OECD Economics Department Working Papers No. 690

The Determinants of Employment and Earnings in Indonesia: A Multinomial Selection Approach

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https://dx.doi.org/10.1787/224864812153

OECD

Unclassified **ECO/WKP(2009)31**

Organisation de Coopération et de Développement Économiques
Organisation for Economic Co-operation and Development

English - Or. English

ECONOMICS DEPARTMENT

ECO/WKP(2009)31
Unclassified

THE DETERMINANTS OF EMPLOYMENT AND EARNINGS IN INDONESIA: A MULTINOMIAL SELECTION APPROACH

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ABSTRACT/RESUME

The determinants of employment and earnings in Indonesia: A multinomial selection approach

This paper uses household survey (*Sakernas*) data from the 1996 and 2004 to estimate the determinants of earnings in Indonesia. The Indonesian labour market is segmented, with a majority of workers engaged in informal-sector occupations, and earnings data are available only for formal-sector workers (salaried employees). This posed problems for the estimation of earnings equations, because selection into different labour market statuses is likely to be non-random. In order to describe selection into different labour market statuses we use the most general version of the method proposed by Dubin and McFadden (1984), which Bourguignon, Fournier and Gurgand (2007) proved to be preferable to other available multinomial selection methods. We also deal with reverse causality between education attainment and earnings by estimating the selection equations using an instrumental variable technique. Our findings cast doubt on the use of a binomial selection rule and suggest that workers with higher levels of educational attainment are most likely to find a job in the formal sector, and that the informal sector is perceived by those workers who cannot obtain a job in the formal sector as an alternative to inactivity. This Working Paper relates to the 2008 *OECD Economic Assessment of Indonesia* (www.oecd.org/eco/surveys/indonesia).

JEL codes: J21; J23; J31
Keywords: Indonesia; employment; earnings; multinomial selection

Les facteurs déterminants de l’emploi et des revenus en Indonésie : Une approche de sélection multinomiale

Ce document estime les revenus en Indonésie sur la base des donnés des enquêtes auprès des ménages (*Sakernas*) de 1996 et 2004. Le marché du travail indonésien est segmenté, avec une majorité des travailleurs occupée dans le secteur informel, et les données sur les revenus sont disponibles que pour les salariés du secteur formel. Ceci présente des problèmes pour estimer les équations sur les revenus, car la catégorisation en fonction du statut sur le marché du travail doit être non-aléatoire. Pour décrire cette catégorisation, nous utilisons une version plus générale de la méthode proposée par Dubin et McFadden (1984), que Bourguignon, Fournier et Gurgand (2007) ont montré comme préférable à toutes autres méthodes de sélection multinomiale. Nos conclusions mettent en doute l’emploi d’une règle de sélection binomiale, et impliquent que les travailleurs ayant les plus hauts niveaux d’éducation sont les plus susceptibles de trouver un travail dans le secteur formel et que le secteur informel est perçu comme une alternative à l’inactivité par les travailleurs qui n’ont pas eu de travail dans le secteur formel. Ce Document de travail se rapporte à l’*Évaluation économique de l’OCDE de l’Indonésie,* 2008 (www.oecd.org/eco/etudes/indonesie).

Classification JEL : J21 ; J23 ; J31
Mots-clés : Indonésie ; emploi ; revenue ; sélection multinomiale

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The determinants of employment and earnings in Indonesia: A multinomial selection approach

Margherita Comola and Luiz de Mello[1]

1. Introduction

This paper uses data from the 1996 and 2004 Indonesian labour market survey (*Sakernas*) to estimate the determinants of employment and earnings in the Indonesian labour market. Our aim is to explore how individual characteristics, such us age, place of residence and educational attainment, affect a worker's labour-market status and earnings in a standard Mincerian setting. To do so, we need to deal with the fact that earnings data are available only for salaried workers, but not for the self-employed, employers and household workers, who account for the bulk of employment in Indonesia. It is well known that a truncated earnings distribution poses a problem for the estimation of employment and wage equations. But, while conventional techniques, such as the Heckman selection procedure, can be used to deal with this issue, we argue that a binomial selection rule would be too simple to cover all relevant labour-market statuses in a segmented labour market, such as Indonesia's.

In order to obtain unbiased parameters in the wage equation, we generalise Heckman's binomial selection procedure using the multinomial framework proposed by Dubin and McFadden (1984) by including the informal sector as an alternative labour-market status. In doing so, we follow Hill (1983) in recognizing that the underlying selection rule that best describes the labour market is thricotomous: individuals may be inactive (*i.e.* they may be unemployed or drop out of the labour force), they may work in the formal sector (*i.e.* as salaried workers) or they may also work in the informal sector (*i.e.* as self-employed or household workers). We also deal with potential endogeneity in the relationship between earnings and educational attainment. To address this issue, we follow Duflo (2001) and use information on the number of schools built during implementation of *Sekolah Dasar INPRES* between 1973-74 and 1978-79, a government-sponsored programme on school infrastructure building as an instrument for educational attainment in the earnings equations.

Another consideration is that educational attainment is likely to be endogenous in the earnings equations. To deal with this problem, which is well documented in the empirical literature on developing countries (*e.g*. Strauss and Thomas, 1995), we follow Duflo (2001) and use information on the number of schools built in the different district during implementation of a large school construction programme

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1. Margherita Comola is in the Paris School of Economics and Luiz de Mello is in the OECD Economics Department. The authors are indebted to Mohamed Chatib Basri, Kyungsoo Choi, Andrew Dean, Stephen Grenville, Peter Jarrett, Hal Hill, Mohamad Ikhsan, Diego Moccero, Arianto Patunru, Thee Kian Wie, and the participants of the EDRC Policy Seminar on Indonesia, held on 9 June 2008, for helpful comments and discussions. Special thanks go to Anne Legendre for research assistance and to Mee-Lan Frank for excellent technical preparation.

(*Sekolah Dasar INPRES*) between 1973-74 and 1978-79. We use information on the number of new schools built in the district of birth of individuals of different cohorts to build our instruments for educational attainment. Duflo (2001) shows that the cohort of individuals borne in districts that benefited from the programme was more likely to stay longer at school and to earn more once joining the labour force.

We show that the multinomial selection rule produces estimates of the earnings determinants that are different from those obtained on the basis of an OLS estimation that ignores the selection bias and of the binomial Heckman procedure. The parameter estimates that differ particularly significantly across specifications are those most closely related to individual selection into different labour market statuses, such as place of residence (rural or urban), marital status and educational attainment. The findings are fairly robust to the use of school construction as an instrument for educational attainment. For instance, living in rural areas and being a married woman reduce a worker's earnings probability, as expected, only in the regression that account for multinomial selectivity. Also, the magnitudes of the estimated returns to higher levels of education (upper secondary and tertiary), as well as the average years of schooling of household members, are more realistic when multinomial selectivity is used to estimate the wage equation. The results therefore confirm the expectation that returns to education differ from those expected for a randomly chosen individual.

The evidence reported in this paper strongly supports the hypothesis of a selection bias in the wage equations: since rural individuals and married females are less likely to work in the formal sector, while highly educated individuals are more likely to do so, it is necessary to correct for the selection bias arising from the relative frequency of these groups in the sample in order to obtain consistent estimates on the basis of a survey that only reports earnings for salaried workers. We argue that in a dual labour market, such as Indonesia's, the difference between formal and informal workers' selection probabilities needs to be taken into account. The empirical analysis also shows that a binomial selection rule is too crude to describe the selection process facing Indonesian workers in comparison to a more complex, multinomial approach.

The paper is organised as follows. Section 2 is devoted to the literature review, Section 3 overviews labour-market participation, employment, unemployment and informality trends in Indonesia. Section 4 describes the data, the estimating methodology and the empirical findings. Conclusions are presented in Section 5.

2. Literature review

This paper follows the empirical literature on the estimation of Mincerian wage equation (Mincer, 1974). This setting allows for the empirical estimation of individual characteristics, such as age, educational attainment and marital status, among others, that affect earnings (Willis, 1987; Card, 1999; Heckman *et al.*, 2003). Several methodological extensions have been proposed to deal with the limitations of the conventional Mincerian model: for instance, Ichino and Winter-Ebmer (1999) show how the choice of instruments affects the estimated returns to education, and Björklund and Kjellström (2002) discuss how well the schooling coefficients of standard Mincer equations approximate the rate of return to education. Empirical evidence is now available for a host of developping and emerging-market countries, including Panama (Heckman and Hotz, 1986), Mexico (Brown, Pagan and Rodriguez-Oreggia, 1999), Colombia (Gaston and Tenjo, 1992) and Brazil (Dickerson, Green and Arbache, 2001).

An important extension to the empirical literature is the Heckman selection model, which deals with truncations in the wage distribution (Heckman, 1979). This is case, for example, of the data used in this paper, where information on earnings is available only for salaried workers. It is known that OLS estimates of the Mincerian equation are inconsistent if the earnings distribution is truncated. The literature has also proposed alternative methods for dealing with multinomial selectivity, as in the case where labour-market status cannot be described by just two alternatives. Different methods were proposed by Lee (1983) and Dubin and McFadden (1984), and a non-parametric alternative was developed by Dahl (2002). These multinomial selection models have been applied in different settings, ranging from the study of self-selection into technical training (Trost and Lee, 1984) to the estimation of demand for electricity (Dubin and McFadden, 1984). In their methodological survey, Bourguignon, Fournier and Gurgand (2007) perform Monte Carlo simulations to compare these different multinomial selection methods and conclude that the Dubin-McFadden approach is preferred in its most general version. Therefore, in what follows, we adopt the most general version of the Dubin-McFadden estimator as described by Bourguignon, Fournier and Gurgand (2007). In this framework, the original Dubin-McFadden restriction that all correlation coefficients sum up to zero is relaxed.

While the empirical literature on employment is relatively rich for Indonesia (Lim, 1997; Islam and Nazara, 2000; Suryadarma, Suryahadi and Sumarto, 2007; Islam and Chowdhury, 2007), evidence is considerably more limited on the determinants of earnings. Among the few contributions available to date, Pirmana (2006) uses four waves of *Sakernas* to estimate earning differentials among groups of workers. He concludes that socio-demographic factors, human capital and place of residence are powerful determinants of individual earnings, and that only 42% of the earnings differential between males and females is caused by differences in individual characteristics. Suryahadi, Sumarto and Maxwell (2001) use a panel of *Sakenas* data from 1988 to 2000 to gauge the impact of changes in the minimum wage on earnings and employment, and find that the elasticity of average wages with respect to the minimum wage is positive but statistically insignificant. Skoufias and Suryahadi (1999) use a synthetic cohort approach and show that the decline in real wages induced by the financial crisis of 1997-98 was evenly distributed across cohorts, while the impact of the crisis on wage inequality within cohorts was mixed. Deolalikar (1993) uses National Socio-Economic Survey (*Susenas*) data to estimate an earnings equation and the returns to schooling for different groups. His approach is comparable to ours in that he acknowledges the problem of selectivity. But he deals with it on the basis of a dichotomic selection rule (*i.e.* individuals may work as wage-earners or not), while we argue that a multinomial selection is more appropriate.

3. Labour market trends and informality in Indonesia

Table 1 reports labour force participation, employment, unemployment and informality rates for 1996 and 2004. Labour force participation has been fairly stable over time at about two thirds of individuals aged at least 15 years. It is higher in rural areas and for males. It also tends to rise with educational attainment. Employment patterns are comparable to those of labour supply: it is higher for males, in rural areas and among prime-age individuals.

Unemployment is particularly high for youths and for workers with upper secondary and tertiary education. It increased substantially during 1996-2004, albeit from a small base, for older workers and for the least educated individuals (*i.e.* those with no schooling). By contrast, although it remains high, unemployment fell among individuals with tertiary education, probably reflecting a rising demand for skilled labour to the detriment of less educated workers. To a certain extent, high unemployment among the workers who would otherwise be best equipped to find a job in the formal sector suggests that these individuals may be reticent to work in the informal sector. When faced with a job loss, they may prefer to wait for a formal job, instead of working informally, so long as they can support themselves and their families in the meantime.

Informality is widespread. For the purpose of the empirical analysis reported below, we consider two different definitions of informality. Definition A treats all self-employed (own-account workers, with or without assistance[2]) and unpaid workers as informal. A stricter concept (definition B) includes, in addition to those workers treated as informal by definition A, all individuals working in agriculture, regardless of whether or not they declare themselves as salaried workers.[3] According to definition A, informality accounted for about 65% of employment in 1996 and 70% in 2004. Instead, according to definition B, informality rises to 70% of employment in 1996 and 76% in 2004. In either case, informality is more widespread among women than men, workers living in rural than urban areas, and among elderly individuals. As expected, informality declines with educational attainment.

Of course, there is no universally accepted definition of labour informality. Conventional metrics are based on social security coverage, depending on the breadth of a country's social protection mechanisms, and on labour market and/or occupational status, according to which workers are considered informal if they are employed in low-productivity, precarious jobs.[4] In the case of Indonesia, a social security-based definition of informality would make little sense, because the country has only very limited formal retirement schemes and no unemployment insurance.[5] A definition based on labour market status is therefore more appropriate. This is in line with conventional definitions used by Indonesian scholars, which focus on self-employment, as is common practice for other developing countries (Jaffe and Azumi, 1960; Hill, 1983). For instance, Suryahadi *et al*. (2003) treats as informal all self-employed workers, except for those who are assisted by permanent or non-permanent employees (except in agriculture). Based on this definition, informality accounted for about 62% of employment in 1996, which is comparable to, albeit slightly lower than, the informality rate implied by definition A described above. A slightly more restrictive definition is that of the Indonesian Bureau of Statistics (BPS), according to which the self-employed without assistance and working in professional, leadership and managerial jobs are treated as formal-sector workers.

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2. Respondents who declare to be "employers" (in 1996 questionnaire) or "self-employed assisted by permanent paid workers" (in 2004 questionnaire) are relatively few (1.5% and 4.1% of total workers respectively). It can be argued that these groups do not necessarily belong to the informal sector. However, we are forced to consider them as informal, because *Sakernas* does not report earnings data for these workers.

3. Another consideration is that the (already high) estimates of informality may in fact be biased downwards. This is because individuals working independently in the informal sector may define themselves as employees; as a result, *Sakernas* data may underestimate the size of the informal labour market.

4. For example, the International Labour Organisation (2003) treats as informal the employees of small private non-agricultural unregistered unincorporated enterprises with less than five paid workers producing at least part of their output for sale or barter. See OECD (2004 and 2007), Maloney (2004) and Gasparini and Tornarolli (2007) for more information.

5. The main Indonesian social security programme (Jamsostek) was launched in 1992. Only formal workers employed in firms with more than 10 employees or payroll of more than one million rupiah are entitled to participation in Jamsostek (old-age pensions, life and health insurance, and job-related disability and illness compensation). The main shortcut of the programme is that compliance is very low: according to the Ministry of Manpower and Transmigration, only about one-fifth of the employed population was enrolled with Jamsostek in 2002. Also, the ILO estimates that only about one-half of employers required to enrol in the scheme are actually enrolled. See OECD (2008) for more information.

Table 1. **Trends in labour-force participation, unemployment and employment, 1996 and 2004**

(In per cent, individuals aged 15 years and above)

	1996					2004				
	Labour force participation	Employment	Unemploy-ment	Informal sector (A)[1] (in % of employment)	Informal sector (B)[2] (in % of employment)	Labour force participa-tion	Employment	Unemployment[3]	Informal sector (A)[1] (in % of employment)	Informal sector (B)[2] (in % of employment)
Total	**66.1**	**62.6**	**5.3**	**65.4**	**70.3**	**65**	**60.7**	**6.7**	**69.6**	**75.6**
By gender										
Males	82.7	78.9	4.6	61.1	66.2	83.5	78.6	5.8	67.7	73.9
Females	49.9	46.7	6.5	72.5	77.1	46.7	42.9	8.2	72.9	78.6
By age										
15-24	50.9	42.6	16.4	57.7	63	50	39	22.1	58.8	68.8
25-54	76.5	74.7	2.4	64.1	68.9	74.2	71.8	3.2	68.5	74.3
55-64	66.1	65.9	0.3	83.3	88.2	63.5	63.1	0.6	88.4	90.4
65+	40.3	40.2	0.2	89.8	93.8	39.7	39.6	0.2	95.5	96.6
By residence										
Rural	71.7	69.4	3.2	77.2	83.9	69.8	67.1	3.9	86.3	91.1
Urban	58.8	53.8	8.6	45.7	47.7	60.1	54.2	9.9	48.7	56.1
By education										
No schooling	67.6	67	0.9	82.4	90	63.5	62.8	1.2	92.2	95.5
Primary	67.5	65.7	2.7	74.2	79.9	66.6	64.9	2.6	84.4	89.8
Lower secondary	51.4	47.9	6.9	62.6	65.5	55.9	51.7	7.5	72.2	80.5
Upper secondary	71.2	61.4	13.8	34.2	35.7	68.9	58.7	14.8	41	48.9
Tertiary	86.3	76.3	11.6	12.4	13	85.3	77.3	9.4	15.9	19

1. The informal-sector is defined as including all self-employed, employers and unpaid workers.
2. The informal-sector is defined as including all self-employed, employers, unpaid workers, and agricultural workers regardless of their job status.

Source: *Sakernas* and authors' calculations.

4. Data, methodology and results

The data

We use two waves of data (1996 and 2004) from the Indonesian National Labour Force Survey (*Sakernas*), which started to be collected in 1976 and is currently carried out by BPS on an annual basis. The 1996 and 2004 waves surveyed 73 629 and 75 371 households (247 199 and 237 290 individuals), respectively.

Data on earnings and employment are reported in *Sakernas* as follows. Each family member belonging to the working-age population (those aged 10 years and above until 1997, and 15 years and above since 1998) is classified as employed or unemployed depending on his/her activities during the previous week. Employed individuals are classified as employees (salaried workers), self-employed or unpaid workers. While *Sakernas* data are overall considered to be good, earnings data are collected for employees only, thus excluding a large number of workers, and those in the informal sector among them.

The methodology

Because earnings data are available only for wage-earners, estimation of a Mincerian equation by ordinary least squares (OLS) would produce biased estimators if, as expected, selection into different job-market statuses were correlated with potential determinants of earnings. In his influential paper, Heckman proposes a two-step procedure to obtain consistent estimators in the presence of sample selection: in the first step, the non-selection hazard ratio (*i.e.* the ratio of the probability density function over the cumulative density function of a distribution, the so-called inverse Mills ratio) is estimated to be included as an additional regressor in the wage equation in the second step. This new variable captures the variation of employment probability among individuals and corrects for the selection bias that occurs when estimating the coefficients of the Mincerian equation using data for working individuals only.

The multinomial model, where individuals can chose among *M* alternatives, can be defined as:

$$y_s = x_s\beta_s + e_s \text{ and } y_s^* = z_s\gamma_s + v_s, \tag{1}$$

where $s = 1,...,M$, $E(e_s \mid x,z) = 0$ and $E(v_s \mid x,z) = \sigma_s^2$.

The outcome variable y_s^* is selected if and only if $y_s^* > \max_{j \neq s} y_j^*$, so that category *s* is chosen. The procedure consists of estimating β_s and γ_s, while taking into account the correlations that may exist between e_s and v_s, which make OLS estimations inconsistent. Vector γ_s can be estimated by maximum likelihood, so long as the v_s disturbances are independently distributed. This is because the selection rule for category *s* ($y_s^* > \max_{j \neq s} y_j^*$) implies that $z_s\gamma_s > \varepsilon_s = \max_{j \neq s}(y_j^* - v_s)$, so that the cumulative and density functions of v_s can be specified as a multinomial logit model with $P(z_s\gamma_s > \varepsilon_s) = \dfrac{\exp(z_s\gamma_s)}{\sum_j \exp(z_j\gamma_j)}$.

There are nevertheless different methods for estimating β_s. Assuming $\Gamma = (z\gamma_1,..., z\gamma_M)$, $P_k = \frac{\exp(z\gamma_k)}{\sum_j \exp(z\gamma_j)}$ and $E(e_s \mid \varepsilon_s < 0, \Gamma) = \mu(P_1,..., P_M)$, all available methods (Lee, 1983; Dubin and McFadden, 1984; Dahl, 2002) estimate β_s consistently including a selectivity correction term of the form:

$$y_s = x_s \beta_s + \mu(P_1,..., P_M) + \omega_s, \quad (2)$$

where ω_s is mean-independent of the regressors. The functional form of the correction term differs according to the method used: in this paper, we follow the approach of Dubin and McFadden (1984) in its most general version, which relaxes the restriction that all correlation coefficients add up to zero, as discussed in Bourguignon, Fournier and Gurgand (2007).

We assume that workers select themselves into three labour market statuses: inactivity (unemployment or non-participation), employment in the informal sector and employment in the formal sector. These three categories are thus the outcomes of our multinomial selection equation. The set of exogenous explanatory variables is standard. It includes age, age squared, dummies to identify individuals living in rural areas, gender (male or female) and marital status (married or single). We also include an interaction term between the dummies *female*married*. Additional dummies are included for each level of educational attainment (primary, lower secondary, upper secondary and tertiary; the omitted category is "no education"), as well as the average years of schooling of the adult members of the reference individual's household (excluding the reference individual). Finally, provincial dummies (the omitted province is Aceh) and sectoral dummies (the omitted sector is agriculture) are included in the regressions.

The determinants of earnings

The results of the estimation of a Mincerian wage equation are reported in Tables 2 and 3. The sample includes all individuals aged 15-65 years who have worked at least one hour as salaried workers over the previous week. The dependent variable is the logarithm of hourly wages.[6] Outliers at the upper or lower 0.1% tail of the distribution are excluded (90 and 75 observations for 1996 and 2004, respectively). While information on all individuals (formal, informal and inactive) is used in the selection equation (reported below), the wage equation uses data on formal-sector workers only. For each year, the results of three different specifications of the wage equation are reported: OLS, ignoring the selection bias (column 1); the standard binomial correction procedure proposed by Heckman (1979), where individuals are assumed to work in the formal sector or not (*i.e.* non-activity and informality fall in the same category); and the multinomial selection process described above with three choices: formality, informality and inactivity (column 3). The results reported in Table 2 are based on the less restrictive definition of informality (definition A), whereas the estimation results based on the more restrictive definition (definition B) are reported in Table 3.

The estimation results reported in Table 2 show that a few parameter estimates change across specifications. For instance, the rural dummy is positive in the first two specifications (OLS and binomial selection), while it is negative and highly significant in column (3), where we take into account the fact that salaried work is infrequent in rural areas. Likewise, the interaction variable *female*married* is

6. Respondents are asked the number of hours worked during the previous week and their average monthly wage as employees. For those employees who are temporarily out of work at the time the survey is conducted, the number of hours worked in the previous week is computed as the mean of the sample distribution.

negatively signed, as intuition would suggest, only when the wage equation incorporates the multinomial selection rule: given a lack of affordable child care, married women with children rarely work in the formal sector. Also the educational attainment dummies show interesting discrepancies across the three specifications: the estimated returns to higher levels of education (upper secondary and tertiary), as well as the average years of schooling in the reference individual's household, which proxies for family background, are higher in magnitude when the wage equation is estimated with the multinomial selection rule. Likewise, the estimated multinomial selection-corrected returns are lower for lower levels of education. This is consistent with the fact that, on average, the educational attainment of formal-sector workers is higher than that of the other two categories.

The other coefficients are comparable in sign and magnitude across specifications. For instance, wages rise with educational attainment and age (albeit for age in a non-linear manner), women are paid less than men, and being married is associated with a wage premium in the labour market. Moreover, all else equal, workers in agriculture (the reference sector), sales/trade and education/health are paid less than in mining, natural resources and professional services. Finally, there are important regional effects on earnings.

Comparison of the regression results for 1996 and 2004 is instructive. The negative wage premium associated with being a woman and the positive wage premium associated with being married seem to have weakened. As regards sectoral effects, workers in sales/trade and education/health had a positive wage premium over agriculture in 1996, while in 2004 this premium became negative. Some of the provincial effects also changed, possibly reflecting changes in the geographical distribution of economic activity and growth. Finally, the lower estimated returns for lower levels of education and the corresponding higher estimates for higher levels of education in the case of the multinomial correction procedure relative to OLS and binomial correction applies to both years.

Finally, the inverse of Mills ratio reported in the multinomial correction specifications (column 3) in Tables 2 and 3 suggest that the selection variables are significant. The positive value of the selection term for formal-sector workers in 2004 indicates that those individuals with higher employment probabilities are also those earning higher wages. Therefore, the distribution of observed wages is biased upwards compared with the situation in which workers select themselves into the labor market randomly. In the case of the binomial selection correction procedure, the formal-sector selection variable is not significant in 2004, which invalidates the binomial specification as an accurate description of the selection rule.

The results reported in Tables 4 and 5 are based on the instrumentation of the educational attainment dummies. Following Duflo (2001), we constructed a district-level "programme intensity" indicator as the number of schools per district that were built in the period 1973-74 to 1978-79 divided by the number of children aged 5-14 years living in the district in 1971 (in thousands). We then instrumented the dummies for the levels of education by the programme intensity indicator in the district of birth of each individual in the sample multiplied by a set of year-of-birth dummies identifying the different cohorts.[7] Since we restricted our sample to individuals aged 15-65, we obtained a set of fifty instruments for the four educational attainment variables. Based on this instrumentation strategy, we re-ran the OLS results reported above using 2SLS. In the case of the binomial and multinomial selection models, we re-ran the second-stage regressions by 2SLS, instead of OLS.

The regression results obtained on the basis of the instrumentation strategy described above confirm the previous finding of a rising premium on educational attainment in both 1996 and 2004, at least beyond

7. Although it is not obvious to assume that the district of residence is also the district where pupils attend primary school, Duflo (2001) reports that 91.5% children surveyed in the Indonesian Family Life Survey were still living in the district of birth at age 12.

the primary education level, regardless of the estimator used and the definition of informality. Nevertheless, the estimated returns to education are more linear than those estimated without correction for reverse causality: returns are higher for all levels of education and proportionally more so for lower levels.

Table 2. **Wage equations, 1996 and 2004 (definition A of informality)**

(Dep. Var.: Logarithm of hourly wage)

	1996			2004		
	(1)	(2)	(3)	(1)	(2)	(3)
Rural	0.0252***	0.0364***	-0.0866***	0.0325***	0.0372***	-0.1860***
	(0.0001)	(0.0000)	(0.0000)	(0.0000)	(0.0002)	(0.0000)
Age	0.0368***	0.0345***	0.0438***	0.0372***	0.0367***	0.0312***
	(0.0000)	(0.0000)	(0.0000)	(0.0000)	(0.0000)	(0.0000)
Age squared	-0.0003***	-0.0003***	-0.0005***	-0.0003***	-0.0003***	-0.0003***
	(0.0000)	(0.0000)	(0.0000)	(0.0000)	(0.0000)	(0.0000)
Female	-0.2750***	-0.2699***	-0.2738***	-0.1774***	-0.1773***	-0.0663***
	(0.0000)	(0.0000)	(0.0000)	(0.0000)	(0.0000)	(0.0000)
Married	0.1332***	0.1269***	0.2354***	0.0787***	0.0782***	0.0689***
	(0.0000)	(0.0000)	(0.0000)	(0.0000)	(0.0000)	(0.0000)
Female*married	0.0738***	0.1053***	-0.1511***	0.0568***	0.0661***	-0.1115***
	(0.0000)	(0.0000)	(0.0000)	(0.0000)	(0.0001)	(0.0000)
Primary education	0.1401***	0.1393***	0.1071***	0.1187***	0.1174***	0.0926***
	(0.0000)	(0.0000)	(0.0000)	(0.0000)	(0.0000)	(0.0000)
Lower sec. education	0.3206***	0.3153***	0.3173***	0.3112***	0.3083***	0.3205***
	(0.0000)	(0.0000)	(0.0000)	(0.0000)	(0.0000)	(0.0000)
Upper sec. education	0.6473***	0.6258***	0.7982***	0.6139***	0.6062***	0.8164***
	(0.0000)	(0.0000)	(0.0000)	(0.0000)	(0.0000)	(0.0000)
Tertiary education	1.0579***	1.0197***	1.4210***	1.1308***	1.1175***	1.5727***
	(0.0000)	(0.0000)	(0.0000)	(0.0000)	(0.0000)	(0.0000)
Household schooling	0.0086***	0.0083***	0.0159***	0.0129***	0.0127***	0.0328***
	(0.0000)	(0.0000)	(0.0000)	(0.0000)	(0.0000)	(0.0000)
Selection variables						
Formal-sector workers		-0.0522**	-0.0134		-0.0137	0.1009***
		(0.0142)	(0.2872)		(0.4612)	(0.0000)
Informal-sector workers			-0.9776***			-1.0540***
			(0.0000)			(0.0000)
Inactive workers			-0.6230***			-0.1648***
			(0.0000)			(0.0003)
Constant	5.4789***	5.5874***	4.4687***	6.6315***	6.6595***	5.7486***
	(0.0000)	(0.0000)	(0.0000)	(0.0000)	(0.0000)	(0.0000)
No. of observations	45153	45153	45153	38432	38432	38432

Note: Robust *p* values are reported in parentheses. The regressions include provincial and occupational dummies. Statistical significance at the 1, 5 and 10% levels is denoted by (***), (**) and (*), respectively.

Source: *Sakernas* and authors' estimations.

Table 3. **Wage equations, 1996 and 2004 (definition B of informality)**

(Dep. Var.: Logarithm of hourly wage)

	1996			2004		
	(1)	(2)	(3)	(1)	(2)	(3)
Rural	0.0394***	0.0501***	-0.1071***	0.0252***	0.0164	-0.2223***
	(0.0000)	(0.0000)	(0.0000)	(0.0023)	(0.1490)	(0.0000)
Age	0.0413***	0.0399***	0.0481***	0.0393***	0.0400***	0.0324***
	(0.0000)	(0.0000)	(0.0000)	(0.0000)	(0.0000)	(0.0000)
Age squared	-0.0003***	-0.0003***	-0.0005***	-0.0003***	-0.0003***	-0.0003***
	(0.0000)	(0.0000)	(0.0000)	(0.0000)	(0.0000)	(0.0000)
Female	-0.2604***	-0.2581***	-0.2485***	-0.1649***	-0.1642***	-0.0375***
	(0.0000)	(0.0000)	(0.0000)	(0.0000)	(0.0000)	(0.0055)
Married	0.1299***	0.1250***	0.2299***	0.0762***	0.0769***	0.0577***
	(0.0000)	(0.0000)	(0.0000)	(0.0000)	(0.0000)	(0.0000)
Female*married	0.1028***	0.1249***	-0.1341***	0.0557***	0.0411**	-0.1001***
	(0.0000)	(0.0000)	(0.0000)	(0.0000)	(0.0206)	(0.0001)
Primary education	0.1602***	0.1570***	0.1341***	0.1200***	0.1228***	0.1155***
	(0.0000)	(0.0000)	(0.0000)	(0.0000)	(0.0000)	(0.0000)
Lower sec. education	0.3442***	0.3370***	0.3532***	0.3231***	0.3288***	0.3644***
	(0.0000)	(0.0000)	(0.0000)	(0.0000)	(0.0000)	(0.0000)
Upper sec. education	0.6745***	0.6577***	0.8271***	0.6318***	0.6452***	0.8593***
	(0.0000)	(0.0000)	(0.0000)	(0.0000)	(0.0000)	(0.0000)
Tertiary education	1.0764***	1.0503***	1.4151***	1.1439***	1.1657***	1.5802***
	(0.0000)	(0.0000)	(0.0000)	(0.0000)	(0.0000)	(0.0000)
Household schooling	0.0086***	0.0078***	0.0222***	0.0118***	0.0123***	0.0334***
	(0.0000)	(0.0000)	(0.0000)	(0.0000)	(0.0000)	(0.0000)
Selection variables						
Formal-sector workers		-0.0332	0.0122		0.0209	0.1158***
		(0.1142)	(0.3285)		(0.2618)	(0.0000)
Informal-sector workers			-0.908***	-0.9165***		-0.852***
			(0.0000)			(0.0000)
Inactive workers			-0.5329***			-0.0693
			(0.0000)			(0.1170)
Constant	5.5882***	5.6646***	4.5490***	6.9368***	6.8906***	6.0533***
	(0.0000)	(0.0000)	(0.0000)	(0.0000)	(0.0000)	(0.0000)
No. of observations	38816	38816	38816	35813	35813	35813

Note: Robust p values are reported in parentheses. The regressions include provincial and occupational dummies. Statistical significance at the 1, 5 and 10% levels is denoted by (***), (**) and (*), respectively.

Source: *Sakernas* and authors' estimations.

Table 4. **Wage equations, 1996 and 2004 (definition A of informality): IV estimations**

(Dep. Var.: Logarithm of hourly wage)

	1996			2004		
	(1)	(2)	(3)	(1)	(2)	(3)
Rural	-0.0228*	0.0166	0.0464	0.0373**	0.2436***	-1.0677***
	(0.0975)	(0.8556)	(0.8334)	(0.0117)	(0.0021)	(0.0000)
Age	0.0584***	0.0391**	0.1031***	0.0539***	0.0225***	0.0355***
	(0.0000)	(0.0173)	(0.0000)	(0.0000)	(0.0011)	(0.0000)
Age squared	-0.0005***	-0.0002	-0.0011***	-0.0004***	0.0001	-0.0007***
	(0.0000)	(0.3523)	(0.0000)	(0.0000)	(0.6014)	(0.0000)
Female	-0.2581***	-0.1832***	-0.3733***	-0.1812***	-0.1697***	0.3060***
	(0.0000)	(0.0000)	(0.0000)	(0.0000)	(0.0000)	(0.0045)
Married	0.0600***	0.0582	0.5688***	-0.0008	0.0185	0.1219***
	(0.0001)	(0.3516)	(0.0000)	(0.9657)	(0.3245)	(0.0000)
Female*married	0.1344***	0.2798	-0.6561***	0.1329***	0.5500***	-1.0739***
	(0.0000)	(0.2716)	(0.0097)	(0.0000)	(0.0004)	(0.0000)
Primary education	1.1509***	1.5140***	1.2077***	1.5568***	1.5553***	1.1542***
	(0.0000)	(0.0000)	(0.0000)	(0.0000)	(0.0000)	(0.0016)
Lower sec. education	0.9889***	1.3262***	1.2142***	1.4807***	1.2926***	1.6349***
	(0.0000)	(0.0001)	(0.0000)	(0.0000)	(0.0000)	(0.0000)
Upper sec. education	1.0500***	1.5345***	1.6100***	1.7014***	1.3895***	2.9321***
	(0.0003)	(0.0016)	(0.0000)	(0.0000)	(0.0003)	(0.0000)
Tertiary education	1.2850**	2.4544***	2.9159***	1.5408***	1.4338***	5.0324***
	(0.0117)	(0.0009)	(0.0000)	(0.0002)	(0.0048)	(0.0000)
Household schooling	0.0067	-0.0614**	-0.0713***	0.0408**	-0.0037	0.0378*
	(0.7958)	(0.0141)	(0.0002)	(0.0438)	(0.7750)	(0.0839)
Selection variables						
Formal-sector workers		-0.2757	-0.1355		-0.6792***	0.6335***
		(0.5004)	(0.1830)		(0.0019)	(0.0000)
Informal-sector workers			-0.6114			-4.6859***
			(0.6467)			(0.0000)
Inactive workers			-2.0158***			-1.0980***
			(0.0000)			(0.0000)
Constant	4.5945***	5.2889***	2.9018**	5.0907***	6.8258***	1.2436
	(0.0000)	(0.0000)	(0.0208)	(0.0000)	(0.0000)	(0.1714)
No. of observations	44302	44302	44302	36813	36813	36813

Note: Robust *p* values are reported in parentheses. The regressions include provincial and sectoral dummies. Education attainment is instrumented using the product of programme intensity in the individuals' district of birth and cohort dummies for individuals aged 15-65 years. Statistical significance at the 1, 5 and 10% levels is denoted by (***), (**) and (*), respectively.

Source: *Sakernas* and authors' estimations.

Table 5. **Wage equations, 1996 and 2004 (definition B of informality): IV estimations**

(Dep. Var.: Logarithm of hourly wage)

	1996			2004		
	(1)	(2)	(3)	(1)	(2)	(3)
Rural	0.009	0.0596	0.2404	0.0395***	0.2981***	-1.3377***
	(0.5508)	(0.6912)	(0.4011)	(0.0090)	(0.0017)	(0.0000)
Age	0.0704***	0.0502***	0.0939***	0.0561***	0.0273***	0.0408***
	(0.0000)	(0.0029)	(0.0000)	(0.0000)	(0.0000)	(0.0000)
Age squared	-0.0006***	-0.0003	-0.0009***	-0.0005***	0	-0.0008***
	(0.0000)	(0.1792)	(0.0000)	(0.0000)	(0.9916)	(0.0000)
Female	-0.2563***	-0.1840***	-0.3130***	-0.1740***	-0.1931***	0.4393***
	(0.0000)	(0.0000)	(0.0000)	(0.0000)	(0.0000)	(0.0004)
Married	0.0439**	0.0492	0.2887***	-0.001	0.0081	0.1257***
	(0.0166)	(0.5479)	(0.0047)	(0.9566)	(0.6673)	(0.0000)
Female*married	0.1764***	0.3081	-0.1357	0.1283***	0.5625***	-1.2478***
	(0.0000)	(0.3187)	(0.6644)	(0.0000)	(0.0003)	(0.0000)
Primary education	1.3773***	1.7786***	1.7415***	1.3944***	1.3948***	1.3623***
	(0.0000)	(0.0000)	(0.0000)	(0.0000)	(0.0000)	(0.0002)
Lower sec. education	1.3461***	1.7550***	1.9665***	1.4282***	1.2138***	1.9658***
	(0.0000)	(0.0000)	(0.0000)	(0.0000)	(0.0001)	(0.0000)
Upper sec. education	1.1717***	1.7439***	1.9635***	1.6071***	1.2312***	3.2698***
	(0.0002)	(0.0024)	(0.0000)	(0.0000)	(0.0018)	(0.0000)
Tertiary education	1.1896**	2.5234***	2.6405***	1.5004***	1.2447**	5.4922***
	(0.0270)	(0.0023)	(0.0009)	(0.0002)	(0.0147)	(0.0000)
Household schooling	0.0267	-0.0545***	-0.1003***	0.0451**	0.0057	0.0544***
	(0.3247)	(0.0062)	(0.0000)	(0.0157)	(0.5931)	(0.0071)
Selection variables						
Formal-sector workers		-0.2351	-0.0039		-0.6636***	0.6922***
		(0.6019)	(0.9734)		(0.0017)	(0.0000)
Informal-sector workers			1.1968			-4.8794***
			(0.3768)			(0.0000)
Inactive workers			-0.483			-1.1611***
			(0.3635)			(0.0001)
Constant	4.3211***	5.0303***	4.6174***	5.3625***	7.1014***	0.4778
	(0.0000)	(0.0000)	(0.0017)	(0.0000)	(0.0000)	(0.6493)
No. of observations	38000	38000	38000	34281	34281	34281

Note: Robust *p* values are reported in parentheses. The regressions include provincial and sectoral dummies. Education attainment is instrumented using the product of programme intensity in the individuals' district of birth and cohort dummies for individuals aged 15-65 years. Statistical significance at the 1, 5 and 10% levels is denoted by (***), (**) and (*), respectively.

Source: *Sakernas* and authors' estimations.

Selection into the labour market

The results of the multinomial selection equation used in the estimation of the regression reported in column 3 of Table 2 are reported in Table 6. The corresponding estimates for definition B of informality are omitted to economise on space (but are available upon request). The sample includes all individuals aged 15-65. The results reported are for formal-sector and inactive workers, while the outcome "working in the informal sector" is the reference category. To fulfil the exclusion restrictions, three variables that were not included in the selection-corrected wage equation are now included in the regressions: the dependency ratio (computed as the number of household members who are younger than 15 or older than 65 divided by the number of household members aged 15-65), the interaction term *female*dependency ratio*, and a dummy variable taking the value of "1" if the reference individual is attending school, and "0" otherwise. Also, the sectoral dummies are excluded from the selection equation because information is not available for one of the selection category (inactive individuals).

The estimation results suggest that rural individuals are more likely to work in the informal sector than to be inactive than to work in the formal sector. This is consistent with the high rate of employment and informality in rural areas. The effect of age is, as usual, non-linear: older workers are more experienced and thus more likely to obtain a job in the formal sector, but the effect is counterbalanced by the quadratic term, which is negatively signed. Married individuals are more likely to work in the formal sector and less likely to be inactive than single individuals. The effect of being a female on the probability of working in the formal sector is negative in the 1996 equation but positive for 2004. However, in both years the interaction term *female*married* is negatively signed: all else equal, married women are less likely to work in the formal sector and more likely to be inactive than married men. Individuals who are still attending school are less likely to work in the formal sector and more likely to be inactive. Educational attainment seems to be a powerful predictor of job market outcomes: the probability of working as an employee strongly rises with educational attainment. The average years of schooling of the reference individual's household raises his/her probability of both working in the formal sector and being inactive. This seems to suggest that members of highly-educated households tend not to accept low-quality jobs in the informal sector. A high dependency ratio seems to discourage workers from remaining inactive. As for the interaction with the gender dummy, as expected, females living in a household with a high dependency ratio are less likely to have a formal-sector job and more likely to be inactive than those living in a low dependency household. As in the wage equations, regional effects are strong and changed in some cases during 1996 and 2004.

Table 6. **Multinomial selection employment equations, 1996 and 2004**

	1996				2004			
	Working as an employee		Inactive		Working as an employee		Inactive	
Rural	-0.0423	***	-0.1642	***	-0.0575	***	-0.1316	***
	(0.002)		(0.003)		(0.002)		(0.004)	
Age	0.0170	***	-0.0586	***	0.0147	***	-0.0607	***
	(0.000)		(0.001)		(0.000)		(0.001)	
Age squared	-0.0003	***	0.0007	***	-0.0002	***	0.0008	***
	(0.000)		(0.000)		(0.000)		(0.000)	
Female	-0.0147	***	0.1244	***	0.0213	***	0.1555	***
	(0.003)		(0.005)		(0.002)		(0.005)	
Married	0.0932	***	-0.3741	***	0.0843	***	-0.3715	***
	(0.003)		(0.005)		(0.002)		(0.005)	
Female*married	-0.1838	***	0.5274	***	-0.1746	***	0.5293	***
	(0.003)		(0.005)		(0.003)		(0.005)	
Attending school	-0.2106	***	0.5065	***	-0.1542	***	0.5349	***
	(0.002)		(0.003)		(0.002)		(0.003)	
Primary education	0.0011		-0.0598	***	0.0183	***	-0.0730	***
	(0.002)		(0.004)		(0.003)		(0.005)	
Lower sec. education	0.0215	***	-0.0357	***	0.0331	***	-0.0496	***
	(0.004)		(0.006)		(0.004)		(0.006)	
Upper sec. education	0.1276	***	-0.0248	***	0.1148	***	-0.0200	***
	(0.005)		(0.007)		(0.006)		(0.008)	
Tertiary education	0.3650	***	-0.1360	***	0.3789	***	-0.1856	***
	(0.011)		(0.011)		(0.012)		(0.011)	
Household schooling	0.0014	***	0.0178	***	0.0052	***	0.0145	***
	(0.000)		(0.001)		(0.000)		(0.001)	
Dependency ratio	0.0072	***	-0.0333	***	0.0026		-0.0464	***
	(0.002)		(0.004)		(0.003)		(0.007)	
Female* dependency ratio	-0.0248	***	0.0591	***	-0.0495	***	0.0522	***
	(0.003)		(0.005)		(0.005)		(0.009)	
No. of observations	244857		244857		234652		234652	

Note: The models are estimated by multinomial logit, and the marginal effects are reported. Statistical significance at the 1%, 5% and 10% levels is denoted by (***), (**) and (*), respectively. The regressions include provincial and sectoral dummies. Heteroscedasticity-corrected standard errors are reported in parentheses.

Source: *Sakernas* and authors' estimations.

5. Conclusions

This paper uses household survey (*Sakernas*) data from the 1996 and 2004 to estimate the determinants of earnings in Indonesia. The Indonesian labour market is segmented, with a majority of workers engaged in informal-sector occupations, and earnings data are available only for formal-sector workers (salaried employees). This posed problems for the estimation of earnings equations, because selection into different labour market statuses is likely to be non-random. At the same time, correcting for this selectivity bias using a binomial selection rule would not accurately account for the different labour-market outcomes, which includes not only formality and informality, but also the possibility that workers may be inactive (they may be unemployed or drop out of the labour force). Finally, the endogeneity of educational attainment in earnings equations is likely to bias parameter estimates.

In order to deal with these issues, we apply the most general version of the method for multinomial selection proposed by Dubin and McFadden (1984) as defined by Bourguignon, Fournier and Gurgand (2007) to include the informal sector as a separate participation choice. That is, there are three mutually exclusive alternatives in our selection rule: individuals may work in the formal or the informal sectors, and they may remain inactive. Wages are observed only in the first case. We estimate a wage equation accordingly and show that the several key parameter estimates differ from an OLS estimation that ignores the selection bias and the standard binomial selection procedure proposed by Heckman (1979). Overall, our findings cast doubt on the binomial selection specification and suggest that workers with higher levels of educational attainment are most likely to find a job in the formal sector, and that the informal sector is perceived by those workers who cannot obtain a job in the formal sector as an alternative to inactivity.

We dealt with the likely endogeneity of educational attainment by using as instruments the product of cohort dummies identifying individuals aged 15-65 years and the number of new schools built in an individual's district of birth under *Sekolah Dasar INPRES*, a large school infrastructure development programme implemented by the Indonesian government between 1973-74 and 1978-79. Duflo (2001) shows that individuals who benefited from the programme were more likely to stay longer at school and to earn more than those who did not. The regressions estimated on the basis of this instrumentation strategy yield estimates of returns to education that are more linear than those obtained without correction for reverse causality, especially for the multinomial selection models.

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