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Adverse Selection and Career Outcomes in the Ethiopian Physician Labor Market

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Abstract:
This paper uses a newly collected dataset on Ethiopian physicians to shed light on the allocative efficiency of the physician labor market. We use a lottery mechanism by which medical school graduates are assigned to their first jobs to identify the long-term impact of being posted to a rural area instead of the capital, Addis Ababa. We find that physicians who are assigned to Addis are more satisfied with their initial and their current jobs. However, being assigned to the capital through the lottery does not appear to have significant long-run career benefits. This appears to be partly because relatively high ability physicians opt out of the lottery and find jobs in Addis, where they successfully compete with those assigned by the lottery for specialized training.

We also find evidence of adverse selection in the market for physicians who initially participated in the lottery, compared with the market for physicians who did not. We rationalize these findings by suggesting that the lottery, by explicitly randomly assigning new graduates, obfuscates information about them that future employers would otherwise find valuable. High ability workers from the lottery do relatively worse later in their careers than their counterparts who did not take part in the lottery, and are more likely to exit the physician labor market in Ethiopia. Our results suggest that using a lottery to assign new physicians to jobs could compromise the future allocative efficiency of the labor market, and even contribute to the medical brain drain. This is not because the long-term impacts of getting a “bad” draw are negative, but because the lottery makes it difficult for good physicians to signal their quality.

Keywords: Wage Level and Structure, Labor Contracts, Public Sector Labor Markets, Analysis of Health Care Markets

JEL Classification: I11, J45, O20

1 Introduction

Ethiopia faces acute challenges in reaching all of the Millenium Development Goals, including the three goals relating to health - to reduce child mortality, improve maternal health, and combat HIV/AIDS, malaria, and other diseases. This paper assesses one factor that will be important in moving towards these goals – the performance of the physician labor market.

There is on average about one physician for every 30,000 people in Ethiopia (Ministry of Health, 2005), three times the ratio recommended by the WHO. Rural and remote areas of the country are particularly underserved, and by some estimates up to half of the physicians work in the capital, Addis Ababa, home to about 5 percent of the population. Increasing labor supply in rural areas can be effected either by fiat or with financial and other incentives. The Ethiopian government has traditionally relied on the first approach, through the operation of a lottery-based clearing house for the assignment of new medical school graduates to their first postings.

In this paper we use recently collected data from a survey of physicians to address two basic questions about the physician labor market: first, what are the long term effects on a health worker's career prospects of rural assignment?; and second, how does the lottery system affect the subsequent efficiency of the physician labor market? In addressing each of these questions, we use data both on physicians who participated in the lottery system, and on those who chose to enter the market directly.

There are three potential selection nodes in the allocation of newly graduated physicians to jobs.[1] First, although the lottery mechanism is officially mandatory, only about 60 percent of our sample participated, suggesting an element of choice. Second, for those who enter the lottery, job assignment could exhibit some non-randomness, due either to specific aspects of the allocation mechanism or to less formal bargaining and lobbying by some graduates. And third, for those who opt out of the lottery mechanism, assignment is potentially influenced by the preferences on both the demand and supply side of the market. Our data suggest that the determinants of job assignment differ significantly between the second and third nodes. In particular, assignment under the lottery is close to random.

We use matching and standard regression techniques to identify the career impact of assignment to the rural areas, both among lottery participants and across all doctors. We find that lottery participants initially assigned to Addis are no more likely to be (a) currently working in Addis, (b) working in the private sector, or (c) earning higher salaries than those whose first job was outside the capital. Indeed, Addis assignment

[1] Four, if we count the decision to enter medical school.

early on in the career *reduces* physician specialization rates, while increasing current job satisfaction and the likelihood that physicians are currently working in the their home regions.

Our evidence regarding the impact of assignment to Addis has interesting parallels in the recent education literature. Cullen et al. (2006) find that prospective high school students winning a lottery that gives them the option to attend a high performing school in Chicago *do not* seem to benefit. In fact, they demonstrate that students who, *ex ante*, stand to gain the most in terms of peer quality in practice appear to be hurt by winning the lottery, at least in terms of academic outcomes. For example, they are more likely to drop out.

In our data, lottery physicians assigned to Addis find themselves among some of the relatively high ability physicians who opted out of the lottery and found employment in Addis. As in the Chicago education study, this peer effect seems also to have negative consequences, perhaps because the "lucky winners" must compete against higher ability doctors for specialist training opportunities, etc. As Cullen et al. point out, their findings are consistent with the literature on the importance of mismatch (e.g., Light and Strayer (2000)) and of one's relative position (e.g., Kaufman and Rosenbaum (1992)).

To examine the efficiency effects of the lottery system, we propose a model of adverse selection in the physician labor market. The idea is that some jobs are more desirable than others, and that under a market-based mechanism these jobs go to better quality doctors. Initial job assignment then provides useful information to future employers regarding worker productivity. On the other hand, if jobs are initially allocated randomly, then future employers learn little about an individual's inherent ability from the location of this first job. For this group of workers, the labor market is subject to adverse selection, with relatively high quality workers opting out of the profession.

We develop empirically testable implications of this theory and assess them using our newly collected dataset. The short-run implications of the model, pertaining to the allocation of new graduates, are broadly supported by the data: we find that first, the market allocates new graduates to jobs based at least in part on their ability and locational preferences. In contrast, these variables do not predict the initial assignment across regions for lottery participants. In light of this, higher ability graduates tend to opt out of the lottery. The data also indicate that recent growth of demand for private sector physicians is associated with falling lottery participation. And finally, the pattern of job satisfaction expressed amongst lottery participants across ability levels reflects the random nature of the lottery assignment: physicians assigned by the lottery to Addis are on average more satisfied with their first assignment.

Second, the data broadly support the long-term predictions of the model regarding the efficiency of the physician labor market. For example, we observe wage compression in the market for physicians who participated in the lottery: high-ability physicians who participated in the lottery earn significantly less (16

percent) than those who did not, while lottery participation does not significantly affect the future wages of lower ability doctors. Similarly, access to future training opportunities appears to be attenuated for high ability lottery participants relative to similar physicians who opted out of the lottery, while there is little such difference for lower ability graduates. Finally, in light of these dynamics, we find evidence of higher rates of attrition among high-ability physicians who took part in the lottery than for those who did not. These results suggest that the lottery allocation obscures information about physician quality and may lead to adverse selection.

2 Ethiopia's market for physician labor

The number of health workers working in Ethiopia is difficult to estimate. The Ministry of Health (2005) reports that in 2005 there were a total of 2,543 physicians, of which 444 (17%) operated in the private sector, 578 (23%) in the NGO sector, and 354 (14%) in other government organizations (such as the military). Of the 1,077 physicians classified as working for the public sector, 20 percent, or about 215 were located in Addis Ababa.

In recent years, there has been rapid growth in the private health care sector, but the vast majority of this growth has occurred in Addis Ababa. In fact, according to survey data we collected in 2006 on physicians in Ethiopia, 380 out of an estimated 597 physicians working in Addis (or 64%) currently work as physicians outside the public sector, the vast majority in the private sector, earning salaries that are double those in the public sector in Addis and triple those in the public sector outside Addis. In one of the two other regions covered by the survey, Southern Nations Nationalities Peoples Republic (SNNPR), about 10% of physicians are estimated to be working outside the public sector (including NGOs). In the second region, Tigray, virtually all doctors are estimated to work in the public sector.

As suggested by these statistics and confirmed through discussions with health workers themselves, attracting physicians to remote areas is a particular challenge. The problem of rural employment has grown even more acute as opportunities to work abroad expand, partly due to active recruitment efforts of other countries. For example, Clemens and Pettersson (2007) find that 30% of all practicing Ethiopian physicians work abroad.

The primary vehicle by which the supply of rural health workers is maintained is a national clearing house. Each year a national lottery is announced through the media in September. Health workers who graduated in the previous June and July, as well as doctors who have completed their internships, are invited to go to the Ministry of Health, starting in October, to participate in the lottery.

Under the lottery, which is officially mandatory although in practice optional, a participant is randomly assigned to one of the twelve regions of the country. Job assignments at the regional level are administrated by the relevant regional health bureau (World Bank, 2006). Assigned workers are usually expected to serve a fixed number of years before being "released" and permitted to apply for other positions.[2]

National clearing houses for entry level physicians are also common in other countries. For example, in the United States, the market for almost all entry level positions (called residencies) for new doctors is mediated by a clearinghouse called the National Resident Matching Program (NRMP). Applicants and employers submit rank order lists representing their preferences, which are then used by the clearinghouse to centrally determine a match between applicants and employers (Niederle and Roth, 2007,.Roth, 2008). Unlike the NRMP, the Ethiopian lottery system does not seek to explicitly match employer and physician preferences, at least not with respect to the regional location of job assignments.

While the lottery is still officially in place, during the past five years Ethiopia has embarked on a radical decentralization program across all areas of the public sector, with much of the responsibility for service delivery being devolved to lower levels of government. Regional competition for health workers, and the burgeoning private market, have arguably strengthened the incentives for certain new graduates to by-pass the lottery and try their luck in the market place.

3 A model of the physician labor market

3.1 Motivation of the model

In our pre-survey discussions with health workers, a number of potential benefits associated with working in Addis were identified, including higher wages and superior work and non-work amenities. Reflecting these observations, we assume that wage differentials in the entry-level physician labor market do not exactly offset the different costs and non-pecuniary benefits of working in different parts of the country. The resulting geographic imbalance of demand and supply in the physician labor market means jobs must be rationed by non-price mechanisms. The lottery and the market employ potentially different rationing systems, with different allocative properties.

[2]The terminology suggests that rural work is akin to a prison sentence. The maximum number of health workers assigned to each region is decided before October by a 3-person committee at the Ministry of Health, on the basis of the official requests of health workers sent by each region. An exception in the lottery system has been recently introduced with respect to the assignment to posts in the newest regions of Benishangul, Hafar, Somali and Gambella. Before the lottery takes place, each health worker is asked whether he/she would be willing to work in any of these new regions. If the answer is negative, as in the majority of cases, the corresponding posts are added to the lottery.

This raises the question of whether a lottery is a good way to assign graduating physicians to jobs. On the one hand, random allocation is sometimes defended on the basis that it is fair, although this is only true in an ex ante sense.[3] On the other hand, economic theory suggests at least two reasons that a lottery might impact negatively on the workings of the labor market. First, in the short run, if there are important efficiency gains from matching individuals to jobs, then a truly random allocation will be inefficient, compared with an allocation mechanism that explicitly reflects preferences and costs, such as an idealized market.

Second, in the long run, using a lottery to allocate labor could obfuscate important information about health workers that is relevant to future employment decisions. For example, suppose there are important matching efficiencies in the market for graduating physicians. Amongst lottery participants, realized productivity in the first job (as revealed for example through letters of recommendation) may be a poor indicator of underlying potential productivity in a second assignment. Under a market mechanism, on the other hand, we might expect "good" graduates (those who were highly ranked in medical school) to be more likely to be matched to "good" jobs. Even if underlying ability is unobservable later in a physician's career, employers can use information about his first job as an indicator of quality in making their recruitment decisions. In particular, because jobs in Addis are rationed, we can use job location as such an indicator.

Assuming lottery participation itself is observable, the physician labor market will bifurcate into two sub-markets. In the lottery market, employers lack verifiable information on physician quality, which may lead to adverse selection. The effects could include compression in training opportunities and wages, and the departure of high quality physicians from the market (either to other careers, or to migration). The non-lottery market, on the other hand, in which employers have a more informative signal of physician quality, might be expected to operate more efficiently.

These observations suggest that the labor market outcomes of lottery participants and non-participants may differ in systematic ways across different types of physicians. In pre-survey interviews, health officials linked recent expansion of the private sector with a downward trend in lottery participation. In light of this, we model lottery participation incentives as a function of expected search costs in the market, under the assumption that the growth of the private sector has reduced these costs.

We formalize the intuition above in the model below, and then test the implications on our dataset. Because we have detailed information on both lottery and non-lottery physicians, including details of their medical school performance, and their first and current assignments, we are able to investigate both the allo-

[3]It would seem fairer to require all health workers to spend a given amount of time in undesirable jobs, rather than to randomly assign such tasks to an unlucky share.

cation mechanisms themselves and whether there is evidence of adverse selection among lottery physicians.

3.2 Adverse selection in the physician labor market

We propose a model in which there are two types of physicians - type L with low ability, and type H with high ability. The share of L-type physicians in the population is σ. There are also two types of "first" jobs - a first job in Addis, and a first job outside Addis. Physicians first choose whether to enter the lottery. If a physician stays out of the lottery, he suffers a random utility cost ε, which has distribution $G(\varepsilon)$. This disutility cost can be thought of as a search cost the individual expects to incur in the labor market outside the lottery, or as an unknown cost imposed by the government, since lottery participation is officially mandatory.[4]

If a physician enters the lottery, he is randomly assigned to a first job by the government. With probability ρ he gets a job in Addis, and with probability $1-\rho$ his first job is in a rural area. If he does not enter the lottery, he is assigned to a job by the market. We make the extreme assumption that the market assigns type H physicians to Addis and type L physicians outside Addis - effectively the market observes and rewards ability. We assume all type L physicians enter the lottery, along with a fraction η of type H physicians. The assumption about type L physicians will be shown below to be correct in equilibrium, and the value of η will be calculated. Thus the share of the population of all physicians who participate in the lottery is

$$n^{Lott} = \underbrace{\sigma}_{L\text{-types}} + \underbrace{(1-\sigma)\eta}_{H\text{-types}}$$

There are $n^M \equiv (1-\sigma)(1-\eta)$ type H physicians who don't participate in the lottery and enter the market directly. The evolution of the labor market is shown in Figure 1.

After physicians have completed their first assignments, they all search for work, either in the profession (now through the market) or outside. By now, a physician's ability is known only by him, but the location of his first job is public information. For physicians who did not participate in the lottery, the market can use the location of the first as a perfect signal of ability, and reward it accordingly. Physicians who were not in the lottery receive a wage equal to their productivity: π_H for type H physicians, and $\pi_L < \pi_H$ for type L physicians. (In equilibrium all type L physicians are in the lottery.) For physicians who were in the lottery, the market must offer a constant wage. We assume that this is equal to the average productivity *of*

[4] We show below that federally funded doctors are more likely to enter the lottery than those with private funding, suggesting the threat of government sanctions is operative.

physicians who accept a job at that wage, $\overline{\pi}$.

Without loss of generality, assume that all type L physicians have the same outside option, which is strictly less than their productivity in the profession, π_L. On the other hand, type H physicians have an outside option equal to $\widetilde{\pi}_H + \mu$, where $\widetilde{\pi}_H < \pi_H$ and μ is randomly distributed according to cdf F, with mean zero (so on average the outside option is less than a type H physician's productivity in the job), and finite support. Let us assume that $\max_\mu(\widetilde{\pi}_H + \mu) < \pi_H$, so it is Pareto optimal for all type H physicians to continue in the profession.

A type H physician from the lottery will not enter the market for the second job and take his outside option instead as long as

$$\widetilde{\pi}_H + \mu > \overline{\pi},$$

which occurs with probability $1 - F(\overline{\pi} - \widetilde{\pi}_H) \equiv 1 - \phi(\overline{\pi})$. The number of H-type physicians from the lottery who enter in the market is then $(1-\sigma)\eta\phi$. Since $\pi_H > \pi_L$, the average productivity of type L lottery participants who stay in the market is at least as high as the outside option they face, so the total number of lottery participants who stay in the market is

$$n_{in}^{Lott} = \underbrace{\sigma}_{L\text{-types}} + \underbrace{(1-\sigma)\eta\phi(\overline{\pi})}_{H\text{-types}}.$$

The average productivity of all physicians (both type L and type H) who were in the lottery and who enter the market is

$$\overline{\pi} = \frac{1}{n_{in}^{Lott}} \left[\sigma\pi_L + (1-\sigma)\eta\phi(\overline{\pi})\pi_H\right]. \tag{1}$$

This equation can be rearranged to yield

$$\overline{\pi} - \pi_L = \left(\frac{1-\sigma}{\sigma}\right)\eta\phi(\overline{\pi})[\pi_H - \overline{\pi}]$$

At $\overline{\pi} = \pi_L$, the right hand side of this expression is strictly positive, while the left hand side is zero. At $\overline{\pi} = \pi_H$, the left hand side is positive and the right hand side is zero. A sufficient condition for a unique solution to exist is that the right hand side be strictly decreasing in $\overline{\pi}$ between π_L and π_H This in turn can be guaranteed if

$$\frac{\phi'(\overline{\pi})}{\phi(\overline{\pi})} = \frac{f(\overline{\pi} - \widetilde{\pi}_H)}{F(\overline{\pi} - \widetilde{\pi}_H)} < \frac{1}{\pi_H - \overline{\pi}}$$

in this range. The right hand side of this expression attains its smallest value (in the range $[\pi_L, \pi_H]$) at $\overline{\pi} = \pi_L$. So for given properties of the distribution function F, as long as π_H is not too much larger than

π_L there will be a unique solution to (1), which depends on π_L, π_H and $\widetilde{\pi}_H$, as well as σ and η.

Note that for a fixed value of η, as outside opportunities improve for type H physicians, i.e., as $\widetilde{\pi}_H$ increases, the equilibrium value of $\overline{\pi}$ falls as a greater share of type H physicians from the lottery pool quit the market. In addition however, the share of type H physicians who enter the lottery to begin with (for the first job) will fall. Taking π_L, π_H $\widetilde{\pi}_H$ and σ as parametric, η is the only endogenous variable, so let us write the equilibrium average productivity of lottery participants who enter the medical market after their first jobs as $\overline{\pi}(\eta)$.

To determine the share of type H physicians who initially enter the lottery, η, note that when type H physicians from the lottery are deciding whether to enter in the market for their second job, they compare the wage $\overline{\pi}$ with their outside option $\widetilde{\pi}_H + \mu$. If $\mu > \overline{\pi} - \widetilde{\pi}_H$ then they do not enter the market and earn $\widetilde{\pi}_H + \mu$; if $\mu < \overline{\pi} - \widetilde{\pi}_H$ then they enter in the market and earn $\overline{\pi}$. Thus the expected future wage for a type H physician who chooses to initially enter the lottery is

$$\overline{w}_H(\eta) = \frac{1}{n^{Lott}} \left(n_{in}^{Lott} \times \overline{\pi} + n_{out}^{Lott} \times \left[\widetilde{\pi}_H + \int_{\overline{\pi} - \widetilde{\pi}_H}^{\infty} \mu dF(\mu) \right] \right) \tag{2}$$

where $n_{out}^{Lott} = n^{Lott} - n_{in}^{Lott}$. Note that we assume that μ is only revealed to a type H physician at the beginning for his second job search and is therefore not known when he decides whether to enter the lottery or not for his first job. The expected wage of a type H physician not in the lottery is simply π_H.

Because $\overline{\pi} \geq \pi_L$, all type L physicians enter the lottery. Type H physicians enter the lottery as long as

$$\overline{w}_H > \pi_H - \varepsilon$$

where ε is the cost of not participating in the lottery. That is, H types participate in the lottery as long as $\varepsilon > \pi_H - \overline{w}_H$. Thus the share of type H physicians who enter the lottery is

$$\eta(\overline{w}_H) = 1 - G(\pi_H - \overline{w}_H). \tag{3}$$

Solving (2) and (3) gives the equilibrium share of type H physicians who participate in the lottery, η^*, and their expected future wage, $\overline{w}_H^*$, as illustrated in Figure 2.

3.3 Empirical implications of the model

The model above includes a number of empirically testable assumptions and predictions. The assumptions and some of the predictions relate to short-term effects, immediately following completion of physician

training. Other predictions reflect the longer-term evolution of physicians' career paths.

- Main assumptions:

1. There are regional differences in monetary and/or non-monetary returns that favor working in Addis.

2. When the market allocates new graduates to jobs in different regions, this allocation is based at least in part on a worker's ability and locational preferences. Under the lottery, these variables do not predict the initial assignment across regions.

- Short-term predictions:

1. High ability physicians are more likely to select out of the lottery than low ability physicians.

2. Growth of demand for private sector services increase outside options and should therefore be associated with falling lottery participation.

3. If the lottery assigns graduates randomly, then physicians assigned to Addis should have higher first job satisfaction in their first assignment.

- Long-term predictions:

1. Among high-ability physicians, current wages should be lower for lottery participants than for those who did not participate in the lottery.

2. In light of this, rates of attrition among high-ability physicians should be higher for lottery participants than for those who did not participate in the lottery.

4 Empirical set-up: Sampling, data, and model validity

In this section we review our sampling methodology, present descriptive statistics, and confirm the basic empirical assumptions of our model regarding the attractiveness of working in Addis Ababa and the workings of the job allocation mechanisms, both inside and outside the lottery system.

4.1 Sampling methodology

Our sampling strategy aimed at obtaining representative samples of doctors from three of Ethiopia's eleven regions – the capital city of Addis Ababa, and two more remote regions of Tigray and Southern Nations

and Nationalities Peoples Republic (SNNPR). Addis is a city of about 3 million people and is located in the central highlands. Tigray has a population of about 4 million people and lies in the north of the country, bordering Eritrea, while SNNPR, with a population of 14 million lies to the south west of Addis and borders Kenya to the south. The regional capital of Tigray is Mekele, and that of SNNPR is Awassa. Our sample is representative within these geographic areas.[5] The design over-sampled physicians in SNNPR and Tigray due to the small number of physicians outside Addis Ababa: all physicians in these rural regions were sampled, while only about one third of physicians in Addis were. Our final sample included 219 physicians working in health centers and hospitals.

A random sample of 1/3 of doctors was achieved in Addis Ababa by (a) randomly sampling facilities of the various types with sampling weights corresponding to the estimated proportion of doctors working across the different facilities; and (b) interviewing all doctors at the sampled facilities. In SNNPR and Tigray, all doctors were included in the sample. This was achieved by sampling all public hospitals in SNNPR and Tigray (there are generally no doctors in non-hospital health facilities in these regions and there were no private hospitals). In addition to interviewing health workers, we administered a facility level survey with the facility administrator or other senior official at each facility we visited. A summary of our physician sample is provided in Table 1.

Amongst doctors, the interview response rate varied across regions: 86% in Tigray, while in SNNPR and Addis Ababa it was lower – 58% and 66% respectively. However, exluding doctors on leave, the response rate was considerably higher. In Addis, the response rates were similar among public and private facilities (70% versus 64% respectively), but the reasons differed. At public facilities, all doctors present agreed to be interviewed, although 21% of sampled doctors were absent on the day of the interview for unexplained reasons, and 9% for planned leave). In contrast to public facilities, the share of sampled doctors who were present but refused to be interviewed was 22% at private facilities. Further, no unexplained absences were recorded, while 15% of doctors were absent on planned leave. In Tigray, non-response arose because one sampled facility no longer existed, and one was inaccessible for security reasons. In SNNPR, nine out of ten of the physicians listed as being employed but not interviewed were absent at the time of the facility visit for training purposes.

[5] Other regions, such as Oromia (which surrounds Addis Ababa) and Amhara (which is immediately north of Oromia) are larger (with 26 and 19 million residents respectively) and less remote, at least in terms of direct distance measures, but we have no reason to expect this to have introduced systematic biases in our estimates.

4.2 Description of Data

In this section we report summary statistics from both the facility and individual questionnaires, with a view to presenting a picture of working conditions and the physician labor force in the three regions covered by the survey. Table 2 provides summary statistics from the facility survey, weighted by the estimated share of physicians working in each type of facility. Doctors in SNNPR and Tigray work in remote locations: they are 6 hours and 5.3 hours from their regional capitals respectively, which are themselves remote from Addis. However, the table shows that at least along several measurable inputs, facilities in the outlying regions are no worse than public facilities in Addis. In fact, SNNPR and Tigray facilities are better equipped to test for HIV and are more likely to have sufficient water supply. There are in turn differences between the two regions: for example, only half the doctors in Tigray work in facilities with sufficient medicine, compared with 88% of those in SNNPR. Similarly, Tigray has more inpatient beds per doctor and more outpatients than both SNNPR and public facilities in Addis.

Private facilities in Addis are on the other hand much smaller, with about half the number of inpatients and outpatients per doctor compared with public facilities in the capital. Some quality indicators, such as water availability, are reported as significantly better in Addis' private facilities, but on other dimensions private facilities report being either no better (equipment), or somewhat worse (medicine).

Demographic and economic data from the individual-level questionnaires are reported in Table 3. The top portion of that table shows that doctors in Addis Ababa, especially those working in the private sector, are more experienced than those in the regions. In Addis, men are somewhat over-represented in the private sector, while in SNNPR there are virtually no female doctors whatsoever. We find evidence that doctors are more likely to have moved away from their home region to Addis than to either of the regions. This is reflected in the fact that three quarters of those in Tigray reported having lived there at age 10, compared with 53% in SNNPR, and about 43% in Addis.

In economic terms, doctors in Addis do better than those in the regions. As reported in the bottom part of Table 3, asset ownership is higher in Addis, with one half and one quarter of the doctors working in private and public facilities, respectively, reporting ownership of a car, compared with less than two and five percent, respectively, in SNNPR and Tigray. House ownership is higher among private sector physicians in Addis (35%), but the rates among other doctors are similar (10-16%).

Table 4 reports labor market characteristics of sampled physicians. Salaries in Addis, especially amongst those working in the private sector, are considerably higher than those earned in SNNPR and Tigray. Doctors working in the public sector in Addis earn salaries about 50% more than the average doctor in the regions,

while salaries of private sector doctors are three times as much. The gap between private sector salaries in Addis and those of other doctors is partly offset by additional sources of income: public sector doctors in Addis earn additional income equal to 22% of their salaries, while the figures in SNNPR and Tigray are 17% and 33% respectively, and between a third and a half of doctors in the regions outside Addis report receiving housing allowances (although we do not have data on the monetary value of these allowances). Indeed, significant shares of doctors working outside the Addis private sector report holding more than one job – from 23% in the Addis public sector, to 12% in Tigray. On the other hand, private sector doctors in Addis supplement their (much higher) salaries by only 3 percent. Finally, physician household incomes are higher in Addis than elsewhere.

Part of the salary premium observed in Addis reflects higher rates of specialization amongst doctors there - about 40% compared with 20% in Tigray and just 7% in SNNPR. However, we find that the rates of specialization in the public and private sectors in Addis are virtually identical, suggesting that training is not the sole driver of observed income differentials.

Finally, a similar proportion across the four employment categories, about 57 percent, reports having participated in the lottery, and between 59 and 80 percent of doctors had their medical training sponsored by the federal government (as opposed to a regional or foreign government, or a private sponsor). Lastly, the table shows the proportion of physicians who applied to receive an official release formally authorizing them to work in the private sector. Of those currently working in the private sector, most (86%) report having applied for this release with the vast majority having been successful (95%). The corresponding application numbers are much lower among physicians working in the public sector – 39, 20, and 5 percent, respectively, for Addis, SNNPR, and Tigray, and their success rates are lower too – 74, 48, and 25 percent, respectively.

4.3 Testing the model's assumptions

We begin by testing the main assumptions of the model regarding (i) the attractiveness of working in Addis relative to the regions, and (ii) the observable determinants of the location of physicians' first jobs, and how they differ between lottery participants and non-participants.

4.3.1 Job Satisfaction from working in Addis

Pre-survey discussions with healthworkers suggest that the average physician perceives significant net benefits, in terms of salary and urban amenities, from working in Addis. This suggests that wages are not flexible enough to reduce these benefits to zero, or that physician jobs in Addis are qualitatively different to those

in rural regions. The simple unconditional mean comparisons in Table 4 above, particularly with regard to wage differentials, support this notion. It is also consistent with separate work on the same sample of physicians by Hanson and Jack (2008), who find that relatively large financial incentives are necessary to induce sizeable shifts in physician labor to rural areas.

We confirm the attraction of working in the capital by estimating the relationship between having a job in Addis and wages, incomes, and job satisfaction, controlling for observable physician characteristics such as ability (as measured by academic class rank) and experience, and several other individual characteristics. We estimate an equation of the form

$$y_i = \beta_0 + \beta_1 D_i^{Addis} + x_i'\gamma + \epsilon_i,$$

where x_i is a vector of characteristics of physician i, D_i^{Addis} is a dummy variable indicating whether physician i works in Addis, and y_i represents an employment characteristic such as wages, or a measure of job satisfaction. Conditional on x_i and assuming no omitted variable bias, the coefficient β_1 should be 0 or even negative if y_i is a measure of wages and the compensating wage differential framework holds. A positive value of $\beta_1$indicates there are net benefits to having a job in Addis.

The results, reported in Table 5, confirm that differences in labor market outcomes between Addis and the regions remain, even conditional on a vector of observables. We find that physicians currently working in Addis earn salaries that are between 78 and 82% higher, and are considerably more content with various aspects of their work, especially those who are currently working in Addis and who initially participated in the lottery. Note that non-lottery physicians currently working in Addis are significantly more content with their jobs overall than their non-lottery counterparts working in the rural regions despite *not* being more content about their much higher salaries, their workload, and their training opportunities. This suggests that Addis Ababa is also likely to have favorable non-employment characteristics. In sum, these tables support a main assumption of the model that on average, a job in Addis is more attractive than one outside the capital.

4.3.2 Determinants of first job assignments: lottery versus market

We next look at the determinants of first job assignment. If the lottery is random, we should find no significant predictors of first job assignment. On the other hand, if jobs in Addis are rationed, then market allocation might be correlated with certain individual characteristics. We limit the sample to doctors at least 2 years out of medical school. This is the sample used below when looking at longer term outcomes.

About 59% of physicians in our sample participated in the lottery, of whom about 11% were assigned to a first job in Addis Ababa. None of these swapped their assignment with other lottery participants. However, among the 89% of doctors assigned to one of the rural regions, 21% swapped his assignment with someone else, also assigned to one of the rural regions. In other words, there is some post-lottery sorting across rural regions. Among the others assigned to the rural region who did not swap, 2% still reported having their first job in Addis. We will use the assignment itself (intention to treat), not whether the actual first posting was in Addis, in the analyses below unless otherwise noted. Among non-lottery physicians, 20% found their first job in Addis. We run separate regressions for the two sub-samples (lottery and non-lottery (market)), the results of which are reported in Table 6.[6]

The results confirm that the determinants of first job assignments differ systematically between lottery and non-lottery participants. Indeed, in line with the model, assignment appears to follow a market principle among non-lottery physicians, but not among lottery physicians, under the assumption that employment in Addis is favorable. Among physicians who opted out of the lottery, those who report ranking in the 2nd and 3rd quintiles are respectively 21 and 25 percentage points less likely to find a first job in Addis Ababa compared to those who ranked in the top quintile[7]. Social connection to the medical profession, as proxied by having a relative working in the sector also improves a non-lottery participant's chance of securing employment in Addis. In sum, it is both *what* and *who* you know that helps get a job in the capital.[8]

On the other hand, as expected, class rank is not a significant determinant of job assignment among lottery participants, and neither does connection to the profession influence the chance of such individuals being posted to Addis or the regions. Nevertheless, the 2nd and 3rd columns of the table do show that assignment within the lottery is not entirely random: physicians whose medical studies were sponsored by regional authorities are 12.5% less likely to have a first job assignment in Addis than lottery physicians whose studies were sponsored by the federal government. We interpret this as reflecting the discretion of officials in charge of the national lottery to give regions priority in recruiting those graduates whose medical training they funded. The only other variable correlated with the job assignment of lottery participants is

[6] Linear probability estimation is used instead of probit maximum likelihood since there are a few instances where probit estimations are forced to drop several observations. For example, in the lottery sample, there are 3 healthworkers whose parents were also healthworkers. Because all three work outside Addis, these are dropped in probit estimations.

[7] 39% of physicians reports being in the 1st quintile, 41% in the 2nd, and 20% in the 3rd, while 0% in the 4th and 5th quintiles.

[8] Somewhat surprisingly, doctors with a parent in the sector are *less* likely to get a first job in Addis. One reason might be that such doctors might be inclined to join their parents' practices, which could be outside Addis.

sex: men are 26.2 percentage points less likely to be assigned to Addis than women. This difference could reflect preferences on both the demand and supply sides: first, Hanson and Jack (2008) find that the value of a job in Addis Ababa is significantly higher for women than for men; and second (and perhaps related) we do not rule out the possibility that the regional authorities in Addis submit physician openings specifically targeting female graduates.

In the following two sections we turn to empirical tests of both the short-run and long-run implications of the model.

5 Short-run impacts of the lottery system on the physician labor market

5.1 Who participates in the lottery?

While lottery participation has officially been mandatory, as we observed above many physicians in our sample did not get their first job through this mechanism. The model predicts that high ability physicians should be more likely to select out of the lottery than low ability physicians. This is tested in the first column of Table 7. Indeed, third ranked students are nearly 25 percentage points more likely to participate in the lottery than 2nd and 1st ranked students.

The lottery is operated by the federal government, which also sponsored the training of 71 percent of the physicians in our sample. We find that these physicians are more likely to participate in the lottery, perhaps because they face a higher cost of opting out, given the federal government's sponsorship role. Specifically, physicians whose medical training was sponsored by regional authorities (who make up 12% of all physicians) were 25 percentage points less likely, and those sponsored privately or by foreign governments (who combined make up 16% of all physicians) were 42 percentage points less likely, to participate in the lottery than federally sponsored physicians.

Other determinants of lottery participation include family size (those from large families are more likely to participate), and birth order (those born later are less likely), which may reflect differential costs (ϵ) of opting out of the lottery. The coefficients on years of experience (the number of years since graduation) reflect the general decline in lottery participation.

5.2 Impact of private sector growth on lottery participation

The growth of demand for private sector services can similarly be interpreted as a reduction in the search or other utility costs, ϵ, associated with opting out of the lottery, and should therefore lead to a reduction in lottery participation. We take the demand for physician labor by the private sector as exogenous to any graduate's lottery participation decision. Columns II and III in Table 7 report our findings.

Although we lack comprehensive data on the rise of the private sector, surveyed physicians were asked if private clinics were already fairly common at the time they started their medical training. We use their responses as a proxy for the size, and growth, of the private sector. Column II in the table above shows that the coefficient estimate on this variable is not significantly different from zero. However, after introducing the interaction with class rank (column III), both the coefficient on the variable itself, and on its interaction with second rank becomes very significant and large in size. In particular, it suggests that consistent with the model above, before the expansion of the private sector, lottery participation was no different between first and second ranked students, but 25 percentage points higher among third ranked students – possibly because the lottery was perceived to increase the chances that a third-ranked doctor would get a job in Addis. After the expansion of the private sector, third ranked students are still 25 percentage points more likely to participate than first rank students, although both groups experience a large drop in participation of 52 percentage points. Second ranked students, on the other hand, do not experience a decrease in lottery participation, which seems puzzling.

We can speculate on the forces behind this pattern of effects. One possibility is that physicians in general aim to enter the private sector at some point in their careers. First ranked physicians expect to command a high salary immediately in the private sector, so they are willing to incur costs of quitting the lottery. The estimation reported in column IV of the table shows what factors determine whether a physician currently has his primary job in the private sector. Indeed, the private sector attracts the best ability physicians, as measured by their medical school ranking and their years of experience. Physicians in both the second and third quintile are about 18 percentage points less likely than physicians in the 1st quintile to work in the private sector.

However, as shown in the next column, it is not the case that doctors who undergo further training and specialize are more likely to be working in the private sector (both are choice variables so this is merely presented as a correlation conditional on other variables). Still, as reported in the last column, column VII, physicians who specialize earn considerably higher wages (70% higher), even controlling for experience, rank and other background variables. Column VI seeks to reconcile these facts. In particular, it shows that while lower ranked physicians and physicians participating in the lottery are less likely to specialize, the gap in

specialization rates between lottery and non-lottery physicians declines with class rank. For second and third ranked physicians, the probability of receiving specialization training is very similar inside and outside the lottery, and similar to those of first ranked physicians inside the lottery. The fact that there is no significant difference across the ranks within the lottery is consistent with our model of adverse selection.[9].

In sum, the rise of the private sector provides a clear incentive for first ranked physicians to leave the lottery; doing so not only allows them to take advantage of private sector opportunities, but significantly increases their chance of receiving specialization training, thus raising their public sector wage opportunities. By the same reasoning the growth of the private sector should also strengthen the incentives of second and third ranked physicians to quit the lottery, although to a lesser degree since leaving the lottery is not associated with improved specialization training prospects. The reason private sector growth has *not* increased lottery exit among second rank physicians remains unclear.

5.3 Initial job satisfaction of lottery participants and non-participants

Within the group of lottery participants, we expect satisfaction with the first assignment to be higher among those who were (randomly) assigned to high valued jobs such as those in Addis, compared with those who were (randomly) assigned to the rural regions. This is explored in Table 8, which provides OLS, ordered probit, and nearest neighbor matching (NNM) estimates of the short-term sample average treatment effects (Abadie and Imbens, 2002) of having a first job *assignment* to Addis Ababa, controlling for background variables such as class rank, sponsor, etc. We estimate the impact of initial job assignment for the two sub-samples (lottery and non-lottery participants) assuming any selection into Addis is on observables. This identifying assumption is clearly tenuous among non-lottery participants since there could be unobserved covariates that are correlated with the initial Addis assignment but independent of an individual's class rank and whether (s)he has relatives in the health profession. Our main focus is therefore on the lottery sample.[10]

The main result is shown in the bottom row: among physicians who participated in the lottery (columns I and II), the ordered probit and NNM estimates are both positive, indicating higher overall first job satisfaction for those initially assigned to Addis, although only the latter is significant. Similarly, none of the other ordered probits for the satisfaction variables are significant, while the NNM estimates indicate that

[9] Specialization rates relative to 1st ranked physicians outside the lottery: (1) 1st ranked physician inside lottery (-37%); (2) 2nd ranked physician outside lottery (-23%) and inside lottery (-0.47%); and (3) 3rd ranked physician outside lottery (-29%) and inside lottery (-40%)

[10] Note that the small sample size (121 lottery observations) means that we are unlikely to detect relatively small differences in outcomes.

lottery participants assigned to Addis were significantly *less* satisfied with their wages, training opportunities, and work load. As mentioned above, this result has an interesting parallel with the findings by Cullen et al. (2006) who find that prospective high school students winning a lottery that gave them the option of attending a high-performing school in Chicago did not seem to benefit, suggesting a potential mismatch not foreseen by lottery participants. That overall satisfaction was nevertheless significantly higher may be more of a reflection of non-work amenities provided by working in Addis than the job itself. The results among market physicians (columns III and IV) are ambiguous. The ordered probit satisfaction estimates are similarly not significant, while the NNM suggest lower wage and overall satisfaction, but higher training satisfaction, for those who start their careers in the capital. Lastly, both ordered probit and NNM estimates indicate that the duration of the first assignment is significantly longer in Addis for lottery as well as market physicians.

6 Longer-term dynamics in the physician labor market

We now turn to an examination of the longer-term impacts of initial job assignments early in the careers of physicians. The two aspects of first job assignment we distinguish between are first *where* a physician is assigned, and second *by which mechanism* he is assigned – i.e., lottery or market. That is, we first estimate the impact of getting a first job in Addis Ababa on future labor market outcomes, which will help shed light on the long-term private costs of assigning graduates to rural facilities. We then turn to the impact of the lottery itself on the workings of the labor market.

6.1 Long term impact of initial assignment to Addis

Although jobs in Addis are more attractive because of the income and amenity values they provide, is getting such a posting early in one's career an important determinant of future labor market outcomes? In this subsection we explore this issue, first using the lottery system as a quasi-randomized experiment to examine the impact on lottery participants, and then employing matching techniques to measure the impact on all physicians in our sample. Table 9 examines how the impact of having had a first job in Addis differs between lottery participants and non-participants.

The long-term impact is similar to the short-term one. Overall satisfaction is significantly higher for both the ordered probit and NNM estimate, despite signficantly lower chances of being specialized than doctors initally assigned by the lottery to one of the rural regions. In contrast, as shown in columns III and IV, both the OLS/ordered probit and NNM estimates indicate that market physicians with a first assignment

in Addis are more likely to be specialized. One explanation for this difference is that Addis attracts high-ranking medical students through the market with whom average-ranked lottery students must compete for specialist training. Perhaps related, lottery doctors assigned initially to Addis are not more likely to be currently employed there or have employment in the private sector.

The table shows further that, except for the specialization estimate, for market physicians the effects of getting a first job in Addis are unclear, as shown in columns III and IV. None of the other coefficients on being first assigned to Addis in the OLS estimates are significant, while all NNM estimates are very significant yet unclear. They suggest that physicians landing a job in Addis after medical school are significantly more likely to still be working there, and earn higher incomes, but are less likely to work in the private sector and less satisfied with their current job. We are reluctant to interpret these non-lottery findings not only because of likely omitted variable bias, but because these NNM non-lottery findings are very sensitive to the matching variables used.[11]

In sum, the estimates for those who participated in the lottery suggest that in the long run there is a fare amount of mobility following the initial assignment. Still, physicians assigned to Addis through the lottery may fare slightly better than those assigned to the rural area as measured by their current job satisfaction. This is despite having lower levels of specialization than lottery physicians initially assigned to the rural regions. The bottom row in the table may be able to reconcile these findings. Physicians assigned to Addis are significantly more likely to be living now in the region in which they lived as adolescents, suggesting that despite lower specialization, they may benefit from non-employment-related compensating differences.

6.2 Evidence of adverse selection

Consistent with the notion that the lottery obscures important information, we found that differences in specialization rates between lottery participants and non participants were smaller among low ranked physicians than high ranked physicians. Next we investigate the extent to which the data further support the idea that the labor market in which lottery participants operate later in their careers suffers from adverse selection. We examine wage compression and labor market attrition.

[11] For example, including only rank and whether parents and relatives have been health workers (the only correlates with initial Addis assignment) as matching variables, all estimates are insignificant (smallest p-value = 0.29), except specialization which remains significantly positive.

6.2.1 Wages

If information on worker quality is publicly observable then a physician's first job does not provide a useful signal to future employers. In our empirical analysis we do allow for the possibility that working in Addis Ababa (either in a good facility, or in a place with access to other colleagues and a richer learning environment) has a real, positive effect on productivity. In this case, conditioning on class rank, future wages may be positively correlated with having a first job in Addis. However, the distribution of wages should be the same for both lottery participants and those who enter the market immediately after graduation. On the other hand, if the lottery obfuscates worker quality information, then we expect that the conditional wage distribution will be narrowed. Figure 3, which shows the unconditional wage distribution by rank separately for lottery and non-lottery physicians, provides suggestive evidence to this effect.

Consistent with the model, the graph shows that physicians who were 3rd ranked students earn virtually the same whether they were initially in the lottery or not. Among 2nd rank ones, non-lottery physicians earn slightly more, but not much. However, there is a large difference among 1st ranked physicians, with non-lottery physicians earning 39% more on average. Table 10 explores this in a regression context predicting log wages using interactions between class rank and lottery participation. Here, 3rd rank is the left out category to highlight the focus on 1st rank dynamics.

The table first shows that there is not enough power to include a dummy for lottery participation and its interaction with dummies for rank 1 and rank 2 – none of these are significant (column I). Forcing the effect of lottery participation to be zero for 3rd ranked physicians (consistent with the graph above), the coefficient estimates on the interaction terms both fall just outside the significance range (column II). Combining 1st and 2nd rank in their interaction with lottery participation, column III shows that compared with 3rd ranked physicians, 2nd ranked physicians earn 18% more if they are outside the lottery (p-value is 0.159) but earn the same as 3rd ranked physicians inside the lottery (a combination of the direct effect and the interaction). On the other hand, 1st ranked physicians earn 48% more than 3rd ranked physicians outside the lottery, but only 24% more inside the lottery (a combination of the direct and interaction effect). This is consistent with the model's prediction that there is substantial wage pooling within the lottery. It is conceivable that an omitted variable could bias our results, for instance if it acted both to increase wages and to induce individuals to opt out of the lottery. However we believe this is unlikely for two reasons. First, if this were the case, then one would expect 3rd ranked physicians to also earn more outside the lottery. And second, if there is no wage pooling inside the lottery, one would expect 2nd ranked students inside the lottery to earn more than 3rd ranked students inside the lottery.

6.2.2 Labor market attrition

Recall that mong the pool of high ability lottery physicians, those with high later life reservation wages are predicted by the model to leave the profession, leading to adverse selection. Naturally, by the mere fact that we cannot observe physicians who left the population of physicians, finding evidence of attrition is challenging. Figure **??** and Table 11 provide two pieces of evidence that are at a minimum consistent.

First, the time series of lottery participation show a drop not just among the latest 2006 cohort which is consistent with anecdotal evidence that the lottery is unravelling (we are unable to identify whether this change reflects a real drop in lottery participation, delayed attrition from the health sector by non-participants, or a combination of both.), but also among the oldest cohorts before 1993. Since anecdotal evidence suggest that government enforcement of the lottery was greater in the past, one would expect that lottery participation was highest among the oldest cohorts. If this was the case, then differential attrition rates between lottery and non-lottery participants over time could have given rise to this pattern.

Second, Table 11 below explores in a regression context the extent to which high-ranked lottery participants have left the profession more than similar individuals who did not participate in the lottery.

The dependent variable is a dummy for being first ranked. The positive coefficient on experience (0.035) indicates that older cohorts are more likely to be first-ranked than younger cohorts, suggesting that over time first ranked individuals have chosen not to enter the profession (in Ethiopia)[12]. On the other hand, the negative coefficient on the interaction between experience and lottery participation indicates that within older cohorts, lottery participants in our sample are less likely to be first ranked than non-participants. This suggests that amongst high-ranked individuals, lottery participants have left the profession more than non-participants. This is consistent with the idea that the lottery has long-term impacts on the workings of the physician labor market.

7 Conclusion

Delivering health and other public services to remote areas of developing countries is perhaps one of the greatest challenges facing poor countries that aspire to reach the Millennium Development Goals. This paper has used a newly collected dataset on Ethiopian physicians to shed light on issues of rural physician

[12] Alternatively, it could be that younger cohorts of physicians are more humble in reporting their class rank. Because all the estimations control for experience, this would not affect our findings. Still, there is little reason to think that the younger generation is somehow more humble.

labor supply, including the dynamics of career evolution, and the allocative efficiency of the physician labor market. We have used a lottery mechanism employed to assign medical school graduates to their first jobs to identify the long-term impact of initial postings to rural areas, and have examined the performance of the physician labor market born of that lottery mechanism.

We find the market for new physicians operates surprisingly efficiently. Although new graduates are allocated randomly by the lottery, better graduates opt out of the lottery, especially since the rise of private health sector opportunities, and earn more in the short and long run than lower quality physicians. And although the lottery is ex ante fair, ex post we find that physicians assigned through the lottery to Addis were more satisfied with their first assignment and remain more satisfied with their current assignment. However, we find that being posted under the lottery to a rural area is not the end of a physician's chances of a successful career: indeed, they are more successful in getting specialized training than lottery participants initially assigned to Addis, and they are no less likely to be currently working in Addis. In fact, there is some indication that doctors initially assigned to Addis through the lottery compete unsuccessfully with higher ranked non-lottery doctors for specialization training, and opt to move to their home regions instead. This suggests that the long term costs of rural assignment are not especially high.

There is evidence that the lottery mechanism obfuscates information about worker quality, which can lead to adverse selection in the physician labor market later on. We find that amongst lottery participants, rates of specialization and wages are compressed. A high-ability physician participating in the lottery earns less and is less likely to be specialized compared with a similar physician who did not take part in the lottery. Consequently, there is some indirect evidence that better ranked lottery participants are more likely to leave the profession over time. These observations support our hypothesis that the lottery has some negative long run effects on the workings of the labor market, and could possibly contribute the medical brain drain. Enforcing full participation in the lottery is unlikely to ameliorate these effects. Instead, policy should focus on explicit financial or in-kind incentives to attract physicians to rural positions, and to motivate them once there.

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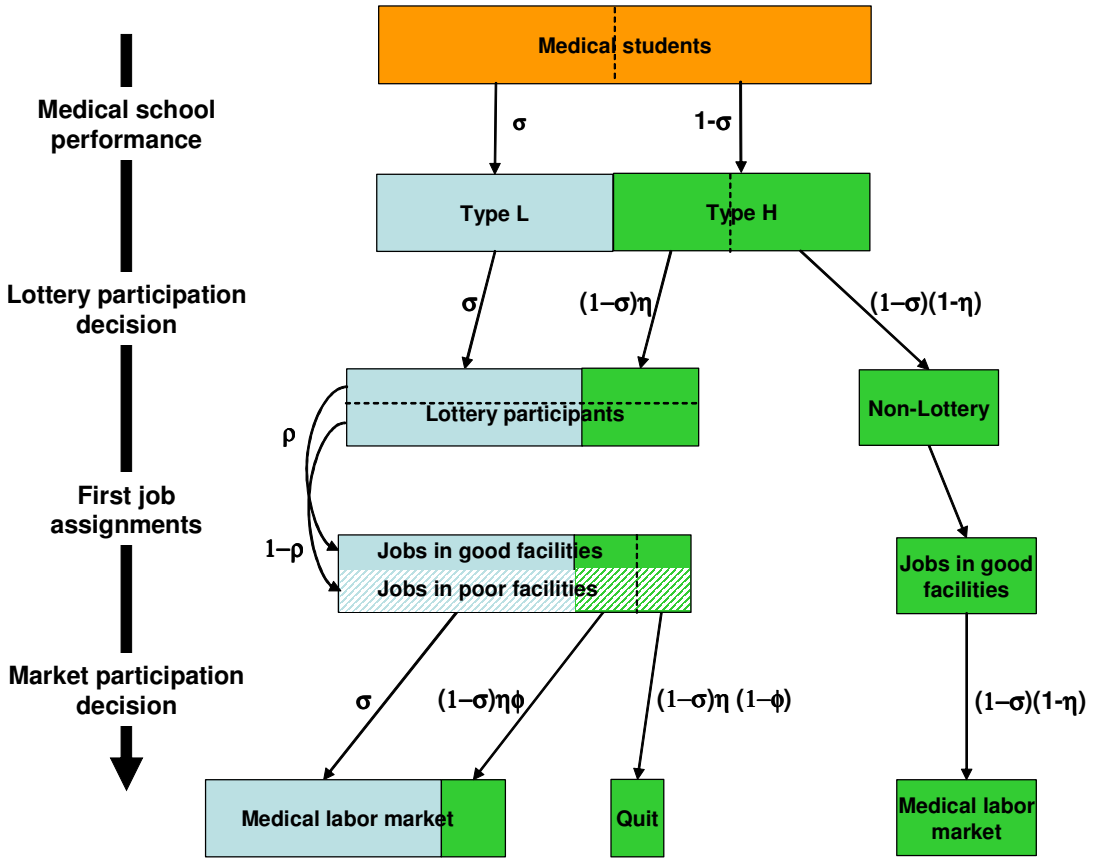

Figure 1: Evolution of the physician labor market. Performance at medical school determines doctor quality. The pool of type L and H doctors sorts itself into the lottery and non-lottery systems. First jobs are assigned randomly under the lottery to good and poor facilities. All non-lottery participants get first jobs in good facilities. Of those who participate in the lottery, further sorting occurs after the initial job assignment: some continue in the health sector, and others quit the profession, due to adverse selection.

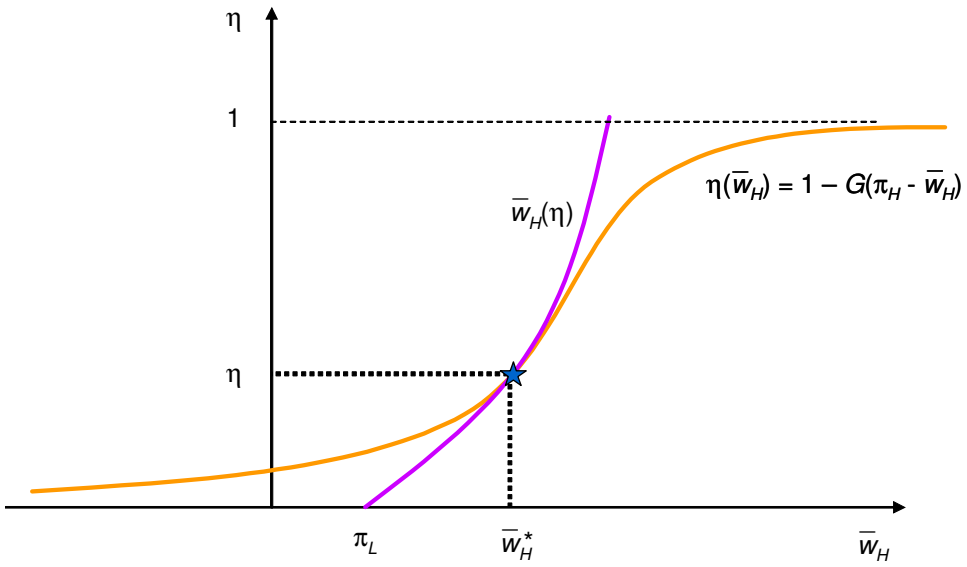

Figure 2: Equilibrium lottery participation by type H doctors, η^*.

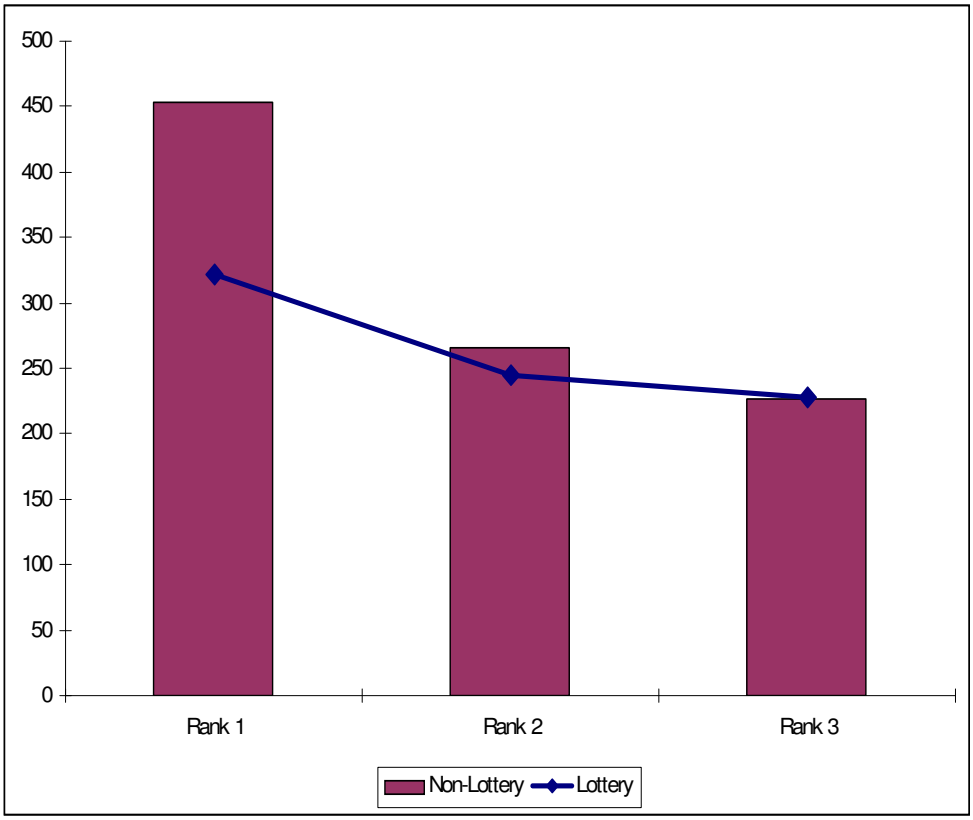

Figure 3: Monthly salaries (US$) of physicians by lottery participation and medical school rank

	Addis Ababa	SNNPR	Tigray	Total
Total sampled facilities with physicians	39	21	17	77
Hospitals	3	12	11	26
Health centers and clinics	36	9	6	51
Sampled physicians	91	72	56	219

Table 1: Numbers of facilities and physicians surveyed

	All surveyed regions	Addis Ababa		SNNPR	Tigray
		Public	Private*		
Facility size					
Number of physicians (est.)	848	217	380	189	62
Physicians per facility	3.8	6.9	2.6	5.2	2.6
	(4.9)	(10.6)	(2.4)	(4.8)	(2.2)
Number inpatient beds	79.5	141.5	21.5	114.5	121.3
	(91.7)	(112.2)	(40.1)	(63.5)	(105.6)
Number inpatient beds per physician	20.9	20.5	8.3	22.0	46.7
Number outpatients	104.4	181.5	38.0	139.8	143.9
	(93.3)	(86.9)	(43.0)	(77.0)	(106.8)
Number outpatients per physician	27.5	26.3	14.6	26.9	55.3
Hours travel to regional capital	–	–	–	6.0	5.3
				(5.5)	(5.0)
Facility conditions (%)					
Reliable electricity/phone	99.3	100	100	97.4	97.9
Functioning X-raty machine	91.3	77.0	81.6	85.2	83.3
Functioning laboratory	100	100	100	100.0	100.0
Functioning operating theatre	62.1	61.8	42.6	92.6	97.9
Equipment to test for HIV	83.6	66.4	86.8	92.6	100
Sufficient water supply	74.5	23.0	96.0	87.3	85.4
Sufficient medicine	79.1	88.5	72.9	88.4	50.0
Sufficient equipment	87.1	83.9	84.5	100.0	70.8

* Includes for-profit and non-profit NGO and missionary facilities. ** Includes 3 private facilities
Statistics are calculated using frequency weights corresponding to total number of doctors by region working in (1) public hospitals, (2) private hospitals, (3) government health centers, and (4) private, NGO, or missionary clinics

Table 2: Facility level information, based on interviews with an administrator, for facilities with at least one physician

	All	Addis		SNNPR	Tigray
Demographics		Public	Private		
Share female (%)	17.1	30.0	16.0	2.6	26.8
Share married (%)	55.5	61.3	74.0	33.3	45.2
Age (years)	36.1	39.2	41.2	29.3	31.5
	(0.90)	(1.64)	(1.78)	(1.16)	(1.61)
Birth order	*	2.81	3.55	2.70	3.10
	*	(0.12)	(0.33)	(0.35)	(0.22)
Number of siblings	6.4	6.1	6.5	6.4	6.6
	(0.19)	(0.31)	(0.37)	(0.26)	(0.62)
Number of children	1.01	0.90	1.68	0.44	0.71
	(0.11)	(0.14)	(0.22)	(0.22)	(0.20)
Share with no children (%)	52.6	48.5	28.0	82.1	61.6
Number of children (for those with)	2.14	1.75	2.33	2.48	1.85
	(0.15)	(0.15)	(0.23)	(0.54)	(0.20)
Family connections to profession (%)					
Parents Health Workers	1.8	5.2	0.0	0.85	2.3
Siblings Health Workers	18.2	14.8	18.0	20.5	19.8
Other family Health Workers	18.5	19.9	26.0	13.7	7.0
Live in same region as at age 10	50.2	44.1	42.0	53.0	75.6
Assets (%)					
Own a car		26.9	51.0	1.9	4.8
Own land		14.8	4.1	13.9	2.4
Own house		15.2	34.7	10.2	15.7

Table 3: Demographic and economic characteristics of sampled health workers

	All	Addis		SNNPR	Tigray
Incomes		Public	Private		
Salary (US$)	284.5	244.6	480.5	156.4	176.6
	(17.4)	(10.5)	(39.0)	(14.8)	(13.9)
Total income of health worker (US$)	320.9	297.0	496.8	181.4	233.1
	(24.8)	(24.8)	(40.1)	(29.7)	(38.2)
Total income of household (US$)	443.8	509.2	696.9	196.3	264.3
	(28.1)	(49.1)	(55.7)	30.0	(46.8)
Other compensation with job (%)	52.7	29.3	46.0	85.5	53.5
Housing allowance (%)	18.9	0	0	52.1	34.8
Type of job (%)					
Primary job in the private sector	36.9	0	100	9.4	0.0
Holds more than one job	**	23.5	20.4	16.7	12.0
Specialist	27.8	40.4	38.0	6.8	19.8
Institutional features (%)					
Participated in the lottery	57.4	62.0	56.0	54.7	58.1
Medical training sponsored by federal government	71.4	67.7	80.0	70.1	59.3
Applied for official release from public sector	44.9	38.7	86.0	19.7	4.7
of whom, release granted	84.1	73.9	95.3	47.8	25.0

Table 4: Incomes and assets of sampled health workers

	Lottery	Market
Current salary (log)	0.821***	0.780***
	(0.144)	(0.167)
Current income (log)	0.733***	0.767***
	(0.176)	(0.157)
Doctor is specialized	0.289**	0.352***
	(0.112)	(0.131)
Satisfaction with current wage	0.943**	0.774
	(0.455)	(0.577)
Satisfaction with current training opportunities	-0.050	-0.480
	(0.310)	(0.422)
Satisfaction with current workload	0.773**	0.558
	(0.303)	(0.393)
Overall satisfaction with job	0.651*	0.809**
	(0.386)	(0.368)
Number of observations	120	85

Notes: Lottery includes those who participated in the lottery, while market includes those who did not. Each cell represents a separate OLS estimation (rows 1 and 2) or (ordered) probit estimation (rows 3 to 7) and reports the coefficient on a dummy variable indicating whether the current job is in Addis (1) or one of the two regions (0). The dependent variable is in the left hand column. Other controls are: class rank, family connections with the profession, sponsor, gender, experience, siblings, and birth order. Standard errors corrected for clustering at facility level.

Table 5: Impact of currently working in Addis on physician job characteristics and satisfaction

Predicting first job in Addis Ababa					
	Lottery			Market	
	I	II	III	IV	V
2nd ranked student	0.094	0.063		-0.176~	-0.210~
	(0.079)	(0.070)		(0.117)	(0.134)
3rd ranked student	0.038	0.045		-0.304*	-0.250**
	(0.102)	(0.103)		(0.151)	(0.124)
Parents health workers	-0.007	-0.001		-0.348*	-0.261**
	(0.087)	(0.082)		(0.195)	(0.120)
Other relatives health workers	0.055	0.082		0.265**	0.303***
	(0.107)	(0.107)		(0.129)	(0.106)
Sponsor: regional authorities	-0.180***	-0.161**	-0.125**	0.024	
	(0.064)	(0.065)	(0.058)	(0.100)	
Sponsor: private/foreign government	0.136	0.103	0.087	0.017	
	(0.111)	(0.096)	(0.088)	(0.165)	
Male (=1)	-0.250***	-0.256***	-0.262***	-0.126	
	(0.086)	(0.087)	(0.083)	(0.175)	
Years experience	0.004	0.001		-0.007	
	(0.018)	(0.016)		(0.019)	
Years experience squared	-0.000	-0.000		0.000	
	(0.001)	(0.001)		(0.001)	
Order of birth	0.001	0.006		0.035	
	(0.015)	(0.014)		(0.029)	
Number of siblings	0.010	0.009		-0.024	
	(0.017)	(0.017)		(0.032)	
Observations	122	122	122	85	85
R-squared	0.1577	0.1764	0.1341	0.2244	0.1916

Notes: Linear probability model. In columns I, IV, and V the dependent variable is the actual location of the first job (Addis=1), while in columns II and III it is the location of the first job as *assigned* under the lottery. Standard errors corrected for clustering at facility level. P-values: *** 1%, ** 5%, * 10%, ~15%.

*

Table 6: Predicting assignment to Addis Ababa in first job after medical school

	Lottery participation			Currently in private sector		Physician is specialized	Salary (log)
	I	II	III	IV	V	VI	VII
2nd ranked student	0.031	0.032	-0.071	-0.175*		-0.233***	-0.174
	(0.093)	(0.092)	(0.098)	(0.093)		(0.082)	(0.112)
3rd ranked student	0.245***	0.245***	0.242***	-0.179~		-0.303***	-0.137
	(0.092)	(0.092)	(0.091)	(0.112)		(0.080)	(0.125)
Parents health workers	-0.032	-0.021	0.110	-0.235*	-0.195**	-0.204***	-0.236
	(0.231)	(0.230)	(0.145)	(0.129)	(0.093)	(0.075)	(0.181)
Other relatives	-0.049	-0.046	-0.122	0.122	0.131	-0.184***	0.189
health workers	(0.108)	(0.107)	(0.107)	(0.096)	(0.102)	(0.057)	(0.117)
Sponsor:	-0.246*	-0.250*	-0.220	-0.206**	-0.207**	-0.212***	-0.148
regional authorities	(0.134)	(0.133)	(0.140)	(0.099)	(0.099)	(0.051)	(0.104)
Sponsor:	-0.417***	-0.415***	-0.448***	-0.220**	-0.241**	0.162	-0.206**
private/foreign govt	(0.111)	(0.112)	(0.110)	(0.105)	(0.108)	(0.162)	(0.099)
Male (=1)	0.014	0.012	-0.004	0.104	0.092	0.126*	-0.027
	(0.118)	(0.118)	(0.121)	(0.093)	(0.093)	(0.073)	(0.097)
Years experience	0.061***	0.060***	0.070***	0.027	0.028	0.000	0.051***
	(0.015)	(0.015)	(0.014)	(0.018)	(0.018)	(0.004)	(0.016)
Years experience^2	-0.002***	-0.002***	-0.002***	-0.000	-0.000		-0.001***
	(0.000)	(0.000)	(0.000)	(0.001)	(0.000)		(0.000)
Order of birth	-0.068***	-0.066***	-0.061**	0.029	0.018	0.073***	0.029
	(0.025)	(0.025)	(0.027)	(0.021)	(0.020)	(0.020)	(0.021)
Number of siblings	0.042**	0.041**	0.036*	-0.005	0.005	-0.059***	0.007
	(0.019)	(0.019)	(0.019)	(0.017)	(0.015)	(0.021)	(0.015)
Private clinics		-0.046	-0.519***				
common		(0.150)	(0.146)				
2nd rank x Private			0.462***				
clinics common			(0.052)				
3rd rank x Private			0.204				
clinics common			(0.305)				
Specialist training					0.123		0.695***
					(0.114)		(0.120)
Participated in lottery						-0.519***	
						(0.189)	
Lottery participant						0.136*	
x rank (linear)						(0.087)	
Observations	216	216	216	207	207	207	203
(Pseudo) R-squared	0.1581	0.1586	0.2110	0.2023	0.1840	0.2750	0.2690

Notes:Probit models (dprobit coeffieints reported) for lottery participation, based on entire sample. Linear probability for private sector participation (probit omits five observations whose parents were helth workers since none of these work in the private sector). OLS for log salary. Private sector and specialization limited to physicians at least 2 years out of medical school.

Table 7: Determinants of lottery participation, private sector work, and specialization

	Lottery		Market	
	OLS/OProbit	NNM	OLS/OProbit	NNM
	I	II	III	IV
Duration (years) first job	1.092***	2.625***	1.957**	3.275***
	(0.364)	(0.338)	(0.798)	(0.970)
Wage satisfaction, first job	-0.048	-0.362*	0.558	-2.012***
	(0.467)	(0.195)	(0.500)	(0.382)
Training satisfaction, first job	-0.375	-3.535***	0.004	0.871***
	(0.507)	(0.142)	(0.609)	(0.209)
Work load satisfaction, first job	0.204	-0.376**	0.086	-0.339
	(0.286)	(0.161)	(0.301)	(0.313)
Overall satisfaction, first job	0.483	3.518***	0.154	-1.766***
	(0.394)	(0.382)	(0.576)	(0.399)
Number of observations	121	121	85	85

Notes: Each cell represents a separate OLS (duration), ordered probit (satisfaction), or NNM with robust std errors and bias correction estimation and reports the coefficient on a dummy variable equal to one if the first job assignment was in Addis. Dependent variables are in the first column. Controls are: dummies for class rank, parents or relatives health workers, medical school sponsor, gender, experience, experience^2, number siblings, and birth order. All estimations exclude physicians less than two years out of medical school. p-values: *** 1%, ** 5%, * 10%, ~15%. Ordered probit std errors corrected for clustering at facility level.

Table 8: The short-term impact of having a first job in Addis Ababa

	Lottery		Market	
	OLS/OProbit	NNM	OLS/OProbit	NNM
	I	II	III	IV
Current job in Addis	0.121	-0.025	0.036	0.388***
	(0.241)	(0.214)	(0.130)	(0.097)
Specialized	-0.158**	-0.165***	0.190*	0.412***
	(0.073)	(0.039)	(0.098)	(0.145)
Current job in private sector	0.195	0.266~	0.140	-0.620***
	(0.193)	(0.168)	(0.199)	(0.130)
Current salary (log)	0.140	0.465***	0.054	0.335**
	(0.199)	(0.173)	(0.184)	(0.155)
Overall satisfaction, current job	0.867*	1.720**	0.014	-3.058***
	(0.520)	(0.676)	(0.559)	(0.471)
Currently lives in same region	0.358***	0.271***	-0.130	-0.262***
as at age 10	(0.117)	(0.055)	(0.187)	(0.073)
Number of observations	121	121	85	85

Notes: Each cell represents a separate OLS, ordered probit (for satisfaction), or NNM with robust standard errors and bias correction estimation (Abadie and Imbens, 2002) and reports the coefficient on a dummy variable equal to one if the first job assignment was in Addis. Dependent variables are in the first column. Controls are: dummies for class rank, parents or relatives health workers, medical school sponsor, gender, experience, experience^2, number siblings, and birth order. All estimations exclude physicians less than two years out of medical school. p-values: *** 1%, ** 5%, * 10%. Ordered probit std errors corrected for clustering at facility level.

Table 9: The long-term impacts of having a first job in Addis Ababa

	Log current salary		
	I	II	III
1st ranked student	0.421**	0.505***	0.476***
	(0.178)	(0.155)	(0.137)
2nd ranked student	0.067	0.153	0.178~
	(0.156)	(0.130)	(0.125)
1st ranked x lottery	-0.182	-0.291	
	(0.214)	(0.193)	
2nd ranked x lottery	-0.082	-0.196	
	(0.207)	(0.139)	
1st and 2nd ranked			-0.240*
x lottery			(0.121)
Lottery	-0.116		
	(0.169)		
Parents healthworkers	-0.332	-0.344	-0.324
	(0.293)	(0.286)	(0.258)
Other relatives	0.061	0.064	0.067
healthworkers	(0.130)	(0.129)	(0.127)
Years experience	0.061***	0.058***	0.058***
	(0.020)	(0.019)	(0.019)
Years experience^2	-0.002***	-0.001***	-0.001***
	(0.001)	(0.001)	(0.001)
Sponsor:	-0.310*	-0.304*	-0.311*
regional authority	(0.165)	(0.164)	(0.163)
Sponsor:	-0.167	-0.158	-0.156
private/foreign govt.	(0.115)	(0.115)	(0.116)
Order of birth	0.066**	0.068**	0.070**
	(0.028)	(0.028)	(0.027)
Number of siblings	-0.020	-0.020	-0.022
	(0.019)	(0.018)	(0.019)
Observations	203	203	203
R-squared	0.2823	0.2810	0.2799

Notes: All estimations exclude physicians who were less than two years out of medical school. OLS estimations with standard errors corrected for clustering at facility level. p-values: *** 1%, ** 5%, * 10%, ~15%, ~$p = 0.159$.

Table 10: Wage evidence of adverse selection among lottery participants

	1st ranked
Lottery participation	0.142
	(0.139)
Lottery participation x	-0.020*
experience	(0.011)
Experience	0.035*
	(0.019)
Experience^2	-0.079~
	(0.050)
Number of observations	209

Notes: Robust standard errors clustered at the facility level. OLS estimation excludes physicians who were less than two years out of medical school.
p-values: * 10%, ~15%.

Table 11: Attrition evidence of adverse selection among lottery participants