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Dual Practice by Health Workers: Theory and Evidence from Indonesia

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Dual Practice by Health Workers: Theory and Evidence from Indonesia*

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Abstract

Using a simple theoretical model we conjecture that dual practice may increase the number of patients seen but reduce hours spent at public facilities, if public physicians lack motivation and/or if their opportunity costs are very large. Using data from Indonesia, we then test these theoretical conjectures. Our identification strategy relies on a 1997 legislation necessitating health professionals to apply for license for private practice only after three years of graduation. Results using a difference-in-difference regression discontinuity design provides support to our conjectures, identifying the role of weak work discipline, lack of motivation and opportunity costs of public service provision.

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1 Introduction

There is an intrinsic motivation for the health professionals to work in the public sector as patient's welfare enhances doctor's welfare. Work in the public sector also provides valuable benefits including career prospects, job insurance, pension and also the public facilities to work. Low public salary may, however, induce public sector health professionals to supplement earnings by engaging in private practice part time in countries where both public and private health care systems coexist. This is commonly known as dual practice. Recent years have seen a growing incidence of dual practice of health professionals, including doctors, nurses and paramedics, partly attributable to the rapid and mostly unregulated growth of the private health sector, especially in developing and emerging economies (Ferrinho et al., 2004). There seems to be a general consensus in the literature that the work performance of dual practitioners in the public hospital sector is significantly lower than the input of public hospital physicians who are not involved in dual practice (Berman and Cuizon, 2004; Hipgrave et al., 2013). With a steep increase in health care spending across the globe as medical technology continues to evolve, achieving value for money is key to the success and sustainability of any public health system. There is, however, an absence of robust evidence identifying the causal effect of dual practice on public doctor's labor supply behavior, especially in situations characterized by weak monitoring. The present paper aims to bridge this gap in the literature.

If the public health professionals continue to work conscientiously in the public sector even after they start practicing privately, there is of course no conflict of interest and no adverse impact on public health provisions. But this is not necessarily the case: just as there are motivated professionals, there may also be some non-motivated workers or moonlighters (Biglaiser and Ma, 2007) and both groups may indulge in dual practices. Unlike the motivated professionals, moonlighters may provide bad services in the public sector because they face stronger incentives (in terms of higher incomes) from private practice. The engagement in dual practice is, thus, expected to increase the opportunity costs of effort in the public sector, especially among moonlighters, which in turn are likely to affect their public labor supply behavior. Moonlighters are thus believed to become less involved in the public hospital work, for example, by neglecting some of the public practice activities and/or devoting some of the public practice hours or general work efforts to the private job (Jan et al., 2005; Ferrinho et al., 2004; Ensor and Duran-Moreno, 2002). The obvious question is how moonlighters manage to shirk in their public jobs. We argue that this is more likely to be the case when monitoring is weak and/or when moonlighters hold positions of power. Naturally, the lower work effort of moonlighters in the public sector has been argued to result in lower quality of public health care services (World Health Organization, 2000). Further, there are arguments that allowing dual practice results in a lower quantity of healthcare services overall. Using a panel of health-facility level data from Indonesia, the present paper examines the effect of dual practice on public health workers' labor supply behavior both theoretically and empirically.

Indonesia is an important case. The government is committed to the provision of quality health care and has resorted to a series of regulations to provide quality health services to all Indonesians, a historical account of which is summarized in Appendix 2. Given the relative low pay of civil servants, including government-employed physicians, allowing private practice for government doctors is thought to be essential to help supplement their public service earnings, thereby making it easier to attract health professionals to rural areas and also ensuring the stability and sustainability of the government health care system. Accordingly, the Ministry of Health in Indonesia has allowed public health professionals to conduct private practice, but on the condition that such practice be conducted after the close of the official public work day (around midday) and in many cases private practice is conducted at the public hospital. A 1994 review of the health sector workforce (World Health Organization, 1996) estimated that the private practice accounted for about 79% of total income for specialists in urban areas and varied between 25% and 70% for rural general practitioners in outer islands (non-Java/Bali), though we were unable to obtain a more recent estimate in this respect. Nevertheless, it highlights the prevalence of significantly greater opportunity for private practice in urban regions. Recent literature, however, highlights the problems of weak governance in the provision of public health services (e.g., see Chaudhury et al., 2006; Muralidharan et al., 2011). Frequent absence of public health workers, especially those of higher rank or power, has been observed in a number of developing countries including Indonesia (Chaudhury et al., 2006). Clearly, the presence of weak disciplining environment and growing opportunities for private practices can challenge the public service provision as the opportunity costs of public health provision increases; this could be particularly problematic when health workers are poorly motivated.

In this paper we first develop a simple theoretical model that incorporates some of the essential features of the Indonesian dual labor market with a view to derive our hypotheses. We pay special attention to the scenario where monitoring is weak or nonexistent in public sector jobs, which may facilitate shirking, especially when the health professionals are more powerful and have some decision making authority, thus lowering the likelihood of getting caught and fired. We conjecture that in a weak discipline work environment, dual providers (relative to those working in the public sector only) may see more public patients but spend less time at the public facility if they are poorly motivated and/or if their opportunity cost of working at the public facility is higher, among others. The rest of the paper empirically identifies the causal effect of dual practice on number of hours worked and number of patients seen in the public health facilities in Indonesia.

Clearly, the decision to practice privately is a strategic choice and is therefore potentially endogenous to the dual practitioner's decisions about his/her labor supply behavior, e.g., the number of patients seen or the hours worked in the public hospitals. We therefore devise an innovative difference-in-difference (D-in-D) regression discontinuity (RD) strategy to identify the causal effects of dual practice. The present paper exploits the exogenous variation in private practice of health professionals arising from the introduction of 1997 Ministry of Health Regulation Act 916 in Indonesia that necessitated health professionals to get a license for private practice after at least three years of compulsory service after graduation. We argue that the implementation of this 1997 regulation makes the timing of the initiation of the private practice random because the precise timing depends on the administration processing the application and also the 1988 Regulation 1,[1] entailing that the maximum contract period in the government job is 5 years after graduation. As such these professionals will be out of employment if they do not have the license for practice at the end of 5 years. The health professionals involved are therefore unlikely to influence the timing of getting the license for private practice.

Accordingly, we adopt a two-stage instrumental variable approach (à la Fajnzylber, Maloney and Montes-Rojas, 2011). In the first stage, we determine the likelihood of private practice using the threshold level of experience between 2-6 years since the graduation year; this exercise establishes that an experience threshold at five years ($exp5$) is the only one associated with a significant discrete jump in the likelihood of private practice among sample health professionals in the post-1997 years ($post97$), dictated by the 1988 regulation. The strength of the relationship between

[1] http://www.searo.who.int/entity/human_resources/data/Indonesia_profile.pdf)

the experience threshold and the likelihood of private practice in the post-1997 years validates the use of the instrument ($exp5 \times post97$) for determining the private practice likelihood. At the second stage we determine the number of patients seen per week and the number of hours worked per week by puskesmas heads as a function of the predicted value of private practice generated from the first stage estimates, among other covariates.

Our estimates show a positive and significant effect of private practice on the number of patients seen per week at public facilities, but a significant reduction in the number of hours worked per week in the full sample, in line with our theoretical predictions. This evidence would be more compelling if we could demonstrate that the subgroup where we would expect stronger responses are the subgroups driving the average effects in the full sample. The latter would help undermining any concerns about omitted variables or confounding events as they would have to exhibit the same heterogeneity in impact as the outcomes we model. Along this line, we split the sample into rural and urban regions and expect the regulation to be more effective in the urban region with more opportunities for private practice. Chomtiz et al. (1997) noted that the Indonesian government generally struggles to recruit and retain health professionals in rural Indonesia where private practice opportunities are much lower and therefore regularly offer various exemptions to induce health professionals to rural regions. As such, we predict that the impact of dual practice in the full sample is more likely to be driven by the results in the urban regions, characterized by higher opportunity costs of public service. There is indeed confirmation of our theoretical predictions in the urban sample only. The effects of dual practice on the selected outcome variables, however, remain insignificant in rural areas as expected. We test the robustness of our results to inclusion of additional controls, choice of alternative functional forms and also rule out the competing explanation that our results can be attributed to the greater efficiency of dual practitioners because by virtue of the RD design we focus on health workers under first ten years of experience after graduation.

The existing literature on dual practice is limited and rather diverse encompassing the economics of dual job holding as well as its implications especially for public goods (e.g., health) provision.[2] Few theoretical models have been developed to analyze the issue. Among the theoretical studies, Paxson and Sicherman (1996) identify factors that influence a worker's decision to

[2] See Eggleston and Bir (2006), García-Prado and González (2011), Socha and Bech (2011) and González (2014) for reviews on dual practice.

supplement his or her primary job, while most of the existing works focus on analyzing physicians' incentives as dual providers (see, for instance, González, 2004; Barros and Olivella, 2005; González, 2005; Biglaiser and Ma, 2007, and Brekke and Sørgard, 2007).[3] The related empirical literature is rather descriptive and tends to look at various case studies. For example, Berman and Cuizon (2004) review the prevalence of multiple job holding (MJH) in the context of health systems and government policies in several low and middle-income countries, and summarizes recent evidence on the phenomenon. Dual practice may be associated with competition for time, since health workers engaged in dual practice may replace hours they should be working at the government job by hours in the private clinic, thereby compromising public service delivery. In this respect, Ferrinho et al. (1998, 2004) suggested that health workers engaged in dual practice are often unproductive, inefficient and corrupt. There is also an emerging literature that highlights the governance issues in the provision of public services in developing countries. For example, health workers are often simply absent from work (Chaudhury et al., 2006; Muralidharan et al., 2011). Or doctors often spend just a few minutes with patients, providing lower quality care, and simultaneously over- and under-treating patients (see Das, Hammer and Leonard, 2008, and Das and Hammer, 2014, for reviews). There is, thus, a lack of understanding of the causal effect of dual practice on public health provision especially in weak monitoring set-up and we aim to bridge this gap in the literature using public facility-level Indonesian Family Life Survey data over 1993-2007.

The paper is developed as follows. Section 2 describes the institutional background. Section 3 presents a theoretical model of dual practice. Section 4 describes the data and explains the empirical methodology. Section 5 presents and analyzes the results. Finally, Section 6 concludes.

2 Institutional Background

In most developing countries, government actions in health have largely focused on setting up publicly-financed and government-operated health service delivery programs to provide a basket of health care services to the population as a whole. Indonesia follows a vertical hierarchy of its health administration at the regional level. That is, it is a geographically organized pyramid of

[3] González (2004), Biglaiser and Ma (2007), Brekke and Sørgard (2007) and González and Macho-Stadler (2013) also investigate on the optimality of allowing dual practice and explore different policy options to deal with this phenomenon.

health care facilities in a vertical hierarchy, with health sub-centers and health centers at the lower levels and several levels of hospitals above them. A more basic set of ambulatory care services is provided at the lower level facilities, with increasingly specialized services provided moving up the pyramid.

Our analysis focuses on the sub-district level health centers, called puskesmas, run by the Government, usually headed by a medical doctor though any other health professionals including nurses, midwives or paramedics may also act as heads; about 63% of puskesmas heads are doctors in our sample. Given the nature of the available data, our analysis focuses on the heads of the puskesmas - we observe the number of patients seen or the number of hours worked by the heads of the puskesmas only.

The size of the Indonesian health sector workforce has grown rapidly over the decades. In 1974, there were fewer than 50,000 health workers employed in government health institutions. After a decade, by 1983, this figure had grown to 84,000, which further exploded to 178,000 by 1992. The rapidly growing health care workforce has put a serious dent on fiscal manageability, and as a result, since 1992 the Ministry of Health (MoH) has relied on quasi-contractual arrangements to mobilize physicians for service instead of the historical practice of automatically hiring newly graduate health professionals as civil servants. In this sense, many government physicians in the 1990s became private contractors to the government.

Given the relative low pay of civil servants, including government-employed physicians, allowing private practice for government doctors is thought to enable them to augment their public service earnings, thereby making it easier to attract people to rural areas and ensuring the stability and sustainability of the government health care system. Accordingly, the MoH in Indonesia has allowed public health professionals to conduct private practice, but on the condition that such practice be conducted after the close of the official public work day (around midday); some are observed to conduct private practices in the public hospital at the end of their workday. Monthly and hourly salaries of public doctors, midwives and nurses appear to compare favorably with those of other workers of similar education, but incentives are needed for them to provide quality services to the poor. A 1994 review of the health sector workforce estimated that private practice accounted for about 79% of total income for specialists in urban areas and varied between 25% and 70% for rural general practitioners in outer islands (non-Java/Bali) (World Health Organization, 1996).

Unfortunately, there is no systematic records of public doctors' private practice and as such a more up-to-date information of public and private salaries of health professionals is not available.

Since 1996, the average number of physicians per puskesmas has grown. At the same time, more puskesmas have no doctor, especially in rural areas, confirming distributional concerns. Moreover, the gap between rural and urban areas in the ratio of private physicians to population has increased and, at present, the supply of private physician services is far greater in urban areas simply because of greater opportunities for private practice in those areas (World Bank, 2010). An obvious implication of the latter is that the opportunity cost of working in the public facilities is likely to be higher in urban than in rural areas (see further discussion in Section 4.3).

Further, recent literature highlights the problems of governance in the provision of public health services in many developing and emerging economies (e.g., see Chaudhury et al., 2006; Muralidharan et al., 2011). Frequent absence of public health workers, especially those of higher rank or power, has been observed in a number of countries including Indonesia, highlighting the lack of motivation of public health workers. At the same time, disciplinary action for absences are rare and health providers are almost never fired.

In this context, it is also important to consider two major events that affected Indonesia during the period of our study. The 1997 Asian Financial Crisis had a dramatic impact on Indonesia. The country suffered from a severe economic contraction, which was followed by a political crisis caused by Suharto's resignation from 32 years of power. However the commitment of the government to provide health care services during this period remained unaffected.

Fiscal decentralization was introduced in Indonesia at the turn of the new Millennium. While the decentralization of health services may permit a more efficient planning and recruitment system, there prevails a lack of clarity on roles and responsibilities of lower levels of administration, especially with respect to hiring and firing. The latter has obstructed the impact of decentralization in this respect, thus limiting a more even distribution of health workers across rural and urban areas. The central government is still heavily involved in the recruitment, deployment, and financing of public doctors working under civil service contracts. In contrast, the decentralization has offered more autonomy to the local governments (especially districts) in the provision of resources for relocation and performance incentives.

The 2000 and 2007 Indonesian Family Life Survey (IFLS) data provides information on whether the heads of puskesmas has authority to hire and fire staff (unfortunately this information is not available for the 1993 and 1997 rounds of the survey). It shows that a significantly higher proportion of puskesmas heads with private practice (33% as opposed to 29% of those without private practice) has this authority. In other words, it is possible to argue that the head's authority to hiring/firing of puskesmas staff may enable them to work in the private practice; in particular, these heads can ask their subordinate staff to cover their responsibility when they are away thus covering for their absence. We can identify two possible ways a puskesmas head can facilitate their dual practice compared to any other subordinate staff. (a) Table 1 suggests that average tenure (i.e., number of years spent in the current puskesmas) of the head is higher in the post-1997 years, especially for the dual providers. Longer tenure in the same puskesmas may help the heads to establish their influence and authority over other puskesmas staff. (b) The second factor that may facilitate heads' dual practice is the availability of the support staff who can cover the head's job during his/her absence from the facility. As such, we consider the number of supporting doctors and nurses in puskesmas as well. We find that the number of supporting doctors and nurses are significantly higher in puskesmas where the head is practicing privately (relative to those where the head is not doing so). In other words, it is easier for the heads of puskesmas to shirk from the public job at the puskesmas with a view to indulge in private practice when there are more supporting doctors and nurses to cover them.

3 A theoretical model of dual practice

We adopt two essential institutional features of the Indonesian dual providers' market to develop a simple theoretical framework of dual practice. These are: (a) weak disciplining work environment where monitoring is inexistent; (b) higher opportunity costs of working in the public sector when there are more opportunities for private practices; the latter is more of a problem when health workers have lower motivation.

The structure of the basic model is as follows. There is a physician that provides medical services in the public sector. The physician is partially altruistic. Thus, his preferences are represented by a linear combination of his patients' benefits and his own monetary payments. Let

$\theta > 0$ be the degree of altruism (or motivation) the physician is endowed with. The physician's task is to provide health care to a certain number of patients n.[4] In order to avoid selection issues, we assume that patients are homogeneous and represented by a typical representative patient.[5] We denote by t_c the consultation time, or time the physician spends in responding to the medical problems presented by the representative patient. We consider that the health benefit of a patient is increasing and concave in the consultation time, and it is given by $(t_c)^{1/2}$. In providing health care to n patients, the physician incurs a total cost or disutility, cn, a strictly increasing and linear function, where c denotes the marginal cost of providing medical care to the representative patient and includes, among other things, the cost of history taking, diagnosis, and treatment.

The physician's utility function has some additional components. First, as mentioned above, the physician cares about overall patients' health benefits, $n(t_c)^{1/2}$. Moreover, the larger the level of motivation of the physician, θ, the larger the weight he gives to the overall patients' health benefits in his utility function. Second, the physician also cares about financial rewards, which depend on how he is paid. We assume that the physician receives a fixed salary w conditional upon him providing a certain working time for his public activities t. If the physician is also allowed to work in the private sector he receives an extra private income. In the private sector the physician is paid on a fee-for-service basis, i.e., he receives a fee $p > 0$ per each private patient treated.[6] In order to keep the model as simple as possible we do not include the physician's total private income, but a proxy of how this private income might be affected by his public performance. In particular, we consider that the physician might use his public performance to refer some public patients to his private practice and, therefore, we assume that the physician's private income is positively related to the number of patients that he has seen in the public sector. More precisely, if the physician treats n patients in the public sector a proportion of them, $\alpha > 0$, will actually end up in his private practice, yielding an extra private income to the physician of $p\alpha n$.[7] In order to avoid a degenerate

[4] The model abstracts away patients' decisions and the physician's decisions in their private practice. We examine only incentives issues for those physicians whose careers involve the public sector.

[5] This modelization avoids selection incentives by physicians. Barros and Olivella (2005) and González (2005), for instance, analyze the issue of cream skimming by dual providers. In Biglaiser and Ma (2007) patients also differ by income.

[6] Our financial rewards are consistent with empirical evidence in Indonesia and in most health systems where public and private medical practice coexist. In most European mixed health care systems, for instance, physicians receive a fixed monthly salary in the public sector and full time physicians' working hours in the public sector range between 35 and 40 hours per week. In the private sector, on the contrary, physicians are usually paid on a fee-for-service basis.

[7] This modelization allows us to focus on the physician's public performance when he is a dual provider, without explicitly modeling the private sector.

solution in which the public physician would like to treat in the public sector as many patients as possible, but devoting them a negligible consultation time, we make the assumption that $\alpha \leq \frac{p}{c}$. This condition requires that the proportion of public sector patients that accept the physician's offer to resort to the private sector can not be extremely high.

Finally, we consider that devoting t units of time to public activities is costly for the dual practitioner, according to the cost function δt, where $\delta > 0$ is the cost of devoting one more unit of time to public activities. We interpret this cost as the opportunity cost of working t hours in the public sector, in the sense that the larger the number of hours the physician devotes to public practice, the less time he can work in the private sector and the lower the private income he can get.[8]

3.1 Strong Monitoring Work Environment

Consider that government sets the total working time in the public sector at $\bar{t}$. Suppose also that the work environment is not permissive or physician's working hours can be monitored, so that the physician always fulfills that requirement. In this scenario the physician chooses the number of patients he is going to treat in the public sector, $n^{pb}(\bar{t})$.

If the physician only works in the public sector he faces:

$$\underset{n}{Max}\, U^{pb} = \left[w + \theta n(t_c)^{1/2} - cn\right] \quad (1)$$
$$s.t. \qquad t_c = \frac{\bar{t}}{n}.$$

While if the physician is dual provider his maximization problem is:

$$\underset{n}{Max}\, U^{d} = \left[w + \theta n(t_c)^{1/2} + p\alpha n - cn - \delta\bar{t}\right] \quad (2)$$
$$s.t. \qquad t_c = \frac{\bar{t}}{n}$$

The following lemma summarizes the physician's choices in a strong monitoring work environ-

[8]Notice that we could have also included an opportunity cost of time for a solo public practice provider, since such physician would have, for instance, less time to leisure. We have adopted this simpler modelization to reduce the casuistic of the analysis. However, all our qualitative results would hold in an extended model provided the marginal opportunity cost of time δ is larger for dual than for solo public practice providers. Similarly, we could think that the opportunity cost is larger for urban dual health providers than for rural ones.

ment.[9]

Lemma 1. *In a strong monitoring work environment, given the total working time in the public sector $\bar{t}$, a physician who only works in the public sector chooses $n_S^{pb*}(\bar{t}) = \frac{\theta^2 \bar{t}}{4c^2}$, while a dual provider physician chooses $n_S^{d*}(\bar{t}) = \frac{\theta^2 \bar{t}}{4(c-p\alpha)^2}$. Moreover, solo practice and dual provider's consultation times are $t_{cS}^{pb*} = \left(\frac{2c}{\theta}\right)^2$ and $t_{cS}^{d*} = \left(\frac{2(c-p\alpha)}{\theta}\right)^2$ respectively.*

As one might expect, $n_S^{pb*}(\bar{t})$ and $n_S^{d*}(\bar{t})$ are increasing in the level of physician altruism and in the working time at public facilities, and decreasing in the marginal cost of providing medical care. Moreover, $n_S^{d*}(\bar{t})$ is increasing in the private fee, p, and in the proportion of public patients that accept the physician's offer to resort to private treatment, α. Finally, the larger the difference between the marginal cost (c) and benefit (αp) of providing medical care in the public sector, the lower the number of patients treated by the dual provider at public facilities.

The following proposition compares the choices of a solo practice physician and a dual provider in a strong monitoring work environment.

Proposition 1. *In a strong monitoring work environment, given the total working time in the public sector $\bar{t}$, it holds that $n_S^{d*}(\bar{t}) > n_S^{pb*}(\bar{t})$ and $t_{cS}^{d*} < t_{cS}^{pb*}$.*

Thus, when the physician is a dual supplier he decides to treat more patients in the public sector in order to increase the number of patients that accept to resort to his private practice and, consequently, increase his private income. At the same time, since total working time $\bar{t}$ is fixed, the consultation time devoted to the representative patient is lower for dual practitioners. This reduction in the consultation time is larger the less altruistic or motivated the physician is.

3.2 Weak Monitoring Work Environment

Suppose now that monitoring is non-existent so that the public physician has some freedom to choose his working time at public facilities. Thus, the public physician does not only choose the number of patients he is going to see in the public sector, n, but also his hours actually worked at public facilities, t. Since it is difficult to assess the extent to which absence is authorized, we consider that $t \in [t_{\min}, t_{\max}]$.

[9] Proofs of lemmas and propositions are in the Appendix.

Formally, the physician maximizes U^{pb} or U^{d} (depending on whether he works only for the public sector or he is a dual provider) choosing n and t, and subject to the constraints that $t_c = \frac{t}{n}$ and $t \in [t_{\min}, t_{\max}]$.

Lemma 2 below summarizes the physician's choices in the weak monitoring work environment.

Lemma 2. *In a weak monitoring work environment a physician who only works in the public sector chooses* $n_W^{pb*}(t_{\max}) = \frac{\theta^2 t_{\max}}{4c^2}$ *and* $t_W^{pb*} = t_{\max}$. *A dual provider physician chooses* $n_W^{d*}(t_W^{d*}) = \frac{\theta^2 t_W^{d*}}{4(c-\alpha p)^2}$, *where:*

If $c - \alpha p \in \left(0, \frac{\theta^2}{4\delta}\right)$, $t_W^{d*} = t_{\max}$.

If $c - \alpha p \geq \frac{\theta^2}{4\delta}$, $t_W^{d*} = t_{\min}$.

Moreover, solo practice and dual provider's consultation times are $t_{cW}^{pb*} = \left(\frac{2c}{\theta}\right)^2$ *and* $t_{cW}^{d*} = \left(\frac{2(c-p\alpha)}{\theta}\right)^2$ *respectively.*

Lemma 2 shows that if the physician only works in the public sector, since he is altruistic and cares about patients' health, he would always choose $t_W^{pb*} = t_{\max}$. If he is dual provider, however, two different regions for $c - \alpha p > 0$ emerge. If the opportunity cost of working time in the public is below $\frac{\theta^2}{4(c-\alpha p)}$ or, equivalently, $c - \alpha p < \frac{\theta^2}{4\delta}$, the positive effect of an increase in the working time at the public sector (since the number of patients treated at public facilities could be larger) always compensates the larger opportunity cost and the physician chooses $t_W^{d*} = t_{\max}$. On the contrary, if the opportunity cost δ is above $\frac{\theta^2}{4(c-\alpha p)}$, i.e., $c - \alpha p \geq \frac{\theta^2}{4\delta}$, the positive effect on patients' health never compensates the larger costs suffered by the physician and he optimally chooses $t_W^{d} = t_{\min}$. Notice that the less altruistic or motivated the physician, or the larger his opportunity cost of working time at public facilities δ, the larger the region where the solution is $t_W^{d*} = t_{\min}$.

Note that the expressions for the optimal consultation times coincide with the ones in the strong work monitoring scenario. Thus, the consultation time devoted to the representative patient is always lower for dual practitioners. The comparative statics in Lemma 2 with respect to $n_W^{pb*}(t_{\max})$, $n_W^{d*}(t_{\max})$ and $n_W^{d*}(t_{\min})$ also resemble the ones in Lemma 1.

Finally, we compare the choices of a solo practice physician and a dual provider in the weak monitoring work environment. The following proposition summarizes the results of the comparison.

Proposition 2. *In a weak monitoring work environment dual provider's choices and choices by a physician who only works in the public sector compare as follows:*

Region a) *If* $\frac{\theta^2}{4\delta} \leq c\left(\frac{t_{\min}}{t_{\max}}\right)^{1/2}$, *then*

If $c-\alpha p \in \left(0, \frac{\theta^2}{4\delta}\right)$, $t_W^{d*} = t_W^{pb*} = t_{\max}$ *and* $n_W^{d*}(t_{\max}) > n_W^{pb*}(t_{\max})$. *(Region a.1)*

If $c-\alpha p \in \left[\frac{\theta^2}{4\delta}, c\left(\frac{t_{\min}}{t_{\max}}\right)^{1/2}\right)$, $t_W^{d*} = t_{\min} < t_W^{pb*} = t_{\max}$ *and* $n_W^{d*}(t_{\min}) > n_W^{pb*}(t_{\max})$. *(Region a.2)*

If $c-\alpha p \geq c\left(\frac{t_{\min}}{t_{\max}}\right)^{1/2}$, $t_W^{d*} = t_{\min} < t_W^{pb*} = t_{\max}$ *and* $n_W^{d*}(t_{\min}) \leq n_W^{pb*}(t_{\max})$. *(Region a.3)*

Region b) *If* $\frac{\theta^2}{4\delta} > c\left(\frac{t_{\min}}{t_{\max}}\right)^{1/2}$, *then*

If $c-\alpha p \in \left(0, \frac{\theta^2}{4\delta}\right)$, $t_W^{d*} = t_W^{pb*} = t_{\max}$ *and* $n_W^{d*}(t_{\max}) > n_W^{pb*}(t_{\max})$. *(Region b.1)*

If $c-\alpha p \geq \frac{\theta^2}{4\delta}$, $t_W^{d*} = t_{\min} < t_W^{pb*} = t_{\max}$ *and* $n_W^{d*}(t_{\min}) \leq n_W^{pb*}(t_{\max})$. *(Region b.2)*

Moreover, in all the regions $t_{cW}^{d*} < t_{cW}^{pb*}$.

Proposition 2 characterizes two different regions depending on the relationship between the physician's degree of altruism, θ, the opportunity cost of working time in the public sector, δ, the marginal cost of providing medical care to a representative patient, c, and the ratio $\frac{t_{\min}}{t_{\max}}$. Note that for all parameter configurations, the optimal dual provider's consultation time is always below the one a solo practice provider would choose. Suppose first that the parameter configurations are such that $\frac{\theta^2}{4\delta} \leq c\left(\frac{t_{\min}}{t_{\max}}\right)^{1/2}$.[10] Within this region the results depend on the difference between the marginal cost of providing medical care in the public sector and the marginal benefit. If such a difference is low (region a.1), a dual provider physician chooses to work at public facilities the same amount of time as a solo provider physician would choose, but he decides to provide medical services to a large number of patients in order to raise the number of public patients that end up at his private practice. This effect was already at hand in the strong monitoring work environment described in Proposition 1. If the difference is very high (region a.3), the dual provider reduces his working time at public facilities in order to save opportunity time costs, and this reduction in the working time comes accompanied by fewer medical services provided to also reduce costs of providing medical care. Finally, for intermediate values of $c - \alpha p$ (region a.2), the dual provider physician devotes less time to public duties than if he worked exclusively for the public sector but, at

[10] Notice that the lower the physician's motivation, the higher the opportunity cost of working at public facilities, the lower c, or the larger $\frac{t_{\min}}{t_{\max}}$ (because the difference between $t_{\min}$ and $t_{\max}$ is small), the more likely to be in this region.

the same time, he provides medical care to more public patients than what a solo practice physician would do. In this case the physician has a strong incentive to reduce consultation time for public patients so that, at the end, more patients are treated in a shorter working period. Importantly, the lower the physician's motivation, the higher the opportunity cost of working at public facilities, or the lower the difference between $t_{\min}$ and $t_{\max}$, the more likely to be in region a.2. Suppose now that the parameter configurations are such that $\frac{\theta^2}{4\delta} > c\left(\frac{t_{\min}}{t_{\max}}\right)^{1/2}$. In this case, results in region b.1 are equivalent to those in region a.1, while the physician's behavior in region b.2 is analogous to that in region a.3.[11]

Thus, Propositions 1 and 2 summarize the effects of allowing dual practice in a strong and weak monitoring work environment respectively. In the strong monitoring work environment there is a clear-cut result: a dual supplier physician always reduces consultation time in order to raise the number of patients treated and thereby the number of patients that accept to resort to his private practice. Under weak monitoring results are more ambiguous. Interestingly, we find that when the public physician lacks motivation (because, for instance, he is poorly paid in their public performance), or faces large opportunity costs of working at public facilities (because the private alternative is much more attractive), allowing dual practice could imply a reduction in the working time at public facilities together with an increase in the number of public patients seen, as described in region a.2.

Since we have argued in Section 2 that the Indonesian dual providers' market is characterized by weak monitoring, higher opportunity costs of working in the public sector when there are more opportunities for private practices and low motivation of health workers, we shall now turn to describe the data and explain the empirical strategy that we adopt, with a view to assess the validity of our theoretical results.

[11] Region b.2 would only exist if $c\left[1-\left(\frac{t_{\min}}{t_{\max}}\right)^{1/2}\right]-\alpha p \geq \frac{\theta^2}{4\delta}$. In particular, if $t_{\max} \rightarrow t_{\min}$ region b.2 does not exist.

4 Data and empirical strategy

4.1 Data

We have health facility/puskesmas-level panel data from four Indonesian Family Life Survey (IFLS) rounds (1993, 1997, 2000 and 2007) for over 300 communities. The IFLS contains information for the head of the puskesmas (who could be a doctor or other health professional) and other administrative data who constitutes the units of assessment in our analysis.

The standard Indonesian medical school curriculum is six years long. The four years undergraduate program is composed mainly of classroom education, continued with the last two years in professional program that primarily includes rotations in clinical settings where students learn patient care first hand. If they pass undergraduate program they will have "S.Ked" (Bachelor of Medicine) in their title and if they finished the professional program and pass the national examination arranged by the Indonesian Medical Association they will become general physician and receive "dr.(doctor)" MD title. After graduation, doctors are absorbed in public services, mostly on a contractual basis since the introduction of Pegawai Tidak Tetap (PTT) in 1991.

Since the introduction of the PTT in 1991, the MoH also required from them a compulsory period of service which varies somewhat depending on whether they are placed in urban, rural or remote rural areas. After their first 3 years, these health professionals had the opportunity to continue their post-graduate education, go into the private sector, or become civil servants by taking the national civil service examination (usually, the PTT doctors who had served in remote or very remote areas through the PTT scheme would receive priority in the subsequent civil service recruitment process). We study the impact of the 1997 MoH regulation 916 in this context. The major change introduced by the 1997 regulation is that it necessitates doctors to get license for private practice and they can apply for this after at least 3 years of compulsory service after graduation. This means that a doctor can go for private practice after three years of compulsory service only if their license is granted. The licensing requirement was absent before the introduction of the 1997 regulation. Thus before 1997 the doctors could initiate private practice when they started their compulsory PTT program; this is because private practice (at the close of the public hospital around mid-day) has been legal in Indonesia since the late 1970s.

In case these professionals choose to get into the private sector after three years of experience (at the minimum) in the government facility, in post-1997 years they need to apply for certification, registration and licensing, all of which may take some time because of the underlying administrative process. Note however that the maximum period of compulsory service after graduation is five years (by virtue of a 1988 regulation) and hence these professionals need to get a license within five years at the maximum; otherwise they can be out of employment. There is therefore a window of 3-5 years for getting the license for private practice in the post-1997 years. We therefore argue that the exact timing of obtaining the license for private practice depends on the administrative process, and as such, is likely to be beyond the influence of individual professionals and can therefore be treated as random. Accordingly, the key variable for identifying the effect of private practice on selected outcome variables is the years of experience since graduating as a medical doctor. In order to understand the effect of the regulation, we split our sample between pre- and post- 1997 reform: while IFLS rounds 1993 and 1997 correspond to the pre-1997 period, rounds 2000 and 2007 correspond to the period after the introduction of the regulation in the subsequent analysis.

Table 1 summarizes the descriptive statistics for the selected outcomes and other variables for the full sample and separately for pre- and post-1997 subsamples. About 75% of health professionals practice privately and the proportion declined somewhat in the post-1997 years. On average, they work 20 hours a week seeing about 84 patients and they spend about 15 minutes per patient; note however that hours worked per week declined somewhat while number of patients seen increased in the post 1997 years. Finally, the average incidence of referral of public patients from puskesmas to private practice is reported to be around 32% in our sample after 1997.

The presentation of the raw data establishes the transparency of the research design and thus justifies the choice of the cut-off points for the assignment variable 'experience' measured in years in this case. Figure 1 shows the proportion of number of heads for each value of experience between 0-20 years, analyzing separately for 1993-1997 (pre-regulation) and 2000-2007 (post-regulation) years. We show the distribution of experience for all heads and also for heads with private practice. In general, these figures highlight that there is a shift in the distribution of experience to the right in the post-reform years in our sample indicating that the pool of puskesmas heads is more experienced in the post-1997 years, as dictated by the 1997 regulation 916. While there are some professionals practicing privately with less than three years of experience (11% and 5% respectively for pre- and post-regulation years), an overwhelming majority tend to have more than three years of experience. Incidence of professionals with experience less than three years and practicing privately primarily pertains to rural (often remote) placement where government often offers some exemption from general rules (as per Chomitz et al. 1997) in an attempt to ensure steady supply of trained doctors in these areas.

The seminal work of Hahn et al. (2001) has established local linear nonparametric regression as a standard approach for estimating the treatment effect in a regression discontinuity (RD) design. Hahn et al. (2001) chose the local linear estimator over the local polynomial for its smaller order of asymptotic bias. Figure 2 shows the smooth local polynomial regressions of mean likelihood of private practice among puskesmas heads with different levels of experience (since graduation), abbreviated by *exp* for pre- and post-1997 years in our sample. Here we use Epanechnikov kernel with a polynomial of degree 1 (see upper panel) and also degree 2 (see lower panel). The figure highlights the difference in the private practice likelihood in pre- and post-1997 years after the introduction of the health regulation. In the pre-regulation years, the likelihood of private practice increases monotonically while in the post-regulation years there is a discrete jump in the private practice likelihood at around the experience cut off of five years in our sample.

The obvious question is why the threshold level of experience turns out to be five years and not three years as entailed by the medical regulation. The regulation requires health workers to apply for private practice after the completion of three years of public service. Even if one applies for the license right after the expiration of three years of experience (since the graduation), one needs to allow for the time taken for administrative processing of applications - so it is unlikely that the valid experience threshold will be exactly at three years. Second, by virtue of government regulation 1 of 1988, the maximum period of compulsory service after graduation is five years for health workers, which dictates that the professionals need to obtain the license for private practice before completing the five years of service; otherwise they would be out of service. The latter perhaps dictates the presence of a significant discrete discontinuity at the experience cut-off of five years. Our empirical strategy is then to compare these two groups of health workers, $exp >= 5$ (i.e., eligible for private practice) and $exp < 5$(i.e., not eligible for private practice) before and after the introduction of the regulation in 1997 to identify the causal effect of dual practice of health workers. Figure 2 suggests that the difference between eligible and non-eligible workers was blurred in the pre-regulation years, i,e., health professionals with private practice were distributed continuously across this threshold before the policy was implemented. In this case, there should have been no unobservable differences, on average, between heads who were just above and just below the experience threshold (which is also supported by the insignificant t-statistic of mean comparisons of private practice likelihood between eligible and non-eligible professionals before 1997; see Table 3 and discussion below). In the post-reform years, however, there is a discrete jump in private practice likelihood from 0.74 at $exp = 4$ years to 0.80 at $exp = 5$ and thereafter it stabilizes, thus justifying the use of a RD design. The graph also highlights that the post-regulation treatment status does not align perfectly with the 5-year experience threshold, thus justifying a case for fuzzy regression discontinuity design.

Our sample comes from the heads (doctors or other health professionals) of the puskesmas who had chosen to continue with their medical profession. Given that our interest is to focus on observations around the selected cut-off level of experience, we use the subsample of heads with at most ten years of experience.

The graphical inference from Figure 2 is also compatible with the mean comparisons of selected variables for the chosen cut-off points three and five years, as respectively summarized in Table 2 and Table 3. In particular, Table 2 summarizes the mean comparisons of the outcome variables at the cut-off point of three years and above, while Table 3 shows the same at the cut-off point of five years and above; in each case we distinguish between pre- and post-1997 subsamples as indicated above. First, the mean difference in the likelihood of private practice is not significant at the cut-off point of three years in the post-97 years (see Table 2), but it is significant at the cut-off point of five years. Second, for the post-1997 period, the unconditional likelihood of having a private practice is significantly higher for professionals with experience $exp \geq 5$ years of experience: 78% as opposed to 71% for those with $exp < 5$ years. Thus in view of Figure 2 and Tables 2-3, we use of the experience threshold $exp \geq 5$, using a fuzzy RD design.

Among the outcome variables, on average, the number of patients seen is significantly higher for professionals with more than five years of experience. However, the hours worked per week appear significantly lower, on average, for heads with experience greater than or equal to five years. Finally, there is suggestion that health professionals with more than five years of experience are less likely to hold private practice in the public clinic and this difference is statistically significant. We, however, do not have information on the health outcomes of patients treated by these dual practitioners and hence the current paper focuses on testing the effects of private practice on labor supply behavior of public doctors only, using relevant observable outcome variables: number of hours worked during the week and number of patients seen during the week.

Having explored the data in terms of simple descriptive statistics and diagrams, we shall now move on to the regression analysis to examine if these bivariate comparisons hold when we control for other factors that may also influence the selected outcome variables.

4.2 Empirical strategy

The basic empirical model of public doctor's labor supply decisions that we want to estimate is as follows:

$$y_{it} = \alpha_0 + \alpha_1 pp_{it} + f(exp5_{it}, exp_{it}) + \alpha_2 X_{it} + C_i + T_t + u_{it}, \tag{3}$$

where y refers to selected outcome variables ($hours\_wk$ and $n\_patient\_wk$) and pp is a dummy variable indicating if a health professional holds a private practice pertaining to the labor supply behavior of the head of the puskesmas (doctor or other health professional) i in year t. Our key explanatory variable is therefore pp that measures the dual practice of the puskesmas head. The set of variables X contains other covariates that may also influence y. In this respect, we include a dummy variable for urban puskesmas ($urban$), and a dummy variable $llang$ that takes a value of 1 if the doctor's knows the local language and 0 otherwise. As indicated above, there are pronounced rural-urban differences in the placement of health professionals and also their private practice. As such, the urban dummy would account for the differential effect of urban regions on the outcome variables, if any. Second, there are about 500 different dialects spoken in Indonesia's multicultural society and as such the knowledge of local language is an essential quality of a doctor to be able to converse with his/her patients which is an essential prerequisite for practicing privately in the community. Inclusion of this binary variable would thus allow us to account for the differential effect of the knowledge of local language, if any, on public health provision. By construction of the RD design, we focus on health professionals around the experience threshold of five years, we assume that they are on a relatively comparable payscale for the public job; as such we do not control for their income, which is also potentially endogenous to their private practice. Later we also estimate an extended model with additional control variables (see Section 5.2). We also include a polynomial (linear, quadratic or cubic) $f(exp5, exp)$ on experience, separately for exp <5 and exp ≥5, and $exp5 = 1$ if exp ≥5 years and 0 otherwise. Finally, C_i refers to district (Kabutapen) fixed-effects and T_t to survey year fixed-effects to account for unobserved district and year-specific factors that may also influence the likelihood of private practice. It is important to control for the district dummies as the districts received the fiscal authority in the post-decentralization years. As such, we compare the public health professionals' labor supply in local health facilities known as puskesmas within districts, thus minimizing the inter-district variation especially in the post-2001 years in our sample.

Given the potential endogeneity of pp and in the light of our discussion in Section 4, we consider the following D-in-D design:

$$pp_{it} = \beta_0 + \beta_1 exp5_{it} + \beta_2 post97_{it} + \beta_3(exp5_{it} \times post97_{it}) + f(exp5_{it}, exp_{it}) + C_i + T_t + \upsilon_{it}, \quad (4)$$

where $post97$ is a binary variable that identifies pre- and post-1997 reform observations, and it takes values 0 for years 1993 and 1997, and 1 for 2000 and 2007. Note that in practice $post97$ is collinear with T, and it is thus redundant. In other words, $post97$ captures the unobserved year fixed effects in this equation.

We do not observe the precise timing of the start of private practice for each professional. But in view of MoH Health Regulation 916 of 1997 (see Section 2 and Section 4), we rationalize using an assignment based on the years of experience since graduation within a RD environment. In particular, we will use $exp5$ for identification where we observe the sharpest discontinuity among the possible values of experience. Thus, our identification for determining the likelihood of private practice rests on the randomness of the threshold variable $exp5$ in the post-1997 years as it relies on the administrative procedure to process the license.

Accordingly, model (4) follows a D-in-D strategy to identify the effect of private practice pp on dual practitioner's public labor supply indices with a view to test our key hypotheses pertaining to the hours worked and number of patients seen per week, using $z = exp5 \times post97$ as an instrumental variable (IV) for pp in equation (3). Since the validity of the instrument depends on comparing observations close to the $exp = 5$ cut-off, we also adopt a RD design, where larger weights are attached to observations with $|exp - 5|$ being small. We use data weighted in a scheme that amplifies those closer to the cut-off. In doing so, we assume that the unobservables are the same before and after the discontinuity about the cut-off, which constitutes an important identification mechanism. This also ensures that we focus on health workers who are rather comparable in terms of their efficiency and income.

An important challenge is to identify the correct functional form of the relationship between the assignment variable experience and the outcome measure in the absence of treatment. To the extent that the specified functional form is correct, the estimator implied by the regression discontinuity will be an unbiased estimator of the mean program impact at the threshold $exp5$. If the functional form is incorrectly specified, treatment effects will be estimated with bias, because the identification could be solely based on misspecifying the functional form. For example, if the true functional form is highly nonlinear, a simple linear model can produce misleading results. There are two theoretical reasons for a nonlinear relationship between outcomes and ratings. One is that the relationship between mean counterfactual outcomes and ratings is non- linear, perhaps because of a ceiling effect or a floor effect; the other is that treatment effects vary systematically with ratings. Consequently, we test a variety of functional forms in $f(.)$ — including linear, quadratic models, and cubic models to make sure the functional form that is specified is as close as possible to the correct functional form (see Lee and Lemiux (2010) for a discussion of RD).

We implement the two-stage least-squares difference-in-differences regression discontinuity (2SLS-D-in-D-RD) estimator of Fajnzylber, Maloney and Montes-Rojas (2011) in which observations close to the proposed discontinuity are given a greater weight than those far away from the discontinuity. The estimator builds on a weighted 2SLS methodology with analytical weights given by a Gaussian kernel with a given bandwidth. Let Y be a $N \times 1$ vector with the outcome variable, P a $N \times 1$ vector containing the private practice indicator (endogenous variable), X a $N \times k$ matrix containing the k exogenous regressors (including the district and year dummies, $llang$, $urban$, and a polynomial of exp interacted with $exp5$), Z a $N \times q$ matrix with the q instrumental variables, given by $exp5 \times post97$. We consider weights constructed using a normal density function $\omega \sim N(0, \sigma)$ with density function $\phi(\omega)/\sigma$ where the standard deviation (σ) in years of experience used to standardize the difference in years of experience with respect to the break-point of experience equal to $\omega = (exp - (5 - \epsilon))/\sigma$ with $\epsilon = 0.5$. In this case, the bandwidth parameter corresponds to the values of σ. Let W be a $N \times N$ diagonal matrix with the squared root of the N weights (i.e. $\sqrt{\phi_{it}}$, where

$\phi_{it} = \phi((exp_{it} - (5 - \epsilon)) / \sigma)/\sigma$ in its diagonal. Define $Y^* = WY$, $P^* = WP$, $X^* = WX$, $Z^* = WZ$ and let $B^* = [P^*, X^*]$, $K^* = [X^*, Z^*]$. The weighted least-squares estimator for the effect of Z and X on P is thus given by $\beta_{OLS} = (B^{*\prime}B^*))^{-1} B^{*\prime}Y^*$ and the 2SLS-D-in-D-RD estimator for the effect of X and P on Y $\beta_{2SLS} = \left(B^{*\prime}\left(K^*(K^{*\prime}K^*)^{-1}K^{*\prime}\right)^{-1}B^*)\right)^{-1} B^{*\prime}\left(K^*(K^{*\prime}K^*)^{-1}K^{*\prime}\right)^{-1}Y^*$.

4.3 Heterogenous effects

So far we study that the effect of dual practice on public labor supply behavior (number of patients seen and hours worked per week) was most pronounced in the full sample. This evidence would be more compelling if we could demonstrate that the sub-group where we would expect stronger responses are the subgroups driving the average effects. The latter would help undermining any concerns about omitted variables or coincident events as they would have to exhibit the same heterogeneity in impact as the outcomes we model. Our theoretical model suggests that in weak monitoring environments, holding the doctor's motivation constant, dual practice is associated with lower hours worked and higher number of patients seen when opportunity costs of public service are higher. Among other things, this is possible when there are more private practice opportunities. Following the World Bank (2010) study that suggests greater private practice opportunities in urban Indonesia, we explore the variation in the effect of dual practice on public labor supply behavior in rural and urban regions.

We start with a comparison of private practice likelihood in urban (Figures 3) and rural (Figure 4) regions in our sample. Evidently, Figure 3 resembles more like the full sample (see Figure 2) in that there is a discrete jump in private practice likelihood in the post reform years from experience level four to five years in the urban region. This is however not visible in the rural region (see Figure 4). In this case, there is very little change from an experience level of four to five years; if at all, it shows a slight drop in private practice when experience is five years.

In order to explore the rural-urban differences further, we consider possible measures of private practice opportunities in our sample. IFLS data allow us to identify the number of private medical practices existing in each community. Using this information, we can compare the mean differences in number of private practices existing in rural and urban regions. The average number of private practices has been about six in urban areas and five in rural areas over the sample period

1993-07 with a t-statistic of 7.4337, thus confirming that the average number of private practices is significantly higher in urban than in rural areas. If, however, we compare the number of private practices per 100 population, the urban mean is much smaller 0.8 as opposed 20 in rural areas with a t-statistic of -18.1605, thus indicating an even more statistically significant rural-urban difference. The latter is a better measure of private practice opportunities as it measures the average population pressure on individual private practices in urban relative to rural regions; this in turn highlights the significantly higher private practice opportunities in urban areas. The latter may explain why the government of Indonesia struggles to recruit and retain health professionals in remote rural regions and is therefore forced to relax the recruitment conditions of health workers deployed in rural areas (Chomitz et al. 1997). The rural-urban difference plays an important role in our analysis as we explain below. In particular, we expect that the full sample effect of dual practice would be driven by that for the urban sample where the dual practice effect is likely to be stronger on both hours worked and number of patients seen by health workers.

5 Findings

In this section we shall present and analyze the results of both equations (1) and (2). Before we proceed to consider the estimates, it is imperative that we ensure that the common trend assumption is satisfied for the heads with/without private practice in the pre-reform years 1993 and 1997. Mean comparisons of the two outcome variables (see Table A0) suggest that there were no significant differences in the selected outcome variables, i.e., hours worked per week and number of patients seen per week in the pre-reform years 1993 and 1997. In other words, puskesmas heads with and without private practice behaved similarly with respect to the outcome variables in the pre-reform years. Thus, any differential effect in the outcome variables can be attributed to the new regulation, after controlling for all other factors that may also influence the outcomes. Below we use our data to explore if this is the case.

5.1 First-stage: effect of the 1997 administrative rule on private practice likelihood

We start by analyzing the effect of the proposed discontinuity variable 'experience' (exp) on the likelihood of puskesmas' heads doing private practice (pp) as in equation (2). In this respect we use $exp5$ interacted with the $post97$ dummy, which allows us to exploit the variation in private practice among eligible health professionals (those with $exp \geq 5$ years of experience) before/after the introduction of the health regulation 916 in 1997.

In order to evaluate the D-in-D RD local effect of the administrative rule on pp we implement the weighted least squares estimation procedure described in Section 3 in equation (2). We consider the coefficient estimates of $exp5 \times post97$ on pp, using $exp5$, $post97$, X and district level fixed-effects as additional covariates. Note that we cannot use year fixed effects here as it would be collinear with the $post97$ dummy.

Table 4 reports the weighted least-squares estimates of the likelihood of private practice for a selected bandwidth of $\sigma = 1$ for eq. (2) using linear (column 1), quadratic (column 2) and cubic (column 3) polynomials for $exp5$ interacted with $post97$. The results indicate that $exp5$ and $post97$ are not individually statistically significant for determining the likelihood of private practice. However, the interaction ($exp5 \times post97$) turns out to be positive and significant and the coefficient estimates is quite stable as we compare the estimates using linear, quadratic and cubic polynomial in columns (1)-(3) of the table. It follows that the private practice likelihood has been about 0.21 points higher among those with experience$\geq$ 5 years in the post-1997 years in our sample.

Table A1 implements further tests about the validity of the treatment ($exp5 * post97$) at any other cut-off values of experience between 2-6 years. A comparison of results shown in columns (1)-(4) of the table confirms that the chosen instrument, i.e., ($exp\ k$ * $post97$) remains statistically insignificant when $k = 2, 3, 4$ or 6 years are used. In other words, $exp5$ in the post 1997 years is the only variable where we identify a statistically significant effect of the regulation on the likelihood of private practice.

In Figure 5, panel a, we implement the above model for different bandwidth choices, using a cubic polynomial in exp with interactions with $exp5$. Moreover, we show the point estimates together with the 95% confidence interval using White-heteroskedasticity-robust standard errors. We consider bandwidth values in {1,1.1,...,2} (for $\sigma < 1$ standard errors increase considerably and all specifications deliver statistically insignificant results). The figures show that the local effect is the largest for $\sigma = 1$, and its magnitude decreases monotonically as the bandwidth increases.

Overall they suggest that if a D-in-D RD strategy were to be implemented with $exp5$ and $post97$, only a local effect with $\sigma = 1$ delivers a statistically significant effect.

Finally we follow Lee and Lemieux (2010) to formally test the covariates balance around the treatment ($exp5 \times post97$) in our sample. These results are summarized in Table 4a where we regress each of the covariates, namely, *llang* (i.e., the head speaks the local language), *headdoc* (i.e., head is a doctor), *urban* (the puskesmas is located in an urban region) on $exp5$, $post97$, and $exp5 \times post97$ including linear polynomials and the district dummies. The joint p-value provides the p-value from a test of joint significance of $exp5$ and $exp5 * post97$ coefficients in columns (1) to (3), which rejects the joint significance of the treatment in the post-97 year on the covariates.

5.2 Second Stage: Effect of Dual Practice on Selected Public Health Provision Measures

Our next step is to evaluate the effect of dual practice on indices of public health provision, namely, hours worked per week (*hours_wk*) and number of patients seen in a week (*patients_wk*) by the puskesmas head. To this end, we use the first stage procedure described in Section 5.1 to instrument private practice (*pp*) by ($exp5 \times post97$). OLS (i.e. non instrumented) regression results are shown in the Appendix Table A2. These non-IV OLS estimates indicate that private practice does not exert any statistically significant effect either on hours worked or patients seen per week by the public health professionals (who are heads of puskesmas) in our sample irrespective of the choice of polynomial. We argue that these insignificance is attributed to the simultaneity bias between the likelihood of private practice and the resultant labor supply by the dual practitioner, thus necessitating us to consider the 2SLS-D-in-D-RD estimates that we show in Tables 5 and 6.

Table 5 shows the 2SLS-D-in-D-RD estimator coefficients for equation (1) where the outcome of interest is *hours_wk*, i.e., hours worked per week by the heads with at most 10 years of experience. Columns (1)-(3) show the estimates for all health professionals while columns (4)-(6) show those for the doctors only subsample. Controlling for all other factors, we find that dual practice is associated with significantly less hours worked per week irrespective of the type of health professionals (doctors or others). Clearly, the effect is independent of the choice of the polynomials, i.e. linear, quadratic and cubic, especially for all health professionals. Note that the effect is still negative for doctors for quadratic and cubic polynomials, while it turns out to be insignificant (though still negative) for linear polynomial (see column 4). Clearly, the size of the effect is the largest for linear polynomial and then falls as we move from linear to quadratic and then to cubic polynomials; we see similar pattern for any health professional. Overall, these estimates suggest that dual practice of health professionals (relative to those without any private practice) is associated with about 18 working hours less per week on average. Figure 5 panel b presents the point estimates of pp on hours worked together with the 95% confidence interval using White-heteroskedasticity-robust standard errors for different values of bandwidths in $\{1, 1.1, ..., 2\}$, which emphasizes that the effect is only significant on a local interval about the $exp = 5$ cut-off. Evidently, the figure shows that the effect of pp is decreasing in the bandwidth and it becomes insignificant for a bandwidth value >1. The fact that the confidence interval increases means that it only works close to the cut-off $exp5$ which justifies the RD implementation in our set up.

Second, Table 6 summarizes the 2SLS-D-in-D-RD estimates of number of patients seen per week ($patients\_wk$) by the heads of puskesmas. Columns (1)-(3) show the estimates for all health professionals while columns (4)-(6) show those for doctors only. Note that the effect of dual practice on number of patients seen per week remains insignificant for linear polynomial among doctors, but turns out to be statistically significant for quadratic and cubic polynomials and this holds both for any health professionals and also doctors in our sample. Ceteris paribus, dual practice is associated with about 7 additional patients seen per week by health professionals; the number is higher (about 12-13 patients per week) for doctors. As before, the size of the effect is the highest for the linear polynomial and decreases continuously as we move from quadratic to cubic polynomial in our sample. Figure 5 panel c presents the coefficient estimates of pp for determining the number of patients seen per week together with the 95% confidence interval using White-heteroskedasticity-robust standard errors for different values of bandwidths in {1,1.1,...,2}. It follows that the effect of pp is increasing in the bandwidth, but becomes statistically insignificant for a bandwidth value above 1.5. As we increase the bandwidth, the regression discontinuity design becomes weaker. The fact that the confidence interval increases means that it only works close to the cut-off $exp5$ which also justifies the RD implementation in our set up.

We thus argue that these results are compatible with our theoretical results (Propositions 1 and 2): dual practice always reduces the consultation time that the public physician devotes to public patients.[12] Proposition 2 shows that this result is more likely to arise if physicians lack motivation, and/or if their opportunity costs of working at public facilities are very large. We also find some evidence in support of the above mechanisms. First, we consider the link between number of public patients seen by the dual practitioner and the likelihood of referring these patients to private practice from the puskesmas concerned as a measure of motivation of dual providers. IFLS data ask heads of puskesmas if they refer public patients to (a) other puskesmas; (b) hospitals; (c) private practice. We use this information to calculate the likelihood of referring a puskesmas patient to private practice (as opposed to public hospitals for example), which can assume significance in measuring motivation for the dual providers in particular. A simple t-test of mean comparisons suggests that the likelihood of private referral of puskesmas patients is about 24% for a puskesmas run by a dual practitioner head; the corresponding figure drops to 18% if the head of the puskesmas is not a dual practitioner and the mean difference is statistically significant. In order to explore the link between private referral of public patients and dual practice of health workers, we further regress the likelihood of referring public patients to private clinics on the likelihood of dual practice of puskesmas heads. Results suggest that the estimated coefficient of private referral is 0.10 with a standard error of 0.03 (see column 1 of Table 7) without any other control, and about 0.0320 with a standard error of 0.0127 with other controls that may also affect private referral. These results lend support to the fact that dual providers are motivated to use their public jobs to facilitate their private practice. As argued earlier, this practice is strengthened by their positions as the heads of puskesmas that allow them to use subordinate staff to cover their absence from the public jobs. Second, following on from our theoretical arguments we consider the role of private practice opportunities in this respect. Following on from our discussion of rural-urban difference in private practice opportunities in Section 4.3, we conjecture that in the full sample private practice opportunities are bare boosted by higher average of urban private practice opportunities. Accordingly, we conjecture that the opportunity costs of public service provision are higher if private practice opportunities are greater. Finally it is important to rule out an important competing explanation of our results and that is that our results are not driven by higher efficiency of dual practitioners. One obvious defense in support of our hypothesis is that our RD framework is developed in such a way that it focuses on health workers around the experience threshold of five

[12] Unfortunately IFLS data do not have consultation time information and we are thus basing our conclusion on the ratio of number of patients seen and hours worked.

years. So long as a key driver of medical efficiency is experience, we can argue that we consider health workers of comparable efficiency, thus ruling out the possibility that this result is an artifact of greater efficiency of dual practitioners in our sample. Taken together, we argue that results from Table 5 and Table 6 provide significant support to our key hypotheses explaining the effect of dual practice on hours worked and number of patients seen in a week.

We test the robustness of our second stage results to additional controls, including number of public patients per unit of health professionals (doctors and nurses) in the puskesmas and also community's access to all-weather roads, buses and sea. While greater access to public roads and transport would make the puskesmas more accessible, total number of public patients seen on average by any puskesmas health professional (rather than just by the head) would directly account for the demand for the health services provided in the puskesmas. We therefore test if our baseline results from Tables 5 and 6 are robust to the inclusion of these additional controls. These estimates, as summarized in Table 8, confirm that dual practice of health professionals is still associated with lower hours worked and more patients seen per week in our sample, thus confirming the robustness of our baseline results (see Tables 5-6). Note, however, that the size of the private practice effect is somewhat larger for the number of patients seen while that for number of hours worked the effect is similar, when we include additional controls.

5.3 Heterogeneity: Rural-urban estimates

Table 9 splits the sample by urban/rural regions and considers the first stage RD estimates of private practice likelihood for rural and urban regions separately using linear (columns 1-2), quadratic (columns 3-4) and cubic (columns 5-6) polynomials. Following on from Figures 3 and 4, we identify private practice by the variation in experience$\geq$5 years after the introduction of the 1997 MoH regulation. This is captured by the interaction term ($exp5 \times post97$). We find that the interaction term ($exp5 \times post97$) is statistically significant only in urban regions, but not in the rural areas irrespective of the choice of the polynomials (linear, quadratic, cubic). There are two possibilities that may explain the insignificance of the rural results: First, our discussion in Section 4.3 shows that the opportunities for private practice are significantly lower in rural Indonesia (see discussion in Section 4.3). Second, the Indonesian government traditionally struggles to recruit and retain health workers in rural regions (Chomitz et al. 1997) which may induce them to relax the implementation of the 1997 regulation there and, hence, the identification mechanism for dual practice fails.

We therefore proceed to conduct the second stage IV estimates for the urban regions only. Table 10 shows the 2SLS-D-in-D-RD estimates of hours/week and patients/week using quadratic polynomials for the urban region only. Evidently, these results confirm the findings from the full sample (see Tables 5-6): dual practice is associated with a significantly higher number of patients seen during the week, but lower hours worked per week in urban areas. In other words, the full sample estimates discussed in the previous section seems to be driven by the estimates for urban regions.

6 Conclusion

The present paper examines, both theoretically and empirically, the effects of dual practice on public doctors' labor supply decisions as reflected in the hours worked and number of patients seen during a week.

Theoretically, we find that allowing dual practice always reduces the consultation time that the public physician devotes to public patients. This is true both in the strong and weak monitoring work environments and it has to do with the fact that the larger the number of patients treated at public facilities the larger the amount of patients that decide to resort to private treatment. Moreover, in a weak monitoring work environment allowing dual practice might reduce the working hours that dual providers spend at public facilities. If the opportunity cost of working time at the public sector is high enough, the positive effect on patients' health of a marginal increase in the working time never compensates for the larger costs suffered by the physician and, hence, the dual provider reduces working time at public practice. Finally, it might happen that the reduction in the consultation time for public patients is so large that a dual provider may end up treating more patients at public facilities in a shorter period of time. This behavior is more likely to arise if physicians lack motivation, and/or if their opportunity costs of working at public facilities are very large.

Using four rounds of the Indonesian Family Life Survey facility (puskesmas) level data for the period 1993-2007, the present paper then tests the empirical validity of these hypotheses. Since participation in private practice is unlikely to be random, we use a novel quasi-experimental method to identify the causal effect of private practice on provision of public health services. In particular, we make use of the introduction of the 1997 Ministry of Health Regulation 916 that requires health professionals to obtain a license for private practice after at least three years of graduation and exploit the variation in private practice before and after the introduction of this 1997 regulation among those eligible and non-eligible for private practice. We argue that the professionals involved are unlikely to influence the timing of obtaining the license for private practice; as such, the implementation of the regulation makes the timing of the initiation of the private practice random because the precise timing depends on the administrative process involved in applying for the license after at least three years of experience till she obtains the license. Accordingly, we use a fuzzy regression discontinuity difference-in-difference model to identify the causal effect of private practice.

Our data sample shows that there is a significant discontinuity at the experience cut-off of 5 years. While the 1997 regulation suggests that a health professional can apply for a license at least after three years of experience, by virtue of a 1988 regulation the maximum period of compulsory service after graduation is five years. Allowing for the administrative process of application processing, we find that there is a pronounced discontinuity at around 5 years of experience after graduation. This discontinuity also validates the randomness of the initiation of private practice in the post-1997 years. Within a RD framework, we focus on the heads of puskesmas within first 10 years of experience after graduation, thus ensuring relative homogeneity of their experience, efficiency and earnings. It also helps in the execution of the regression discontinuity design used for identification of the private practice likelihood. Adopting a two-stage estimation method, we first determine the likelihood of private practice as a function of at least five years of experience in the post-1997 years and obtain the predicted value of private practice as an IV to determine hours worked per week and number of patients seen per week by heads of puskesmas.

Our empirical results provide some support to the hypothesis of interest that we develop theoretically: controlling for all other factors, dual practice of public health workers is likely to be associated with a significant reduction in the number of hours of work a week in the public facility; further, dual practitioners might end up seeing more patients during the week. These results are robust and hold irrespective of the choice of polynomials and additional controls. Finally, we argue that these results arise when physicians lack motivation, and/or if their opportunity costs of working at public facilities are very large, as the theoretical model suggests, and provide evidence in this respect: (i) all sample of health workers are the heads of the public facility so that they have considerable power and influence to avoid monitoring, on the one hand, and also to use supporting staff to cover their responsibilities when they are away from the public clinic serving in the private practice. (ii) The dual practitioners are also more likely to refer public patients to private practice for their private gain relative to those who do not practice privately. (iii) There is also a pronounced rural-urban heterogeneity in private practice opportunities so that opportunity cost of public service is significantly higher in the urban areas. The latter may explain why our results hold only in urban regions when we split the sample into rural and urban regions. The latter may also suggest that the full sample results are driven by those in the urban regions. Finally, we also rule out the possibility that the effect of dual practice on number of patients seen can be attributed to the greater efficiency of dual providers as use of RD methodology necessitates that we focus on health workers with comparable experience and efficiency.

As far as we are aware, ours is the first study to identify the causal impact of dual practice on public health provisions. With the growing privatization of many public services across the globe, dual practice of health professionals is rising alarmingly, especially in many emerging economies and in many cases the private medical sector remains totally unregulated. Thus, results of our analysis have important implications for countries other than Indonesia.

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7 Appendix

Proof of Lemma 1

If the physician only works in the public sector, he solves (1). The first order condition of (1) is

$$\theta \bar{t}^{1/2} \frac{1}{2n^{1/2}} - c = 0.$$

Since U^{pb} is concave in n, the optimal number of patients treated in the public sector is given by:

$$n_S^{pb*}(\bar{t}) = \frac{\theta^2 \bar{t}}{4c^2}.$$

And the consultation time devoted to a representative patient is

$$t_{cS}^{pb*}(\bar{t}) = \frac{\bar{t}}{n_S^{pb*}(\bar{t})} = \left(\frac{2c}{\theta}\right)^2.$$

For the dual provider, the first order condition of (2) is:

$$\theta \bar{t}^{1/2} \frac{1}{2n^{1/2}} + p\alpha - c = 0.$$

Since we have assumed $\alpha \leq \frac{p}{c}$ and U^d is concave in n, the optimal number of patients treated in the public sector is given by:

$$n_S^{d*}(\bar{t}) = \frac{\theta^2 \bar{t}}{4(c - p\alpha)^2}.$$

And the consultation time he chooses is

$$t_{cS}^{d*}(\bar{t}) = \frac{\bar{t}}{n_S^{d*}(\bar{t})} = \left(\frac{2(c - p\alpha)}{\theta}\right)^2.$$

This completes the proof.

Proof of Proposition 1

Since $p\alpha > 0$, it follows directly from Lemma 1 that $n_S^{d*}(\bar{t}) > n_S^{pb*}(\bar{t})$ and $t_{cS}^{d*} < t_{cS}^{pb*}$.

Proof of Lemma 2

If the physician only works in the public sector he faces:

$$\begin{aligned} &\underset{n,t}{Max}\, U^{pb} = \left[w + \theta n (t_c)^{1/2} - cn \right], \\ &s.t \qquad t_c = \frac{t}{n} \text{ and } t \in [t_{\min}, t_{\max}]. \end{aligned}$$

The optimal number of patients treated in the public sector is given by:

$$n_W^{pb}(t) = \frac{\theta^2 t_W^{pb*}}{4c^2},$$

where t_W^{pb*}, is now endogenously determined in the model.

Since the physician is motivated and cares about overall patients' health, the physician's utility is always increasing in t. Thus, the solution of the optimization program with respect to t is trivially at the corner $t_W^{pb*} = t_{\max}$.

If the physician is dual provider his maximization problem is:

$$\begin{aligned} &\underset{n,t}{Max}\, U^{d} = \left[w + \theta n (t_c)^{1/2} + p\alpha n - cn - \delta t \right] \\ &s.t \qquad t_c = \frac{t}{n} \text{ and } t \in [t_{\min}, t_{\max}]. \end{aligned}$$

And the number of patients treated at public facilities is given by

$$n_W^{d*}(t) = \frac{\theta^2 t_W^{d*}}{4\left(c - \alpha p\right)^2}.$$

In order to calculate t_W^{d*}, we evaluate U^d at $n_W^{d*}(t)$.Then:

$$U^d\left(n_W^{d*}(t)\right) = w + \frac{\theta^2 t_W^{d*}}{4\left(c - \alpha p\right)} - \delta t_W^{d*}.$$

$U^d\left(n_W^{d*}(t)\right)$ is linear in t_W^{d*}, which implies that the optimal choice of the physician regarding his working time at public facilities will be one of the two corner solutions $t_W^{d*} = t_{\min}$ or $t_W^{d*} = t_{\max}$. The first derivative of $U^d\left(n_W^{d*}(t)\right)$ with respect to t is $\frac{\theta^2}{4(c-\alpha p)} - \delta$. Thus, for $c - \alpha p > 0$ two different regions emerge depending on the comparison between the marginal cost (c) and benefit (αp) of providing care to a public patient and the opportunity cost of time, δ.[13] If $\delta \geq \frac{\theta^2}{4(c-\alpha p)}$ or, equivalently, $c - \alpha p \geq \frac{\theta^2}{4\delta}$, $\frac{\partial U^d}{\partial t} \leq 0$ and the solution is $t_W^{d*} = t_{\min}$. On the contrary, if $\delta < \frac{\theta^2}{4(c-\alpha p)}$ or, equivalently, $c - \alpha p \in \left(0, \frac{\theta^2}{4\delta}\right)$, $\frac{\partial U^d}{\partial t} > 0$ and the solution is $t_W^{d*} = t_{\max}$.

Finally, it is straighforward to check that the optimal consultation time for solo practitioners is $t_{cW}^{pb*} = \frac{t_{\max}}{n_W^{pb*}(t_{\max})} = \left(\frac{2c}{\theta}\right)^2$, while dual provider's optimal consultation time is

$$t_{cW}^{d*} = t_{cW}^{d*}(t_{\max}) = t_{cW}^{d*}(t_{\min}) = \left(\frac{2\,(c - p\alpha)}{\theta}\right)^2.$$

This completes the proof.

Proof of Proposition 2

Regarding physician's total working time, it is direct to see that if $c - \alpha p \in \left(0, \frac{\theta^2}{4\delta}\right)$ the physician chooses $t_{\max}$ both when he is dual provider and when he works only in the public sector ($t_W^{d*} = t_W^{pb*} = t_{\max}$). In the remaining cases, i.e., when $c - \alpha p \geq \frac{\theta^2}{4\delta}$, the optimal working time in the public sector for dual providers is lower than for solo public providers, as $t_W^{d*} = t_{\min}$ and $t_W^{pb*} = t_{\max}$. It is also direct to see that $t_{cW}^{pb*} < t_{cW}^{d*}$, since $p\alpha > 0$.

Regarding the comparison between the number of patients treated at public facilities for dual and solo practice providers we see that: If $c - \alpha p \in \left(0, \frac{\theta^2}{4\delta}\right)$, since $t_W^{d*} = t_W^{pb*} = t_{\max}$, then $n_W^{d*}(t_W^{d*} = t_{\max}) > n_W^{pb*}(t_W^{pb*} = t_{\max})$. When $c - \alpha p \geq \frac{\theta^2}{4\delta}$, the physician chooses $t_W^{d*} = t_{\min}$ when he is dual provider and $t_W^{pb*} = t_{\max}$ when he works only in the public sector. If we compare $n_W^{d*}(t_{\min})$ and $n_W^{pb}(t_{\max})$, we find that $n_W^{d*}(t_{\min}) > n_W^{pb}(t_{\max})$ provided

$$\frac{\theta^2 t_{\min}}{4\,(c - \alpha p)^2} > \frac{\theta^2 t_{\max}}{4c^2}, \tag{5}$$

which is fulfilled if $c - \alpha p < c\left(\frac{t_{\min}}{t_{\max}}\right)^{1/2}$.[14]

[13] Note that the case $c - \alpha p \leq 0$ is excluded from our analysis since we have assumed that $\alpha \leq \frac{p}{c}$.

[14] Some comparative statics allow us to see that the larger the benefit of treating a new patient in the public sector,

Combining Lemma **2** and condition (5) we can compare dual provider's choices and choices by a physician who only works in the public sector in a weak monitoring work environment. Assume first that $\frac{\theta^2}{4\delta} \leq c\left(\frac{t_{\min}}{t_{\max}}\right)^{1/2}$. We already know that $t^{d*} = t^{pb*} = t_{\max}$ if $c - \alpha p \in \left(0, \frac{\theta^2}{4\delta}\right)$, while $t^{d*} = t_{\min} < t^{pb*} = t_{\max}$ if $c - \alpha p \geq \frac{\theta^2}{4\delta}$. At the same time, for $c - \alpha p < c\left(\frac{t_{\min}}{t_{\max}}\right)^{1/2}$, $n^{d*}(t_{\min}) > n^{pb*}(t_{\max})$, while for $c - \alpha p \geq c\left(\frac{t_{\min}}{t_{\max}}\right)^{1/2}$, $n^{d*}(t_{\min}) \leq n^{pb*}(t_{\max})$. Therefore, we can ensure that for $c - \alpha p \in \left[\frac{\theta^2}{4\delta}, c\left(\frac{t_{\min}}{t_{\max}}\right)^{1/2}\right)$ it holds that $n^{d*}(t_{\min}) > n^{pb*}(t_{\max})$. Suppose now that $\frac{\theta^2}{4\delta} > c\left(\frac{t_{\min}}{t_{\max}}\right)^{1/2}$. In this case if $c - \alpha p \in \left(0, \frac{\theta^2}{4\delta}\right)$, then $t^{d*} = t^{pb*} = t_{\max}$ and $n^{d*}(t_{\max}) > n^{pb*}(t_{\max})$. If, on the contrary, $c - \alpha p \geq \frac{\theta^2}{4\delta}$, it holds that $t^{d*} = t_{\min} < t^{pb*} = t_{\max}$ and $n^{d*}(t_{\min}) \leq n^{pb*}(t_{\max})$.

This completes the proof.

$p\alpha$, the more likely condition (5)holds. At the same time, the larger the ratio $\frac{t_{\min}}{t_{\max}} \leq 1$, i.e., the closer $t_{\min}$ and $t_{\max}$, the more likely condition (5) holds. Note that in the limit case where $t_{\max} \to t_{\min}$ the condition trivially holds. Finally, an increase in the marginal cost of providing medical care, c, makes the condition more demanding.

Tables

Table 1. Descriptive statistics at the Puskesmas level 1993-2007

Variable	Obs	ALL Mean	Std. Dev.	Obs	1993-1997 (pre-1997) Mean	Std. Dev.	Obs	2000-2007 (post-1997) Mean	Std. Dev.
If practice privately	3411	0.74934	0.433456	1520	0.776316	0.41685	1891	0.727657	0.445283
PP in the puskesmas	3896	0.184805	0.388189	2005	0.189526	0.392024	1891	0.179799	0.384122
Head is a doctor	3893	0.591575	0.491606	2002	0.548951	0.497722	1891	0.6367	0.481077
Hours worked/wk	3234	20.45625	19.05246	1364	29.30132	12.46039	1870	14.00455	20.39464
Patients seen/wk	3038	84.21988	92.1034	1318	79.24507	77.73932	1720	88.03198	101.6049
Referral to private pr	3896	0.323409	0.467837	2005	0.581546	0.493429	1891	0.049709	0.217401
Experience (in years)	2849	11.83959	7.260543	1380	5.39	2.87	1469	5.89	2.98
Speaks local language	3293	0.947464	0.223139	1402	0.947932	0.222244	1891	0.947118	0.223857
Urban region	3896	0.598819	0.4902	2005	0.582544	0.493263	1891	0.616076	0.486468

Source: Four rounds of IFLS

Table 2: Mean comparisons of selected variables below/above 3 years of experience

Post-97 comparison	**Experience>=3yrs**	**Experience<3yrs**	**T-stat**
If holds a private practice (pp)	0.73	0.72	0.5152
Hours worked/wk	14	13	0.0258
Patients seen/wk	88	92	0.3940
Refers patients to private clinic	0.05	0.09	-1.5540
Holds private practice in the public hospital	0.17	0.30	-2.795***
Speaks local language	0.95	0.79	6.5220***
Urban region	0.63	0.41	3.8613***
Pre-97 comparison	**Experience>=3yrs**	**Experience<3yrs**	**T-stat**
If holds a private practice (pp)	0.79	0.70	2.3912**
Hours worked/wk	29.4	27.2	1.4686
Patients seen/wk	79.9	67.7	1.3428
Refers patients to private clinic	0.58	0.54	1.0233
Holds private practice in the public hospital	0.18	0.30	-3.696***
Speaks local language	0.95	0.88	2.8561***
Urban region	0.59	0.47	3.1769***

Note: *** p<0.01, ** p<0.05, * p<0.1.

Table 3: Mean comparisons of selected variables below/above 5 years of experience

Post-97 comparison	**Experience>=5yrs**	**Experience<5yrs**	**T-stat**
If holds a private practice (pp)	0.78	0.71	2.0119**
Hours worked/wk	14	16	-1.7656*
Patients seen/wk	88	85	1.4083
Refers patients to private clinic	0.05	0.06	0.7345
Holds private practice in the public hospital	0.17	0.30	-4.5080***
Speaks local language	0.96	0.86	5.8713***
Urban region	0.64	0.41	6.4019***
Pre-97 comparison	**Experience>=5yrs**	**Experience<5yrs**	**T-stat**
If holds a private practice (pp)	0.78	0.75	1.1553
Hours worked/wk	30	27	2.1978**
Patients seen/wk	81	65	2.3501**
Refers patients to private clinic	0.58	0.57	0.5584
Holds private practice in the public hospital	0.16	0.32	-6.6978***
Speaks local language	0.96	0.88	4.0477***
Urban region	0.60	0.48	4.0797***

Note: *** p<0.01, ** p<0.05, * p<0.1

Table 4. Regression discontinuity: First stage linear probit estimates of the likelihood of private practice (PP) 1993-07

VARIABLES	(1) All *PP*	(2) All *PP*	(3) All *PP*
Experience>=5 (exp5)	-0.118	0.0108	0.280
	(0.125)	(0.171)	(0.241)
Post 1997	-0.0653	-0.0681	-0.0685
	(0.0753)	(0.0757)	(0.0758)
*exp5*post97*	0.206**	0.212**	0.214**
	(0.104)	(0.105)	(0.105)
Constant	0.873***	0.798***	0.697***
	(0.127)	(0.155)	(0.197)
Polynomial	Linear	Quadratic	Cubic
Weights	Yes	Yes	Yes
District dummies	Yes	Yes	Yes
No of observations	923	923	923
F-test on cut-off	3.93**	4.12**	4.18**
R-squared	0.136	0.139	0.140

Robust standard errors in parentheses; *** p<0.01, ** p<0.05, * p<0.1.
The dependent variable is the private practice dummy pp. Exp5 is a binary variable indicating if the head has at least 5 years of experience since graduation. Post97 is a binary variable indicating post 1997 IFLS rounds, i.e., years 2000 and 2007. Exp5*post97 is the interaction between exp5 and post97.

Table 4a. Test of Covariates Balance

VARIABLES	(1) llang	(2) headdoc	(3) urban
exp5	0.0180	-0.0343	0.0849
	(0.0558)	(0.0734)	(0.0698)
post97	-0.0220	0.118***	0.0487
	(0.0367)	(0.0435)	(0.0443)
*exp5*post97*	0.00944	-0.0714	-0.101
	(0.0424)	(0.0580)	(0.0660)
Constant	0.702***	0.629***	0.262***
	(0.0803)	(0.0901)	(0.0911)
District dummies	Yes	Yes	Yes
Polynomials	Linear	Linear	Linear
Joint P-value	0.85	0.21	0.19
Observations	923	923	923
R-squared	0.097	0.112	0.412

Robust standard errors in parentheses; *** p<0.01, ** p<0.05, * p<0.1.

The table provides a test of balanced covariates (a la Lee and Lemieux, 2010). Joint p-value" provides the p-value from a test of joint significance of exp5 (treatment) and (exp5*post) coefficients in columns (1) to (3), which leads to the acceptance of the null hypothesis that these two coefficients are jointly zero.

Table 5. Regression discontinuity second stage: 2SLS IV estimates of hours worked per week 1993-07

VARIABLES	(1) All	(2) All	(3) All	(4) Doctors	(5) Doctors	(6) Doctors
Holds PP	-17.92*	-18.16*	-18.00*	-17.57	-17.65*	-17.42*
	(10.84)	(10.46)	(10.30)	(11.15)	(10.48)	(10.19)
Experience>=5	-2.360	-3.396	-2.043	-3.797**	-4.145	-0.490
	(1.731)	(3.358)	(10.00)	(1.852)	(4.114)	(11.43)
Speaks local lang	-0.610	-0.485	-0.503	2.126	2.206	2.153
	(2.470)	(2.393)	(2.365)	(4.199)	(3.951)	(3.866)
Urban region	-1.031	-1.042	-1.033	-2.827	-2.853*	-2.838*
	(1.221)	(1.231)	(1.229)	(1.749)	(1.706)	(1.686)
Head is a doctor	-3.422***	-3.406***	-3.403***			
	(1.193)	(1.204)	(1.200)			
Constant	32.02***	33.36***	34.67***	26.15***	26.93***	27.88***
	(8.597)	(8.077)	(10.10)	(8.478)	(7.357)	(8.960)
District/year dummies	Yes	Yes	Yes	Yes	Yes	Yes
Weights	Yes	Yes	Yes	Yes	Yes	Yes
Polynomial	Linear	Quadratic	Cubic	Linear	Quadratic	Cubic
No of observations	889	889	889	656	656	656
R-squared	0.124	0.116	0.122	0.301	0.299	0.306

Robust standard errors in parentheses; *** p<0.01, ** p<0.05, * p<0.1.
The private practice dummy *pp* is instrumented by the *exp5*post97*.

Table 6. Regression discontinuity second stage: 2SLS IV estimates of patients seen per week 1993-07

VARIABLES	(1) All	(2) All	(3) All	(4) Doctors	(5) Doctors	(6) Doctors
Holds PP	7.079**	6.786**	6.710**	13.89	12.98*	12.69*
	(3.462)	(3.337)	(3.293)	(13.92)	(6.747)	(6.530)
Experience>=5	-1.519	-20.59	-46.70	-9.398	-41.89*	-94.94
	(7.777)	(13.48)	(41.09)	(22.34)	(23.39)	(70.51)
Speaks local lang	5.785	7.385	7.632	-26.90	-22.66	-21.62
	(8.865)	(8.580)	(8.498)	(42.68)	(22.16)	(21.48)
Urban region	7.732	7.634	7.627	0.396	0.200	0.241
	(5.961)	(5.867)	(5.846)	(14.57)	(9.294)	(9.171)
Head is a doctor	23.62***	24.09***	24.10***			
	(4.635)	(4.580)	(4.563)			
Constant	1.827	18.63	34.97	3.543	30.33	50.64
	(26.87)	(25.99)	(37.97)	(94.62)	(42.72)	(58.68)
Polynomial	Linear	Quadratic	Cubic	Linear	Quadratic	Cubic
Weights	Yes	Yes	Yes	Yes	Yes	Yes
District/Year dum	Yes	Yes	Yes	Yes	Yes	Yes
No of observations	822	822	822	585	585	585
R-square	0.2143	0.2132	0.2147	0.2253	0.2245	0.2300

Robust standard errors in parentheses; *** p<0.01, ** p<0.05, * p<0.1

The private practice dummy *pp* is instrumented by the *exp5*post97*.

Table 7. Regression discontinuity second stage: 2SLS IV estimates of referral to private clinics 1993-07

VARIABLES	(1) Referral	(2) Referral
Holds PP	0.100**	0.0320**
	(0.0494)	(0.0127)
Experience>=5		0.0172***
		(0.00436)
Speaks local lang		-0.0143***
		(0.00531)
Urban region		0.000899
		(0.00328)
Head is a doctor		-0.00269
		(0.00300)
Constant	0.384***	0.447***
	(0.0453)	(0.0192)
District dummies	Yes	Yes
Year dummies	Yes	Yes
Polynomial	Linear	Linear
Weights	Yes	Yes
Observations	923	923
R-squared	0.356	0.746

Robust standard errors in parentheses; *** p<0.01, ** p<0.05, * p<0.1

Table 8. Second stage estimates of public doctors' services with additional controls

VARIABLES	(1) hours_wk	(2) n_patient_wk
Holds PP	-17.61*	33.98***
	(10.35)	(10.48)
Experience>=5	0.118	-9.378**
	(3.905)	(3.913)
Speaks local lang	-3.802**	1.168
	(1.533)	(12.34)
Urban region	-3.274**	6.917***
	(1.508)	(1.400)
Head is a doctor	-4.030***	8.355***
	(1.444)	(1.886)
Number of public patients per health professional	0.0117	0.447***
	(0.0105)	(0.119)
Access to all-weather roads	1.028	3.654***
	(1.502)	(1.359)
Access to bus	-4.517***	1.551
	(1.178)	(1.180)
Access to sea	6.692***	-0.123
	(1.542)	(3.436)
Constant	12.11***	-60.99***
	(1.237)	(11.21)
District dummies	Yes	Yes
Year dummies	Yes	Yes
Weights	Yes	Yes
Polynomials	Quadratic	Quadratic
Observations	889	822
R-squared	0.289	0.583

Robust standard errors in parentheses; *** p<0.01, ** p<0.05, * p<0.1
The private practice dummy *pp* is instrumented by the *exp5*post97*.

Table 9. Regression discontinuity: First stage estimates of the likelihood of private practice 1993-07 by region

VARIABLES	(1)Urban	(2) Rural	(3) Urban	(4) Rural	(5) Urban	(6) Rural
Experience>=5 (exp5)	-0.259	-0.0655	-0.230	0.127	-0.0550	0.437
	(0.170)	(0.187)	(0.247)	(0.255)	(0.366)	(0.358)
Post 1997	-0.231*	0.0285	-0.234*	0.0212	-0.235*	0.0204
	(0.121)	(0.104)	(0.122)	(0.105)	(0.122)	(0.105)
*exp5*post97*	0.310**	0.180	0.317**	0.193	0.320**	0.196
	(0.151)	(0.151)	(0.151)	(0.153)	(0.152)	(0.153)
Constant	0.835***	0.896***	0.925***	0.759***	1.018**	0.619**
	(0.285)	(0.139)	(0.325)	(0.187)	(0.403)	(0.250)
Polynomial	Linear	Linear	Quadratic	Quadratic	Cubic	Cubic
Weights	Yes	Yes	Yes	Yes	Yes	Yes
District dummies	Yes	Yes	Yes	Yes	Yes	Yes
Number of observations	465	458	465	458	465	458
R-squared	0.207	0.186	0.213	0.192	0.216	0.193

Robust standard errors in parentheses *** p<0.01, ** p<0.05, * p<0.1
The dependent variable is the private practice dummy pp. Exp5 is a binary variable indicating if the head has at least 5 years of experience since graduation. Post97 is a binary variable indicating post 1997 IFLS rounds, i.e., years 2000 and 2007. Exp5*post97 is the interaction between exp5 and post97.

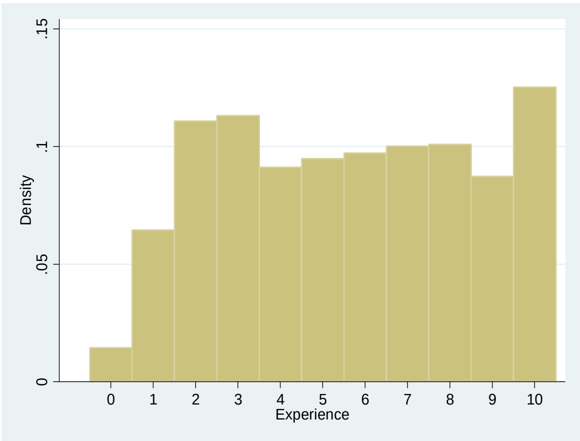
Table 10. Regression discontinuity: Second stage estimates of outcome variables, Urban

	Urban		(2) Urban & Doctors	
VARIABLES	hours_wk	patients_wk	hours_wk	patients_wk
Holds PP	-23.47***	29.80*	-24.91*	38.11
	(8.437)	(17.29)	(15.15)	(24.78)
Experience>=5	4.261	-81.12	4.819	-111.8
	(4.033)	(54.48)	(5.532)	(85.72)
Speaks local lang	-3.211	-14.85	4.656	-11.05*
	(2.139)	(28.84)	(3.640)	(6.326)
Urban region	-8.289***	12.96***		
	(2.748)	(4.446)		
Constant	33.96***	-160.4	15.01*	-14.99
	(8.979)	(147.6)	(7.780)	(117.5)
Polynomial	Quadratic	Quadratic	Quadratic	Quadratic
Weights	Yes	Yes	Yes	Yes
District/Year	Yes	Yes	Yes	Yes
No. of observations	448	438	356	345
R-squared	0.149	0.258	0.231	0.301

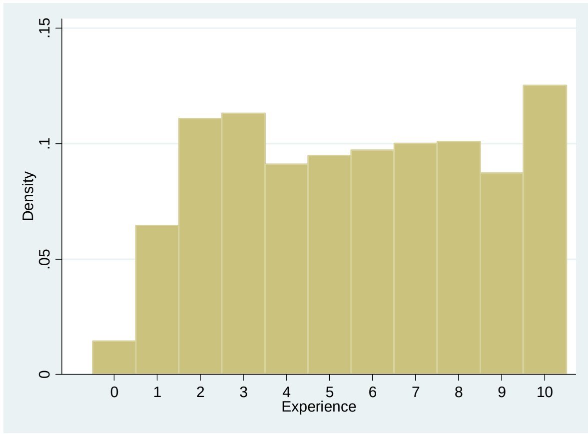
Robust standard errors in parentheses; *** p<0.01, ** p<0.05, * p<0.1.
The private practice dummy *pp* is instrumented by the *exp5*post97*.

Figures

Figure 1. Frequency distribution (histogram) of experience in years before/after the regulation

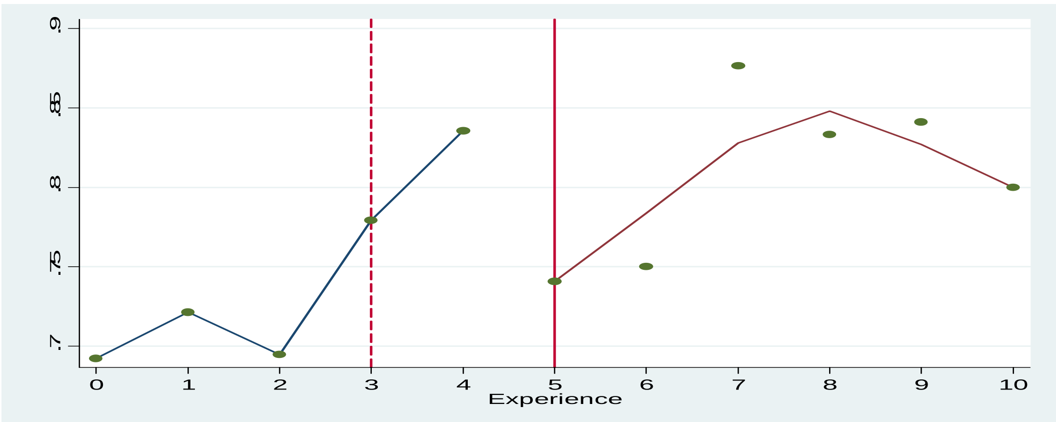


Pre-regulation

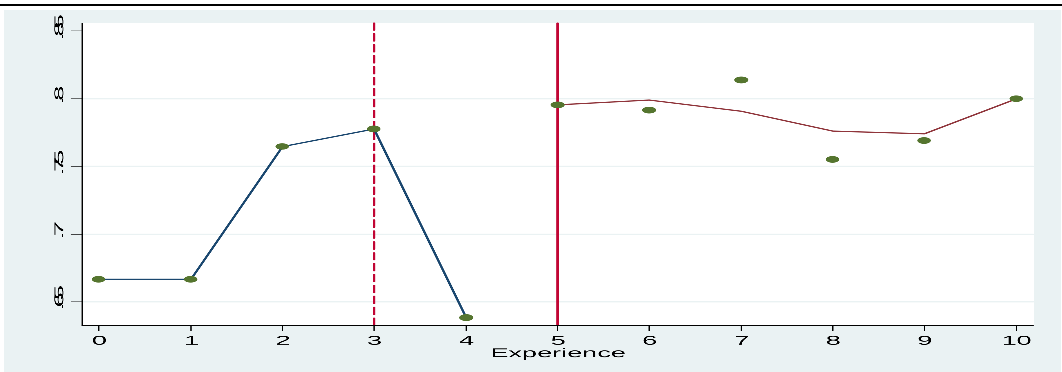


Post-regulation

Figure 2. Likelihood of private practice, regression discontinuity in experience before and after the regulation (full sample)



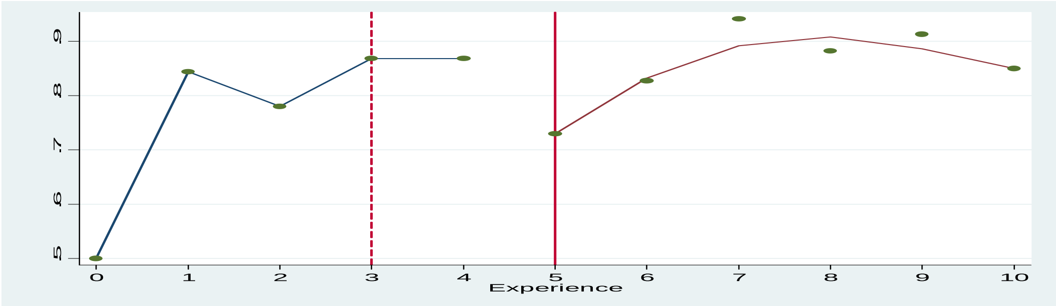
Pre-regulation



Post-regulation

Figure 3. Likelihood of private practice, regression discontinuity in experience before and after the regulation (Urban)

Pre-regulation



Rural – post-regulation

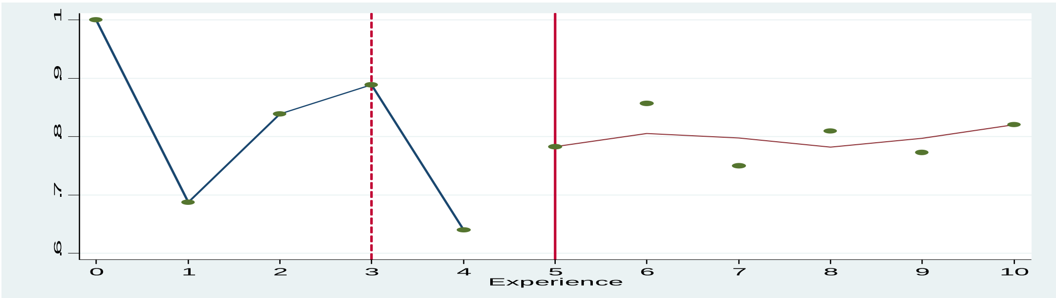
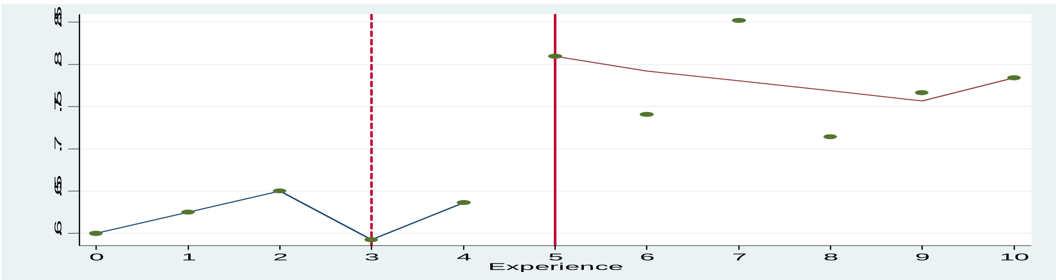


Figure 4. Likelihood of private practice, regression discontinuity in experience before and after the regulation (Rural)

Pre-regulation



Post-regulation

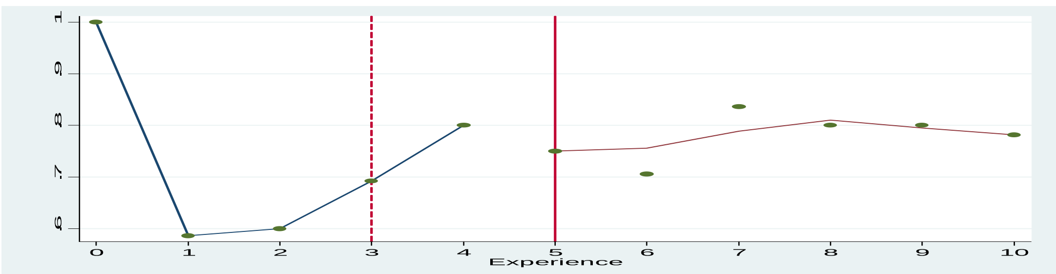
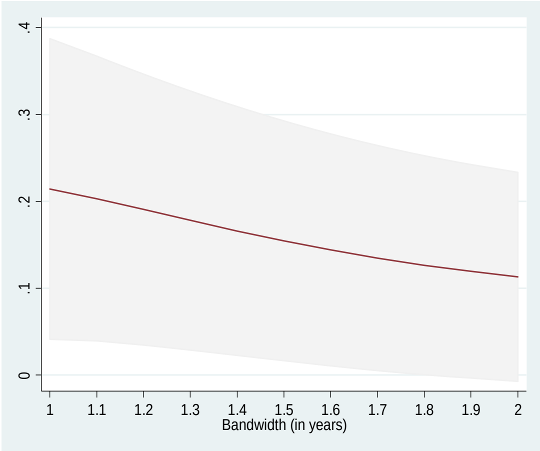
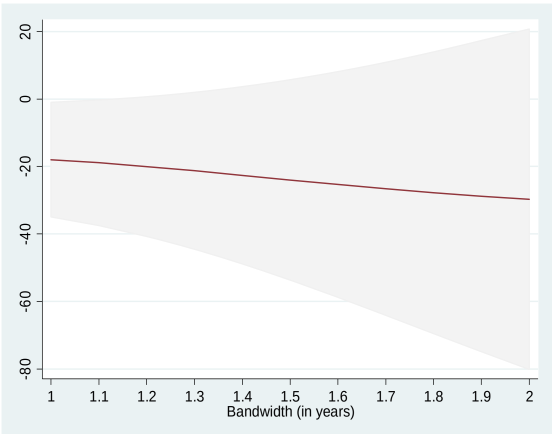


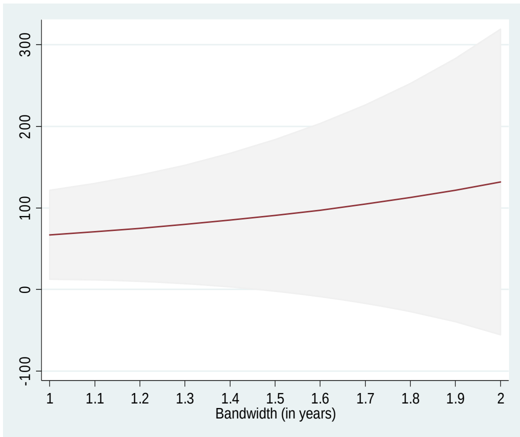
Figure 5. Confidence interval estimates



Panel a. Effect of experience on likelihood of private practice – RD Confidence interval



b. Effect of private practice (proxied by experience threshold) on hours worked/week



c. Effect of private practice (proxied by experience threshold) on patients seen/week

Appendix 1

Table A1. Likelihood of private practice: Placebo test at different threshold levels of experience since graduation

VARIABLES	(1) Exp=2	(2) Exp=3	(3) Exp=4	(4) Exp=6
Post 1997	0.0734	0.0184	0.0139	0.0711
	(0.331)	(0.0737)	(0.0602)	(0.0802)
Experience = 2	0.179			
	(0.329)			
(Exp=2)*Post 1997	-0.104			
	(0.337)			
Experience=3		0.172		
		(0.177)		
(Exp=3)*Post 1997		-0.0484		
		(0.102)		
Experience=4			-0.110	
			(0.164)	
(Exp=4)*Post 1997			-0.0439	
			(0.103)	
Experience=6				-0.0855
				(0.231)
(Exp=6)*Post 1997				-0.000398
				(0.111)
Constant	0.685*	0.835***	1.000***	0.777***
	(0.350)	(0.162)	(0.0928)	(0.161)
District dummies	Yes	Yes	Yes	Yes
Polynomial	Quadratic	Quadratic	Quadratic	Quadratic
Weights	Yes	Yes	Yes	Yes
F-stat (P-value)[1]	0.21 (0.89)	0.33 (0.80)	0.34 (0.79)	0.58 (0.63)
Observations	923	923	923	923
R-squared	0.216	0.196	0.148	0.116

Robust standard errors in parentheses; *** p<0.01, ** p<0.05, * p<0.1

[1] The reported F-statistic tests the relevance of the instrument using the following joint hypothesis: (Expk=0) (post97=0) (Expk*Post97=0) where k=2,3,4,6.

Table A2. OLS non-IV estimates of outcome variables

VARIABLES	(1) *hours_wk*	(2) *patient_wk*	(3) *hours_wk*	(4) *patient_wk*
Holds PP	1.803	-3.026	1.724	-3.288
	(2.573)	(7.032)	(2.584)	(7.168)
Speaks local lang	-2.657	13.84	-2.656	14.18
	(3.057)	(14.81)	(3.059)	(14.52)
Urban	-5.120	23.02**	-5.113	22.88**
	(4.897)	(11.02)	(4.849)	(10.93)
Head is a doctor	-10.53	38.77***	-10.56	38.76***
	(8.380)	(13.03)	(8.442)	(12.90)
Constant	22.82***	59.35**	25.33**	67.32**
	(7.561)	(23.15)	(9.327)	(27.00)
Polynomial	Linear	Linear	Quadratic	Quadratic
Weights	Yes	Yes	Yes	Yes
District & Year dummies	Yes	Yes	Yes	Yes
Observations	892	886	892	886
R-squared	0.185	0.251	0.188	0.253

Robust standard errors in parentheses; *** p<0.01, ** p<0.05, * p<0.1

PP is a binary variable indicating if the head of the puskesmas holds private practice.

Appendix 2

Table A1. A historical account of government regulations in the health sector in Indonesia

Regulation	Description
Constitution 1945	Guarantees "the right to health" as a realization of general welfare
Presidential Instruction 1974	Mandated that all new medical graduates serve in under-served rural districts for 1-3 years
Presidential Regulation No. 37 1991	Regulated the recruitment of doctors as temporary employees.
Health Act 23 1992	Regulates health personnel training and education as conducted by government and private sector institutions.
Government Rule No. 23 1996	Regulates type of health personnel
Ministry of Health Regulation No. 916 1997	Regulates the licensing of Medical Practitioners
Ministry of Health Decree No. 1239 2000	Nurse's Registration and Practice regulations
Ministry of Health Regulation No. 1540 2002	Regulates the placement of health doctors during the service period
Ministry of Education Act No. 20 2003	Develops standards for higher education for medical professionals
Medical Practitioner Act No. 29 2004	Regulates that every doctor and dentist has to ensure quality services and cost containment.
Social Security Law No. 40 2004	Mandates the nature of social security contributions and services
Local Government Authority Act No. 32 2004	Provides each local government the authority to recruit their own medical personnel as local government authority
Ministry of Health Regulation No. 1419 2005	Regulates the conduct of medical and dental practice

Source: USAID, 2009

Table A2. Variable definitions

Variable abbreviations	Definitions
pp	Binary variable indicating private practice of health professionals
Exp5	Binary variable indicating if experience>=5 years and 0 otherwise
Post97	Binary variable indicating the years after the introduction of the 1997 regulation and 0 otherwise
hours_wk	Hours worked per week by the head of the puskesmas
patients_wk	Number of patients seen per week by the head of the puskesmas
Referral	Binary variable indicating if any puskesmas patient is referred to a private clinic
Private practice in the public hospital	Binary variable indicating if private practice is held in the public hospital
Llang	Binary variable indicating if the health professional speaks the local language
Urban	Binary variable indicating if the puskesmas is in the urban region