0.001	0.015	***	0.001
Experience <sup>2</sup>	0.0	***	0	0	***	0.0
1 = above minimum wage	1.486	***	0.009	1.492	***	0.009
Manufacturing sectors	6.131	***	0.015	0.128	***	0.014
Service sectors	0.211	***	0.013	0.175	***	0.012
1 = government workers	0.376	***	0.014	0.418	***	0.014
1 = private workers	0.022	***	0.011	0.078	***	0.01
1 = male	0.177	***	0.01	0.191	***	0.009
1 = urban	0.072	***	0.009	0.125	***	0.009
Time FE	Yes			Yes		
Region FE	Yes			Yes		
R-squared	0.646			0.623		
Observations	27,511			32,837		

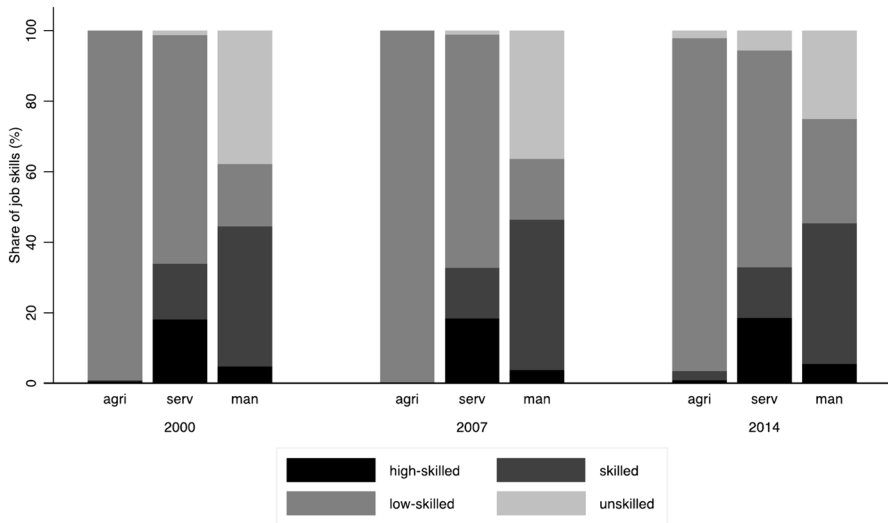
Source: Authors' calculation based on IFLS rounds. Survey weight applied

\*, \*\*, \*\*\* indicate significant level at 10%, 5% and 1% respectively

and conducted separate estimations for each period. The results, reported in Table 3, indicate that returns to all types of education decreased significantly between these two periods. The fall was sharpest for tertiary education, returns to which dropped from 0.303 to 0.188. As posited above, this is consistent with one of two possibilities: either an oversupply of education (despite its very low base) or low availability of a sufficient number of sectoral/occupational niches to absorb workers entering the market. The latter possibility is confirmed by the fact that we observe falling returns to manufacturing and service sector employment, which is consistent with the proposition made earlier of a low availability of high-skill and high-productivity niches.

The main purpose of the decomposition analysis that follows is to disentangle the corresponding effects of these two potential explanations of falling returns to characteristics, namely, the changing characteristics or composition of the labour force versus the changing returns to characteristics. Before proceeding with this analysis, we cast a further glance at the skill composition of different sectors, shown in Figure 3 below. Figure 3 captures the composition of workers within each industry by their skill levels. We follow a normative definition of skill levels based on the occupation type and predetermined required level of education, as described in Sparreboom





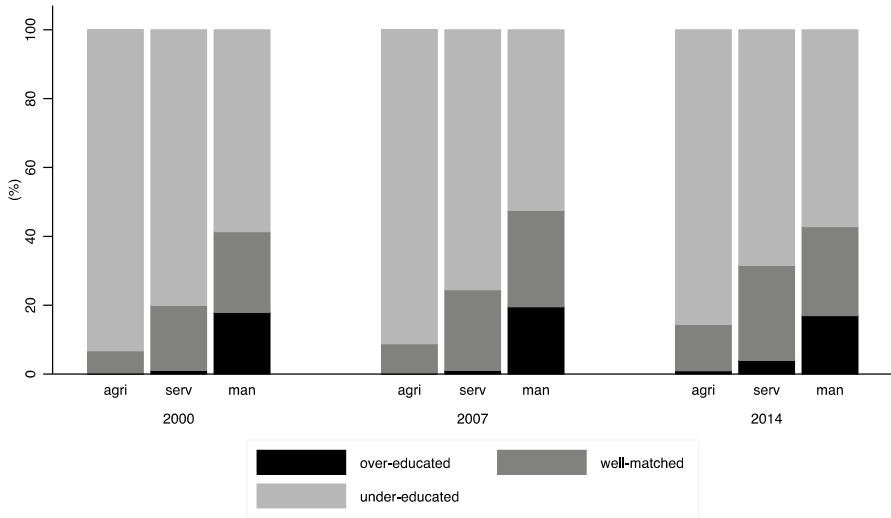
**Fig. 3** Skill distribution by sector. We classify sectors in agriculture (agri), service (serv) and manufacturing (man). High-skilled refers to workers with professional occupation with tertiary education; skilled refer to workers with non-manual occupation and secondary education; low-skilled refers to workers with manual occupation and secondary education; unskilled refers to workers with elementary occupation and primary education. For detail classification, see Sparreboom and Staneva (2014, p. 25). *Source:* Author’s calculation based on IFLS rounds. Survey weight applied

and Staneva (2014).<sup>2</sup> These statistics conform only partially to the observations of Di Gropello et al. (2011), as highlighted in Section “[Economic and labour market trends in the Indonesian context](#)”. In keeping with these observations, we do find a low availability of high-skilled jobs across sectors. At the same time, the availability of high-skilled and skilled jobs in the manufacturing sector is on a par with that of lower-skilled jobs and exceeds that of the service sector. It is possible that over the past few years, or at least between 2007 and 2014, Indonesia was able to generate a larger number of relatively skill-intensive niches in the manufacturing sector. This trend aligns with the earnings overlap we observed in Figure 2 for 2014 compared to the two preceding years.

Rather than availability of skill-intensive jobs per se, falling returns to skills and sectors of employment may be indicative of a low quality of skills generated by the educational system or of a high level of mismatch between skills supplied and

<sup>2</sup> First, the study classifies the occupation by the first digit of ISCO-88, which consists of nine major groups, then classifies skill levels based on the education level required by each of the occupations into four categories: high-skilled, skilled, low-skilled and unskilled occupations. High-skilled occupations include legislators, officials, managers; professionals; technicians and associate professionals (with requirements of tertiary education); low-skilled occupations include clerical support, service and sales (with requirements of secondary education); skilled manual occupations are skilled agricultural, fishery; craft and related trades; plant and machine operators and assemblers (with requirement of secondary education); the unskilled category includes elementary occupation. A detailed description is available in Sparreboom and Staneva (2014, Table 5.1, p. 25).





**Fig. 4** Skill mismatch across sectors. Skill mismatch is calculated by each sector—agriculture (agri), service (serv) and manufacturing (man). We measure it as over-education, well-matched and under-education, based on a fixed set of occupation category and required level of education for a particular occupation as described in Sparreboom and Staneva (2014, p. 25). Over-educated refers to workers with education level over the required criteria for a particular occupation; well-matched refers to workers with just the required level of education for their occupation; under-education refers to workers with lower level of education as required by their occupation. *Source:* Author’s calculation based on IFLS rounds. Survey weight applied

demanded. While it is difficult to rigorously test the former hypothesis without reliable measures of educational quality, in Fig. 4 we highlight some statistics on skill mismatch across sectors.<sup>3</sup> We observe skill matching of no more than 20% in each sector, indicating that proper alignment of the educational system with the requirements of the changing demand side of the market is needed both for the generation of high returns to skills and for greater efficiency.

Finally, we observe an increase in returns to salaried employment in both the government and private sectors compared to the omitted category of self-employed individuals. There is no substantial change in returns to minimum wages between the two periods.

### Decomposition Methodology

The estimations in Sect. “[Evolution of Returns to Characteristics](#)” give us only a partial explanation of the determinants of earnings and their changes over time

<sup>3</sup> There are alternatives for measuring skill mismatch, as discussed in McGuinness et al. (2017). After careful critical perusal of this literature, the study adopts a normative measure based on the predetermined mapping between the job and the required level of education. ‘Over-educated’, ‘well-matched’ and ‘under-educated’ refer to workers with higher than the required level, at the same level as required, and below the required education for their occupations, respectively.



as they account only for returns to characteristics. Combining them with insights from the descriptive statistics in Sect. “Data and Preliminary Statistics” allows us to derive a tentative explanation as to how the changing characteristics of the labour force (for instance via increase in the supply of skills) and the returns to those characteristics (which are influenced by the demand side of the market) affect changes in earnings inequality over time. Rigorous decomposition analysis adds to this by quantifying and disentangling the specific contributions of changing characteristics and returns to characteristics.

Although our main interest is in the decomposition of earnings inequality rather than earnings levels, the former is derived from the latter. Hence, we begin by explaining (a) how changes in levels of earnings over time are decomposed and (b) when and how we can substitute wage levels with wage inequality measures as a key dependent variable. The evolution of earnings over time can be measured by subtracting the average earnings of workers in the initial year from the average earnings of workers in the final year of the period of interest. In our case, this involves subtracting the earnings averaged across the pooled 2000–2007 sample from the average earnings in the pooled 2007–14 sample, namely,

$$E[W|D_B = 1] - E[W|D_A = 1], \quad (2)$$

where  $D_A$  refers to workers observed in period 1 and  $D_B$  refers to workers observed in period 2. We have information on actual earnings and other individuals’ characteristics for the two periods, and it is difficult to disentangle the individual effects of changing workers’ characteristics (composition effect) and prices associated with those characteristics (wage structure effect), when both the characteristics of workers and the demand-side conditions in the economy and the labour market are experiencing changes over time. To solve this problem, we need to answer the counterfactual question of, ‘How much would workers in the final year have been paid if they were rewarded according to the earnings structures of workers in the initial year?’ When we incorporate this counterfactual element, equation (2) becomes (Fortin et al. 2010)<sup>4</sup>

$$\begin{aligned} & E[W|D_B = 1] - E[W|D_A = 1] \\ &= \{E[W_B|D_B = 1] - E[W_A|D_B = 1]\} + \{E[W_A|D_B = 1] - E[W_A|D_A = 1]\} \end{aligned} \quad (3)$$

Equation (3) can then be used to estimate the overall wage differential as follows:

$$\bar{W}_B - \bar{W}_A = [\bar{X}_B'(\hat{\beta}_B - \hat{\beta}) + \bar{X}_A'(\hat{\beta} - \hat{\beta}_A)] + (\bar{X}_B' - \bar{X}_A')\hat{\beta} = \hat{\Delta}_s^\mu + \hat{\Delta}_x^\mu \quad (4)$$

Equation (4) represents the Oaxaca–Blinder decomposition methodology, which breaks down the overall difference in average earnings into two

<sup>4</sup> Notice that the intuition behind equation (3) is closely related to the treatment effects literature, where the left-hand side represents the Average Treatment Effect (ATE), the first term on the right-hand side represents the average treatment effect of the treated (ATT) and the second term on the right-hand side represents the average treatment effect on the non-treated.





components, (i) the change in earnings due to differences in returns to observe workers' characteristics, or the wage structure effect, captured by the first term, and (ii) the change in observed characteristics (the estimated composition effect). Conveniently, the methodology can be disaggregated further to account for the individual contributions of each explanatory variable in the earnings equation specification as follows:

$$\hat{\Delta}_s^\mu = \sum_{j=1}^k \bar{X}_{B,j}' \left( \hat{\beta}_{B,j} - \bar{\beta}_j \right) + \bar{X}_{A,j}' \left( \hat{\beta}_j - \bar{\beta}_{A,j} \right) \tag{5}$$

$$\hat{\Delta}_s^\mu = \sum_{j=1}^k (\bar{X}_{2,j}' - \bar{X}_{1,j}') \hat{\beta}_j, \tag{6}$$

where Eq. (5) describes the wage structure effect as the sum of changes of all explanatory variables, while Eq. (6) describes the composition effect as a sum of changes of all explanatory variables.

A serious drawback of this method is that it does not allow us to go beyond averages in understanding earnings changes over time. To overcome this shortcoming, we use the recentered influence function decomposition, proposed by Firpo et al. (2009). This methodology can be seen as a generalisation of Oaxaca–Blinder beyond the mean, and is used in the decomposition analysis of outcome differentials of any distributional statistics of interest (for instance, a variance, a Gini coefficient, or quantiles) (Firpo et al. 2009; Becchetti et al. 2013).

Using as a starting point the Oaxaca–Blinder methodology highlighted above, we first replace the wage in equation [4] with the so-called recentered influence function:

$$RIF(w;v) = v(F_w) + IF(w;v), \tag{7}$$

where  $v$  is the distributional parameter of the wage function. The recentered influence function involves adding the distributional parameter of  $v$  to the influence function of  $IF(w;v)$ . For instance, when we deal with quintiles of the wage distribution, the influence function for the quintile is  $IF(W;Q_\tau) = \frac{\tau - \psi(WQ_\tau)}{f_w(Q_\tau)}$ , where  $\psi$  is the indicator function and  $f$  is the density of the marginal distribution of the parameter of interest.

Since we are interested in decomposing the changes in earnings inequality observed in Fig. 1, our distributional parameter of interest  $v$  is the earnings Gini. The detailed decomposition analysis is then carried over the earnings Gini changes across 2000–07 and 2007–14, whereby equations (5) and (6) are converted into

$$\hat{\Delta}_s^{\mu v} = \sum_{j=1}^k \bar{X}_{B,j}' \left( \hat{\beta}_{B,j} - \bar{\beta}_j \right) + \bar{X}_{A,j}' \left( \hat{\beta}_j - \bar{\beta}_{A,j} \right) \tag{8}$$



**Table 4** Decomposition analysis

Sub-period	2000–2007		2007–2014	
	Coef.	s.e.	Coef.	s.e.
Estimated difference in Gini (t1–t0)	– 0.00171	(0.00045)	– 0.00006	(0.00040)
<b>Composition effect</b>				
Education	0.00023	(0.00006)	0.00013	(0.00007)
Experience	0.00006	(0.00006)	0.00000	(0.00003)
Experience sq	0.00011	(0.00007)	– 0.00005	(0.00007)
Minimum wage	0.00103	(0.00012)	0.00018	(0.00006)
Industry	– 0.00011	(0.00005)	– 0.00050	(0.00007)
Employment	0.00033	(0.00010)	– 0.00138	(0.00014)
Gender	– 0.00005	(0.00004)	0.00017	(0.00004)
Spatial	– 0.00005	(0.00003)	– 0.00008	(0.00005)
Total composition effect	0.00155	(0.00019)	– 0.00153	(0.00019)
<b>Wage structure effect</b>				
Education	– 0.00031	(0.00089)	– 0.00141	(0.00094)
Experience	– 0.00773	(0.00334)	– 0.00254	(0.00304)
Experience sq	0.00420	(0.00194)	0.00074	(0.00179)
Minimum wage	0.00350	(0.00045)	– 0.00028	(0.00039)
Industry	– 0.00173	(0.00081)	0.00027	(0.00081)
Employment	– 0.00104	(0.00041)	– 0.00018	(0.00053)
Gender	– 0.00056	(0.00059)	– 0.00084	(0.00051)
Spatial	0.00098	(0.00109)	0.00113	(0.00099)
Constant	– 0.00057	(0.00246)	0.00456	(0.00225)
Total wage structure effect	– 0.00326	(0.00044)	0.00146	(0.00041)

The results are based on RIF-OLS decomposition as proposed in Fortin et al. (2009) and estimated using rifreg syntax in Stata. All procedures are carried out following the description in Fortin, et al. (2011). The coefficient of human capital is a cumulative coefficient from the four education levels (less than primary as reference), industry occupation is cumulative coefficient from two industrial occupation dummies (self-employed as reference), and spatial coefficient is a cumulative effect of urban (rural as reference) and four regional dummies (Sumatera as reference). Standard errors are in parentheses. Source: Authors' calculations based on IFLS rounds

$$\hat{\Delta}_s^v = \sum_{j=1}^k (\bar{X}_{2,j'} - \bar{X}_{1,j'}) \hat{\beta}_j \quad (9)$$

## Decomposition Results

Table 4 highlights the results from the detailed decomposition of the Gini coefficient of monthly earnings for the periods 2000–2007 and 2007–2014. Recall that our interest is in disentangling the relative importance of the composition effect (namely the change in characteristics) from the earnings structure effect (or returns



to characteristics). Our preliminary data analysis to this point has indicated that the supply of education in Indonesia increased steadily from 2000 to 2014. This increase was accompanied by falling returns to higher levels of education. During the same period, returns to involvement in the service sector, and to a smaller extent in the manufacturing sector, also fell. This suggests that (a) the economy struggled to provide a sufficient number of productive opportunities to its new graduates, (b) the educational system struggled to supply appropriate skill sets matching the existing high-skill niches in the economy, or both. A further important and relevant trend in the economy during the same period is the massive increase in minimum wages, whose potential effect on earnings inequality is controversial. Our results thus far show the expected positive effect of minimum wages on earnings as well as an absence of change in returns to minimum wages across the two periods. We see that working in the salaried government and private sectors became more remunerative over time than being self-employed, which is consistent with the insider–outsider effect of rising minimum wages.

Our results on changes in earnings inequality during 2000–2007 and 2007–2014, highlighted in Table 4, indicate that the compositional effect of higher levels of education increased inequality, but to a lesser extent during the second sub-period than during the first. This inter-temporal change is consistent with the increased supply of education and with the possibility that increased higher educational supply coincided with greater inclusiveness of the educational system. At the same time, the earnings structure (or returns to education) effect of education is negative during both periods, larger than the composition effect, and increasing over time. This is consistent with the hypothesis of oversupply of skills in an economy struggling to absorb the quantity and type of skills supplied. This proposition is likewise supported by the trends and observations on broader aspects of the Indonesian economy and labour market mentioned in Section “[Economic and labour market trends in the Indonesian context](#)”.

During both sub-periods studied, the industry-based composition effect (that is, the effect of belonging to either the manufacturing or the service sector) is equalising, increasingly so in the second sub-period. This is perhaps indicative of job availability across the skill distribution. At the same time, while the earnings structure effect of sector of employment is equalising during the first sub-period, it is dis-equalising during the second. This may reveal polarisation within these sectors and the availability of small high-productivity niches able to pay higher returns, which is supported by some of the evidence highlighted in Section “[Economic and labour market trends in the Indonesian context](#)”. It is also interesting to note that the largest earnings structure effects are those of industry and experience. Aside from demand-side factors, namely whether and how many highly productive job opportunities are available, this may indirectly capture an educational quality effect. In this context, the role of the observed education-based skills supplied is lower than that of other factors such as experience. Unfortunately, the available data and empirical results do not allow us to further disentangle this issue.

Finally, we observe that (a) the composition effect during the second period and (b) the earnings structure effect of working in the salaried employment sector during both periods reduce inequality. This may be merely a counterfactual of the substantially more multi-layered and unequal self-employment sector. As expected, we



observe an inequality-augmenting compositional effect of minimum wages (perhaps on account of the insider–outsider effect of minimum wages), which falls substantially during the second period compared to the first period. We also found an inequality-reducing earnings structure effect of minimum wages, which as mentioned earlier, is of a smaller dimension than the much more dominant earnings structure effects of industry and experience.

## Concluding Remarks

“Rise in earnings inequality” has become a buzz phrase. It is of concern to governments both in advanced economies experiencing technological change-driven job polarisation and in emerging markets where premature deindustrialisation is a key issue. Numerous labour market and social inclusion-related government policies have aimed at creating a level playing field in terms of access to skills and integrating individuals from all strata into a shrinking labour market. Earnings inequality reduction in the midst of steady economic growth is typically taken as a benchmark for the success of these policies.

However, could declining or even levelling off of earnings inequality in the context of steady growth be itself a cause for concern? We address this question with the use of state-of-the-art decomposition techniques. We analyse representative household data from Indonesia, covering the period from 2000 to 2014, during which we observe falling and subsequently levelling off earnings inequality in the midst of impressive growth. We find that the declining earnings inequality was largely driven by declining returns to skills, the relatively low ability of the economy to absorb high-skilled workers and a relatively high mismatch between skills supplied and skills demanded in the labour market. Note that economic health and long-term economic performance hinge on the ability of an economy to generate a high level of skills and provide high-value opportunities for the absorption of these skills into the labour market. Therefore, the earnings inequality dynamics in Indonesia may be more indicative of a bane than a boon for long-term efficiency and economic health.

The structural transformation and labour market experience of Indonesia echo examples from numerous low- and middle-income economies around the world. For a large proportion of such economies, premature deindustrialisation constrains the ability to absorb a large proportion of the population in equitable, growth-enhancing low skill manufacturing (Trefler 2006). Additionally, institutional and other factors hinder efforts to move towards higher value niches (Ibid). Furthermore, although barriers to educational access around the world are gradually falling, the ability of schooling systems to cater to the requirements of a changing labour market is often questionable.<sup>5</sup> Meanwhile, the pervasiveness of skill mismatch is frequently a major issue. In other words, any critical assessment of the pros and cons of equality or inequality of earnings should be based on a holistic approach. The approach should take into account both the structural characteristics of individual settings and the

<sup>5</sup> See ILO: <http://www.ilo.org/employment/areas/youth-employment/work-for-youth/lang--en/index.htm>.



environment of skill generation and inclusion, all while considering their potential influence on both long-term economic health and the individual welfare of economic participants.

## Appendix

See Table 5.

**Table 5** List of variables and definitions

Variable	Definitions
<b>Outcome variables</b>	
Real monthly wage (log)	Natural logarithm of individual monthly wage
Gini Index	Gini coefficient range from 0–1 as a measure of inequality. Zero indicates perfect equality and vice versa
<b>Dependent variables</b>	
Less than primary*	Dummy; 1 = zero year education or attended but did not finish primary school
Primary	Dummy; 1 = finished primary school or attended but did not finish lower secondary
Lower secondary	Dummy; 1 = finished lower secondary or attended but did not finish upper secondary
Upper secondary	Dummy; 1 = finished upper secondary or attended but did not finish tertiary education
Tertiary	Dummy; 1 = finished tertiary education or more
Experience	Potential years of experience; age minus total year spent in education minus five years
Experience sq	Squared value of experience variable to take into account for non-linearity
Agriculture*	Dummy; 1 = worked in agriculture, forestry
Manufacture	Dummy; 1 = worked in one of the sectors: mining and quarrying, manufacturing, electricity, gas, water and construction
Service	Dummy; 1 = worked in one of the sectors: wholesale, retail, restaurants and hotel, transportation, storage and communications, finance, insurance, real estate and business services, and social services
Self-employed*	Dummy; 1 = worked as self-employed
Government	Dummy; 1 = worked in the government
Private	Dummy; 1 = worked in the private sector
Minimum wage	Dummy; 1 = wage was equal or above the minimum wage (available in terms of monthly earnings)
Island1*	Dummy; 1 = reside in Sumatera
Island2	Dummy; 1 = reside in Java and Bali
Island3	Dummy; 1 = reside in Nusa Tenggara
Island4	Dummy; 1 = reside in Kalimantan
Island5	Dummy; 1 = reside in Sulawesi
Male	Dummy; 1 = male
Urban	Dummy; 1 = reside in urban area



**Data availability** Not applicable.

## Declarations

**Conflict of interest** The authors whose names are listed immediately below certify that they have no affiliations with or involvement in any organization or entity with any financial interest (or non-financial interest) in the subject matter or materials discussed in this manuscript.

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