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The Vietnam reforms, change in wage inequality and the role of the minimum wage[1]

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Abstract

The Vietnam 'renovation' reforms were implemented during the 1990s, but their full effect was only felt several years later. We present evidence on the developments in real wage growth and inequality in Vietnam from 1998 to 2008. Using a variety of approaches (traditional measures of inequality, comparison of density functions, decomposition of the change in real wage by sector as well as a detailed decomposition of the change in the Gini), we present a consistent picture: contrary to what one might have expected given the nature of the reforms, inequality declined sharply in the private sector (but not in the state sector). This study links these developments to the policy of aggressively increasing the minimum wage over the past several years, differences in implementation by sector as well as variation in the over-time changes in minimum wage.

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1. Introduction

During Vietnam's central planning period (prior to 1986), policies were aimed at preserving an egalitarian income distribution. Development during this period was accompanied by misallocation of resources as a result of perverse incentives (see, for example, Taylor, 2004). The *DoiMoi* ('renovation') reforms were initiated in 1986 and aimed at establishing a market-based economy; however, these reforms actually started taking hold during the 1990s. The consequences of the reforms were dramatic, with output per person increasing significantly during the first decade of the reforms and the labour market being particularly impacted.

Before the implementation of the reforms, public sector remuneration policy led to a compression of earnings differentials across groups with different education qualifications. The process of dismantling the old public sector wage system began in 1990.[2] The role of state-owned enterprises was lessened, salaries of public servants were set according to market rates and the salary wage structure would reward public sector workers according to education level, job responsibility and performance. Private firms were free to set wages without government interference; for foreign ventures, however, an effective minimum wage was set which was higher compared with the market wage and the minimum wage set for domestic firms.[3]

The full impact of these reforms probably came only years later, as those hired prior to 1994 were largely exempted (World Bank, 1996). The implementation of these reforms led to an increase in the demand for certain types of labour, particularly in trade and services. This resulted in a shortage of high-level technical experts, skilled technical workers, administrative and managerial experts and researchers, among others (Nguyen *et al.*, 1991).

There are several studies which relate to inequality, using various methodologies and mostly for developed, Newly Industrialized and Transition Economies.[4] Studies in this context are lacking for Vietnam (along with most countries in S.E. Asia), especially studies using recent advances in methodology and recent data. Existing studies for Vietnam include: Nguyen *et al.* (2006) who decomposed the urban–rural inequality from 1993 to 1998 using a quantile regression approach; Pham and Reilly (2007) who analysed the gender pay gap along the earnings distribution from 1993 to 2002 and found a narrowing gender pay gap; Gallup (2002) who derived conventional measures of inequality in the 1990s and examined the contribution of wage employment to income growth and inequality and Glewwe *et al.* (2002) who examined changes in poverty in

[2] Remuneration of public sector workers ceased to be based on length of service and jobs were no longer guaranteed for life (Hiebert, 1993; Norlund, 1993).

[3] Between 1993 and 1996, the minimum wage for all firms was 120,000 VND (about US $12) per month, compared with a minimum wage for firms with foreign ownership of US $35 in Hanoi and HCM city and US $30 elsewhere.

[4] For example, Lukyanova (2006), Meng (2004) and Fields and Yoo (2000).

the 1990s and found that poverty declined drastically between 1993 and 1998 (more so in urban areas, more educated households and households headed by women), while household inequality increased slightly. Le and Booth (2010) used data from 1993 to 2006 to analyse urban–rural household expenditure inequality in Vietnam using a simplified version of the same novel methodology used in this study. Recently, Imbert (2012) compared wages earned by Vietnamese public employees with earnings in the private sector from 1993 to 2006. Using a decomposition methodology, he found that the advantage of public sector workers did not decrease, but rose considerably after the transition to a market economy. He also found that changes in the returns to skills were the driving factor.

The objective of this study was to examine the developments in wage growth and inequality in Vietnam by sector of employment during the 1998–2008 period; that is, the period from when reforms started taking hold until the Vietnamese economy and in particular the labour market had been transformed. We use the Vietnam Living Standards and Vietnam Household Living Standards data from 1998 to 2008 and various methodologies which are intended to bring out differences in the change in inequality between the state and private sectors, the role of the policy of aggressively increasing the minimum wage, how increases in minimum wages were applied in the two sectors and variations in the over-time changes in minimum wage.

2. Methodology

The method of analysis is tailored to the objective of this study, which is as follows: first, to identify changes in wage inequality by sector in Vietnam in the post-reform period and second, to provide evidence in a consistent manner on the likely role of minimum-wage policies on inequality change. We use a variety of tools, starting with estimation of conventional measures of inequality. This is followed by a density function analysis. We, subsequently, implement two decompositions: one is an *aggregate* decomposition of the real wage growth by sector (as well as the private–public sector wage gap) at quantiles using counterfactual distributions; the other is a *detailed* decomposition of the change in the Gini coefficient by sector.

Aggregate decompositions of a distributional statistic identify two components – the part due to differences in characteristics (composition component) and that due to differences in coefficients (wage structure component). Going beyond decompositions at the mean, computing an aggregate decomposition of more general distributional statistics is relatively straightforward, as there are several implementable estimators with good asymptotics. Such parametric or semi-parametric approaches include those proposed by Juhn *et al.* (1993), Machado and Mata (2005) and Melly (2005). There are also non-parametric approaches, such as the one by DiNardo *et al.* (1996). Aggregate decomposition methods are closely linked to the treatment effects literature and the identification assumptions generally involved carry-over from this literature.

In an aggregate decomposition, the components of interest of the overall difference Δ_o^v in a distributional statistic, v, are[5] as follows: (1) the component associated with differences in the distribution of observable characteristics (what if everything except the distribution of X was the same); (2) the component associated with the distribution of unobservable characteristics (what if everything except the distribution of unobservables was the same); (3) the component of differences associated with the return to observable characteristics, X, contained in the structural functions (what if everything except the return to X was the same for the two groups), and (4) the component associated with differences in the return to unobservable characteristics in the structural functions (what if everything except the return to unobservable characteristics was the same). In practice, because of the presence of components involving unobservables, one cannot compute all four components, at least without additional assumptions.

Detailed decomposition methods, on the other hand, aim at deriving the effect of individual covariates for a distributional statistic other than the mean, and are more recent, less established and still evolving. DiNardo *et al.* (1996) suggested a reweighting approach to derive the subcomponents of the composition effect. A weakness of such methods is that they are *path dependent*; the decomposition depends on the order it is performed (Fortin *et al.*, 2010).

One recent method which is close to the spirit of the Oaxaca–Blinder (OB) decomposition is Firpo *et al.* (2009). This method which is *path independent* replaces the original left-hand-side variable with the re-centred influence function (RIF) of the distributional statistic, and estimates a RIF regression to derive coefficients which are in turn used to implement a detailed decomposition.

In this study we choose the method suggested by Melly (2005) to implement an aggregate decomposition of the change over time in the real wage at percentiles. The method used is an extension of the Machado and Mata's (2005) decomposition method (and is outlined in Appendix 2); it decomposes differences in distribution into three components: characteristics, coefficients and residuals. In the first step, the distribution of the dependent variable, Y, (logarithm of real hourly wage) conditional on the independent variables, X, is estimated using linear quantile regression (Koenker, 2005). The conditional distribution of Y is then integrated over the independent variables to obtain the unconditional distribution. This procedure allows us to estimate more precisely the unconditional distribution of Y by using the information contained in the regressors. More important, this procedure allows the estimation of counterfactual unconditional distributions. This estimator is a special case of the class of estimators discussed in Chernozhukov *et al.* (2013)[6] , and its statistical properties, as well as the validity of the bootstrap, follow from their results. Additional advantages of this methodology are that it accounts for heteroscedasticity and is more efficient compared to the Machado and Mata (2005) method.

[5] For a detailed discussion of various methods for aggregate and detailed decompositions, identification assumptions, advantages and limitations, see Fortin *et al.* (2010).

[6] This type of decomposition has been suggested by Juhn *et al.* (1993).

We also compute a detailed decomposition of the over-time change in the Gini coefficient in Vietnam, using the Firpo *et al.* (2009) method. As is the case with other methods, this method is not without problems. The main problem of this estimator is that, although it is well suited to studying the effect of small changes in the value of a continuous covariate on the unconditional quantile of the dependent variable, it is not consistent when analysing discrete changes, as would be the case in this study (for a detailed discussion, see Rothe, 2012).

As developments in the minimum wage and their effects on wage inequality are central to the study, the methodological approach exploits two dimensions of variation in the minimum wage[7] : first, how changes were applied in the private vs. the state sector and second, variations in over-time changes in the minimum wage.[8] The first paragraph of Section 4.1 discusses the implications of these two dimensions of variation in the minimum wage.

3. Data and estimation samples

3.1 Summary statistics

The data used draw on the household questionnaires from the 1997/1998 Vietnam Living Standard Surveys (VLSS) and the 2008 Vietnam Household Living Standard Survey (VHLSS 2008).[9] The VLSS 1997/1998 comprised a sample of nearly 6,000 households, whereas the VHLSS 2008 comprised just over 9,000 households. Although the VLSS/VHLSS are representative surveys with appropriate weights, they were conducted on registered households only; hence, the data miss migrant workers, especially in urban areas. From the wide range of questions included in the household questionnaire, we utilize information on household members such as age, gender, place of residence, education qualifications as well as employment information of workers employed for wages, such as earnings, sector of employment, occupation and major industry of employment.

As this study focuses on the wage and salary sector and excludes the self- employed (for whom there is no earnings information), the results are not representative of

[7] Magruder (2013) exploited the varied ways minimum wage increased in Indonesia, with 32 different minimum wage regimes countrywide (the regimes are either provinces or collections of districts within a province), and a difference in spatial differences identification approach to show that minimum wages may coordinate development at the high-wage equilibrium.

[8] The other variation in minimum wage in Vietnam is by zone (depending on the level of socioeconomic development in each zone): Zone 1 covers urban Hanoi and HCM City; Zone 2 covers rural Hanoi and HCM City along with urban Can Tho, Da Nang and Hai Phong; Zone 3 covers provincial cities and the districts of Bac Ninh, Bac Giang, Hai Duong and Vinh Phuc, and Zone 4 covers the remaining localities.

[9] The surveys were conducted by the General Statistics Office, assisted by the World Bank and funded by United Nations Development Program (UNDP) and the Swedish International Development Cooperation Agency. These surveys are similar in design to the World Bank's Living Standard Measurement Surveys and are nationally representative.

changes in household income or consumption inequality. The reason for focusing on wage inequality is its direct link to labour market reforms in Vietnam and related policies, such as maintaining a minimum-wage policy which is reviewed every few years.

One should look at changes in the proportion of wage employment over the period examined. From the 1992 and 1998 VLSS and the 2008 VHLSS, the proportion of wage and salary employees in total employment (including farm employment) was 20 percent in 1992/93 and 21 in 1998; this proportion increased to 27 percent in 2002, 31 percent in 2006 and 32 percent in 2008. The category within wage employment which accounts for this increase is workers employed for other households (small household enterprises), which increased sharply from 1998 to 2008.

The dependent variable is the logarithm of the hourly wage from the primary job including supplementary earnings (such as bonus), deflated to 1998 prices using the CPI for Vietnam. The hourly wage is estimated using information on hours worked. The estimation samples include all those aged 15–65 years who were employed for wages in the state sector (state-owned and collective economic sector) and the private sector (including the small foreign invested sector). Table A1 in Appendix 1 presents the mean characteristics of workers by year and sector.

Mean real earnings grew strongly, with the real wage increasing by 66 percent over the decade; however, wage growth was much stronger for workers in the state sector (150 percent compared to about 30 percent for private sector workers). The size of the private sector increased over time, from 60.5 percent in 1998 to about 68 percent in 2008. The majority of workers in the state sector were in professional and managerial occupations, whereas in the private sector more than 80 percent of workers were skilled and unskilled labourers.

Education endowments increased substantially; the proportion of workers with tertiary qualifications in the public sector doubled and in the private sector increased fivefold; even in 2008, however, the proportion of tertiary educated workers in the private sector was less than 5 percent, compared to 37 percent in the public sector. The work experience profile of public and private sector employees changed substantially over time. In the state sector, the proportion of young workers with 0–10 years of experience increased from 20 percent in 1998 to nearly 30 percent in 2008, whereas the proportion of workers with 16–25 years of experience decreased from 37 percent to 23 percent. In the private sector, the proportion of workers with 0–5 years of experience more than doubled, whereas the proportion of workers with 10–20 years of experience decreased from 60 percent to 42 percent.

4. Estimation

4.1 Minimum wage: Background

In the early 1990s Vietnam introduced a minimum wage. The monthly minimum wage was set on the basis of the cost of living of an employee who is employed in

the most basic job. The government determines and promulgates from time to time a general minimum wage as well as a minimum wage within and outside large cities. From 1993 to 1996, the general minimum wage was 120,000 VND (about US $ 12) per month, compared with a minimum wage for firms with foreign ownership of US $ 35 in Hanoi and HCM City and US $ 30 elsewhere. In 1997, the general minimum monthly wage for unskilled labour applicable to both the public and private sector was set at 144,000 VND per month; however, one important difference is that in the public sector, the minimum wage is used as a base to calculate actual salaries, which were set as a multiple of the minimum earnings. Thus, an increase in the minimum wage led automatically to an increase in public sector wages (see, for example, Belser, 2000). We hypothesize that in the state sector, developments in minimum wage do not significantly affect wage inequality.

While the minimum wage in the domestic sector was modest for international standards (at about 20 percent of median earnings), it has been revised consistently over the years to 180,000 VND in year 2000, 210,000 VND in year 2002, 290,000 VND in year 2004, 450,000 VND in year 2006 and 540,000 VND in year 2008, all in nominal terms.[10] In 2006, the minimum wage was in excess of 40 percent of the median wage in the private sector (and about 33 percent of the median wage in 2008).

Looking at over-time variation in the minimum wage, we observe: first a sustained increase in the real minimum wage until 2006; and second, a subsequent decline between 2006 and 2008 (see Figure 1). At constant (1998) prices, the minimum wage increased by 127 percent between 1998 and 2006; however, between 1998 and 2008 it increased by about 100 percent, as real minimum wage declined over the 2006–2008 period because of high inflation in recent years. With respect to the subsequent deceleration in the increase in the nominal minimum wage (and decline in the real minimum wage), its effect on wage inequality is expected to be the reverse (that is, a tendency for an increase in inequality in the private sector).

4.2 Conventional measures of inequality

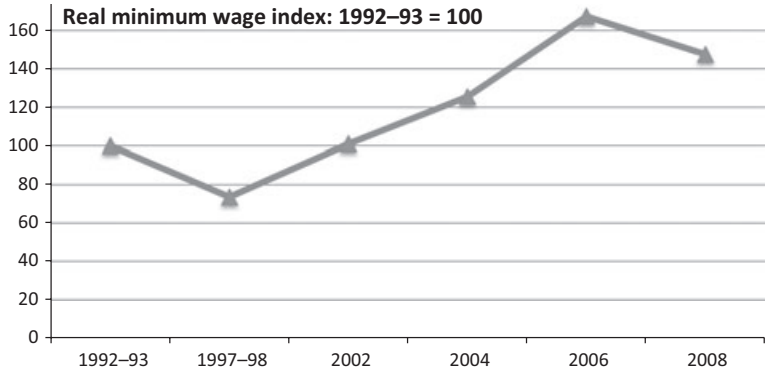
One way to characterize inequality is to compute various summary measures of inequality. Each measure has distinct properties.[11] Tables 1, 2 and 3 present such measures over time and by sector; they reveal a decline in overall wage inequality in Vietnam over time[12] until 2006 and a small increase after that based on the Gini and

[10] With respect to compliance of firms with minimum-wage legislation, it has been reported that wage and benefits violations rank 4th in frequency, at 33 percent, compared to 97, 68 and 38 percent for health and safety, hours of work, and monitoring and documentation violations, respectively (Level Works Ltd., 2013).

[11] For example, the Gini coefficient, in comparison with the Theil index, is more sensitive to transfers between people near the middle of the distribution. Transfers from the top to the bottom of the distribution, on the other hand, tend to produce larger changes in the Gini coefficient in comparison with the Theil index.

[12] Using the surveys for the years between 1998 and 2008, we found that inequality declined steadily until 2006 and levelled off thereafter.

Figure 1. Over-time developments in the real minimum wage



Source: VLSS and VHLSS data from 1992 to 2008 and the CPI for Vietnam.

Table 1. Change in various inequality measures over time: All wage employees

Inequality measure	1998	2006	2008
Gini coefficient	0.353	0.330	0.338
Theil entropy measure	0.214	0.181	0.193
Percentile ratios			
p90/p10	4.99	4.60	4.57
p90/p50	2.28	2.36	2.41
p50/p10	2.19	1.94	1.90

Source: VLSS and VHLSS data from 1998 to 2008.

Table 2. Change in various inequality measures over time: Private sector

Inequality measure	1998	2006	2008
Gini coefficient	0.351	0.284	0.292
Theil entropy measure	0.210	0.143	0.154
Percentile ratios			
p90/p10	4.86	3.43	3.38
p90/p50	2.33	1.87	1.93
p50/p10	2.08	1.83	1.75

Source: VLSS and VHLSS data from 1998 to 2008.

Table 3. Change in various inequality measures over time: State sector

Inequality measure	1998	2006	2008
Gini coefficient	0.348	0.326	0.335
Theil entropy measure	0.212	0.169	0.180
Percentile ratios			
p90/p10	5.00	5.53	5.64
p90/p50	2.24	2.08	2.18
p50/p10	2.23	2.66	2.58

Source: VLSS and VHLSS data from 1998 to 2008.

the Theil measures, while changes in percentile ratios are inconclusive. These changes mostly reflect developments in the private sector; however, we see a sharp contrast between sectors as well as over time. Thus, in the private sector, inequality declined sharply until 2006: the Gini decreased by more than 7 points and by 2006 it stood at 0.3, while percentile ratios also decreased sharply; however, the Gini and the Theil measures increased between 2006 and 2008 in the private sector. In the state sector, however, between 1998 and 2006 the picture is mixed, with the Gini and Theil measures declining and the percentile ratios generally indicating an increase in inequality at the bottom half of the wage distribution.

In the rest of this section and Sections 4.3, 4.4 and 4.5 we provide corroborative evidence that the policy of a sustained increase in the minimum wage and in particular how this policy is applied in the two sectors is likely to be behind developments in wage inequality in Vietnam.

It would be reasonable to assume that, once the reforms were fully implemented, their independent effect in the labour market would be towards increasing wage inequality. There is convincing evidence that the gradual economic reforms[13] in Vietnam had barely any effect in the labour market prior to 1998. Perhaps the best indicator is what happened to the return to human capital. Doan and Gibson (2010) estimated returns to schooling from 1992 to 2008 in Vietnam and found that during the 1992–98 period, the return to schooling remained low at between 3 and 5 percent, as opposed to an average of 10 percent for developing countries. Other evidence on Vietnam (for example, Liu, 2006) also suggests that during this period there is no discernible increasing trend for returns to schooling. However, during the later stages of economic reform (post-1998), the return to schooling increased rapidly and stabilized at about 10 percent – the global average for developing countries. Similarly, the return to experience increased from 1.5 percent in 1998 to 2.5 in 2002, to 4 in 2004 and 5.6 in 2008. Doan and Gibson (2010) attribute the rapid increase in the return to schooling to a deepening of reforms, opening of markets

[13] As opposed to the 'cold turkey' reforms in the Eastern European transition economies.

and integration into the global economy, which resulted in an increase in the labour market requirements for technical skills.

4.3 Density functions

Figures 2–5 show the cumulative densities for the (real) hourly wage and the logarithm of hourly wage by year and sector of employment. If minimum-wage policies and the different way they were applied in the public compared with the private sector were instrumental in the developments in wage inequality, we would expect to see the whole public sector wage scale shifting in response to an increase in the minimum wage, whereas only the lower part of the private sector distribution would be mostly affected.

Figures 3 and 5 for the logarithm of the hourly wage are more revealing as they reflect the approximate percentage change in the hourly wage at different points in the wage distribution. Thus, in the private sector, we see that wage growth over the entire time period is disproportionately large near the bottom of the wage distribution, whereas real wage growth is small for high-wage workers. In the state sector, on the other hand (Figure 5), the wage scale shifts essentially in a parallel fashion with some evidence of a larger increase at higher points in the wage distribution.

Figures A1 and A2 in Appendix 1 show the corresponding changes between 2006 and 2008. With a backdrop of a declining real minimum wage over the 2-year period, in the private sector the shift of the distribution gets progressively smaller towards the bottom (that is, the opposite finding compared with that for the entire period) and essentially there is no shift in distributions at the very bottom. Changes in the state sector are also smaller towards the bottom, but less so than in the private sector.

Figure 2. Cumulative densities over time in the private sector: Hourly wage, 1998–2008

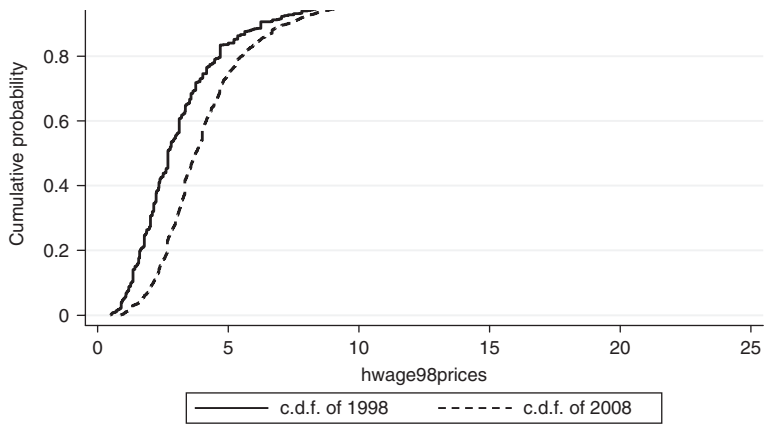


Figure 3. Cumulative densities over time in the private sector: Log of hourly wage, 1998–2008

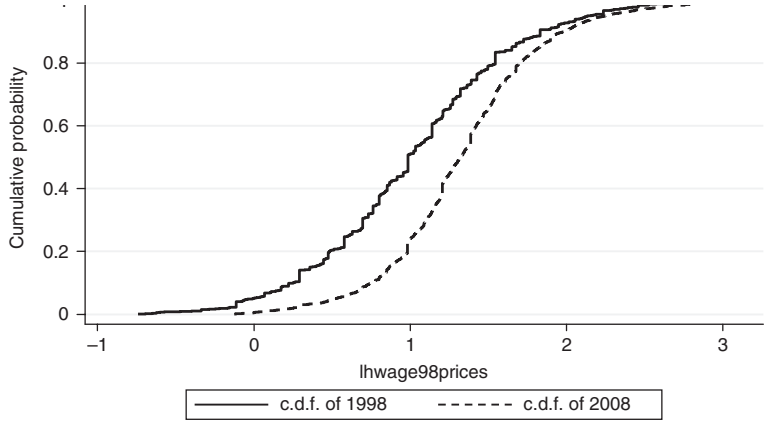
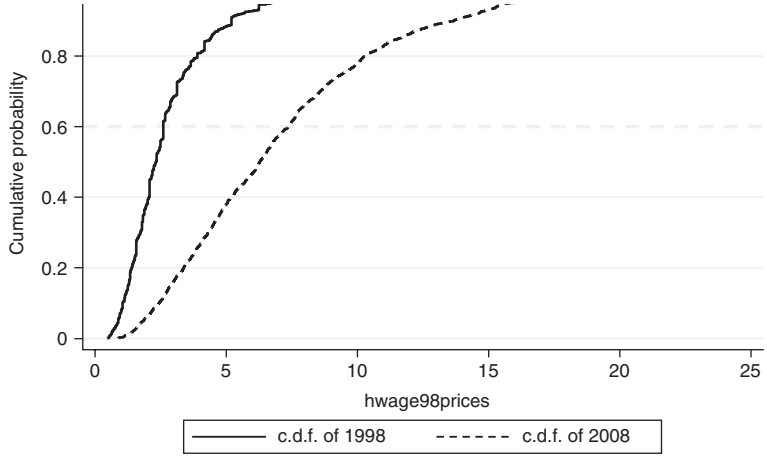


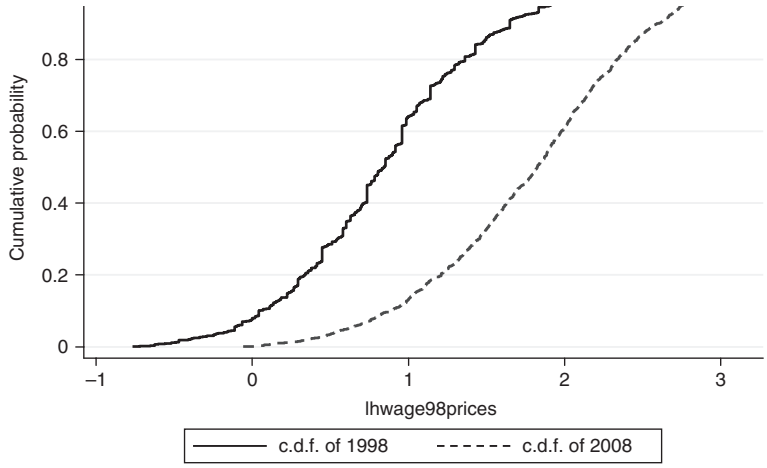
Figure 4. Cumulative densities over time in the state sector: Hourly wage, 1998–2008



4.4 Aggregate decomposition results by sector

In performing the aggregate decomposition, first the distribution based on the composition (characteristics) of the 2008 group, the coefficients (*m***)** for the 2008 group and the residual distribution (*r*) for the 1998 group are estimated. Then, the distribution based on the composition of the 2008 group and the conditional distribution for the 1998 group are estimated. Using these two counterfactual distributions, the raw

Figure 5. Cumulative densities over time in the state sector: Log of hourly wage, 1998–2008



differences in the observed sample distributions (2008 and 1998) are decomposed into three terms: composition, coefficients and residuals.[14]

The decomposition equation is as follows:

$$\begin{aligned}\hat{q}\left(\hat{\beta}^{08}, X^{08}\right) - \hat{q}\left(\hat{\beta}^{98}, X^{98}\right) = &\left[\hat{q}\left(\hat{\beta}^{08}, X^{08}\right) - \hat{q}\left(\hat{\beta}^{\mathrm{m08,r98}}, X^{\mathrm{r98}}\right)\right] \\ &+ \left[\hat{q}\left(\hat{\beta}^{\mathrm{m08,r98}}, X^{\mathrm{r98}}\right) - \hat{q}\left(\hat{\beta}^{98}, X^{08}\right)\right] \\ &+ \left[\hat{q}\left(\hat{\beta}^{98}, X^{08}\right) - \hat{q}\left(\hat{\beta}^{98}, X^{98}\right)\right]\end{aligned}$$

where the first term on the right-hand side represents the effect of changes in prices and quantities of unmeasured characteristics (residuals), the second term the effect of changes in coefficients (observable prices), and the third term the effect of changes in the distribution of observable covariates (measured characteristics).

The specification of the earnings function is that of an extended Mincerian function and includes the following controls which are associated with earnings: gender, marital status, ethnicity, human capital endowment (education level and years of experience group), occupation, major industry affiliation and demographic variables (urbanity and region of residence).

Tables 4 and 5 contain the decomposition results at different points of the wage distribution. While real wage growth at the median in the private sector was about 30 percent, wage growth is declining as one goes to higher points of the distribution, ranging from about 60 percent below the 10th percentile, to near zero above the 90th

[14] The decomposition was performed using the Stata module *cdeco_jmp* made available by Blaise Melly.

Table 4. Decomposition* of change in log wage at selected percentiles in the private sector: 1998–2008

Percentile	Characteristics (composition)	Coefficients	Residuals	Total change
p5	0.008 (0.022)	0.352 (0.025)	0.139 (0.045)	0.499 (0.041)
p10	0.012 (0.016)	0.343 (0.021)	0.118 (0.037)	0.473 (0.032)
p15	0.008 (0.012)	0.334 (0.020)	0.098 (0.028)	0.440 (0.025)
p20	0.004 (0.011)	0.327 (0.021)	0.077 (0.021)	0.408 (0.020)
p25	0.002 (0.010)	0.319 (0.022)	0.062 (0.019)	0.383 (0.016)
p30	0.001 (0.009)	0.313 (0.021)	0.045 (0.018)	0.360 (0.014)
p35	0.000 (0.008)	0.306 (0.020)	0.032 (0.017)	0.338 (0.012)
p40	−0.002 (0.009)	0.300 (0.020)	0.016 (0.016)	0.314 (0.012)
p45	−0.003 (0.009)	0.293 (0.019)	−0.003 (0.014)	0.287 (0.011)
p50	−0.005 (0.008)	0.286 (0.019)	−0.014 (0.014)	0.268 (0.010)
p55	−0.006 (0.008)	0.280 (0.019)	−0.029 (0.015)	0.246 (0.010)
p60	−0.007 (0.008)	0.274 (0.018)	−0.043 (0.014)	0.224 (0.010)
p65	−0.008 (0.008)	0.270 (0.018)	−0.058 (0.015)	0.204 (0.010)
p70	−0.006 (0.008)	0.265 (0.018)	−0.082 (0.015)	0.177 (0.014)
p75	−0.004 (0.008)	0.262 (0.019)	−0.018 (0.015)	0.150 (0.016)
p80	−0.001 (0.009)	0.261 (0.021)	−0.133 (0.018)	0.127 (0.016)
p85	0.004 (0.010)	0.260 (0.021)	−0.174 (0.020)	0.091 (0.019)
p90	0.013 (0.015)	0.268 (0.023)	−0.226 (0.021)	0.055 (0.018)
p95	0.033 (0.023)	0.284 (0.024)	−0.308 (0.025)	0.009 (0.017)

Notes: Standard errors in parentheses. *Using the Juhn *et al.* (1993) method and VLSS/VHLSS data.

percentile. This compares with growth of about 150 percent at the median, 100–120 percent at the bottom and about 140–150 percent at the top in the state sector.

Our hypothesis is that in the private sector, at lower points in the log-wage distribution, a large part of wage growth was due to residuals (unobservables), whereas, at other parts of the distribution, wage growth is mostly accounted for by changes in characteristics and coefficients (prices of characteristics accounted for); in the state sector, on the other hand, we expect that wage growth is accounted for mostly by a combination of changes in characteristics and coefficients.

Looking first at the effect of changes in the distribution of observables, we see that the characteristics component is negligible in the private sector at every point in the wage distribution (hypothesis of no effect is accepted in Kolmogorov–Smirnov test). In both sectors, changes in coefficients are overwhelmingly behind wage growth at every point in the distribution (especially in the state sector); however, in the private sector, a substantial part of wage growth is attributable to unobservables (residuals)

Table 5. Decomposition* of change in log wage at selected percentiles in state sector: 1998–2008

Percentile	Characteristics (composition)	Coefficients	Residuals	Total change
p5	0.031 (0.028)	0.701 (0.34)	−0.023 (0.050)	0.709 (0.032)
p10	0.065 (0.027)	0.698 (0.033)	0.013 (0.045)	0.776 (0.028)
p15	0.084 (0.025)	0.696 (0.035)	0.024 (0.040)	0.805 (0.024)
p20	0.105 (0.022)	0.703 (0.034)	0.030 (0.034)	0.837 (0.023)
p25	0.118 (0.021)	0.713 (0.036)	0.028 (0.031)	0.860 (0.020)
p30	0.133 (0.020)	0.724 (0.035)	0.023 (0.026)	0.880 (0.020)
p35	0.139 (0.019)	0.737 (0.034)	0.020 (0.023)	0.896 (0.019)
p40	0.142 (0.018)	0.749 (0.034)	0.014 (0.022)	0.906 (0.019)
p45	0.140 (0.019)	0.764 (0.035)	0.013 (0.021)	0.916 (0.019)
p50	0.139 (0.019)	0.774 (0.034)	0.012 (0.021)	0.925 (0.019)
p55	0.134 (0.017)	0.785 (0.035)	0.014 (0.020)	0.934 (0.019)
p60	0.130 (0.016)	0.795 (0.035)	0.018 (0.023)	0.943 (0.020)
p65	0.123 (0.016)	0.804 (0.034)	0.024 (0.023)	0.952 (0.020)
p70	0.117 (0.017)	0.810 (0.035)	0.027 (0.024)	0.954 (0.020)
p75	0.111 (0.018)	0.813 (0.034)	0.028 (0.021)	0.951 (0.024)
p80	0.105 (0.018)	0.822 (0.036)	0.019 (0.024)	0.947 (0.025)
p85	0.101 (0.018)	0.826 (0.041)	0.012 (0.027)	0.939 (0.029)
p90	0.092 (0.018)	0.844 (0.043)	−0.009 (0.033)	0.927 (0.036)
p95	0.073 (0.024)	0.849 (0.054)	−0.036 (0.053)	0.886 (0.049)

Notes: Standard errors in parentheses. *Using the Juhn *et al.* (1993) method and VLSS/VHLSS data.

– but only for workers at the lower end of the distribution. Bootstrap post-estimation inference (Kolmogorov–Smirnov test) rejected the hypotheses of no effect of the residual component as well as that of a constant effect across the distribution.

Tables A2 and A3 in Appendix 1 give the results for the 2006–08 period. Given the evidence from the CDF distributions for this period, here the hypothesis is that the stagnation in real wages at the bottom of the distribution[15] in the private sector over the 2-year period (in contrast to a 10 percent increase in median earnings) is mainly due to the effect of residuals contributing towards a decrease in real wage. This is corroborated in Table A2 where the contribution of residuals is significantly negative at the bottom of the distribution, but insignificant elsewhere. Post-estimation inference rejected the hypotheses of a constant effect of the residuals component along the distribution (as well as that of no effect).

[15] The estimates of the change in log wage at the 1st to 4th percentiles were −0.023, 0.014, 0.037 and 0.05, respectively.

In Table 6 we look at developments in wage growth in the private and public sectors from another angle, focusing on private–public wage differentials over time. The sectoral wage gap is estimated at selected percentiles and decomposed into characteristics, coefficients and residual components. The wage gap underwent a fundamental change over the time period examined. In 1998, before the Vietnam reforms took hold, there was a private sector wage advantage of about 18 percent at the median (16 percent at the 10th percentile and 25 percent at the 90th percentile), despite public sector workers having better productive characteristics. The main reason behind the private sector wage advantage in 1998 was better private sector returns to accounted characteristics (coefficients component) with this component exceeding the gross gap at every percentile.

By 2008, the public sector advantage in productive characteristics had substantially increased; furthermore, the return to accounted characteristics had changed from greatly favouring private sector workers to now favouring public sector workers. Of interest is also the nature of effects not accounted in the model (residuals), especially for low-wage workers: whereas in 1998 residuals did not contribute at all to the sectoral wage gap except for high-wage earners, in 2008 residual effects contributed significantly to narrowing the public sector wage advantage for low-wage earners. All in all, in 2008 the wage gap in favour of public sector workers increased substantially as one goes to higher points of the wage distribution. These findings complement the findings in earlier sections of this study, on the likely role of minimum-wage policies on wage inequality in the private and public sectors.

4.5 Decomposition of the Gini coefficient

The focus of implementing a detailed decomposition of the Gini coefficient is to identify the contribution of changes in characteristics and their returns (that is, changes in the return to education, experience, occupation and so on). For example, it would be useful to see whether changes in the return to education contributed to an increase in inequality. We used the Firpo *et al.* (2009) approach (described in Appendix 2).

One should keep in mind, though, that the results for the coefficients effect in such a detailed decomposition are somewhat fragile because of an identification problem; that is, they are not invariant to the choice of reference group (see Oaxaca and Ransom, 1999). One suggested partial solution to this problem has been proposed in Yun (2005). The basic idea of Yun (2005)'s solution is to get the estimates for all possible reference groups and then derive the averaging ones. However, this approach would make interpretation of effects associated with the constants virtually impossible. Firpo *et al.* (2007) show that the residual change captured by the difference in intercepts is very similar to the actual wage changes in the reference group. Here, we are interested in the residual effects associated with low-wage workers – the beneficiaries of minimum-wage policies. Hence, in the earnings functions specification, the reference group is as follows: married men of the majority

Table 6. Decomposition* of private–public log-wage differential in 1998 and 2008

Percentile	Characteristics (Composition)		Coefficients		Residuals		Total	
	1998	2008	1998	2008	1998	2008	1998	2008
p05	−0.103 (0.080)	−0.164 (0.069)	0.232 (0.069)	−0.066 (0.043)	−0.003 (0.062)	0.146 (0.106)	0.126 (0.038)	−0.085 (0.023)
p10	−0.094 (0.069)	−0.213 (0.053)	0.240 (0.063)	−0.064 (0.027)	0.003 (0.045)	0.123 (0.061)	0.149 (0.031)	−0.154 (0.023)
p15	−0.095 (0.059)	−0.244 (0.045)	0.237 (0.060)	−0.065 (0.032)	0.015 (0.038)	0.100 (0.039)	0.157 (0.024)	−0.209 (0.019)
p20	−0.081 (0.055)	−0.266 (0.038)	0.228 (0.059)	−0.071 (0.037)	0.019 (0.036)	0.076 (0.029)	0.167 (0.023)	−0.262 (0.019)
p25	−0.076 (0.053)	−0.283 (0.033)	0.228 (0.056)	−0.081 (0.037)	0.016 (0.033)	0.055 (0.025)	0.168 (0.021)	−0.309 (0.019)
p30	−0.076 (0.051)	−0.300 (0.029)	0.229 (0.055)	−0.098 (0.036)	0.015 (0.030)	0.046 (0.023)	0.168 (0.020)	−0.353 (0.016)
p35	−0.077 (0.050)	−0.315 (0.026)	0.233 (0.056)	−0.110 (0.034)	0.011 (0.027)	0.034 (0.022)	0.167 (0.020)	−0.391 (0.015)
p40	−0.081 (0.045)	−0.325 (0.024)	0.233 (0.055)	−0.121 (0.033)	0.015 (0.024)	0.022 (0.020)	0.168 (0.019)	−0.424 (0.015)
p45	−0.086 (0.042)	−0.333 (0.025)	0.240 (0.054)	−0.132 (0.033)	0.020 (0.024)	0.010 (0.020)	0.174 (0.017)	−0.455 (0.014)
p50	−0.094 (0.038)	−0.344 (0.026)	0.247 (0.052)	−0.139 (0.034)	0.018 (0.025)	−0.003 (0.020)	0.171 (0.017)	−0.486 (0.013)
p55	−0.097 (0.036)	−0.353 (0.026)	0.246 (0.052)	−0.140 (0.034)	0.026 (0.025)	−0.020 (0.022)	0.175 (0.018)	−0.513 (0.014)
p60	−0.102 (0.035)	−0.360 (0.028)	0.248 (0.053)	−0.141 (0.033)	0.034 (0.027)	−0.038 (0.022)	0.179 (0.021)	−0.539 (0.015)
p65	−0.104 (0.034)	−0.365 (0.028)	0.248 (0.052)	−0.144 (0.033)	0.041 (0.026)	−0.054 (0.026)	0.185 (0.022)	−0.563 (0.015)
p70	−0.118 (0.031)	−0.365 (0.029)	0.252 (0.054)	−0.147 (0.034)	0.058 (0.030)	−0.073 (0.032)	0.193 (0.023)	−0.584 (0.018)
p75	−0.131 (0.031)	−0.363 (0.029)	0.248 (0.055)	−0.148 (0.035)	0.080 (0.035)	−0.093 (0.039)	0.197 (0.023)	−0.604 (0.021)
p80	−0.148 (0.031)	−0.361 (0.027)	0.245 (0.058)	−0.157 (0.036)	0.099 (0.041)	−0.106 (0.045)	0.195 (0.023)	−0.625 (0.024)
p85	−0.170 (0.037)	−0.361 (0.028)	0.238 (0.063)	−0.161 (0.035)	0.140 (0.052)	−0.119 (0.051)	0.207 (0.028)	−0.641 (0.029)
p90	−0.201 (0.037)	−0.359 (0.032)	0.237 (0.065)	−0.148 (0.035)	0.187 (0.065)	−0.143 (0.059)	0.222 (0.035)	−0.649 (0.032)
p95	−0.244 (0.030)	−0.332 (0.041)	0.240 (0.059)	−0.113 (0.037)	0.258 (0.069)	−0.168 (0.060)	0.264 (0.042)	−0.613 (0.034)

Notes: Standard errors in parentheses. *Using the Juhn *et al.* (1993) method and VLSS/VHLSS data.

ethnic group in urban areas with less than completed primary education working as labourers in manufacturing and living in the Mekong River Delta region.

Looking first at the state sector (Table 7), the results are unremarkable, given the insignificant change in the Gini over time (about −0.013). The effect associated with the constant is towards increasing inequality in the state sector, but it is imprecisely estimated. In the private sector, however, the estimate of the decline in the Gini is large and highly significant at −0.059 (Table 8). Changes in the wage structure are almost exclusively behind this decrease in inequality in the private sector. Changes in education qualifications of workers and the coefficients associated with education qualifications (mainly increasing returns to education over time) contributed significantly towards increasing inequality. However, the overall decline in the Gini can be attributed to the large negative component of changes in the intercepts, which is associated with a reference group of low-wage workers.

Tables A4 and A5 in Appendix 1 give the corresponding decomposition results from 2006 to 2008. Overall changes in inequality and their aggregate components are small and statistically insignificant. We still see, though, that the estimated effects of the intercept in the private and state sectors are positive and negative, respectively, but both imprecisely estimated.

Finally, we conducted simulations (results are available from the authors upon request) to show that the distribution reacts to changes in the minimum wage and that we are able to generate declines in inequality measures between 1998 and 2008 comparable with those from the data. In particular, we (1) shifted the 1998 distribution by the sum of the characteristics and coefficients components (if this sum

Table 7. Detailed decomposition* of change in the Gini in the state wage sector: 1998–2008

Characteristic	Composition (z-value)	Wage structure (z-value)	Total change (z-value)
Female	0.000 (0.5)	−0.003 (0.4)	−0.003
Marital status	0.000 (0.1)	0.020 (3.0)	0.020
Education	−0.013 (3.3)	−0.033 (0.6)	−0.046
Experience group	0.004 (2.3)	−0.031 (1.5)	−0.027
Occupation	0.004 (2.2)	−0.016 (0.5)	−0.012
Broad industry	0.001 (0.5)	0.032 (1.3)	0.033
Urban/Rural	0.000 (0.2)	−0.035 (3.1)	−0.035
Region	−0.001 (1.3)	0.009 (0.4)	0.008
Residual (intercepts)	–	0.055 (0.8)	0.055
Total	−**0.006** (1.2)	−**0.007** (0.7)	−**0.013** (1.4)

Notes: z-values in parentheses; approximation errors are ignored. *Using the Firpo *et al.* (2009) decomposition and VLSS/VHLSS data.

Table 8. Detailed decomposition* of change in the Gini in the private wage sector: 1998–2008

Characteristic	Composition (z-value)	Wage structure (z-value)	Total change (z-value)
Female	0.000 (0.7)	−0.007 (1.3)	−0.007
Marital status	−0.001 (0.4)	−0.004 (0.5)	−0.005
Education	0.010 (3.1)	0.037 (2.4)	0.047
Experience group	0.003 (2.4)	−0.011 (0.8)	−0.008
Occupation	0.002 (1.5)	0.005 (0.5)	0.007
Broad industry	−0.009 (5.2)	0.012 (1.3)	0.003
Urban/Rural	−0.001 (1.4)	0.010 (1.6)	0.009
Region	0.001 (0.5)	−0.013 (0.9)	−0.012
Residual (intercepts)	–	−0.092 (3.0)	−0.092
Total	**0.005** (1.2)	**−0.064** (7.9)	**−0.059** (7.7)

Note: z-values in parentheses; approximation errors are ignored. *Using the Firpo *et al.* (2009) decomposition and VLSS/VHLSS data.

exceeded the observed change in real minimum wage), and (2) shifted the 1998 distribution by the change in the real minimum wage if the sum of the two components fell short of the observed over-time change in the real minimum wage. We were then able to generate a wage distribution for year 2008 which is broadly similar to the observed; the Gini coefficient associated with the generated counterfactual distribution is 0.28, slightly lower than the one observed from the 2008 data (0.29).

4.6 Challenges

From the perspective of policy, policy makers in Vietnam are aware that the reforms have the potential of increasing wage inequality, especially through changes in the return to human capital. Developments in wage inequality over the entire period examined suggest that wage growth has been inclusive and equalizing in the private sector. The maintenance of a minimum wage and its frequent revisions is probably a major factor in shaping these developments. High inflation in recent years (2006 onwards) eroded the real minimum wage and this erosion may have contributed to the levelling off of the declining trend in wage inequality. Vietnam seems to be committed to inclusive growth and to continue to intervene with further revisions to the minimum wage. Indeed, in 2009 the minimum wage was revised to 690,000 VND (650,000 for the state sector), from May 2010 the minimum monthly wage in non-state local firms was again revised to 810,000 VND (730,000 for state-owned enterprises and 1.04 million VND in foreign invested firms), and from 2011 it was further revised to 1.05 million VND.[16]

[16] The revisions outlined here refer to Zone 3.

But are such aggressive revisions of the minimum wage sustainable in the long term? In the case of Vietnam, minimum-wage revisions have in recent years been contributing significantly to rising inflation. Prices of many consumer goods have been increasing, sometimes even in anticipation of wage increases. For example, in late April 2010 and after the decree issued on March 25th revising the minimum wage for state-owned enterprises to 730,000 (an increase of 12.3 percent), prices rose by 5 percent and in the case of some vegetables, prices increased by 50–100 percent (*Vietnam Business News*, May 4th 2010). In an announcement by the Vietnamese government, the minimum wage was set to increase by as much as half from October 1st 2011, in an attempt to help workers cope with the high and rising inflation (Agence France-Presse, August 24th, 2011). Such revised new minimum wages will for the first time apply to both foreign-owned and Vietnamese firms, boosting the basic wage by 29 percent at foreign companies and 48 percent for domestic firms. In the meantime, the consumer price index for July 2011 rose by 22 percent compared with July 2010, after accelerating for the 11 straight months.

These developments pose a stiff challenge to policymakers; aggressive upward revisions of the minimum wage generate sustained inflation and will eventually affect foreign direct investment and result in higher unemployment.[17] In the presence of several economic imbalances, including large trade, current account and budget deficits, a more sustained approach towards the minimum wage is likely sooner than later. This is likely to increase wage inequality in Vietnam.

5. Conclusion

The Vietnam 'renovation' reforms, initiated in 1986 and implemented during the 1990s aimed at establishing a market-based economy. The full impact of the reforms, especially in the labour market, was felt only in later years. In this study, we use Vietnam Living Standards and Vietnam Household Living Standards data from 1998 to 2008 and various methodologies which were designed to show differences in the change in inequality between the state and private sectors, the role of the policy of aggressively increasing the minimum wage and how increases in minimum wage were applied in the two sectors.

Summary measures of inequality, as well as the results from decompositions indicate that wage inequality in Vietnam declined sharply in the private sector, but showed little change in the state sector. Cumulative density analysis suggests that minimum-wage policies are probably behind these developments. Aggregate decomposition of the growth in real wages at percentiles (and decompositions of the sectoral wage gap) provides additional corroborative evidence for this conclusion.

[17] For example, the vice-chairman of the Vietnam Textile and Apparel Association recently stated that higher wages would be a burden on firms already struggling with higher input costs (Agence France-Presse, August 24, 2011.

Finally, a detailed decomposition of the change in the Gini coefficient reveals that the decline in the Gini in the private sector is mostly due to unaccounted for factors associated with wage changes in low-wage workers, while increases in the return to education over time contributed towards increasing inequality in the private sector. Additional checks to support the interpretation of our results were possible using the over-time variation in the rate of increase in the minimum wage.

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Appendix 1

Table A1. Summary statistics by year: Wage employees 15–65 years (%)

Characteristic	1998			2008		
	All	State	Private	All	State	Private
Hourly wage, 1998 prices (Viet Dong)	3,198	2,862	3,416	5,312	7,194	4,420
0–5 years of experience	7.07	7.33	6.90	13.66	11.35	14.75
6–10 years of experience	19.00	12.08	23.50	17.90	17.56	17.92
11–15 years of experience	18.53	12.88	22.22	11.57	11.36	11.67
16–20 years of experience	15.34	17.40	14.00	11.86	10.27	12.61
21–25 years of experience	15.40	20.07	12.36	12.38	12.88	12.14
26–30 years of experience	10.39	12.17	9.24	12.79	15.68	11.43
31–35 years of experience	6.73	8.65	5.48	10.10	12.08	9.17
36–40 years of experience	4.24	5.77	3.25	5.61	5.91	5.46
>40 years of experience	3.28	3.64	3.05	4.23	2.93	4.85
Average years of experience	18.70	20.76	17.35	19.23	19.93	18.90
Male	61.35	55.89	64.90	60.86	54.58	63.84
Female	38.65	44.11	35.10	39.14	45.42	36.16
Married	57.75	74.04	47.15	64.85	77.09	59.05
Not married	42.25	25.96	52.85	35.15	22.91	40.95
Majority	93.94	95.69	92.80	94.30	92.75	95.04
Ethnic minority	6.06	4.31	7.20	5.70	7.25	4.96
Urban	44.18	55.35	36.91	39.28	51.75	33.36
Rural	55.82	44.65	63.09	60.72	48.25	66.64
Public sector	39.42	–	–	32.17	–	–
Private sector	60.58	–	–	67.83	–	–
< Primary education	22.00	4.60	33.32	12.92	1.67	18.25
Completed primary	25.13	11.97	33.69	20.13	5.70	26.97
Lower secondary	22.77	23.30	22.42	22.12	11.96	26.94
Completed secondary	13.72	24.76	6.53	11.91	11.72	12.00
Secondary vocational/Tech	8.46	16.88	2.99	17.82	31.87	11.17
Completed tertiary	7.92	18.48	1.04	15.10	37.09	4.67
Manager/Official	4.96	12.17	0.27	3.60	10.74	0.22
Professional/Assoc. Professional	22.09	50.55	3.57	20.28	51.82	5.32
Service/Sales	7.02	6.51	7.36	8.17	12.98	5.89
Skilled labour	37.76	19.71	41.62	33.50	14.29	42.61

Table A1. (Continued)

Characteristic	1998			2008		
	All	State	Private	All	State	Private
Unskilled labour	28.16	7.78	41.43	34.44	10.17	45.96
Primary sector	19.21	8.32	26.29	26.94	12.68	33.70
Industry	39.80	23.03	50.71	44.14	17.10	56.97
Trade/Services	40.99	68.65	22.99	28.92	70.22	9.33
Red River delta	20.49	26.38	16.66	26.45	26.73	26.32
North	17.20	22.69	13.63	16.54	25.62	12.23
Central	11.83	10.70	12.57	12/15	13.03	11.74
South-East	26.86	23.78	28.87	23.65	22.07	24.40
Mekong River delta	23.61	16.45	28.26	21.21	12.55	25.32
N	2,984	1,198	1,786	6,624	2,181	4,443

Note: Excluded groups in RIF regressions in bold.
Source: VLSS/VHLSS data from 1998 and 2008.

Table A2. Decomposition* of change in log wage at selected percentiles in private sector: 2006–2008

Percentile	Characteristics (composition)	Coefficients	Residuals	Total change
p5	0.025 (0.011)	0.094 (0.014)	−0.059 (0.020)	0.060 (0.010)
p10	0.024 (0.008)	0.090 (0.013)	−0.035 (0.014)	0.079 (0.012)
p15	0.023 (0.007)	0.088 (0.011)	−0.023 (0.011)	0.087 (0.013)
p20	0.023 (0.006)	0.088 (0.010)	−0.018 (0.010)	0.091 (0.014)
p25	0.022 (0.006)	0.084 (0.010)	−0.013 (0.010)	0.093 (0.013)
p30	0.023 (0.005)	0.081 (0.010)	−0.007 (0.008)	0.096 (0.013)
p35	0.023 (0.005)	0.080 (0.010)	−0.003 (0.007)	0.099 (0.012)
p40	0.023 (0.004)	0.078 (0.010)	−0.001 (0.007)	0.100 (0.013)
p45	0.022 (0.005)	0.077 (0.010)	0.000 (0.006)	0.099 (0.013)
p50	0.022 (0.005)	0.075 (0.010)	0.001 (0.006)	0.098 (0.013)
p55	0.020 (0.005)	0.075 (0.010)	0.001 (0.005)	0.096 (0.013)
p60	0.020 (0.005)	0.072 (0.010)	0.001 (0.005)	0.093 (0.013)
p65	0.020 (0.005)	0.070 (0.011)	−0.002 (0.005)	0.089 (0.013)
p70	0.020 (0.006)	0.069 (0.012)	−0.004 (0.006)	0.086 (0.013)
p75	0.020 (0.006)	0.068 (0.013)	−0.008 (0.007)	0.079 (0.013)

Table A2. (Continued)

Percentile	Characteristics (composition)	Coefficients	Residuals	Total change
p80	0.021 (0.007)	0.066 (0.013)	−0.010 (0.009)	0.076 (0.015)
p85	0.021 (0.008)	0.065 (0.015)	−0.011 (0.012)	0.075 (0.019)
p90	0.026 (0.011)	0.063 (0.019)	−0.008 (0.017)	0.081 (0.027)
p95	0.036 (0.021)	0.064 (0.023)	0.008 (0.025)	0.108 (0.037)

Note: Standard errors in parentheses. *Using the Juhn *et al.* (1993) method and VLSS/VHLSS data.

Figure A1. Cumulative densities over time in the private sector: Log of hourly wage, 2006–08

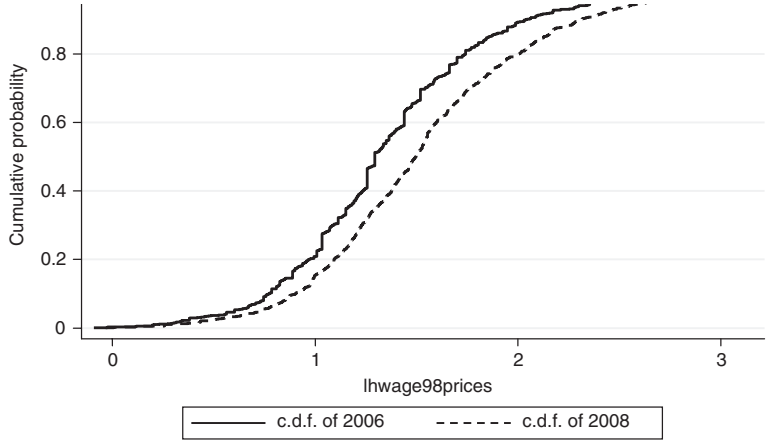

Figure A2. Cumulative densities over time in the state sector: Log of hourly wage, 2006–08

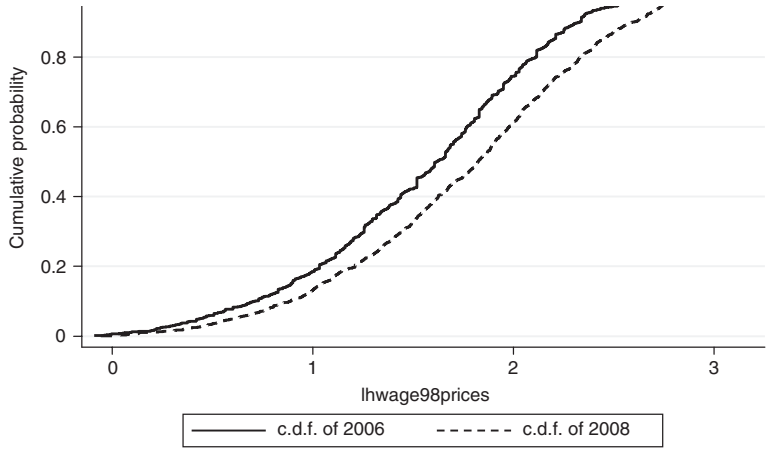

Table A3. Decomposition* of change in log wage at selected percentiles in state sector: 2006–08

Percentile	Characteristics (composition)	Coefficients	Residuals	Total change
p5	0.014 (0.019)	0.014 (0.045)	0.052 (0.035)	0.080 (0.038)
p10	0.020 (0.017)	0.020 (0.036)	0.057 (0.023)	0.097 (0.036)
p15	0.021 (0.016)	0.026 (0.031)	0.049 (0.016)	0.096 (0.031)
p20	0.029 (0.015)	0.031 (0.030)	0.033 (0.013)	0.094 (0.028)
p25	0.033 (0.014)	0.037 (0.028)	0.024 (0.011)	0.093 (0.027)
p30	0.040 (0.014)	0.041 (0.028)	0.017 (0.011)	0.099 (0.025)
p35	0.044 (0.013)	0.044 (0.026)	0.012 (0.012)	0.100 (0.022)
p40	0.044 (0.013)	0.048 (0.023)	0.010 (0.012)	0.101 (0.020)
p45	0.044 (0.013)	0.051 (0.022)	0.007 (0.011)	0.103 (0.019)
p50	0.047 (0.013)	0.054 (0.021)	0.006 (0.011)	0.106 (0.019)
p55	0.045 (0.013)	0.054 (0.020)	0.007 (0.012)	0.107 (0.019)
p60	0.044 (0.014)	0.056 (0.019)	0.007 (0.012)	0.107 (0.020)
p65	0.043 (0.014)	0.057 (0.020)	0.010 (0.013)	0.109 (0.020)
p70	0.038 (0.014)	0.059 (0.019)	0.013 (0.015)	0.110 (0.021)
p75	0.036 (0.013)	0.062 (0.019)	0.015 (0.018)	0.114 (0.022)
p80	0.037 (0.013)	0.062 (0.018)	0.023 (0.020)	0.122 (0.025)

Table A3. (Continued)

Percentile	Characteristics (composition)	Coefficients	Residuals	Total change
p85	0.036 (0.013)	0.062 (0.016)	0.033 (0.022)	0.132 (0.028)
p90	0.035 (0.016)	0.065 (0.017)	0.052 (0.025)	0.151 (0.031)
p95	0.038 (0.013)	0.063 (0.017)	0.069 (0.027)	0.170 (0.032)

Note: Standard errors in parentheses. *Using the Juhn *et al.* (1993) method and VLSS/VHLSS data.

Table A4. Detailed decomposition* of change in the Gini in the private wage sector: 2006–08

Characteristic	Composition (z-value)	Wage structure (z-value)	Total change (z-value)
Female	−0.000 (0.4)	−0.009 (2.2)	−0.009
Marital status	0.000 (0.4)	−0.005 (0.9)	−0.005
Education	0.005 (3.8)	0.002 (0.2)	0.007
Experience group	0.001 (1.5)	−0.008 (1.2)	−0.007
Occupation	0.000 (0.1)	−0.006 (1.1)	−0.006
Broad industry	−0.004 (2.0)	0.002 (0.5)	−0.002
Urban/Rural	0.000 (0.7)	0.007 (1.6)	0.007
Region	0.001 (1.4)	0.004 (0.4)	0.005
Residual (intercepts)	–	0.019 (0.9)	0.019
Total	**0.003 (0.8)**	**0.004 (0.8)**	**0.007 (1.2)**

Note: z-values in parentheses; approximation errors are ignored. *Using the Firpo *et al.* (2009) decomposition and VLSS/VHLSS data.

Appendix 2

Aggregate decomposition of wage growth across the distribution

Starting with an independent sample $\{Y_i, X_i\}_{i=1}^{N}$ from a population, where X is a vector of characteristics and the τ^{th} quantile of Y conditional on X_i given by:

$$F_Y^{-1}|X(\tau|X_i) = X_i\beta(\tau), \tau \in (0,1).$$

Assuming a linear relationship between the dependent variable, Y (logged real hourly wage), and the covariates (human capital characteristics), the quantile

Table A5. Detailed decomposition* of change in the Gini in the state wage sector: 2006-2008

Characteristic	Composition (z-value)	Wage structure (z-value)	Total change (z-value)
Female	−0.000 (0.4)	0.004 (0.8)	0.004
Marital status	−0.002 (2.1)	−0.003 (0.3)	−0.005
Education	−0.001 (0.8)	0.063 (1.3)	0.062
Experience group	0.000 (0.7)	0.001 (0.2)	0.001
Occupation	−0.001 (0.5)	0.004 (0.2)	0.003
Broad Industry	0.001 (1.4)	0.005 (0.3)	0.006
Urban/Rural	0.001 (1.2)	0.005 (0.7)	0.006
Region	0.000 (0.0)	−0.051 (3.3)	−0.051
Residual (intercepts)	–	−0.022 (0.4)	−0.022
Total	**−0.001 (0.4)**	**0.010 (1.7)**	**0.009 (1.5)**

Note: z-values in parentheses; approximation errors are ignored. *Using the Firpo *et al.* (2009) decomposition and VLSS/VHLSS data.

regression coefficients can be interpreted as the return (or more generally the wage effect) to different characteristics at different points of the conditional wage distribution. Following Koenker and Bassett (1978), the estimate of $\beta(\tau)$ is given by:

$$\hat{\beta}(\tau) = \arg\min_{b \in \mathcal{R}^K} \frac{1}{N} \sum_{n=1}^{N} (Y_i - X_i\mathbf{b})(\tau - 1(Y_i \leq X_i\mathbf{b}).$$

$\beta(\tau)$ is estimated separately for each τ, and the vector of all quantile regression coefficients is as follows: $\hat{\beta} = (\hat{\beta}(\tau_j))$. Given that this is a model for the conditional quantiles of Y, while the intention is to estimate the unconditional quantiles of Y, one needs to integrate the conditional distribution over the entire range of the distribution of X_s. Melly (2005) shows that one can overcome the potential lack of monotonicity to derive the sample analogue of the θ^{th} quantile as:

$$\hat{q}(\hat{\beta}_\theta, X) = \inf\left\{ q : \frac{1}{N} \sum\nolimits_{i=1}^{N} \sum\nolimits_{j=1}^{J} (\tau_j - \tau_{j-1}) I(X_i \hat{\beta}(\tau_j) \leq q) \geq \theta \right\}$$

where the θ^{th} quantile of the sample is estimated by weighing each observation by τ_j–$\tau_{j\text{-}1}$; under standard restrictions, $\hat{q}$ is a consistent and asymptotically normally distributed estimator. In practice, if the sample is large (as in our case), a smaller number of quantile regressions are estimated. Statistical inference can be conducted using bootstrapping.

Now consider distributions of two samples, 1 and 0; in our case one group in year 2008 and the other in year 1998. The aggregate decomposition is as follows:

$$\hat{q}\left(\hat{\beta}_{1\tau}^{-}, X_1\right) - \hat{q}\left(\hat{\beta}_{0\tau}, X_0\right) = \left[\hat{q}\left(\hat{\beta}_{1\tau}, X_1\right) - \hat{q}\left(\hat{\beta}_{m1,r0,\tau}, X_1\right)\right] + \left[\hat{q}\left(\hat{\beta}_{m1,r0,\tau}, X_1\right) - \hat{q}\left(\hat{\beta}_{0\tau}, X_1\right)\right] + \left[\hat{q}(\hat{\beta}_{0\tau}, X_0) - \hat{q}(\hat{\beta}_{0\tau}, X_0)\right]$$

where $\hat{\beta}_{m1,r0}$ is calculated as $\hat{\beta}_1(0.5) + \hat{\beta}_0(\tau) - \hat{\beta}_0(0.5)$, and $\hat{q}(\hat{\beta}_{m1,r0}, X_0)$ is the quantile estimate of the distribution that would have prevailed if the median return to characteristics had been the same as in sample 1 but residuals had been distributed as in sample 0. Therefore, the first component measures the residual effect, the second the wage structure effect and the last the composition effect.

Detailed decomposition

The Firpo *et al.* (2007, 2009) approach for decomposing the Gini coefficient is based on unconditional quantile regression, by first deriving the re-centred influence function (RIF) for (Y; v^{G}), where Y is the earnings variable and v^G is the distributional statistic of interest – the Gini.

The Gini coefficient is defined as:

$$V^G(F_Y) = 1 - 2\mu^{-1}R(F_Y)$$

where $R(F_Y) = \int_0^1 GL(p; F_Y)\mathrm{d}p$ with $p(y) = F_Y(y)$, and the generalized Lorenz ordinate of F_Y

$$\mathrm{GL}(p; F_Y) = \int_{-\infty}^{F-1(p)} z dF_Y(z).$$

The influence function of the Gini coefficient is as follows:

$$\mathrm{IF}(y; v^G) = 2\mu^{-1}R(F_Y) + 2\mu^{-2}R(F_Y) + [2\mu^{-1}[y[1 - p(y)] + \mathrm{GL(p(y); }F_Y)]].$$

Referring to the three components on the right-hand side of the above equations as A(F_Y), B(F_Y) and C(F_Y), respectively, the re-centred influence function (RIF) of the Gini is as follows:

$$\mathrm{RIF}(y; v^{\mathrm{G}}) = 1 + B(F_Y)y + C(y; F_Y).$$

The GL coordinates are computed using a series of discrete data points y_1, … y_n, with observations ordered so that $y_1 < y_2$, … $< y_n$. The RIF regressions are estimated by replacing the usual dependent variable, Y, by the estimated value of RIF (y;v^{G}). Once the cofficients $\gamma_t(v^{\mathrm{G}})$, $\gamma_C(v^{\mathrm{G}})$ are estimated, where t refers to time and C refers to the counterfactual, one can then estimate the two components of the decomposition: the wage structure effect (Δ_S, Δ_X). For a more detailed presentation, see Firpo *et al.* (2007).