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The Economics of Teacher Supply in Indonesia

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Abstract

This paper examines the phenomenon of the over-supply of teachers but shortage of qualified teachers in Indonesia. Using a theoretical framework of government-dominated market with government-set wage rate and demand for teachers, the analysis explores how teacher supply, particularly the composition of the teaching force with low or high qualification, would be determined by current and future public policies. Using 2001 to 2008 Indonesian Labor Force Survey data, the paper further estimates the potential effect of the most recent teacher law, which could give college educated teachers a significant pay increase, on the composition of the Indonesian teaching force with differentiated education backgrounds. Using a sample of workers *with college education,* the author finds that the relative wage rate of teachers and that of alternative occupations significantly influence the decision of college educated workers to become teachers. It is also found that the wage rate set by the most recent teacher law would increase the share of teachers approximately from 16 to 30 percent of the college-educated labor force. This increase that is due to the new government-set wage rate, would result in a pupil-teacher ratio of 24 to 25 pupils per teacher with college education, but will require a more than 31 percent increase in the wage bill for teacher salaries. The empirical approach of this paper is derived from a structural model that takes into account the endogeneity of the wage rate and corrects for sample-selection bias due to occupational choice.

The Economics of Teacher Supply in Indonesia[1]

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I. Introduction and literature review

Teachers are not only a major determinant of student learning, but also absorb a large amount of public resources. The supply of teachers has attracted much attention in academic research as well as in public policy debate. Dolton (2006) gave a comprehensive review of the existing empirical work on teacher supply issues, including entering teaching as the first job, staying in teaching, changing jobs and exiting teaching, and re-entering teaching. A majority of the existing literature on teacher supply is on developed countries, such as the US and the UK, where teacher supply issues have received a high level of attention, matched with rich micro and time-series data. One major research area is the determinants of the choice for teaching as an occupation, and particularly the effects of the differentiated earnings of teaching and non-teacher occupations.

Manski (1985)'s early work examined the relationship between academic ability, earnings, and the decision to become a teacher through analysis of data from a national sample of college graduates in the US. He found that the frequency of choice of teaching as an occupation is inversely related to academic ability. In the meantime, the earnings of teachers tend to rise only slightly, if at all, with academic ability. An econometric analysis suggests that in the absence of a minimum ability standard, increases in teacher earnings would yield substantial growth in the size of the teaching force but minimal improvement in the average academic ability of teachers. The average ability of the teaching force can be improved and the size of the teaching force maintained if minimum ability standards are combined with sufficient salary increases.

Flyer and Rosen (1997) examined the effects of the rising labor force participation of women on both demand for and supply of teachers. They concluded that in the US, the rising demand for teachers during the past few decades is attributable to the growing market opportunities for women and thus higher demand for a market substitute for home schooling. Widened occupational choice for women has also attracted women away from the traditionally female dominated occupations. Nonetheless, the flexibility of teaching and less wage penalty for temporary leaves remain important attractions for women to work in teaching jobs during their productive years.

Using the US longitudinal survey of the High School Class of 1972, Van der Klaauw (1997) estimated a dynamic utility model of occupational choice and occupational mobility, accounting for first and subsequent occupation choice. He found that teacher salaries and opportunity wages are important determinants of the supply and retention of teachers. Csellack (2002) also used a dynamic structural model and panel data (NLSY 1979, US) looking into teacher occupational choice. The simulation results show that a 2 percent increase in teachers' wages increases teacher supply by 2.6 percent.

Hanushek and Pace (1995), on the other hand, find that in the US, participation in teacher training is not significantly affected by relative teacher earnings. In addition, teacher candidates perform lower on tests than other graduates, and teacher training completion is lowered by state requirements for courses and teacher tests.

Using UK data, Dolton (1990) and Dolton and Chung (2004) focused on looking into the problem of recruiting graduates into the teaching profession and retaining them in the UK. Dolton (1990) found that relative earnings in teaching and non-teaching occupations and the corresponding growth in earnings in these two choices have a

marked effect on graduates' choices. In particular, the lower are the relative wages or wage growth in teaching, the less likely is a graduate to choose that career. These earning effects operate on initial choices and choices made later in an individual's career. Dolton and Chung (2004) compared the earnings of qualified teachers who choose to teach with the opportunity wage for those who do not teach. They find that the rate of return on career choice for teachers has been declining for both men and women over the past 25 years although teaching is still relatively well paid for women.

There are also a few studies on the earnings effect on the aggregated teacher labor market. Thomas (1975) uses UK time series data between 1962 and 1970, and finds significant salary effects suggesting a 1 percent fall in relative starting salaries will induce a 2-5 percent fall in the relative supply of male graduates entering teaching and similar effects for average salaries of teachers. Effects for female graduates are up to twice as big. Zabalza, Turnbull and Williams (1979) also used UK time series, and estimated that the elasticity of graduate new entrants with respect to wage equals 2.4-3.9 for men and 0.3-1.8 for women; and that with respect to relative starting wages, it is 3.4 for men and 2.8 for women. Court et al. (1995) updated the time-series study in the UK, extending the study period to 1986-1992. The salary effect is still strong, suggesting that a 1 percent fall in relative starting salaries will induce a 4 percent fall in the relative supply of graduates entering teaching.

One recent study outside the US and UK is by Ortega (2006). Using Venezuelan data, his results suggest that the teacher wage premium and wage dispersion have little effect on the quality mix of applicants to teaching. Most students' preference for teaching

is unresponsive to wage levels relative to other occupations and to wage growth prospects within teaching.

II. Indonesian context

The overall teacher supply seems sufficient in Indonesia, with the pupil-teacher ratio declining steadily in recent years (Figure 1). The current pupil-teacher ratio is estimated at 19:1 for the primary level and 13:1 for the secondary level. These ratios clearly indicate that at an aggregated level, Indonesia does not have teacher shortage issues, unlike some other countries in the region, such as the Philippines or Cambodia. As a matter of fact, its pupil-teacher ratios are close to those of some developed countries such as Japan (20:1 at primary level, 13:1 at secondary level), or the US (15:1 at primary level and secondary level)[2]. Based on a school survey, the World Bank (2007) reports that a large proportion of Indonesian schools has an over-supply of teachers even according to the existing generous staffing norm. The report further points out that there is some space to improve the efficiency of the staffing norm. Based on the recommended formula, nearly 85 percent of the schools are over-staffed.

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[2] Edstats online database.

Figure 1: Pupil-Teacher Ratio in Indonesia: 2001-2006
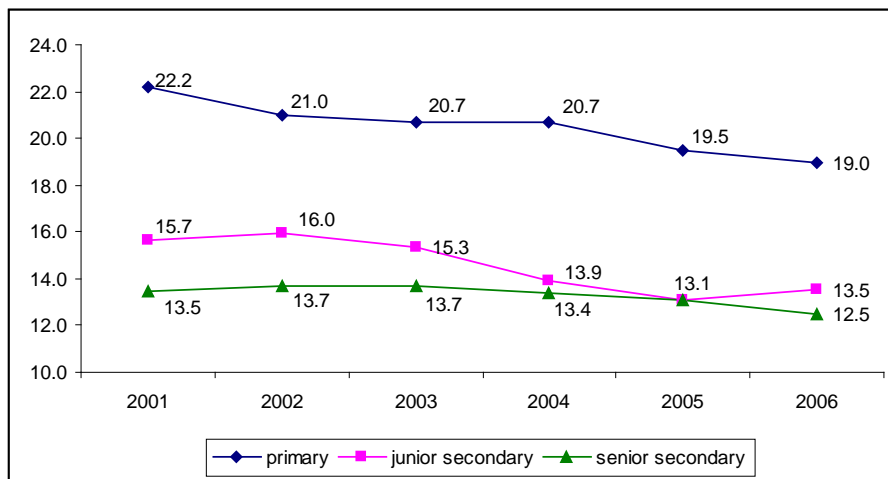
However, in recent years, concern with the composition of the teaching force has been more prominent, particularly with the general recognition that learning outcomes are influenced by the ability of teachers who guide the learning process. There is an often expressed dissatisfaction with the distribution of ability within the present teaching force, with the public sentiment that public policies should induce desirable changes. With this line of thought, teachers' minimum qualification, in terms of educational attainment, has been raised several times during the past decade, even though there is little consensus on whether educational attainment is a good measure of "ability" relevant for teachers.

The most significant policy change in teacher employment is the latest Teacher Law (UU14/2005) passed in 2005. It caught much attention with the 100 percent teacher salary increase for certified teachers. One of the key requirements for certification is four or more years of college education (S1 or D4). The Ministry of Education set the goal that by 2015, the whole teaching force should be comprised of only certified teachers. The magnitude of the potential change will be large given that a large proportion of incumbent teachers are below the minimum qualification level (Table 1). For example, by early 2006, over 80 percent of the primary school teachers were without college education. Given that there are nearly 2.7 million teachers in

Indonesia, and about half of them are primary school teachers, this translates to a large number of teachers that need to be upgraded or replaced.

Table 1: Number and percentage of teachers below required qualification before and after the new teacher law

	Primary	Junior secondary	Senior secondary
Minimum qualification starting in 2005	**4-year degree or diploma**	**4-year degree or diploma**	**4-year degree**
% of teachers below min. qualification	82%	33%	13%
Minimum qualification before 2005	**2-year diploma**	**3-year diploma**	**4-year degree**
% of total teachers below min. qualification	33%	15%	13%

While the Ministry of Education is carrying out a massive upgrading program with recognition of prior experience for incumbent teachers, whether the law will be successful in the longer run depends foremost on how it would influence the occupational choice decision of college-educated workers. Until now, there has been no basis for making such forecasts. In the absence of empirical analysis, we can only guess at the impact of changes in teacher salaries on the composition of the teaching force.

Under a theoretical framework with a government-dominated market with a government-set wage rate and demand for teachers, this paper explores how teacher supply, particularly the resulting composition of the teaching force with low or high qualification, would be determined by current and future public policies. Using 2001 to 2008 Indonesian Labor Force Survey (SAKERNAS) data, this paper further estimates the potential effect of the latest teacher law, which gives high qualification teachers a significant pay increase, on the composition of the Indonesian teaching force with differentiated education backgrounds.

III. Theoretical framework: Aggregate teacher labor market

Following Zabalza, Turnbull, and Williams (1979), the labor market for teachers can be thought of within a traditional supply and demand framework, with the additional complication that the government is virtually the sole hirer of labor. The demand for teachers can be determined by the number of children in the country of school age, and the government's desired pupil–teacher ratio. For a given such ratio, the demand for teachers is therefore a constant, denoted by $q*$ in Figure 2. Under the reasonable assumption that the supply of teachers with college education is a positive function of average teacher earnings, an upward-sloping labor supply schedule can be drawn as *S*. In a perfectly competitive market, a teacher wage of $w*$ would therefore clear this labor market.

Figure 2: The labor market for teachers
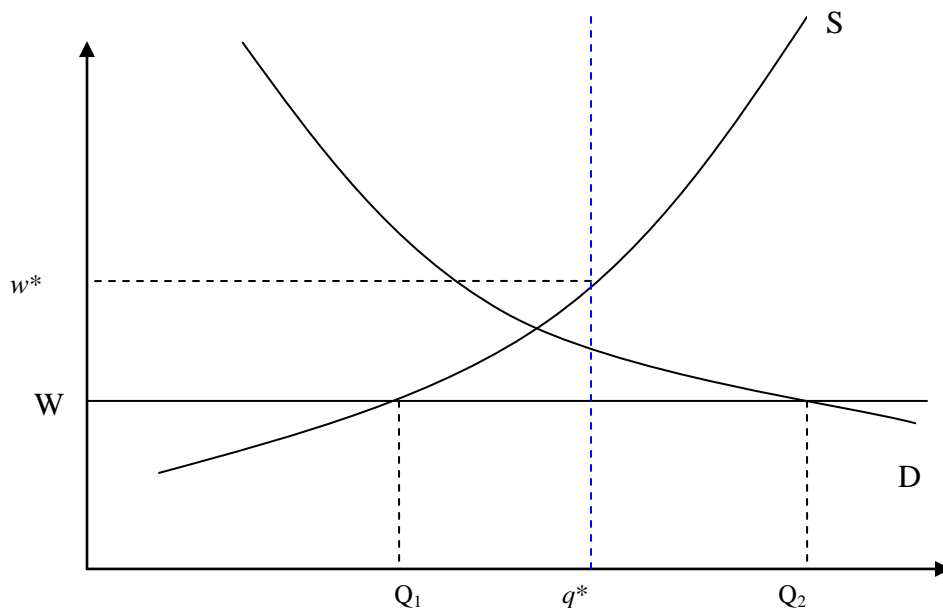
However, the teachers' labor market is of course not competitive, and the government, in its role as (almost) exclusive purchaser of teaching labor, has other considerations, prime among which is the level of expenditure on teachers' salaries in total. For a given level of such expenditure, an inverse relationship can be plotted between teachers' earnings and the number of teachers hired, labeled D in Figure 2. If the government wants to raise the salaries of teachers, it can afford to hire fewer of them, given a fixed budget.

Another complication added to the model is that teacher salaries do not adjust freely, as a majority of the teachers are civil servants, and therefore in most cases, their salaries follow a country's civil servant remuneration scale.

Figure 2 illustrates a general case of how an aggregated teacher labor market would work. With a mostly fixed wage rate W, the government can afford to hire Q_2 teachers at this salary level. However, the market supply of teachers with college education at this salary level could be only Q_1. Therefore the government can hire (Q_2-Q_1) low qualification teachers. Q_2 can be higher than what is the actual need for teachers q^*, as in this case, and therefore over-supply of total number of teachers, measured as (Q_2-q^*), can co-exist with the shortage of teachers with college education, measured as (q^*-Q_1). This seems to explain the situation in Indonesia. Among all teachers Q_2, the proportion of qualified teachers is thus (Q_1/Q_2), while that of under-qualified teachers is (Q2-Q1)/Q2.

On the other hand, if the government wants to hire all needed teachers (q^*) with college education, the wage rate then needs to be set at w^*. However (q^*, w^*) could be above the fiscal capacity. This case is illustrated in Figure 3: the government would have

the choice of either hiring only q_0 college-educated teachers, or lower the wage rate to W'

to meet the demand for teacher numbers but with lowered average qualifications, with

Q_1' teachers with college education, and (q^*-Q_1') teachers under qualified.

Figure 3: Labor market for teachers: low public budget
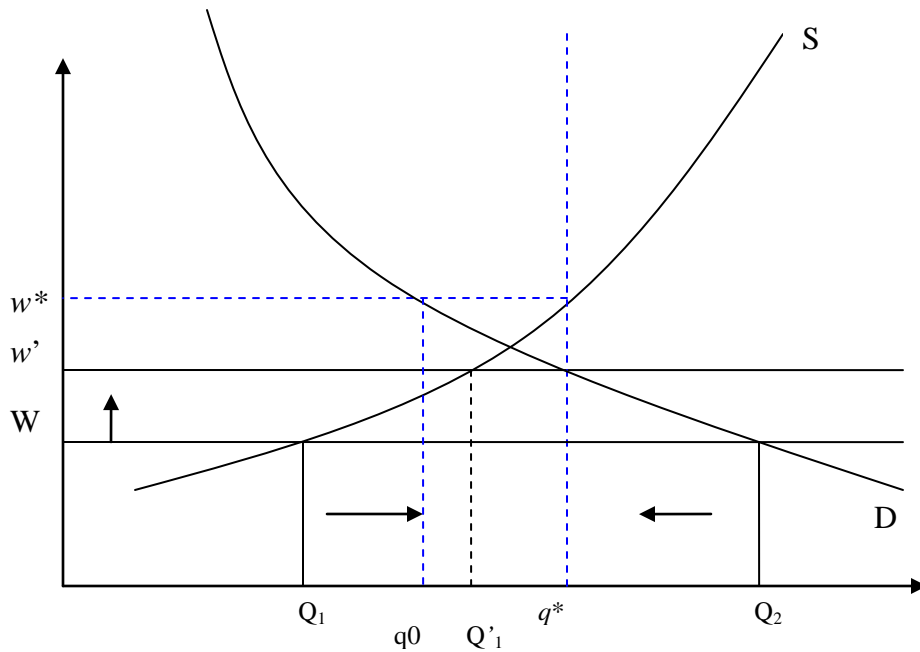
The other scenario is that (q^*, w^*) is below the fiscal constraint line D, as

illustrated in Figure 4. In this case, increasing the teacher salary level to w^* would

reduce the total excess of teachers, retain the right number of teachers with college

education, as well as save public resources. However, in reality, if this is the case, there

would usually be an upward pressure to further raise teacher salaries beyond the

necessary level, or hiring more teachers, until the total budget allocation is spent. These

can be illustrated by the move upward of teacher salary from w^* to w'', or hiring q^*'

teachers rather than q^*.

Figure 4: Labor market for teachers: high public budget
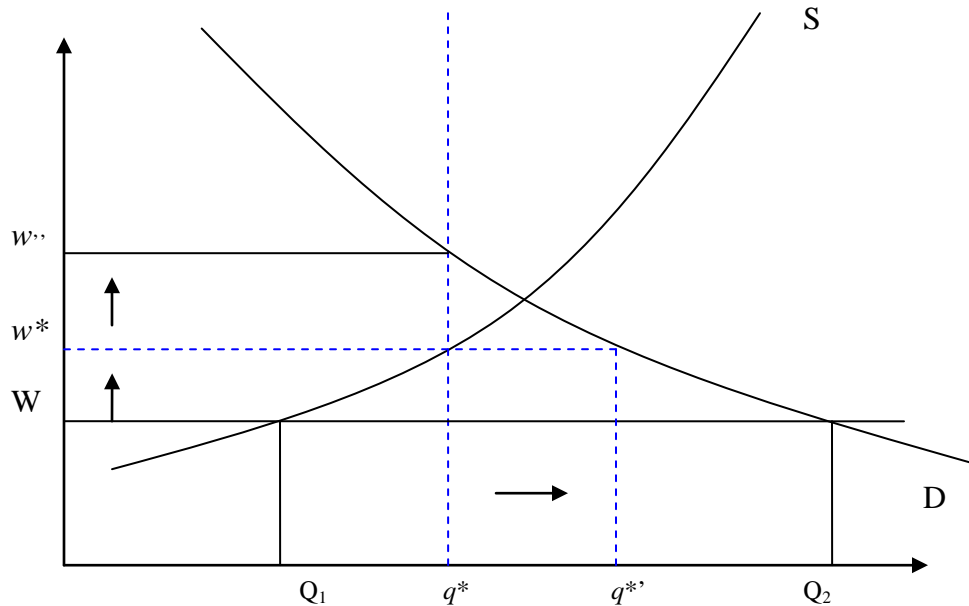
For public policies that aim at inducing changes in aggregated teacher profile by changing teacher remuneration, key information is needed on the slope of *S*, and the level of *w** that can induce the desired level *q**.

IV. Estimating teacher supply

The econometric model that this paper uses is based on Dolton (1990), which modifies that of Zabalza et al. (1979) and Willis and Rosen (1979), and considers that there are two possible outcomes to a college graduate's decision. The graduate can either decide to become a teacher (*a*) or not (*na*). It is assumed that the earnings streams in these two regimes may be parameterized by a simple geometric process. In this model, decisions are considered from the perspective of life-cycle earnings.

Consider an individual chooses to enter teaching at time T then the present value of his expected earnings stream is:

$$V^a = \int_T^\infty \left[\left(\frac{\rho}{1-\rho} \right) W^a(t) \exp(-rt) \right] dt. \tag{1}$$

The maximum present value of earnings, chosen over alternative occupations is:

$$V^{na} = \underset{s}{Max} \int_T^\infty \left[\left(\frac{1-\rho}{\rho} \right) W^{na}(t;s) \exp(-rt) \right] dt, \tag{2}$$

Where:

$W(t)$ is earnings at time t;

ρ is "propensity to teach";

s is the choice set of other occupations.

We further define the earnings profile for teachers from time T and onwards is:

$$W^a(t) = W_T^a \exp\left[g^a(t-T) \right] \qquad if \quad T < t \leq \infty. \tag{3}$$

Similarly, define earnings profile for non-teachers as:

$$W^{na}(t,s) = W_T^{na}(s) \exp\left[g^{na}(s)(t-T) \right] \qquad if \quad T < t \leq \infty, \tag{4}$$

where:

W_T is the earnings at period T, and g is earnings growth rate.

Individual chooses not to go to teaching if $V^{na} > V^a$. Defining $I = ln(V^{na}/V^a)$, and plugging equation (3) and (4) into (1) and (2) would give:

$$I_{1i} = \ln\left(\frac{1-\rho}{\rho} \right) + \ln W_T^{na} - \ln\left(\frac{\rho}{1-\rho} \right) - \ln W_T^a - \ln\left(r - g^{na} \right) + \ln\left(r - g^a \right). \tag{5}$$

A linear approximation of equation (5) can be written as:

$$I = \delta_0 + \delta_1 \left(\ln W_T^{na} - \ln W_T^a \right) + \delta_2 g^a + \delta_3 g^{na} + \delta_4 \rho + X\beta,$$ (6)

which is able to be estimated empirically.

This teacher supply framework has various drawbacks when applied to empirical work. One obvious limitation is that earnings data are rarely available across any appreciable time span in the life cycle. This poses problems for meaningful econometric analysis. This means that little can be said about life cycle earnings without some assumption concerning earnings growth. In addition, even though panel data can provide a few observations per individual at different points of time, the existing panel data sets in Indonesia (i.e. three waves of "Indonesia Family Life Survey") do not have large enough samples for teachers, particularly of teachers with college education. In this paper, we use labor force survey data for a few consecutive years and control for year-specific fixed-effects in earnings estimation for teachers and non-teachers.

The second limitation of the model is that the non-pecuniary rewards of teaching, or the individual's "propensity to teach," cannot be directly measured. Females with children may have higher propensity to become a teacher given that teaching is usually a more flexible job, and has less wage penalty when temporary leave happens (Flyer and Sherwin 1997). Dolton (1990) used the probability of having the first job as a teacher as a proxy for propensity to teaching when estimating occupation change between teacher and non-teacher at later stages of one's career. However, this requires panel or historical data that is not easily available for the intended analysis. Even under this approach, equal non-pecuniary rewards to jobs were assumed for prior entry into any job any individual has. In this paper we include variables such as dummy for female, marital status,

household size in an attempt to capture the variations in individual's preference for teaching.

The third key empirical difficulty is obviously the problem of how to estimate the foregone earnings in other occupations that influence an individual's occupational decision, as one can only observe the earnings in the occupation that has been chosen. To solve this issue, we follow Dolton (1990)'s empirical approach involving 3-stages of estimation.

We need to estimate two earnings functions for teachers and non-teachers:

$$\ln W^a = X\beta_1 + u_1 \text{, and} \qquad\qquad (7)$$

$$\ln W^{na} = X\beta_2 + u_2 . \qquad\qquad (8)$$

Obviously, people are not randomly selected into teachers and non-teachers. OLS estimates would be biased. Sample selection bias can be corrected by starting with estimating a probit model of being a teacher:

$$I(a) = Z\gamma + \varepsilon , \qquad\qquad (9)$$

where I equals 1 if an individual is a teacher, and 0 otherwise. Z includes all exogenous variables.

The second stage estimates the log earnings function for teachers and non-teachers (eq. 7 and 8), by inserting Mill's ratio (λ) on the right-hand side. For teacher and non-teacher sub-samples, the consistent estimates can be obtained by OLS estimates of the following:

$$\ln W^a = X\beta_1 + \sigma_1 \rho_1 \lambda_1 + \xi_1 \text{, and}$$

$$\ln W^{na} = X\beta_2 + \sigma_2 \rho_2 \lambda_2 + \xi_2 .$$

where

$$\lambda_1 = -\frac{\phi(Z\gamma/\sigma_\varepsilon)}{\Phi(Z\gamma/\sigma_\varepsilon)},$$

$$\lambda_2 = \frac{\phi(Z\gamma/\sigma_\varepsilon)}{1-\Phi(Z\gamma/\sigma_\varepsilon)},$$

$$\sigma_1 = \text{var}(u_1),$$

$$\sigma_2 = \text{var}(u_2),$$

$$\rho_1 = corr(\varepsilon, u_1),$$

$$\rho_2 = corr(\varepsilon, u_2).$$

These first and second stages can also be estimated using maximum likelihood based on conditional distributions of earnings for teachers and non-teachers. The likelihood function of teacher earnings is

$$f(u_1 | Z\gamma + \varepsilon > 0) = f(u_1 | \varepsilon > -Z\gamma) = f(u_1 | \varepsilon < Z\gamma) = \frac{\phi(\ln W^a - X\beta_1)}{\Phi(Z\gamma)}.$$

The likelihood function for non-teacher earnings is:

$$f(u_2 | Z\gamma + \varepsilon < 0) = f(u_2 | \varepsilon < -Z\gamma) = \frac{\phi(\ln W^{na} - X\beta_2)}{1-\Phi(Z\gamma)}$$

With consistent estimates of β_1 and β_2, we use predicted values of W^a and W^{na} for each individual to estimate the structural model of the following:

$$I = \delta_0 + \delta_1 \left(\ln \hat{W}_T^{na} - \ln \hat{W}_T^a \right) + \delta_2 Z + \eta \qquad (10)$$

V. Data and results

We use the 2001-2008 Indonesia Labor Force Survey (SAKERNAS) to look into the occupational choice of working cohorts with college education. Our sample includes 40,019 workers with college education from year 2001 to 2008. Overall, only around 3%

of the 20-year old and above population are able to attain this level of education. The

proportion increases overtime, but at very slow pace between 2001 and 2008 (Table 2).

Table 2 also shows that teaching job is a prominent choice for college graduates.

Between 2001 and 2008, around one-fifth to a quarter of the college graduates are

teachers.

Table 2: Composition of labor force with college education

Year	non-teacher	teacher	Total	% with college education among population age 20 and above
2001	2,414	333	2,747	3.0%
2002	3,729	687	4,416	2.7%
2003	4,750	846	5,596	3.1%
2004	4,979	982	5,961	3.3%
2005	3,411	911	4,322	2.8%
2006	4,363	972	5,335	3.2%
2007	4,683	954	5,637	3.3%
2008	5,160	845	6,005	3.6%
Total	33,489	6,530	40,019	3.1%

Figure 5 depicts the trend of relative earnings for teacher and non-teacher college

graduates by age group. Earnings of teachers have been below that of non-teachers in for

the past few years. However, the real earnings gap is narrowing. Teacher's real earnings

growth has been faster than that of non-teachers in recent years. A closer look reveals

that teacher's real earnings has been mostly constant over the years, while it is non-

teacher's earnings that has actually been eroded by inflation over time.

Figure 5: Log real earnings of teachers and non-teachers with college education in Indonesia, by age group, 2002-2008

Graphs by year
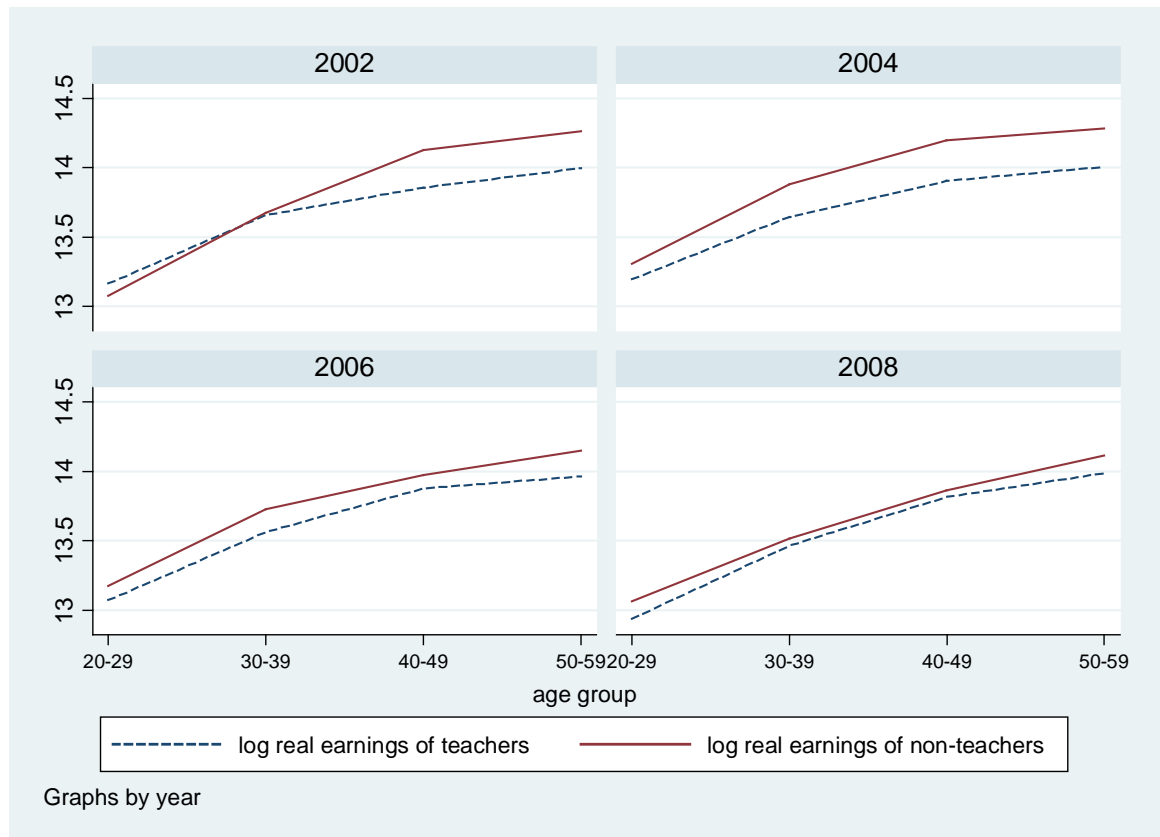
Figure 6 shows the trend of relative earnings (ratio) of teachers, and the share of labor force with college education that are teachers. Between 2001 and 2005, the share of college graduates shows an growing trend, reaching over a quarter of total workers with college education. Between 2005 and 2008, this trend seems to experience a reverse. By 2008, the share of college graduates on the labor market and who are teaching came back down to 19 percent.

For college graduates, even though the premium of non-teaching job is eroding over time, there were periods that show a reversed trend, such as between 2005 and 2008.

The earnings ratio of non-teachers to teachers increased slightly from 1.1 to 1.3. More of interest is the negative correlation between the pay-off of non-teaching job and the share of college graduates in teaching (Figure 7). The correlation is -0.83, and highly significant (P=0.01).

Figure 6: Trend of relative earnings and share of college graduates in teaching, 2001-2008
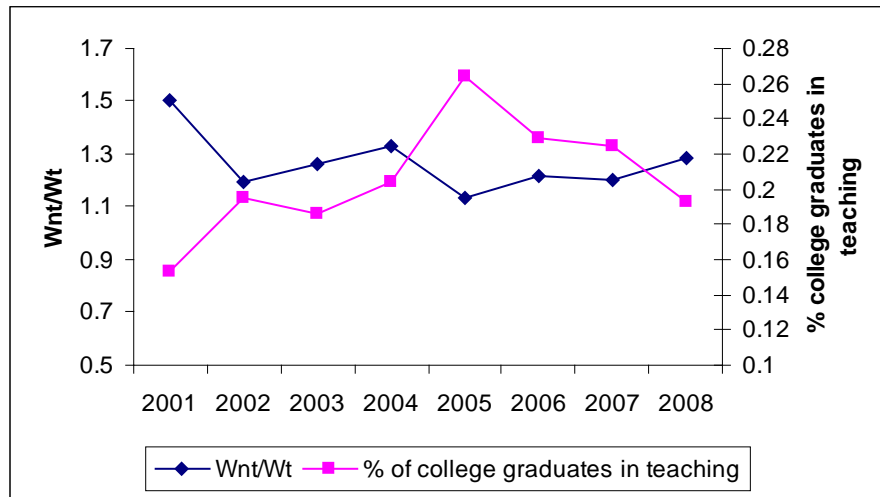
Source: SAKERNAS.

Figure 7: Relative earnings vs. share of college graduates in teaching, 2001-2008
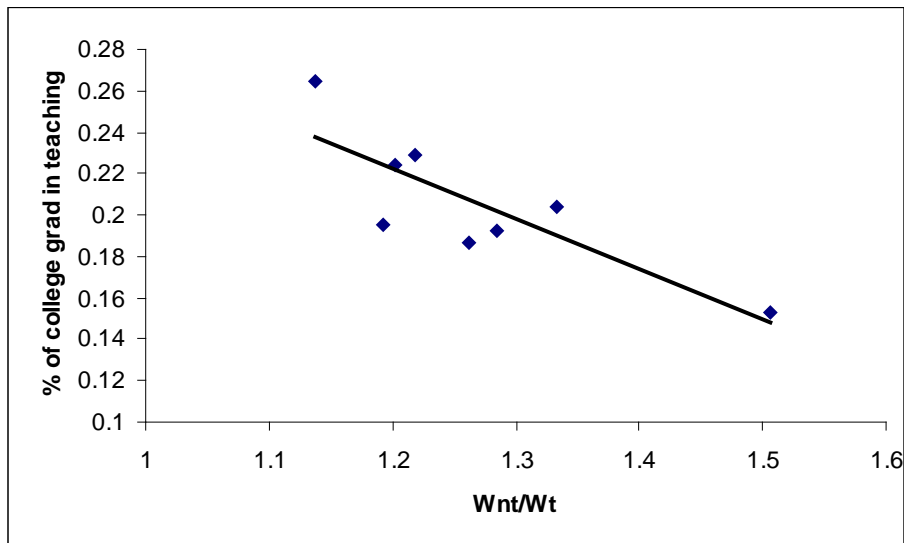
Now we turn to individual level data and estimate the effect of earnings differentials on the occupation choice of teachers versus non teachers, using the empirical framework laid out in the previous section. Table 3 is the descriptive sample statistics.

Table 3: Sample summary statistics:

Variable name	Definition	Mean	Standard error
Dependant variables:			
Dteacher	0-1 dummy variable, =1 if individual is a teacher	0.163	0.370
Earnings	Monthly earnings in Rupiah (Rp)	1,262,190	2,038,909
lnW	Log earnings, =ln(*Earnings*)	14.106	0.757
Explanatory variables:			
Age	age	37.173	10.183
Dfemale	0-1 dummy variable, =1 if individual is female	0.396	0.489
Drural	0-1 dummy variable, =1 if individual lives in rural area	0.153	0.360
Dmarried	0-1 dummy variable, =1 if individual is married	0.725	0.447
D2001	0-1 dummy variable, =1 if individual is from 2001 sample	0.069	0.253
D2002	0-1 dummy variable, =1 if individual is from 2002 sample	0.110	0.313
D2003	0-1 dummy variable, =1 if individual is from 2003 sample	0.140	0.347
D2004	0-1 dummy variable, =1 if individual is from 2004 sample	0.149	0.356
D2005	0-1 dummy variable, =1 if individual is from 2005 sample	0.108	0.310
D2006	0-1 dummy variable, =1 if individual is from 2006 sample	0.133	0.340
D2007	0-1 dummy variable, =1 if individual is from 2007 sample	0.141	0.348
D2008	0-1 dummy variable, =1 if individual is from 2008 sample	0.150	0.357
D11	0-1 dummy variable, =1 if individual lives in Nanggroe Aceh Darusalam	0.026	0.158
D12	0-1 dummy variable, =1 if individual lives in Sumatera Utara	0.037	0.190
D13	0-1 dummy variable, =1 if individual lives in Sumatera barat	0.028	0.165
D14	0-1 dummy variable, =1 if individual lives in Riau	0.017	0.128
D15	0-1 dummy variable, =1 if individual lives in Jambi	0.011	0.103
D16	0-1 dummy variable, =1 if individual lives in Sumatera selatan	0.017	0.131
D17	0-1 dummy variable, =1 if individual lives in Bengkulu	0.014	0.116
D18	0-1 dummy variable, =1 if individual lives in Lampung	0.014	0.116
D19	0-1 dummy variable, =1 if individual lives in Bangka belitung	0.005	0.070
D21	0-1 dummy variable, =1 if individual lives in Kepulauan Riau	0.006	0.079
D31	0-1 dummy variable, =1 if individual lives in DKI Jakarta	0.228	0.419
D32	0-1 dummy variable, =1 if individual lives in Jawa Barat	0.073	0.261
D33	0-1 dummy variable, =1 if individual lives in Jawa Tengah	0.066	0.248
D34	0-1 dummy variable, =1 if individual lives in DI Yogyakarta	0.060	0.237
D35	0-1 dummy variable, =1 if individual lives in Jawa Timur	0.113	0.317

Variable name	Definition	Mean	Standard error
D36	0-1 dummy variable, =1 if individual lives in Banten	0.024	0.152
D51	0-1 dummy variable, =1 if individual lives in Bali	0.039	0.193
D52	0-1 dummy variable, =1 if individual lives in Nusa Tenggara Barat	0.020	0.140
D53	0-1 dummy variable, =1 if individual lives in Nusa Tenggara Timur	0.014	0.119
D61	0-1 dummy variable, =1 if individual lives in Kalimantan Barat	0.015	0.120
D62	0-1 dummy variable, =1 if individual lives in kalimantan Tengah	0.011	0.105
D63	0-1 dummy variable, =1 if individual lives in kalimantan Selatan	0.019	0.138
D64	0-1 dummy variable, =1 if individual lives in Kalimantan Timur	0.017	0.130
D71	0-1 dummy variable, =1 if individual lives in Sulawesi Utara	0.015	0.121
D72	0-1 dummy variable, =1 if individual lives in Sulawesi tengah	0.015	0.120
D73	0-1 dummy variable, =1 if individual lives in Sulawesi Selatan	0.035	0.184
D74	0-1 dummy variable, =1 if individual lives in Sulawesi tenggara	0.017	0.127
D75	0-1 dummy variable, =1 if individual lives in Gorontalo	0.007	0.082
D76	0-1 dummy variable, =1 if individual lives in Sulawesi barat	0.003	0.058
D81	0-1 dummy variable, =1 if individual lives in Maluku	0.013	0.112
D82	0-1 dummy variable, =1 if individual lives in Maluku Utara	0.007	0.081
D91	0-1 dummy variable, =1 if individual lives in Papua barat	0.004	0.065
D94	0-1 dummy variable, =1 if individual lives in Papua'	0.011	0.106

The sample includes the labor force with college education between 2001 and 2008. There are 40,019 observations in our sample, among which about 40 percent are female, and 16.3 percent are primary or secondary school teachers.

The results of the maximum likelihood estimates for college-educated teacher and non-teacher log earnings functions, corrected for self-selection, are presented in Table 4. The result shows that for teachers, controlled for age, there are no significant earnings differentials between urban and rural areas, or between male and female teachers. As mentioned in the previous section, this may reflect the fact that in Indonesia, a majority of teachers are civil servants, and follow standard pay scales.

Table 4: Maximum likelihood estimates of *Log* Earnings function for teachers and non-teachers

Independent variable	Teachers log earnings *LnWt*			Non-teachers log earnings *LnWnt*		
	Coefficient		Standard error	Coefficient		Standard error
Constant	9.516	***	(0.141)	12.114	***	(0.071)
Age	0.153	***	(0.006)	0.078	***	(0.003)
Age^2	-0.001	***	(0.000)	-0.001	***	(0.000)
Dfemale	-0.010		(0.016)	-0.023	*	(0.012)
Drural	0.024		(0.021)	-0.119	***	(0.017)
D2002	0.021		(0.039)	0.066	**	(0.025)
D2003	0.225	***	(0.037)	0.265	***	(0.023)
D2004	0.162	***	(0.037)	0.331	***	(0.023)
D2005	0.229	***	(0.037)	0.291	***	(0.025)
D2006	0.300	***	(0.037)	0.416	***	(0.024)
D2007	0.368	***	(0.037)	0.511	***	(0.024)
D2008	0.405	***	(0.037)	0.538	***	(0.024)
Censored obs	=		33,489	Censored obs	=	6,530
Uncensored obs	=		6,530	Uncensored obs	=	20,934
Wald χ^2 (11)	=		3,228.82	Wald χ^2 (11)	=	3,937.5
Prob > χ^2	=		0.000	Prob > χ^2	=	0.000

*** $p<0.01$, ** $p<0.05$, * $p<0.1$.

For workers in non-teaching jobs, however, there are significant earnings differentials. Equally college-educated, a worker in rural areas earns 12 percent less. Woman also earns less than man. Even though the earnings differential between man and woman is small (2 percent), it is statistically significant.

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In addition, the earnings growth rate, as measured by the coefficient estimates on *Age*, appears to be higher for teachers than for non-teachers: 15 percent per year for teachers as compared with 7.8 percent for non-teachers. However, a teacher's earnings peak at age 54, while a non-teacher's at age 62. This is possibly due to the mandatory retirement age at 55 for civil servant teachers.

Table 5 presents the structural and reduced form estimates of occupational choice, equation (9) and (10) respectively. To avoid relying solely on the non-linearity of the functional forms for identification, excluded variables need to be identified for the earnings function, and the structural function of the occupational choice. The province dummy variables are used for estimating the occupational choice function, but excluded from the earnings function. The argument could be that localized demand for teachers, due to various enrollment rates influence by local household socioeconomic conditions, can affect the likelihood of entering teaching profession, but not teacher earnings. On the other hand, the dummy variables for various years are included in the earnings function estimation to capture overall labor market shifts in labor costs from year to year, but are excluded from the structural estimates for occupational choice assuming the year-to-year labor market change only affects individual's choice through changing earnings differentials.

Table 5: Probit of choosing teaching by college graduates

Independent variable	Reduced form			Structural form		
	Marginal effect		Standard error	Marginal effect		Standard error
Age	0.002	***	(0.000)			
lnWnt_lnWt				-0.295	***	(0.013)
Dmarried*	0.054	***	(0.004)	0.023	***	(0.005)
Dfemale*	0.084	***	(0.004)	0.083	***	(0.004)
Drural*	0.175	***	(0.006)	0.117	***	(0.006)
D11*	0.023	*	(0.013)	0.024	*	(0.013)
D12*	0.001		(0.011)	0.000		(0.011)
D13*	-0.014		(0.011)	-0.015		(0.011)
D14*	-0.014		(0.014)	-0.013		(0.014)
D15*	0.046	**	(0.020)	0.047	**	(0.020)
D16*	0.008		(0.015)	0.008		(0.015)
D17*	0.043	**	(0.018)	0.044	***	(0.018)
D18*	0.030	*	(0.017)	0.027	*	(0.017)
D19*	0.047	*	(0.029)	0.055	**	(0.030)
D21*	0.012		(0.025)	0.011		(0.025)
D31*	-0.081	***	(0.006)	-0.075	***	(0.006)
D33*	0.094	***	(0.012)	0.094	***	(0.012)
D34*	0.000		(0.010)	0.004		(0.010)
D35*	0.052	***	(0.009)	0.051	***	(0.009)
D36*	0.009		(0.014)	0.004		(0.013)
D51*	-0.012		(0.010)	-0.013		(0.010)
D52*	0.114	***	(0.018)	0.113	***	(0.018)
D53*	0.035	**	(0.017)	0.027	*	(0.017)
D61*	0.022		(0.017)	0.024		(0.017)
D62*	-0.021		(0.017)	-0.020		(0.017)
D63*	-0.013		(0.013)	-0.008		(0.014)
D64*	-0.012		(0.014)	-0.012		(0.014)
D71*	-0.030	**	(0.013)	-0.033	**	(0.013)
D72*	0.020		(0.016)	0.022		(0.016)
D73*	-0.018		(0.010)	-0.016		(0.010)
D74*	-0.005		(0.014)	-0.002		(0.014)
D75*	0.008		(0.022)	0.007		(0.029)
D76*	0.016		(0.030)	0.007		(0.022)
D81*	-0.006		(0.016)	-0.008		(0.016)
D82*	0.013		(0.024)	0.011		(0.023)
D91*	-0.039		(0.024)	-0.050	*	(0.022)
D94*	-0.049	***	(0.014)	-0.050	***	(0.014)

	Reduced form			Structural form	
Independent variable	Marginal effect		Standard error	Marginal effect	Standard error
D2002*	0.016	*	(0.010)		
D2003*	0.043	***	(0.010)		
D2004*	0.042	***	(0.010)		
D2005*	0.054	***	(0.011)		
D2006*	0.023	**	(0.009)		
D2007*	0.008		(0.009)		
D2008*	-0.019	**	(0.008)		
	Number of obs =		40,019	Number of obs =	40,019
	LR: χ^2 (43) =		3,103.83	LR: χ^2 (36) =	3,329.76
	Prob > χ^2 =		0	Prob > χ^2 =	0

*** p<0.01, ** p<0.05, * p<0.10.

The primary focus for the occupational choice model is the coefficient on the earnings differential variable (*lnWnt - lnWt*), holding constant the other explanatory variables relating to various background and personal characteristics. A negative and significant coefficient on earnings differential variable would indicate that a college-educated worker is less likely to choose teaching as profession if other occupations pay better. Our estimate result shows the "right" sign and a high significance level. Several other clear effects are notable in predicting whether in teaching profession or not. Being a woman or being married is significantly correlated with being in teaching force. It also appears that the predominant job for a college-educated worker in rural area is teaching. The likelihood of being a teacher is 11 percentage points higher for a college graduate in a rural area than that in an urban area.

Based on the empirical results, double the salary of teachers with college education would result in an increase in the probability of college graduates choice of entering teaching force. The marginal effect would be:

$$\frac{dP}{d\ln\left(\dfrac{Wnt}{Wt}\right)} = \frac{dP}{d\left(\dfrac{Wnt}{Wt}\right)\Big/\left(\dfrac{Wnt}{Wt}\right)} = 0.295 * 0.5 \approx 0.15$$

This would increase the proportion of college graduates choosing teaching profession to about one-third. Using the population projection by BPS (Bureau of statistics), and assuming constant proportion of population above age twenty with college education, this would lead to about 24-25 pupils per teacher with college education. This level of pupil-teacher ratio is higher than the current level, but still falls within the adequate range compared with other countries in the region.

Assuming this can be an acceptable pupil-teacher ratio such as $q*$ in Figure 3, it still requires increased amount of public resources. With increased pupil-teacher ratio from 16:1 to 24:1, but doubled teacher remuneration, the per-pupil cost would increase 33 percent. Without this commitment, there will be either teacher shortage, or a mix of teachers with high and low education background will continue to exist.

VI. Conclusions

Aiming at attracting high caliber human resources into teaching, the latest Teacher Law (UU14/2005) in Indonesia promises a 100 percent teacher salary increase for certified teachers with a minimum 4-year college education or above. In the long run, whether the law will be successful in attracting the needed college-educated labor force into teaching depends foremost on how it would influence their occupational choice decision. Until now, there has been no basis for making such forecasts. The findings of this paper provide some empirical foundations for the latest teacher law in Indonesia.

This paper has analyzed Indonesian teachers' labor supply under a theoretical framework that is based on a government-dominated market with government-set wage rate and demand for teachers. This framework could explain the phenomenon of the overall over-supply of teachers but shortage of qualified teachers in Indonesia. The results from the structural estimates constructed under the framework are particularly useful for looking into the impact of the latest teacher law on the future education profile of Indonesian teaching force.

Using a sample of workers with college education in the Indonesian Labor Force Survey, this paper has found that the relative wage rate of teachers and that of the alternative occupations significantly influence college educated workers' decision of becoming teachers in Indonesia. The large-scale pay increase promised by the law for teachers with college education will have a significant effect on attracting a college-educated labor force to join the teaching force. It is estimated that the wage rate set in the latest teacher law will be able to increase the share of teachers approximately from 16 percent to 30 percent of the college-educated labor force. In addition, the new government-set wage rate can sustain a pupil-teacher ratio of 24-25 pupils per teacher with college education, but will require a more than 30 percent increase in the teacher salary bill.

Finally, we conclude by highlighting that attracting a high caliber labor force into teaching is from the quality concern in the first place. Even though there is general recognition that learning outcomes and education quality are influenced by the ability of teachers who guide the learning process, whether qualification in terms of educational attainment is an appropriate measure for teaching ability is debatable. Even though there

is established literature on the positive sorting of ability and educational attainment (Willis and Rosen 1979), the ability to be a good teacher may also be different from general academic ability. Furthermore, getting the right people to teach is only the vey first step in improving educational quality and learning outcomes. How to make these right people perform well and achieve results is an even a bigger challenge.

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