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Yutaka ARIMOTO [†] Seiro ITO [‡] Yuya KUDO [‡]
Kazunari TSUKADA [‡]

February 2013

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Keywords: Corporate sector, Disclosure concern, Discrimination, HIV/AIDS, Perceived stigma, Social network

JEL classification: D83, I12, M14, M54

[†] Institute of Economic Research, Hitotsubashi University

[‡] Institute of Developing Economies (IDE-JETRO)

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INSTITUTE OF DEVELOPING ECONOMIES (IDE), JETRO
3-2-2, WAKABA, MIHAMA-KU, CHIBA-SHI
CHIBA 261-8545, JAPAN

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Yutaka Arimoto† Seiro Ito‡ Yuya Kudo‡ Kazunari Tsukada‡

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Abstract

This paper explores whether a worker's unwillingness to make his/her HIV-positive status or test-taking experience known by colleagues impedes his/her decision to test for HIV. After analyzing the new survey data provided by employees working for a large multinational enterprise in South Africa (2009-2010), this study finds that this unwillingness is negatively associated with test-taking (at the enterprise's on-site clinic) of workers who are extensively networked with close colleagues (i.e., know their phone numbers). It appears that the expected disutility associated with HIV/AIDS-related stigma prohibits test uptake. When introducing HIV counseling and testing programs into a corporate sector, providing all workers with an excuse to test in the workplace and/or inducing them to privately test outside the workplace may be effective in encouraging the uptake.

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1 Introduction

HIV testing enables affected individuals to receive an appropriate treatment, care and support for infection, as well as to prevent HIV/AIDS epidemic. While HIV testing used to be recommended in medical settings, mainly to those suspected with infection that visited a clinic (client-initiated HIV testing and counseling, CITC), in order to encourage the uptake of HIV testing, an international society has recently started advising health-care workers regularly to offer testing and counseling to all individuals that might benefit from knowing their HIV status in a timely manner. Such measures are seen as beneficial in preventing HIV transmission (provider-initiated HIV testing

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Corresponding author's e-mail address: Yuya_Kudo@ide.go.jp.

†Center for Economic Institutions, Institute of Economic Research, Hitotsubashi University, 2-1 Naka, Kunitachi, Tokyo 186-8603, Japan.

‡Institute of Developing Economies (IDE-JETRO), 3-2-2 Wakaba, Mihama-ku, Chiba-shi, Chiba 261-8545, Japan.

and counseling, PITC) (WHO, 2003, 2011; WHO and UNAIDS, 2004, 2007). Combined with innovation of testing technologies (e.g., rapid testing), this social movement allowed HIV testing and counseling (HTC) to be provided beyond standard health-care facilities and implemented as a part of standard health-seeking behavior in many HIV/AIDS-affected countries and elsewhere, where it is simply a part of sexual health promotion.

One of those external testing alternatives is offering HTC as a part of routine health checks in the workplace. This mode of testing reveals both similarities and differences when compared to testing services in other settings, such as clinic-based voluntary counseling and testing (VCT) in district hospitals.[1] In contrast to local health-care facilities, for example, HTC implementation in the workplace provides efficient and cost-effective access to many individuals, due to strong program enforceability, provided that the testing can successfully be incorporated into a company's welfare programs, such as employer-sponsored on-site/off-site regular health checks. These benefits can be achieved because a company may be able to modify the program to maximize its benefits by using the wealth of pre-existing capital resources, such as human-resource (HR) management skills, medical infrastructure, and inter-staff social relationship built on trust. It is also possible that an employer assures timely care and job security of employees that receive the test. In addition, compared to VCT at distant public clinic, offering HTC at a company's on-site clinic may also induce uptake by reducing both material and emotional burden of receiving the test. Extant studies in this field have identified those costs as important factors prohibiting an individual's uptake (e.g., Angotti et al., 2009; Khumalo-Sakutukuwa, 2008; Wolff et al., 2005) and therefore have, mainly in rural settings, recommended home-based VCT and/or community-based mobile VCT, rather than VCT based on local health-care centers. Moreover, as the workplace could be seen as a small community, whereby workers develop tightly knit connections with each other through job-related day-to-day communication, a fear of stigmatization may also play an important role in the decision to take the test at a company's clinic. This significance is frequently highlighted in the context of non-corporate sector (UNAIDS, 2003; Valdiserri, 2002).

In response to HIV epidemic, a corporate sector in less advanced countries is also in a unique position of significance due to the influence on the economic development. While confidentiality of personnel information must be strictly enforced, understanding the prevalence of population at risk for HIV within a company by relying on an internal welfare program may help the management handle AIDS-related absenteeism, turnover, and reduced employee morale, all of which affect the productivity of the business entity, and ultimately the profits that can be generated. As these factors may, through their effects on business communities and surrounding markets, also influence decision-making of foreign investors and transnational corporations seeking to identify and capitalize on overseas business opportunities, creating an in-house HTC program could have remarkable socio-economic impacts on growing economies.

Despite the evident potential and significance, due to paucity of research other than case studies and policy reports (e.g., Bendell, 2003; Daly, 2000; Dickinson, 2004; Mahajan et al., 2007; Mnyanda, 2006; IFC, 2002), the issues that may arise from offering HIV testing services in the workplace are insufficiently explored. One reason for this lack of prior interest may stem from a difficulty in collecting micro-level data that could be used for a rigorous empirical analysis, which may be in conflict with confidentiality of a company's HR information. With a great support

[1] The CITC is often called voluntary counseling and testing (VCT).

from, and socio-economic contribution of, one local subsidiary of Japan's multinational manufacturing company operating in a northeast province in South Africa, Kwazulu-Natal, the present study overcomes this difficulty, providing empirical evidence pertaining to concerns associated with offering HTC in the workplace. At present, it appears that this research is one of very few empirical attempts to provide insight into the reasons behind the decision to test for HIV, based on high-quality survey data of employees collected within a large multinational enterprise.[2]

Similar to the previous studies highlighting the importance in the context of non-corporate sector (see, for example, MacQuarrie et al. (2009), Mahajan et al. (2008), and Mbonu et al. (2009) for a brief overview),[3] based on conversations with both the health-care and HR department staff of the surveyed enterprise, a fear of HIV/AIDS-related stigma appeared to be the most likely obstacle to encouraging the uptake by exploiting a company's routine health-check program. This is because the uptake may be interpreted as a signal of sexual and/or social misbehavior (e.g., promiscuity, homosexuality, addiction to intravenous illegal drugs) that can deserve discredit, followed by workplace discrimination. Motivated by this belief - as a natural starting point to consider issues that may result from offering HIV testing services in the workplace - this study attempts to explore the likelihood of an employee taking a test in the workplace, when the fear of HIV/AIDS-related stigma is taken into consideration.

The current research uses data drawn from a questionnaire-based survey - HIV Knowledge, Aptitude, Perception, and Behavior Survey (KAPB) - that the authors conducted in 2009-2010, which reached approximately 90% of the employees working for the aforementioned Japanese manufacturing company.[4] Based on the answers to hypothetical questions included into this survey, about 20-30% of all 6241 interviewed employees revealed their reluctance to reveal their HIV-positive status or test-taking experience to their colleagues. Given the likely association between the negative attitude towards disclosure and a worker's perceptions about the magnitude of HIV/AIDS-related stigma prevalent in the workplace (e.g., Simbayi et al., 2007a; Young and Bendavid, 2010; Young and Zhu, 2012), this study will test if this unwillingness to share the HIV-related information with colleagues hinders the uptake of HIV testing.

This study finds that the unwillingness is negatively associated with test-taking of workers who are extensively networked with close colleagues (i.e., workers that have private phone numbers of many close colleagues). Moreover, such negative association is only found for testing at on-site clinic of the enterprise, as there seems to be a perception that there is a higher probability of

[2]Another significant contribution that this study recognizes is Habyarimana et al. (2012). Matching the absence records of employees working for the Debswana Diamond Company in Botswana with the records of their enrollment in a free anti-retroviral therapy (ARVs) program provided by the company, the authors studied the medium and long-term impacts of ARV treatment on worker absenteeism.

[3]Broadly speaking, the previous studies on HIV/AIDS-related stigma may be grouped into (a) those conceptualizing stigma (e.g., Link and Phelan, 2001; Maughan-Brown, 2006; Parker and Aggleton, 2002, 2003), (b) those exploring a good quantitative measure of stigma (e.g., Berger et al., 2001; Kalichman et al., 2005), (c) those investigating association between stigma and HIV testing (e.g., Herek et al., 2003; Kalichman and Simbayi, 2003; Young et al., 2010), (d) those discussing policy instruments that can be implemented in order to reduce a fear of stigmatization (e.g., Baston et al., 1997; Herek et al., 2002; Maughan-Brown, 2010. See also Brown et al. (2001) and UNAIDS (2007) for a brief overview), and (e) some others (e.g., Maughan-Brown, 2010; Simbayi et al, 2007b).

[4]With an estimated 5.6 million people living with HIV in 2009, South Africa is the country most affected by the HIV epidemic in the world (UNAIDS, 2010. See also SANAC (2007, 2010) for a brief overview of general trend of HIV prevalence in this country. See, for example, Butler (2005) for a recent history of HIV/AIDS policies in South Africa), with KwaZulu-Natal at the upper end of its prevalence within the country. In South Africa, South African Business Coalition on HIV & AIDS (SABCOHA), a member-driven organization consisting of more than 150 private companies (as of 2011), has been attempting to coordinate a corporate sector in response to the HIV/AIDS epidemic since 2007. The strength and implications of this background information are a natural reason for this study's choice of the surveyed site.

the test being detected by fellow workers compared to attending an off-site clinic. These findings reveal a parallel to the existing literature highlighting the importance of social relationship in encouraging people's uptake of HIV testing (e.g., Godlonton and Thornton, 2012; Ngatia, 2011) or more generally in inducing people's adoption of innovative health-related products in a tightly knit community (e.g., Munshi and Myaux, 2006). The current study aims to demonstrate this significance in the context of corporate sector.

Based on observational cross-sectional data, many medical literature sources have reported the association between a fear of HIV/AIDS-related stigma and an individual's uptake of HIV test in non-corporate settings. Even though most of those studies provide no rigorous empirical evidence (and even discussions) in support of the causality - an individual's awareness about the significance of HIV/AIDS-related stigma prevents his/her uptake - the authors often provide strong conclusions, even if those conclusions do not always have obvious and explicit relationship to the findings. Because of cross-sectional nature of the KAPB data and lack of adequate instrumental variables for the disclosure concern, it may also be difficult for this study to justify the strong causal inference of the reported findings. However, there is still a significant distinction between the current research and similar extant studies in terms making every effort to identify the negative causal impact of a worker's perceptions about the seriousness of HIV/AIDS-related stigma on his test-taking.[5] This study will provide ample evidence in support of the causal inference from the perspectives of the strength of a worker's social relationship in the workplace and clinic location.

The primary policy implication derived from this study is that, when introducing a HIV counseling and testing program into a corporate sector, providing all workers with an excuse to test in the workplace and/or encouraging them to privately test outside the workplace may be effective in raising the uptake probability. In fact, this lesson was exploited in an experimental HTC intervention (randomized controlled trial, RCT) that the authors conducted in this enterprise after the KAPB survey. In this RCT, the intervention was integrated with a medical surveillance program (MSP) of the company (Arimoto et al., 2012).[6]

This paper is organized in five sections. Section 2 provides an empirical strategy, followed by data overview given in Section 3. The estimation results are presented in Section 4, and the conclusions summarized in Section 5.

2 Empirical Strategy

2.1 Specification

As explained in Section 3, this study uses cross-sectional data drawn from the HIV Knowledge, Aptitude, Perception, and Behavior Survey (KAPB) that was carried out in Kwazulu-Natal in 2009-2010, which included almost all employees working for Japan's multinational manufacturing.

In this paper, HIV/AIDS-related stigma refers to losing social relationship with other workers in the workplace due to taking the test, both in terms of number of colleagues that remain in contact with the individual and the quality of the relationship. In the absence of the stigma,

[5]Henceforth, workers will be referred to using the male pronoun as they constituted 82% of the surveyed employees.

[6]In non-corporate settings, there are several experimental studies implementing interventions to encourage the uptake; for example, by providing AIDS education (e.g., Klepp et al., 1997), universally offering of written and verbal communication (e.g., Simspon et al., 1998), and by providing community-based mobile VCT (e.g., Khumalo-Satukuwa et al., 2008).

testing for HIV benefits workers because, in a seropositive case, they can improve health condition (and hence the utility) by receiving an appropriate treatment after the test. However, by testing for HIV, a worker may lose social contacts once he is stigmatized, which reduces his utility. Therefore, the expected loss of social relationship, i.e., the expected cost of stigma, may prevent a worker's uptake. The empirical goal of this paper is to demonstrate that this expected cost is indeed negatively associated with a worker's decision to test for HIV.

Theoretically, the expected cost can be estimated by multiplying (i) the cost of stigmatization (i.e., disutility resulting from losing social relationship with colleagues) by (ii) subjective probability that test experience will be detected by other workers (i.e., detection probability), as well as (iii) subjective probability that test takers will indeed lose social contacts (i.e., stigmatization probability). For the purpose of an empirical analysis, therefore, it is necessary to identify and quantify the variables capturing these factors.

Detection Probability

With respect to the detection probability, if a worker establishes a wide social network in the workplace, there is a high probability that his test experience is detected by his fellow workers. Based upon this presumption, this study uses a dummy variable n_i, as a proxy for the detection probability, which is equal to one if a worker created a large social network in the workplace and zero otherwise.

Regarding the size of social network, for each worker, the authors collected information on the number of colleagues working in the same team (unit used for a group of workers in the same structured and functioning lines of command) who shared their private phone number with him.[7] Using the median number (5 colleagues) as the criterion of separation, the analysis split employees into those who belonged to a large group in the workplace (upper 50% quantile) and those who belonged to a small group (lower 50% quantile), and created the dummy based on this information.

If a worker establishes sufficiently close social relationship with colleagues to prompt an exchange of phone numbers, it must be difficult to make his test experience private. Thus, under a corporate setting, the dummy based on phone numbers is expected to be a better measure capturing the possibility of detection than that based on spatial proximity often used in the previous studies as a measure of social network in a rural setting (e.g., Godlonton and Thornton, 2012).

Stigmatization Probability and Disutility

Unfortunately, the KAPB data does not include information that allows to independently measure a worker's perception of the likelihood of being stigmatized (measure (iii) in the cost estimate above) as well as his loss of utility arising from losing social relationship (measure (i) above). However, in the KAPB, the authors asked employees to consider a hypothetical situation under which they would select, among items displayed in Table 1, the first person whom they did not want to know that they were infected with HIV or that they tested for HIV. Based on this information, a dummy variable d_i was created, which takes value of one if the answer to the first-person question is 'colleagues' and zero otherwise. While no separate measures are available for those two factors of

[7]While 'Among team members, how many persons' phone numbers do you have?' was wording actually used in the questionnaire, with a verbal instruction to field staff, asking employees to list phone numbers on their cell phone was primarily intended in this question. Approximately 95% of the surveyed respondents owned cell phones. Only 4% of those who had cell phones had no phone numbers of their colleagues, but this figure rose to 64% for employees that did not possess cell phones.

(i) and (iii), it is expected that a worker's unwillingness to share the HIV-related information with his colleagues implicitly measures all those negative concerns associated with HIV/AIDS-related stigma (a composite of subjective probability and disutility of stigmatization).

With respect to the plausibility of the unwillingness as a proxy for the stigma concerns, the relationship between people's perceptions about HIV/AIDS-related stigma and negative attitude towards disclosure of test-taking or infection has often been reported in the literature. For example, using data of outpatients who visited hospitals for medical tests in the US, Young and Bendavid (2010) found that, compared to individuals who took spirometry, allergy testing, mammography, and colonoscopy (recognized as non-stigmatized tests), those who tested for HIV tended to cite, as reasons for visit, issues unrelated to the tests performed. Similarly, those taking the HIV test were inclined to receive additional medical services irrelevant to the tests implemented. The authors interpreted these findings as an attempt to avoid HIV stigma by seeking a psychological cover for HIV testing. Similar observations were also reported by Young and Zhu (2012). In addition, based on data pertaining to HIV-positive men and women living in Cape Town, South Africa, Simbayi et al. (2007a) also found that individuals who did not disclose HIV status to their sex partners were more likely to have experienced HIV/AIDS-related discrimination previously (e.g., loss of employment and a place to stay) than those who willingly shared this information.

The analysis in Table 2 may also suggest that a worker's unwillingness to share the information on the HIV testing experience and subsequent seropositive diagnosis with the colleagues is associated with his concern about HIV/AIDS-related stigma existing in the surveyed enterprise. Based on responses to another couple of hypothetical questions, the authors constructed dummies, equal to one if a respondent expected his colleagues or non-colleagues (family members and neighbors) to either alienate him; speak badly of him/treat him badly; or hesitate to shake hands or share foods and drinks with him if they knew that he was infected with HIV, and zero otherwise. Approximately 18% and 22% of the surveyed employees indicated a concern about those types of discrimination from colleagues and non-colleagues, respectively. In the table, a worker's unwillingness to share the information on the HIV positive status (PS) or test-taking experience (TE) with the colleagues were regressed on those discrimination dummies in order to test for the presence of correlation. Interestingly, whether it is HIV-positive status or test-taking experience that a worker did not want to be known, his unwillingness to share this information with the *colleagues* positively correlated with the expected discrimination from *colleagues* with strong significance in columns (a) and (c), with a similar pattern observed for non-colleagues in columns (b) and (d). It appears that the unwillingness is indeed associated with a worker's perceptions about HIV/AIDS-related stigmatization from a relevant group of concern.

By using these measures, for an employee i working in an area j (unit used for plants and administrative departments), this study derives the following empirical model:

$$T_{ij} = I(\beta_1 + \beta_2 d_i + \beta_3 d_i n_i + \beta_4 n_i + \omega_j + \epsilon_{ij} > 0), \tag{1}$$

where $I(\cdot)$ is an indicator function; T_{ij} takes the value of one if he tests for HIV and zero otherwise; any unobserved area-level characteristics determining net gains from the uptake are measured by a working area dummy ω_j (63 areas); and ϵ_{ij} is a stochastic error. The area fixed effects are expected to capture shared understandings in a respective working area about sexual behavior as well as attitudes towards sexually transmitted diseases (STDs). Assuming that the expected cost of stigma reduces the uptake probability of HIV testing, the negative β_2 and β_3 are expected in an empirical analysis. In Appendix A, these predictions and the empirical model of (1) are derived more formally. For the sake of tractability, this study eventually estimates the linear probability model (LPM) of (1).[8]

Intuitively, a worker's unwillingness to reveal the HIV testing and results to his colleagues may also be affected by the size of social network that he developed in the workplace. In fact, this intuition is supported by the theoretical model presented in Appendix A. Two comments may be expressed with respect to this point. Firstly, if the intuition is correct, it is expected that the negative β_3 indeed identifies an additional impact of the stigma concerns, augmented by the likelihood of detection. Secondly, it may be difficult to strictly segregate the three aspects of the expected cost of stigmatization, i.e. likelihood of detection, likelihood of stigma, and disutility of stigma by using d_i and n_i. However, at the very least, it seems true that the interaction evaluates the overall expected cost of stigmatization.

[Here, Tables 1 and 2]

2.2 Measurement Issues about T_{ij}

In contrast to the d_i and n_i, which were evaluated at the point of the survey, the variable T_{ij} that was actually used in the estimations refers to a worker's past test-taking experience, i.e., it is a dummy variable equal to one if he has ever tested for HIV and zero otherwise. While most of those who have ever tested did so in the recent past in response to the intensive AIDS-prevention campaign in the late 2000s (see Figure 1 for the distribution of the year of the last test-taking experience highly skewed towards the recent past),[9] this makes the estimation results of (1) hard to interpret. To mitigate this interpretation problem, the analysis is performed on two groups of workers - those that tested for HIV in recent years of 2008-2010, and those have never tested before, although this sample restriction almost unaffected the estimation results using all samples.[10] This issue may also result in a problem of reverse causality, whereby the previous test-taking experience might have affected a worker's attitude towards disclosure of HIV infection or uptake both positively and negatively. This point will be discussed in more detail when reporting the estimation results in subsections 4.1 and 4.2.3.

With respect to the variable T_{ij}, the benchmark analysis of this study does not make a distinction about a place in which employees received the test - about 40% of respondents that tested for HIV did so at on-site clinic of the enterprise, with the remaining 60% attending an off-site clinic. Two reasons may account for this consideration. Firstly, it may be straightforward to expect that, compared to the on-site clinic that might have been in the public eye of colleagues, employees who were reluctant to be detected by colleagues might have preferred to test for HIV at an off-site clinic. However, it is also possible that in the workplace, which may be seen as a small community formed by workers, taking a leave to test for HIV and/or to receive treatment at an off-site clinic signals uptake or suspected HIV infection to colleagues. In this case, the selection of clinics may not make a significant difference in accounting for the impact of a worker's negative

[8] The results of probit model can be provided by the authors, upon request, although the non-linear model hardly changed implications obtained from the analysis based on the LPM. In addition, after splitting the sample into two groups of those belonging to small ($n_i = 0$) and large networks ($n_i = 1$), the authors also estimated $T_{ij} = \tilde{\beta}_1 + \tilde{\beta}_2 d_i + \omega_j + \epsilon_{ij}$. The estimated $\tilde{\beta}_2$ for each group yielded similar implications to the estimated β_2 and β_3 in the LPM of (1).

[9] Approximately 75% of employees who had ever tested experienced the last HIV test between 2008 and 2010.

[10] The results using all the test-takers and non-takers are available from the authors upon request.

attitude towards disclosure on his test-taking decision. Secondly, making a distinction between on-site and off-site clinics by using an alternative empirical model, such as multinomial logit, will require additional assumptions that have to be verified. While the importance of selection of clinics will be discussed in more detail in subsection 4.2.3 after presenting the main estimation results, the benchmark estimations attempt to avoid making an analytical approach overly complex.

[Here, Figure 1]

2.3 Unobserved Heterogeneity

Any unobserved characteristics, other than a concern about being stigmatized due to testing for HIV, may affect a worker's unwillingness to share the HIV-related information with his fellow workers as well as his decision to take the test. For example, a worker may simply be nervous about uncovering his HIV PS/TE to colleagues and shy of taking a test. The size of social network that a worker developed in the workplace may also be endogenous in the uptake equation. If workers in a large social network show little propensity to disclose their HIV PS/TE to colleagues as well as to test for HIV due to their unobserved personality traits, this generates negative bias on the estimated β_3. Since the data drawn from the KAPB is cross-sectional and no adequate instrumental variables for d_i and n_i exist, this study cannot provide strong justification for the causal interpretation of the impact. However, to address this problem, two main strategies will be adopted in this paper.

The first strategy conforms to a conditional independence assumption (CIA), i.e., conditional on observables, the variable d_i and n_i are statistically independent of a worker's decision to test for HIV. The validity of CIA largely depends on the ability to eliminate unobserved heterogeneity across workers associated with d_i, n_i and a worker's test-taking decision. Regarding the heterogeneity, in addition to a standard set of regressors, such as age, gender, and education, the analysis controls for a worker's knowledge about HIV/AIDS, HIV/AIDS-related social environment, and - arguably, in some estimations (see subsection 4.1) - previous sexual behaviors.

To measure a worker's knowledge about HIV/AIDS, the authors designed 16 questions that could be answered in a 'true-false' format, which allowed creating test scores for each surveyed employee (0-16 scale).[11] With respect to a worker's HIV/AIDS-related social environment that might have affected his test-taking decision and the process of developing reluctance to reveal HIV PS/TE to colleagues, the authors collected information on whether a worker was surrounded by relatives, neighbors, and colleagues, who were or were suspected to be HIV positive and/or had died of AIDS-related illness, as well as information on whether he knew how they had been treated by others. Several dummy variables to be included in regressors were constructed based on this information.

The available controls for the previous sexual behavior were represented by several dummy variables (i.e., a dummy for having had sexual intercourse in the last 12 months with a person likely to be infected with HIV; a dummy for the previous experience of sexually transmitted diseases (STDs) other than HIV; a dummy equal to one if the last or the second to last sexual partner was casual acquaintance; and a dummy equal to one if a worker did not use a condom during the

[11] When this test is too difficult or too easy, the scores might not reveal any difference in levels of understanding about HIV/AIDS across workers, as almost all respondents would achieve either full or zero score. Appendix Figure 3, which provides the graphical representation of the distribution of the test scores, excludes this possibility. Those 16 questions can be obtained from the authors upon request.

sexual intercourse with the casual acquaintance) and the number of sexual partners in the last 12 months as well as the number of condoms kept at home.

Given the presumption that residential areas may reflect levels of wealth at employees' disposal, time usually needed to commute to the enterprise was also controlled for. For the same reason, a dummy for having a cell phone was also included in the estimations, although almost all surveyed employees owned it and thus there was not much variation in the data with respect to this variable.

Despite these controls, the CIA may still be too strong to be accepted. To avoid incorrect inference and draw a robust picture from the analysis, this study also provides additional support for the hypotheses from the perspectives of types of people that a worker had social contacts with and location of clinics. These will be discussed in more detail in subsection 4.2 after presenting the main estimation results.

3 Data

This paper uses data drawn from the HIV Knowledge, Aptitude, Perception, and Behavior Survey (KAPB) that the authors conducted in a northeast province in South Africa, KwaZulu-Natal in 2009-2010. With 25.8% given as the HIV prevalence among populations aged 15-49 in 2008, compared to the national average of 16.9%, Kwazulu-Natal is the most seriously HIV/AIDS-affected province in a country with the heaviest HIV/AIDS-related socio-economic burden in the world (Shisana et al., 2009, p.35).

In the KAPB, the survey team attempted to interview all employees working for one local subsidiary of Japan's multinational manufacturing company operating in the province, eventually reaching 6241 employees, over 90% of all workers employed by the enterprise. Taking into account the relatively high rate of worker absence observed in most South African companies, the authors believe that the data set represents the employee population of interest very well. The purpose of the KAPB was improving our understanding of difficulty that may arise from introducing a HIV counseling and testing program into a corporate sector. This survey was eventually extended to the subsequent experimental intervention (randomized controlled trial) that the authors conducted in this enterprise in 2010 to encourage a worker's uptake of HIV test (see Arimoto et al. (2012) for details). In this experimental intervention, the research team aimed at integrating a HTC program with an employer-sponsored routine medical check program. Thus, as in this enterprise approximately 78% of the surveyed employees were required to take a regular health surveillance, it provided an ideal setting for the purpose of the overall research project. This local subsidiary was not randomly selected from the population list of similarly-sized enterprises. However, as it is a leading and typical multinational manufacturing company that provides a great number of jobs, it is expected that the findings from this study would be informative in designing an effective HTC program in similar workplace settings.

Table 1 summarizes responses to the hypothetical question of who is the first or second person whom a worker does not want to know that he is infected with HIV or that he has tested for HIV. As already explained in subsection 2.1, the subsequent analysis uses this unwillingness to share this information with the colleagues (as the first person) as a main explanatory variable (d_i). The table shows that approximately 20-30% of the surveyed employees selected colleagues as either the first or second person that they were unwilling to disclose HIV-positive status or test-taking experience to.

After splitting the surveyed employees into three groups - those with $d_i = 1$ and $n_i = 1$ (reluctant and large network, RL), those with $d_i = 1$ and $n_i = 0$ (reluctant and small network, RS), and those with $d_i = 0$ (no reluctance, NR) - Tables 3 and 4 summarize key variables, with a check of the equality of the mean across groups. The balancing test revealed relatively clear differences between individuals in the groups RL and NR. Workers in the group RL were more likely to be females (although the majority of the surveyed workers were males) and younger than those in the group NR. It also appears that the lower average age in the group RL was associated with the observations that employees in that group worked for the enterprise for a shorter time period; were less likely to be in a marital union as well as had less children aged under 15; were more educated (probably because the younger generation received higher levels of education than the old one); had better HIV/AIDS knowledge; and exhibited riskier sexual behaviors in the past (in terms of the previous experience of STDs and the total number of sexual partners in the last 12 months). In contrast to the relationship between the groups RL and NR, except for a couple of variables,[12] no clear relationship between employees in the groups RS and NR was identified.

In the KAPB, employees were also required to grade their perception from scale 0 to 10 about the likelihood that non-medical personnel in the enterprise would know their HIV-test results if they take the HIV test at the company's on-site clinic. The reliability of the subjective expectation may be debatable[13] and approximately 22% of the surveyed employees had difficulty in grading. Nevertheless, rather intuitively, employees in the group RL expressed a greater concern than those in the group NR about the possibility that their test results might be known by the non-medical personnel of the enterprise, although confidentiality relevant to HIV testing was strictly enforced in the surveyed enterprise and, in fact, the majority (about 68%) of all surveyed employees who provided the subjective expectation revealed no concern about the information leak (selecting 0 on the likelihood scale) (see Figure 2 for the entire distribution). In sum, it appears that employees observationally differed across groups, which suggests the importance of controlling for those differences in an empirical analysis that follows.

Several free HIV testing opportunities are available for all employees of the surveyed enterprise. For example, the on-site clinics provide the HIV test as a part of the free primary health-care services. In addition, private insurance companies affiliated with the enterprise offer a health insurance program called 'medical aid' to employees (see also subsection 4.2.3). With no additional costs other than the premium, those that have medical aid whose policy covers HIV test are able to take the test at an off-site clinic. Moreover, public hospitals with adequate facilities offer the HIV test free of charge (although people may sometimes have to queue, which may cause undue stress).

Tables 3 and 4 indicate that at the point of the KAPB survey, approximately 60-70% of the interviewed employees had previously tested for HIV. As described in subsection 2.2, this study uses this information as a dependent variable in an empirical analysis. Although the rate seems quite high, the uptake has recently gained momentum rather temporarily due to the nationally organized

[12] For example, the proportion of employees that achieved levels of education below high school was higher in the group RS than in the group NR, whereas tertiary and master levels of education were more likely to be attained by workers in the group NR. Similar to workers in the group RL, those in the group RS had better HIV/AIDS knowledge and, with higher probability, experienced STDs than those in the group NR. On the other hand, as opposed to the RL workers that were more likely to be females than those in the group NR, the RS workers were more likely to be males than those in the group NR.

[13] However, Devalande et al. (2011) and Manski (2004) provided a rather positive view of the reliability of subjective expectations in an empirical analysis.

intensive AIDS-prevention campaign (see Figure 1).[14] In addition, in an economy with populations at risk for HIV infection, repeated testing is also indispensable for preventing the transmission. Thus, those numbers do not imply that this enterprise has no problem about HIV/AIDS-related management. In fact, further increasing the uptake rate of HIV test was still an urgent issue for this company, when the authors revisited the clinic in late 2012.

[Here, Tables 3, 4 and Figure 2]

4 Estimation Results

4.1 Main Results

The estimation results of (1) (LPM) are reported in Table 5, whereby columns (a) and (b) use a worker's unwillingness to share the information on HIV-positive status with his colleagues as d_i, in contrast to that relevant to HIV-test experience used in columns (c) and (d). For employees in a small network in the workplace, the unwillingness to disclose their HIV PS/TE to the colleagues has no impact on the uptake probability of HIV testing. However, once workers establish a wide social network in the workplace, the unwillingness reduces the probability by 5-7 percentage points in columns (a) and (c).

In columns (b) and (d), several variables associated with the previous risky sexual practices were additionally included in regressors. As approximately 98% of individuals who have ever had sexual intercourse experienced the most recent one within one year from the point of the survey. Hence, once again, in order to mitigate the problem that might arise when interpreting the estimation results, those who tested for HIV in 2008 were excluded from these estimations. Including those variables might be challenged due to their endogenous nature, which would make the underlying theoretical mechanism behind the estimated empirical model ambiguous.[15] In addition, self-reported measures of sexual behavior may not strictly be reliable because of inherently private nature of such information (e.g., Fenton et al., 2001; Weinhardt et al., 1998).[16] Acknowledging these issues, it is still demonstrated that the reluctance to disclose HIV PS/TE to colleagues reduces the uptake probability of HIV test by 9-11 percentage points for employees extensively networked with the members of their team.

In subsection 2.2, an issue of reverse causality was indicated, which results from the fact that T_{ij} is measured based on the (recent) past test-taking experience. For example, employees that tested in the past might have shown strong reluctance to uncover their HIV infection or share the decision to take the test with the colleagues if the previous testing experience was followed by harassment and ridicule from colleagues. Consequently, this would bias the estimated β_2 and β_3 upwards. While the direction of the potential bias arising from the reverse causality is unclear, this issue will serve to strengthen, rather than weaken, the significance of the negative effect of the unwillingness to share the HIV-related information on the uptake probability of HIV testing, provided that the estimated β_2 and β_3 are biased upwards.

On the other hand, downward bias is still an issue of concern. However, assuming that potential mechanisms causing the downward bias are not significantly different between employees in small

[14] Approximately 49% of employees who had tested for HIV experienced the most recent test in 2009-2010.

[15] For example, see Gong (2010), who, by conducting a randomized controlled trial in Kenya and Tanzania, explored the impacts of knowing HIV test results on a subsequent risky sexual behavior.

[16] Extant studies indicate a tendency for under-reporting unsafe sexual behaviors (e.g., Packel et al., 2012).

and large networks - indeed, there is no reason to assume the difference - and given that Table 5 reported no impact of d_i on a test-taking decision of employees in a small network, the existence of (if any) downward bias means that the true impact of the unwillingness to share HIV-related information will be positive for employees belonging to a small group. However, it is highly unlikely that the unwillingness to reveal HIV testing experience and diagnosis to the fellow workers *raises* the probability of testing for HIV.[17]

Moreover, Figure 2 suggests that the likelihood of testing experience or results being actually detected by other workers is very low in this enterprise (although this does not necessarily mean that a worker's *subjective* probability of detection is also low), and if they do take the test, employees normally tend to keep the experience highly secret. These considerations also mitigate the likelihood of the opposite direction of the causality by excluding the possibility that a worker will experience workplace discrimination due to the detected uptake of HIV test. Furthermore, in the absence of the actual detection, it is also unlikely that the previous test-taking experience changes the size of social network, eliminating the possible reverse causality from T_{ij} to n_i.

In addition to those main findings, the estimations in Table 5 offer robust support for the inference that being married and having good knowledge about HIV/AIDS increase the uptake probability of HIV testing. While this finding has to be more carefully explored due to the possibility of reverse causality, providing AIDS education may encourage a worker's uptake of HIV test in a corporate sector. On the other hand, males and senior workers are less likely to test for HIV than are females and young staff, respectively.

The survey data revealed that some employees had colleagues or relatives who were or were suspected to be HIV-positive and/or had died of AIDS-related illness but were not treated badly by others. Interestingly, those workers show higher propensity to take the test compared to those who did not know anyone that suffered such health problems. It is quite likely that workers have a closer social relationship with colleagues and relatives than with neighbors. In that case, the findings may be suggesting that being a close friend or a relative of someone who tested for HIV raises the uptake probability due to peer effects, unless those individuals were stigmatized and discriminated by others.

Somewhat similar to the potential peer effects, having a large social network (β_4) in the workplace also raises the uptake probability of HIV testing with strong significance by 7-8 percentage points. The interpretation appears not to be straightforward if the endogenous process of building a social network is considered seriously (see also Appendix A.3). Nevertheless, this impact may also capture the positive influence of establishing a good social relationship in the workplace. However,

[17]Nevertheless, if potential mechanisms driving the reverse causality are not identical between employees in small and large networks, it is still possible to view the estimation results in Table 5 as an indication of an opposite direction of the causality. For example, employees in a large social network might have received positive responses (e.g., benevolent care and support) from colleagues about their test-taking experience in the past, whereas employees in a small network might have received neither positive nor negative (e.g., discrimination) responses. Then, the estimation results in Table 5 may be consistent with this possibility, because in this case, it is quite likely that employees in a large network that have ever tested for HIV have less negative attitude towards disclosure about infection with HIV or test-taking compared to those in a small network.

However, if employees in a large network might indeed have received such positive responses from colleagues after the detected uptake of HIV testing, they are likely to list 'no one in particular' as an answer to the previously explained first person question (check in Table 1 that this was a dominant answer to the question). In that case, it appears that for employees in a large network, the previous uptake negatively correlates with a worker's unwillingness to share the HIV-related information not only with colleagues but also with *non-colleagues*. However, the analysis in subsection 4.2.1 did not identify such negative association regarding the unwillingness to disclose HIV testing and diagnosis to non-colleagues, whereby there was no significant relationship between $\tilde{d}_i n_i$ and T_{ij}.

the aforementioned negative impact of a worker's awareness about HIV/AIDS-related stigma (β_3) is likely to lessen this encouraging effect.

[Here, Table 5]

4.2 Robustness Checks

The previous subsection showed that a worker's unwillingness to disclose his infection with HIV or testing experience to colleagues reduced the probability of testing for HIV, only if he was extensively networked with the members of his team. However, a worker's unobserved characteristics might have negatively affected the estimations, making the causal interpretation difficult. While this study cannot completely rule out the possibility that personal traits affecting the HIV-testing decision as well as the disclosure concern contaminated the previous estimations, as one solution, this subsection attempts to provide additional pieces of evidence in support of the causality. All those attempts will display a sharp contrast of the significance of internal factors (a worker's unwillingness to share the HIV-related information with the *colleagues*, a social network created *within* a team, testing at an *on-site* clinic) with that of external factors (a worker's unwillingness to share the information with the *non-colleagues*, a social network created *outside* a team, testing at an *off-site* clinic) in a worker's decision to test for HIV.

4.2.1 Colleagues versus Non-colleagues

In columns (a) and (e) in Table 6, in the analysis, d_i was replaced by a dummy ($\tilde{d}_i$), equal to one if the first person with whom a worker did not wish to share the knowledge of HIV infection or test-taking experience was 'non-colleagues' and zero otherwise.

One possible concern for the preceding estimations is that a worker who did not test for HIV might have revealed little propensity to disclose his HIV PS/TE to *anyone* (including medical staff) due to his unobserved personality traits unrelated to fearing post-test stigmatization (e.g., shyness, timidity). In this case, the previously identified interplay (β_3) between a worker's negative attitude towards disclosure of HIV-related information to colleagues and the social network that he developed in the workplace might have implicitly included the impact of the unobserved disposition of employees. However, if such a disposition is a dominant factor of d_i, it is quite likely that the d_i and $\tilde{d}_i$ have similar information contents. Then, a worker's unwillingness to disclose HIV PS/TE to non-colleagues (interacted with n_i) may also show a negative impact on the uptake probability of employees in a large social network. On the other hand, if the previously identified impacts of $d_i n_i$ are not contaminated by workers' unobserved personality traits, the $\tilde{d}_i n_i$ will not reveal any impact on a test-taking decision. This is because it is difficult to expect that the impact of the unwillingness (to share HIV-related information) associated with the relationship with non-colleagues (e.g., family members, friends, neighbors), i.e., people *outside* the enterprise, varies by the existence of social network that a worker created *within* the enterprise.

The estimation results support the latter insightful view. The $\tilde{d}_i n_i$ did not reveal any significant impacts. In columns (b) and (f), the analysis was also based on $\tilde{d}_i$ and $\tilde{d}_i n_i$ in addition to d_i and $d_i n_i$, again revealing no significant effects of $\tilde{d}_i n_i$.

4.2.2 Internal versus External Networks

The survey team collected information on the number of colleagues working *outside* the team (external team members) who shared their private phone number with a worker. Using the median quantity of the external members (7 colleagues) as the separation criterion - in contrast to the previously used network variable n_i, which split employees into two groups based on the number of colleagues working *within* the same team (internal team members) whose phone number a worker had - the analysis included another dummy variable ($\tilde{n}_i$), which takes the value of one if a worker belonged to a group of the upper 50% quantile (large external network) and zero otherwise (small external network). In columns (c) and (g) in Table 6, the analysis was conducted after replacing n_i by $\tilde{n}_i$.

A concern here is that in the preceding estimations, splitting survey respondents based on the number of the internal team members might have selected out, from the interviewed employees, those that belonged to a large internal network who showed little preference to disclose PS/TE to fellow workers due to their unobserved characteristics. If those characteristics also influenced the workers to avoid testing for HIV, this might have biased β_3 in the negative direction. While it is difficult to specify personality traits that would have such an effect, it may be posited that for some unidentified reasons, a worker's great ability to socialize makes him develop negative attitudes towards the disclosure as well as hesitant to test for HIV, for example.

In the data, the number of internal team members whose phone number a worker possessed was positively related to the corresponding number pertaining to the colleagues in his external network.[18] Given this positive correlation, replacing $d_i n_i$ by $d_i \tilde{n}_i$ is also likely to produce similar effects on the uptake probability of HIV testing, provided that the selection was indeed a problem in Table 5. On the other hand, if the previously identified effects of $d_i n_i$ in Table 5 were really associated with the likelihood of detection that a worker worried about, it appears that the $d_i \tilde{n}_i$ will reveal little or no impacts on the uptake probability. This intuition is based on the premise that, in the workplace, a worker has to communicate with the internal team members more frequently than the external ones, and therefore, the social ties with the former will play a more important role in explaining the possibility of detection than those with the latter group.

In the columns (c) and (g) in Table 6, the estimation results provide no evidence in support of the selection problem. In contrast to the impacts of $d_i n_i$ in Table 5, the significantly negative impacts of the unwillingness to share HIV-related information interacted with $\tilde{n}_i$ are now absent. This result suggests that the test-deterrent impact of the reluctance to reveal HIV PS/TE to the colleagues increases with the strength of job-oriented social ties. In columns (d) and (h), the analysis was based on $\tilde{n}_i$ and $d_i \tilde{n}_i$ in addition to n_i and $d_i n_i$. Again, no significant impacts of $d_i \tilde{n}_i$ were identified in those additional estimations.

[Here, Table 6]

4.2.3 On-site versus Off-site Clinics

This subsection provides additional evidence in support of the causal interpretation of the impacts of d_i on a worker's test-taking decision. As already touched upon in subsection 2.2, it is quite likely that individuals hesitant to reveal their HIV PS/TE to colleagues but wanting to test for

[18] Simply regressing the number of internal team members whose phone number a worker knew on the corresponding figure pertaining to the external network revealed a significantly positive correlation.

HIV are more likely to select a way of testing that can reduce the visibility from other workers. Since workers may be able to more easily identify colleagues that visited an on-site clinic for any reason compared to those that visited an off-site clinic, then, the negatively significant impact of the unwillingness to share the HIV-related information on the uptake probability of HIV testing may be observed more clearly in relation to visiting the on-site clinic. Based on this view, by making an explicit distinction between testing at on-site and off-site clinics, Table 7 reports the marginal effects of a multinomial logit (MNL) model of the uptake, whereby not taking a test is a base outcome. In columns (a) and (b), a worker's unwillingness to disclose HIV-positive status to colleagues is exploited as d_i, in contrast to that associated with HIV-test experience used in columns (c) and (d).

A key assumption of the MNL model is the independence from irrelevant alternatives (IIA) property, which states that the ratio of the probabilities of choosing any two alternatives is independent of the attributes or the availability of a third alternative. For this assumption to be likely, close substitutes should not typically be included in the choice set. Hence, the likely substitutability between on-site and off-site clinics is a great concern.

Regarding this point, in contrast to the view in support of the perfect substitutability between the two types of clinics, taking the HIV test at an off-site clinic may fundamentally differ from attending an on-site clinic in terms of both the opportunity and emotional costs. In addition, as already described in Section 3, employees can purchase 'medical aid' that would cover material expenses of such tests. Based on the conversations with medical staff employed at the enterprise clinic, white-collar workers tended to purchase the health insurance and, if they tested for HIV, they typically preferred to do so at an off-site clinic. As free primary health-care services, including HIV test, are available to all employees at the on-site clinic, this background information may also suggest that, whether they were white-collar or blue-collar, workers might not have been willing or able to substitute a visit to the on-site clinic for an off-site clinic to test for HIV. Nevertheless, the authors took the view that the IIA property would still be strong in the current study, given that the quality of basic medical services provided by health-care workers did not significantly differ between those two types of clinics.[19]

Keeping this reservation in mind, the table shows that for employees that created a large social network in the workplace, the significantly negative impact of the unwillingness to share HIV-related information with other workers was observed only in terms of visiting an on-site clinic in columns (a) and (c). On the other hand, for workers in a small network, no negative impacts of the unwillingness were identified in the columns (a) to (d). These results are consistent with the view that a worker who had a tightly knit connection with colleagues and was reluctant to disclose his HIV PS/TE to them avoided testing for HIV at the on-site clinic, because doing so might easily

[19]Several statistical tests for the IIA property are available from the previous studies (e.g., Hausman and McFadden, 1984; McFadden et al., 1976; Small and Hsiao, 1985; Vijverberg, 2011). The most commonly used one is the Hausman-McFadden test, which often yields negative test statistics. Assuming the homoskedasticity of stochastic errors and excluding the area fixed effects from the analysis for computational reasons (however, the exclusion hardly changed implications obtained from the analysis including the fixed effects), the Hausman-MacFadden test was conducted in estimating the MNL model - whereby testing at an off-site clinic was eliminated from the choice set in the restricted model - and the exercises identified negative test statistics (-12.54 and -15.57, respectively). While the negative value may still be used as evidence that the IIA property is not violated (Hausman and MacFadden, 1984, p.1226) and many authors subscribed to this view, it has recently been challenged by Vijverberg (2011). As it seems that there is no consensus regarding the most reliable test, the authors of this paper decided not to rely too much on the test statistics for justifying the IIA property.

be recognized by other workers in the workplace.[20]

Additional support may also be expressed against the reverse causality in all the previous estimations. If testing at the on-site clinic implies greater visibility from fellow workers than doing so at an off-site clinic, the probability that employees who tested for HIV were detected by other workers might have been higher in the case of the uptake at the on-site clinic than in the case of off-site clinic, and therefore the on-site test-takers might have experienced workplace bullying and intimidation from colleagues more frequently than the off-site test-takers. If this resulted in the on-site test-takers' strongly negative attitude towards disclosing HIV infection or test-taking experience to fellow workers, this direction of causality must have biased the impacts of the unwillingness to share HIV-related information on the uptake probability of HIV testing upwards in the preceding estimations. This provides further support for the findings of this study, suggesting that the true impacts of the unwillingness to reveal HIV testing and diagnosis will be more negative for employees in both small and large networks.

Finally, the estimation results in Table 7 also indicate that the educated workers are less likely to receive a HIV test at the on-site clinic and more likely to do so at an off-site clinic. Since they are more likely to be white-collar workers, this finding is consistent with views of medical staff employed by the enterprise, as described above.

[Here, Table 7]

4.2.4 Other Exercises

Further estimations were conducted in order to perform robustness checks. Firstly, while the measure of unwillingness used in estimating (1) is based on an answer to the previously explained first-person question, approximately 28% (23%) of those who selected 'non-colleagues' as an answer to the question pertaining to individuals with whom the respondent would not wish to share HIV-related information indicated 'colleagues' as the second person whom they did not want to know of their HIV infection or testing experience (see columns (c) and (f) in Table 1). Consequently, the measure of d_i based solely on an answer to the first-person question might have failed to capture a worker's true concerns about HIV/AIDS-related stigma. To examine whether this potential measurement problem existed in the preceding regressions, the analysis exploited an alternative measure of d_i, which takes the value of one if an answer to either the first- or the second-person question was 'colleagues' and zero otherwise. Those estimations made the impacts of both the unwillingness to share the HIV-related information and its interaction with a social network insignificant. This suggests that (only) the answer to the first-person question can provide an accurate measure of a worker's perceptions about the significance of HIV/AIDS-related stigma prevailing in the workplace.

Table 2 reported the positive association between d_i and a worker's expectation about discrimination from colleagues. According to UNAIDS (2003), while the discrimination is a different

[20] It is known that the marginal effects and standard errors of two interacted variables in non-linear models may not correctly be calculated by standard statistical software (Ai and Norton, 2003; Norton et al., 2004). To avoid incorrect inference, after splitting the sample into two groups of employees socializing within small and large networks, the authors also applied the MNL model separately to both the groups. This exercise allows the analysis to avoid including the network variable n_i (and thus an interaction term between d_i and n_i as well) in the regressors. The estimations, available upon request, revealed similar implications to those obtained from the results reported in Table 7.

concept from HIV/AIDS-related stigma,[21] it may be possible to use the expected discrimination as a proxy for a worker's perceptions about the stigma prevalent in the workplace. However, replacing d_i by a dummy for the expected discrimination did not reveal any significant impacts, implying that the unwillingness to disclose HIV-related information is a better proxy.

In addition, as mentioned in Section 3, employees in the group RL worried more strongly than those in the other groups about the possibility that information on the results of HIV test taken at the on-site clinic would leak out to nonmedical personnel of the enterprise (although the majority of the interviewed employees that provided this information revealed no concern). In the previous estimations, this information was not used as a regressor because of a relatively large number of respondents that failed to answer this question (about 22%). However, similar to n_i, as this concern may also capture a worker's expectation about detection, the analysis additionally included the subjective score measuring the concern (independently or combined with the interaction with d_i). However, the impacts of the score were literally zero with no significance. This suggests that including the measure in addition to already exploited controls is a redundant exercise.

Furthermore, using a continuous measure of the network size, rather than the dummy variable of small or large networks, also yielded similar implications to those obtained from the estimation results reported in Table 5. All these results are available from the authors upon request.

5 Conclusion

While a corporate sector may be able to play a major role in preventing the transmission of HIV, little is empirically known about the potential difficulty that may arise from offering HIV testing services in the workplace. Using new survey data provided by the employees working for a large multinational enterprise in a northeast province in South Africa, KwaZulu-Natal, in 2009-2010, this paper explored whether a worker's perceptions pertaining to the magnitude of HIV/AIDS-related stigma prevalent in the workplace impeded his decision to test for HIV. It was expected that a worker's unwillingness to reveal his HIV-positive status or testing experience to his colleagues would prevent him from testing for HIV and that the negative impact would increase in the size of a social network that he established in the workplace. These hypotheses resulted from the assumption that the expected cost of stigmatization associated with the uptake of HIV test would be evaluated by multiplying the disclosure concern (a composite of likelihood and disutility of stigma) by the network size (likelihood of detection).

This study found that the negative attitude towards disclosure was negatively associated with test-taking of employees that were extensively networked with the immediate team members. This finding was obtained despite the fact that confidentiality pertaining to HIV testing was rigorously enforced and believed to be effective by most employees in the surveyed enterprise. The analysis also revealed absence of such a test-deterrent impact in relation to the interaction between the unwillingness to share HIV-related information with non-colleagues - people *outside* the enterprise (e.g., friends and family members) - and a social network that workers created *within* the enterprise; the importance of social relationship with colleagues working in the *same* team relative to the relationship with *external* team members in explaining the negative impact of the unwillingness

[21] UNAIDS (2003) defines HIV/AIDS-related stigma as a process of devaluation of people either living with or associated with HIV/AIDS (PLWHA). Discrimination is a slightly different concept from that of stigma, as 'discrimination follows stigma and is the unfair and unjust treatment of an individual based on his or her real or perceived HIV status' (UNAIDS, 2003).

to share HIV-related information with colleagues; and the stronger negative association of the unwillingness with testing at an *on-site* clinic than an *off-site* clinic. All these findings helped this study draw a coherent picture pertaining to a worker's test-taking behavior in the workplace.

As frequently suggested in the context of non-corporate sector, these findings imply that reducing the fear of stigma may encourage the uptake of HIV test in the corporate sector. However, this policy prescription will need further research about the process that each worker develops expectations regarding the significance of HIV/AIDS-related stigma.

Alternatively, creating opportunities where a worker will not realize the stigma may contribute to inducing the uptake of HIV testing. Providing all workers with an excuse to test in the workplace (e.g., medical check) and/or encouraging them to privately test outside the workplace (by, for example, distributing coupons or vouchers) may be feasible policy options with great effectiveness. In fact, following the KAPB, the authors took the first approach and conducted an experimental HTC intervention in this enterprise to encourage the uptake of HIV testing amongst the employees (Arimoto et al., 2012). In the randomized controlled trial, the authors combined the intervention with a medical surveillance program (MSP) of this business entity.

Despite the carefully conducted analysis, however, the strong causal inference of the findings may have to be compromised due to this study's limited ability to control for the endogeneity. However, the authors expended strenuous efforts to support the causality, and some of those efforts suggested that potential biases arising from the endogeneity served to strengthen, rather than weaken, the significance of the results. Another limitation of this study arises from in its inability to make the findings relevant in a much broader context of the corporate sector in the developing world. Given the considerable size of the enterprise surveyed in the current research and a great number of skilled workers it employs,[22] the findings should be treated with caution when attempting to make any generalizations. However, the authors strongly believe that those findings are still informative to many business entities as well as policymakers aiming to address HIV/AIDS-related issues in this sector. With these reservations in mind, nonetheless, this research still displays a striking novelty in terms of providing new pieces of rigorous empirical evidence relevant to concerns associated with offering HIV testing services in the workplace, which most previous studies of this kind have disregarded.

In HIV/AIDS-affected countries, entrepreneurs frequently encounter cases of death and/or turnover of staff that they trained. In the absence of any initiatives, this issue could discourage not only their human capital investment but also their entrepreneurship itself. However, it is encouraging to hear from the field that at present, corporates are making considerable attempts to somehow manage HIV/AIDS-related problems on their own. Nevertheless, there is paucity of rigorous empirical research based on large-scale micro-level data collected within an enterprise, which helps entrepreneurs take a more effective action. Given the evident potential and significance of the corporate sector, it is hoped that further HIV/AIDS-related research will continue.

[22]For example, approximately 90% of the interviewed employees were high-school graduates or above.

A Appendix: Conceptual Framework

To derive an empirical equation (1) and the tested hypotheses, this section outlines a simple theoretical mechanism behind the empirical model. In the theoretical model, it is assumed that workers are aware of HIV/AIDS-related stigma prevalent in the workplace (i.e., perceived stigma),[23] and that being stigmatized means losing social contacts with other workers.

A.1 Period Utility

An individual that is working for an enterprise has a period utility determined by consuming c units of goods whose price is normalized to one (e.g., foods, clothes) and having a close relationship with n colleagues in the workplace, i.e., $u(c, n)$ such that $u_1 > 0$ and $u_2 > 0$. It is assumed that social contacts with other workers (e.g., chatting, having lunch, tea or coffee together) directly raises his utility. The social network that a worker establishes in the workplace is bounded below in the sense that $n \geq \underline{n}$, where $\underline{n} > 0$ is the minimal size.[24] In each period, a worker has one unit of time endowment that is all used for working, together with his productivity a. The productivity is affected by both his endowed health condition, h (> 0), and the size of social network that he created in the workplace as $a = a(h, n)$, given assumptions that having health body increases the productivity ($a_1 > 0$) and that as a worker needs to communicate with other workers in doing his task, the social relationship influences his job performance. The communication raises his productivity at low levels of n. However, since keeping good communication with too many workers is costly, it is assumed that $a_{22} < 0$ and $\lim_{n\to\infty} a_2(h, n) = -\infty$. In other words, with respect to the size of social network, the *marginal* productivity gain of having an additional contact is strictly decreasing (and falls without bound), and the *total* productivity gain displays an inversed-u shape.[25] Assuming that the productivity is rewarded in the enterprise, a worker's wage rate of the one unit of time endowment becomes aw, whereby w is a positive number. Without loss of generality, hereinafter, the w is normalized to one. It is also assumed that a capital market is absent for the sake of simplicity. Thus, in each period, a worker uses up all period earnings for purchasing the consumption goods. For convenience, both the period utility and productivity are differentiable functions defined over R_+. Maximizing a worker's utility subject to his budget constraint, $c = a$, yields the optimal quantity of consumption goods and the size of social network that he establishes in each period.

A.2 Uptake Decision

In the workplace, HIV/AIDS prevalence is high. Then, a worker has beliefs about his HIV serostatus with probability p for seropositive and $1 - p$ for seronegative cases. In the seropositive case, a worker's health condition becomes h^B throughout the rest of his work life, compared to h^G $(> h^B)$ for the seronegative case. While the levels of h^B and h^G are common knowledge, in the absence of opportunities for HIV-test, a worker has no way of not only knowing own serostatus but also updating beliefs about it. For expositional simplicity, assume that irrespective of his HIV serosta-

[23]In contrast to the 'perceived stigma,' 'enacted stigma' refers to stigma experienced and reported exactly by PLWHA (MacQuaarie et al., 2009, p.4).

[24]As the size of social network n can be viewed as measured by an efficiency unit, it evaluates social relationship qualitatively as well as quantitatively.

[25]While the context is different, this assumption refers to Jayachandran and Kuziemko (2011).

tus, a worker can work for the enterprise until his retirement period T.[26] Voluntary retirement or withdrawal from the labor market is disregarded in this model.

With strict confidentiality and post-test job security (as so in Japanese manufacturing company surveyed in this study), the enterprise offers free testing opportunities to all employees, followed by a free treatment. For seropositive workers, together with the appropriate care and support, testing for HIV can raise his health condition to the level of h^G until the retirement period T. However, in the workplace, HIV/AIDS-related stigma is well recognized. Consequently, a worker believes that his test-taking experience will be detected by fellow workers with probability q, and that with probability r, he may be stigmatized by colleagues by testing for HIV, which immediately downsizes his social network to the level of n^S. It is convenient to assume that $n^S = \underline{n}$ and $a_2(h, \underline{n}) > 0$ for all h. This assumption ensures the existence of an interior solution of the optimal network size in each period.[27] In the presence of the concern about HIV/AIDS-related stigma ($qr > 0$), a worker needs positive p to decide to take the testing opportunities, because, otherwise, there are no expected gains from the uptake of HIV testing. Without loss of generality, hereinafter, assume that a worker surely believes his infection with HIV, i.e., $p = 1$.

In each period t, a worker decides to test if and only if [28]

$$(1-qr)\sum_{k=t}^{T}\delta^{k-t}\left(u(c_k^G, n_k^G;\ h_k^G) - u(c_k^B, n_k^B;\ h_k^B)\right) \geq qr\sum_{k=t}^{T}\delta^{k-t}\left(u(c_k^B, n_k^B;\ h_k^B) - u(c(h_k^G, n_k^S), n_k^S;\ h_k^G)\right), \quad \text{(A.1)}$$

whereby δ is a discount factor; c^G (c^B) and n^G (n^B) are the optimal solution of c and n in each period when the health condition is good (bad); and $c(h^G, n^S)$ is the optimal quantity of consumption goods when the health condition is good and the size of social network is n^S.

Note that in the absence of the testing opportunities and with the assumption of $p = 1$, a worker optimally chooses c^B and n^B in each period. As proved in Appendix A.4.1, it can be shown that $u(c^G, n^G;\ h^G) > u(c^B, n^B;\ h^B)$. For brevity's sake, assume that $u(c^B, n^B;\ h^B) > u(c(h^G, n^S), n^S;\ h^G)$.[29] Then, the left- and right-hand sides of equation (A.1) are the expected present value of the future utility gain and loss arising from testing for HIV, respectively. The uptake decision benefits workers because in the absence of HIV/AIDS-related stigma, they can

[26] Assuring post-test job security is indeed a HIV-management policy of the surveyed manufacturing enterprise.

[27] It is also convenient to define $\hat{n}$ such that $a_2(h, \hat{n}) = 0$. A worker unambiguously gains from establishing the social network up to the level of $\hat{n}$. After this point, he weighs the cost of expanding the network by one unit, which results in the loss of productivity (so, consumption), against the utility gain directly obtained from the expansion. At the interior solution, it is always the case that $a_2(h, n^*) < 0$, where n^* is the size of social network that a worker optimally chooses, given the level of health condition h.

[28] Equation (A.1) can be derived by rewriting the following condition:

$$\sum_{k=t}^{T}\delta^{k-t}u(c_k^B, n_k^B;\ h_k^B) \leq qr\sum_{k=t}^{T}\delta^{k-t}u(c(h_k^G, n_k^S), n_k^S;\ h_k^G) + (1-qr)\sum_{k=t}^{T}\delta^{k-t}u(c_k^G, n_k^G;\ h_k^G),$$

whereby the left-hand side is the expected present value of the future utility stream of those who do not test for HIV, whereas the right-hand is that of test-takers.

[29] Precisely, the trade-off between an improvement in health condition and the loss of social contacts determines the inequality as

$$u(c^B, n^B;\ h^B) - u(c(h^G, n^S), n^S;\ h^G) = \left(u(c^B, n^B;\ h^B) - u(c(h^B, n^S), n^S;\ h^B)\right) + \left(u(c(h^B, n^S), n^S;\ h^B) - u(c(h^G, n^S), n^S;\ h^G)\right),$$

where $u(c^B, n^B;\ h^B) > u(c(h^B, n^S), n^S;\ h^B)$ (see proof in Appendix A.4.2) and $u(c(h^B, n^S), n^S;\ h^B) < u(c(h^G, n^S), n^S;\ h^G)$ (since $c(h, n) = a(h, n)$, $u_1 > 0$, and $a_1 > 0$). If the reduction in period utility associated with the loss of social contacts is marginal (so, $u(c^B, n^B;\ h^B) < u(c(h^G, n^S), n^S;\ h^G)$), then, a worker will always prefer to test for HIV.

expect an improvement in health condition (so, productivity) by receiving an adequate treatment after knowing own serostatus. On the other hand, by testing for HIV, a worker may lose social contacts once he is stigmatized, which reduces his utility directly as well as indirectly (through the negative impact on his productivity). In other words, the expected present value of social relationship that he might lose by testing for HIV (the expected cost of stigma) is shown by the right-hand side.

Two important predictions of interest can be derived from equation (A.1). Denoting the net expected utility stream from the uptake decision as V_t (= the left-hand side of (A.1) − the right-hand side of (A.1)) and the loss of period utility in the presence of HIV/AIDS-related stigma as Δu^S ($= u(c^B, n^B;\ h^B) - u(c(h^G, n^S), n^S;\ h^G)$),

Prediction 1 *A worker is less likely to test as a concern about HIV/AIDS-related stigma associated with the uptake is more serious* ($\frac{\partial V_t}{\partial r \Delta u_t^S} < 0$).

Prediction 2 *The negative impact on the uptake probability gets larger as the (subjective) likelihood that test-taking experience is detected by fellow workers becomes larger* ($\frac{\partial^2 V_t}{\partial q \partial r \Delta u_t^S} < 0$).

A.3 From Theory to Empirics

As explained in subsection 2.1, in the empirical analysis, this study used the size of social network that a worker established in the workplace as a proxy for the detection probability q. On the other hand, it was expected that a worker's unwillingness to disclose infection or test-taking experience to colleagues captured his concern about HIV/AIDS-related stigma ($r\Delta u^S$). Then, the above predictions 1 and 2 yielded the empirical model of equation (1) with the hypotheses of negative β_2 and β_3.

Implicitly, the above model allows the endogenously determined size of social network to vary across workers and occupations, depending upon underlying parameters characterizing their preference (i.e., $u_{ij}(c, n)$) and productivity (i.e., $a_{ij}(h, n)$). Then, it is difficult to predict whether the network size positively or negatively affects the uptake probability. This is because it is difficult to compare the expected gain and/or loss from the uptake between workers, who selected the different size of network due to those differing parameters. As a result, the impact of the network size (i.e., β_4 in equation (1)) is purely an empirical question.

A.4 Proof

A.4.1 Proof of $u(c^G, n^G;\ h^G) > u(c^B, n^B;\ h^B)$

Suppose the contrary, that is, $u(c^G, n^G;\ h^G) \leq u(c^B, n^B;\ h^B)$. Note that this can be rewritten as $u(a(h^G, n^G), n^G) \leq u(a(h^B, n^B), n^B)$ because all earnings are exhausted in each period. The assumptions of $a_1 > 0$ and $u_1 > 0$ imply that $u(a(h^G, n^B), n^B) > u(a(h^B, n^B), n^B)$, which allows to obtain $u(a(h^G, n^B), n^B) > u(a(h^G, n^G), n^G)$. However, this is a contradiction to the definition of n^G, which is the size of social network optimally chosen by a worker having good health condition h^G.[30]

[30]Alternatively, the proof can be provided by showing that an improvement in health condition increases the optimal value of $u = u(c, n)$, i.e., that $\frac{du}{dh}\Big(c^*(h), n^*(h)\Big)$ is positive, where the superscript asterisk ($*$) refers to the optimal value chosen by each worker. With a Lagrangian multiplier λ of the budget constraint, $c - a(c, n) = 0$, by

A.4.2 Proof of $u(c^B, n^B;\ h^B) > u(c(h^B, n^S), n^S;\ h^B)$

The proof is again given by contradiction. Suppose the contrary, that is, $u(a(h^B, n^B), n^B) \leq u(a(h^B, n^S), n^S)$. Since $a_2(h^B, \underline{n})$ $(= a_2(h^B, n^S)) > 0$, $u_1 > 0$, and $u_2 > 0$, it is possible to find a small $\rho > 0$ such that $u(a(h^B, n^S+\rho), n^S+\rho) > u(a(h^B, n^B), n^B)$. However, this is a contradiction to the definition of n^B, which is the size of social network optimally chosen by a worker having bad health condition h^B.

applying Theorem 19.5 (Simon and Blume, 1994; p.456), it can be shown that

$$\frac{du}{dh}\Big(c^*(h), n^*(h)\Big) = \lambda^*(h) a_1(h, n^*(h)).$$

By assumption and $\lambda^*(h) > 0$, this is indeed positive. This completes the proof. This equation shows that the utility gain, which a worker receives by improving his health condition (so, productivity) by one unit, is equivalent to the value of earnings $(a_1(h, n))$ evaluated by the shadow price of the human capital $(\lambda(h))$.

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Table 1: Proportion of the First/Second Person that a Worker did not Want to Know HIV-Positive Status or Test-taking Experience

	HIV-positive status			HIV-test experience		
	1st	2nd if 1st is		1st	2nd if 1st is	
		colleagues	non-colleagues		colleagues	non-colleagues
	(a)	(b)	(c)	(d)	(e)	(f)
(1) Colleagues	0.20	0.01	0.28	0.15	-	0.23
(2) Non-colleagues	0.31	0.87	0.58	0.26	0.88	0.61
Spouse	0.02	0.00	0.01	0.02	0.00	0.01
Children	0.02	0.00	0.05	0.01	0.00	0.05
Other family members	0.04	0.02	0.07	0.03	0.02	0.08
Relatives	0.02	0.04	0.08	0.01	0.03	0.09
Unmarried partner	0.00	-	0.00	0.00	0.00	0.00
Boy/girl friends	0.00	0.00	0.01	0.01	0.00	0.02
Neighbors	0.13	0.65	0.14	0.11	0.66	0.12
Friends	0.04	0.12	0.16	0.03	0.11	0.19
Other (incl. medical staff)	0.01	0.02	0.01	0.01	0.02	0.02
(3) No one in particular	0.48	0.10	0.12	0.58	0.11	0.14
No. of workers	6199	1227	1930	6207	933	1646

Notes: (1) The second person was not asked those whose answer for the first-person question was 'no one in particular.' (2) The number is the proportion to the total number of workers in each column. (3) Only a few workers selected 'colleagues' for both the first- and second-person questions regarding HIV-positive status. Column (b) did not discriminate against such answers.

Table 2: Disclosure Concern and HIV/AIDS-related Discrimination (OLS)

Dependent variables:	One if unwilling to disclose			
	HIV-positive status to		HIV-test experience to	
	colleagues	non-colleagues	colleagues	non-colleagues
	(a)	(b)	(c)	(d)
One if expect discrimination associated with infection with HIV				
from colleagues	0.149***	-0.033*	0.095***	-0.024
	[0.019]	[0.020]	[0.019]	[0.019]
from non-colleagues	-0.009	0.142***	-0.010	0.071***
	[0.017]	[0.019]	[0.013]	[0.020]
Constant	0.188***	0.323***	0.127***	0.259***
	[0.007]	[0.005]	[0.007]	[0.007]
Area FE	Yes	Yes	Yes	Yes
R-squared	0.052	0.075	0.044	0.071
No. of observations	6241	6241	6241	6241

Notes: (1) Figures [ ] are standard errors. *** denotes significance at 1%, ** at 5%, and * at 10%. (2) Standard errors are robust to heteroskedasticity and clustered residuals within each working area. (3) The measure of expected discrimination takes one if a respondent expected his colleagues or non-colleagues (family members and neighbors) to either alienate him, speak badly of him/treat him badly, or hesitate to shake hands or share foods and drinks with him if they knew that he was infected with HIV, and zero otherwise.

Table 3: Descriptive Statistics by Disclosure Concern about HIV-positive Status

	The first person whom a worker does not want to know that **he is infected with HIV**								
	Colleagues in a:						Non-colleagues and no one		
	large internal social network			small internal social network					
	Mean	std.	No. of obs.	Mean	std.	No. of obs.	Mean	std.	No. of obs.
Tested (dummy)	0.68	[0.46]	547	0.62**	[0.48]	686	0.66	[0.47]	4979
Network size (internal)	9.73***	[9.37]	547	2.42***	[1.34]	687	6.90	[14.09]	4938
Network size (external)	15.28	[28.98]	545	6.29***	[8.99]	683	16.56	[171.72]	4929
Male (dummy)	0.76***	[0.42]	544	0.85***	[0.34]	682	0.81	[0.38]	4940
Age dummy									
Aged 29 below	0.36***	[0.48]	545	0.28	[0.45]	684	0.31	[0.46]	4905
Aged 30-39	0.40***	[0.49]	545	0.33	[0.47]	684	0.31	[0.46]	4905
Aged 40-49	0.18***	[0.39]	545	0.26	[0.44]	684	0.23	[0.42]	4905
Aged 50 or above	0.04***	[0.20]	545	0.11*	[0.31]	684	0.13	[0.34]	4905
Education dummy									
No education	0.00***	[0.00]	544	0.00	[0.07]	683	0.00	[0.07]	4961
Lower primary	0.00***	[0.06]	544	0.02*	[0.14]	683	0.01	[0.10]	4961
Higher primary	0.04*	[0.19]	544	0.08***	[0.28]	683	0.05	[0.23]	4961
High school	0.50*	[0.50]	544	0.64***	[0.47]	683	0.54	[0.49]	4961
Tertiary	0.40**	[0.49]	544	0.22***	[0.42]	683	0.35	[0.47]	4961
Master	0.02**	[0.16]	544	0.00***	[0.06]	683	0.01	[0.11]	4961
Doctor	0.00	[0.00]	544	0.00	[0.00]	683	0.00	[0.02]	4961
Other	0.01*	[0.10]	544	0.00	[0.07]	683	0.00	[0.05]	4961
Tenure (years)	8.00***	[7.13]	547	10.08	[8.34]	687	10.30	[9.22]	4996
Commuting time (minutes)	33.57	[22.55]	546	33.38	[22.41]	687	32.50	[23.10]	4981
Have mobile (dummy)	0.98***	[0.10]	546	0.91***	[0.28]	686	0.95	[0.21]	4970
Married (dummy)	0.44***	[0.49]	547	0.45**	[0.49]	687	0.50	[0.49]	4987
No. of children aged 15 below	1.40*	[1.41]	538	1.55	[1.60]	684	1.51	[1.68]	4906
HIV/AIDS-related social environment									
Having HIV-positive colleagues (one if yes)									
× Treated badly	0.03**	[0.19]	547	0.02	[0.14]	687	0.02	[0.14]	4999
× Supported	0.08	[0.28]	547	0.05*	[0.23]	687	0.07	[0.26]	4999
× Nothing changed	0.06	[0.25]	547	0.06	[0.25]	687	0.07	[0.26]	4999
× Don't know	0.04	[0.19]	547	0.02	[0.15]	687	0.03	[0.17]	4999
Having HIV-positive relatives (one if yes)									
× Treated badly	0.01	[0.12]	547	0.01	[0.11]	687	0.01	[0.13]	4999
× Supported	0.26	[0.44]	547	0.29***	[0.45]	687	0.23	[0.42]	4999
× Nothing changed	0.10	[0.30]	547	0.12**	[0.32]	687	0.09	[0.28]	4999
× Don't know	0.02	[0.16]	547	0.03	[0.19]	687	0.03	[0.17]	4999
Having HIV-positive neighbors (one if yes)									
× Treated badly	0.04**	[0.21]	547	0.03	[0.18]	687	0.02	[0.16]	4999
× Supported	0.13	[0.34]	547	0.12	[0.33]	687	0.12	[0.33]	4999
× Nothing changed	0.09	[0.29]	547	0.08	[0.27]	687	0.09	[0.29]	4999
× Don't know	0.06	[0.24]	547	0.06	[0.25]	687	0.06	[0.25]	4999
HIV knowledge test score (0-16)	13.26***	[2.76]	547	13.21***	[2.92]	687	12.69	[3.08]	4999
Belief about information leak (0-10)	1.79*	[3.03]	457	1.13***	[2.48]	574	1.51	[2.88]	3771
Risky sexual behavior									
Sex with a person likely infected with HIV (dummy)	0.08	[0.27]	467	0.07	[0.26]	590	0.06	[0.24]	4397
STD experience (dummy)	0.23*	[0.42]	523	0.23*	[0.42]	665	0.19	[0.39]	4708
Total no. of sex partners in the last 12mth.	2.00*	[3.28]	512	1.82	[2.09]	650	1.75	[2.43]	4530
No. of condoms at home	1.62	[3.15]	522	1.58	[2.59]	658	1.63	[4.53]	4685

Note: (1) The network size is the number of colleagues working within (internal) and outside (external) the same team whose phone number that a worker knew. (2) The equality of means between 'colleagues in a large internal network' and 'non-colleagues and no one in particular' and that between 'colleagues in a small internal network' and 'non-colleagues and no one in particular' are examined by T-tests. *** denotes significance at 1%, ** at 5%, and * at 10%.

Table 4: Descriptive Statistics by Disclosure Concern about HIV-test Experience

	The first person whom a worker does not want to know that **he tested for HIV**								
	Colleagues in a:						Non-colleagues and no one		
	large internal social network			small internal social network					
	Mean	std.	No. of obs.	Mean	std.	No. of obs.	Mean	std.	No. of obs.
Tested (dummy)	0.67	[0.46]	380	0.62*	[0.48]	546	0.66	[0.47]	5289
Network size (internal)	9.52***	[8.12]	381	2.35***	[1.32]	548	6.89	[13.86]	5243
Network size (external)	14.53	[31.31]	380	6.64***	[8.65]	546	16.27	[166.75]	5231
Male (dummy)	0.77*	[0.41]	375	0.85**	[0.35]	542	0.81	[0.38]	5252
Age dummy									
Aged 29 below	0.34	[0.47]	374	0.27**	[0.44]	544	0.31	[0.46]	5218
Aged 30-39	0.39***	[0.48]	374	0.34	[0.47]	544	0.31	[0.46]	5218
Aged 40-49	0.21	[0.41]	374	0.28**	[0.45]	544	0.23	[0.42]	5218
Aged 50 or above	0.04***	[0.21]	374	0.10**	[0.30]	544	0.13	[0.34]	5218
Education dummy									
No education	0.00***	[0.00]	380	0.00*	[0.04]	547	0.00	[0.07]	5264
Lower primary	0.00	[0.08]	380	0.02*	[0.15]	547	0.01	[0.10]	5264
Higher primary	0.04	[0.21]	380	0.10***	[0.30]	547	0.05	[0.22]	5264
High school	0.55	[0.49]	380	0.66***	[0.47]	547	0.54	[0.49]	5264
Tertiary	0.36	[0.48]	380	0.19***	[0.39]	547	0.36	[0.48]	5264
Master	0.01	[0.13]	380	0.00***	[0.06]	547	0.01	[0.12]	5264
Doctor	0.00	[0.00]	380	0.00	[0.00]	547	0.00	[0.01]	5264
Other	0.00	[0.08]	380	0.00	[0.06]	547	0.00	[0.06]	5264
Tenure (years)	8.63***	[7.45]	381	9.94	[8.17]	548	10.19	[9.16]	5304
Commuting time (minutes)	34.35	[22.40]	381	33.46	[21.46]	547	32.50	[22.95]	5288
Have mobile (dummy)	0.98***	[0.11]	379	0.91***	[0.27]	547	0.95	[0.21]	5279
Married (dummy)	0.45*	[0.49]	381	0.45	[0.49]	548	0.50	[0.50]	5295
No. of children aged 15 below	1.57	[1.52]	379	1.62*	[1.60]	543	1.48	[1.67]	5208
HIV/AIDS-related social environment									
Having HIV-positive colleagues (one if yes)									
× Treated badly	0.03	[0.17]	381	0.02	[0.16]	548	0.02	[0.14]	5307
× Supported	0.09	[0.28]	381	0.07	[0.26]	548	0.07	[0.26]	5307
× Nothing changed	0.08	[0.27]	381	0.06	[0.24]	548	0.07	[0.26]	5307
× Don't know	0.04	[0.20]	381	0.02	[0.16]	548	0.03	[0.17]	5307
Having HIV-positive relatives (one if yes)									
× Treated badly	0.02	[0.16]	381	0.01	[0.11]	548	0.01	[0.12]	5307
× Supported	0.25	[0.43]	381	0.31***	[0.46]	548	0.23	[0.42]	5307
× Nothing changed	0.09	[0.28]	381	0.13***	[0.34]	548	0.09	[0.28]	5307
× Don't know	0.03	[0.18]	381	0.02	[0.14]	548	0.03	[0.17]	5307
Having HIV-positive neighbors (one if yes)									
× Treated badly	0.04	[0.21]	381	0.02	[0.15]	548	0.03	[0.17]	5307
× Supported	0.14	[0.35]	381	0.16**	[0.37]	548	0.12	[0.32]	5307
× Nothing changed	0.10	[0.30]	381	0.06**	[0.25]	548	0.09	[0.29]	5307
× Don't know	0.06	[0.24]	381	0.06	[0.23]	548	0.06	[0.25]	5307
HIV knowledge test score (0-16)	13.53***	[2.50]	381	13.32***	[2.78]	548	12.68	[3.10]	5307
Belief about information leak (0-10)	2.00***	[3.17]	320	1.27	[2.72]	469	1.48	[2.84]	4013
Risky sexual behavior									
Sex with a person likely infected with HIV (dummy)	0.04*	[0.21]	323	0.07	[0.25]	460	0.06	[0.25]	4673
STD experience (dummy)	0.27***	[0.44]	361	0.27***	[0.44]	523	0.19	[0.39]	5015
Total no. of sex partners in the last 12mth.	1.96	[3.15]	351	1.89	[2.31]	517	1.76	[2.44]	4826
No. of condoms at home	1.75	[3.47]	365	1.59	[2.48]	522	1.62	[4.44]	4981

Note: (1) The network size is the number of colleagues working within (internal) and outside (external) the same team whose phone number that a worker knew. (2) The equality of means between 'colleagues in a large internal network' and 'non-colleagues and no one in particular' and that between 'colleagues' in a small internal network' and 'non-colleagues and no one in particular' are examined by T-tests. *** denotes significance at 1%, ** at 5%, and * at 10%.

Table 5: Impacts on HIV Testing (Linear Probability Model)

Dependent variable:	One if tested at any clinic in			
	2008-2010	2009-2010	2008-2010	2009-2010
	HIV-positive status		HIV-test experience	
	(a)	(b)	(c)	(d)
Unwilling to disclose to	0.003	0.029	0.013	0.022
colleagues (d_i)	[0.016]	[0.025]	[0.019]	[0.034]
d_i × Internal social	-0.052*	-0.111***	-0.073***	-0.093*
network (n_i)	[0.029]	[0.037]	[0.026]	[0.049]
Male	-0.173***	-0.227***	-0.173***	-0.227***
	[0.019]	[0.021]	[0.019]	[0.020]
Aged 30-39	0.028	0.020	0.027	0.021
	[0.022]	[0.024]	[0.022]	[0.025]
Aged 40-49	-0.054**	-0.085***	-0.054**	-0.084***
	[0.026]	[0.030]	[0.026]	[0.030]
Aged 50 or above	-0.099***	-0.128***	-0.098***	-0.126***
	[0.033]	[0.046]	[0.033]	[0.047]
Education				
Lower primary	0.018	0.025	0.018	0.028
	[0.153]	[0.175]	[0.153]	[0.176]
Higher primary	-0.057	-0.096	-0.057	-0.096
	[0.160]	[0.168]	[0.160]	[0.169]
High school	-0.033	-0.118	-0.033	-0.116
	[0.141]	[0.147]	[0.142]	[0.147]
Tertiary	0.039	-0.035	0.039	-0.035
	[0.147]	[0.160]	[0.147]	[0.159]
Master	0.092	0.017	0.089	0.014
	[0.158]	[0.182]	[0.158]	[0.182]
Other	-0.001	0.007	-0.007	-0.003
	[0.175]	[0.214]	[0.173]	[0.209]
Tenure (upper 50%)	0.007	0.001	0.007	0.002
	[0.022]	[0.025]	[0.022]	[0.025]
Internal social network	0.076***	0.083***	0.076***	0.075***
(upper 50%) (n_i)	[0.016]	[0.020]	[0.016]	[0.019]
Commuting time	0.000	0.000	0.000	0.000
(minutes)	[0.000]	[0.000]	[0.000]	[0.000]
Have mobile	-0.026	-0.010	-0.026	-0.012
	[0.033]	[0.046]	[0.033]	[0.046]
Married	0.039**	0.035**	0.039**	0.035**
	[0.018]	[0.016]	[0.018]	[0.016]
No. of children aged	0.001	0.001	0.001	0.001
15 below	[0.006]	[0.007]	[0.006]	[0.007]
Having HIV-positive colleagues				
× Treated badly	0.049	0.045	0.047	0.033
	[0.049]	[0.056]	[0.049]	[0.057]
× Supported	0.075***	0.075*	0.076***	0.074*
	[0.025]	[0.040]	[0.025]	[0.040]
× Nothing changed	0.091***	0.090***	0.092***	0.091***
	[0.021]	[0.031]	[0.021]	[0.031]
× Don't know	0.103***	0.164***	0.104***	0.165***
	[0.037]	[0.048]	[0.037]	[0.048]
Having HIV-positive relatives				
× Treated badly	0.059	0.082	0.061	0.085
	[0.049]	[0.053]	[0.049]	[0.054]
× Supported	0.048***	0.041*	0.047***	0.041*
	[0.012]	[0.022]	[0.012]	[0.022]
× Nothing changed	0.078***	0.083**	0.076***	0.083**
	[0.021]	[0.032]	[0.021]	[0.032]
× Don't know	0.035	0.043	0.035	0.043
	[0.047]	[0.058]	[0.046]	[0.059]
Having HIV-positive neighbors				
× Treated badly	-0.015	-0.007	-0.015	-0.005
	[0.047]	[0.062]	[0.047]	[0.062]
× Supported	-0.028*	-0.030	-0.028*	-0.030
	[0.017]	[0.025]	[0.016]	[0.025]
× Nothing changed	-0.037	-0.029	-0.037	-0.028
	[0.024]	[0.025]	[0.023]	[0.025]
× Don't know	-0.046	-0.011	-0.047	-0.011
	[0.029]	[0.035]	[0.029]	[0.035]
HIV knowledge	0.022***	0.024***	0.022***	0.024***
(test scores)	[0.003]	[0.004]	[0.003]	[0.004]
Risky sexual behavior				
Sex with a person	-	0.031	-	0.028
likely infected with HIV		[0.035]		[0.036]
STD experience	-	-0.017	-	-0.016
(excluding HIV)		[0.015]		[0.015]
Casual acquaintance	-	-0.065	-	-0.061
in the last sex (ca1)		[0.117]		[0.117]
Casual acquaintance	-	0.215*	-	0.211
in the 2nd last sex (ca2)		[0.129]		[0.129]
ca1 × no condom use	-	-0.204	-	-0.205
		[0.168]		[0.168]
ca2 × no condom use	-	0.041	-	0.049
		[0.316]		[0.316]
No. of sexual partners	-	-0.004	-	-0.004
in the last 12 mths.		[0.004]		[0.004]
No. of condoms	-	-0.000	-	-0.000
at home		[0.002]		[0.002]
Constant	0.445***	0.446***	0.442***	0.447***
	[0.139]	[0.160]	[0.139]	[0.162]
Area FE	Yes	Yes	Yes	Yes
R-squared	0.110	0.138	0.110	0.137
No. of obs.	4959	3200	4959	3200

Notes: (1) Figures [ ] are standard errors. *** denotes significance at 1%, ** at 5%, and * at 10%. (2) Standard errors are robust to heteroskedasticity and clustered residuals within each working area. (3) A reference group associated with HIV/AIDS-related social environment is 'not having HIV-positive people'.

Table 6: Robustness Checks (Linear Probability Model)

Dependent variable:	One if tested at any clinic in 2008-2010							
	HIV-positive status				HIV-test experience			
	(a)	(b)	(c)	(d)	(e)	(f)	(g)	(h)
Unwilling to disclose to	-	-0.004	-0.022	-0.003	-	-0.008	-0.009	0.013
colleagues (d_i)		[0.019]	[0.016]	[0.018]		[0.019]	[0.028]	[0.029]
d_i × Internal social	-	-0.059**	-	-0.060**	-	-0.064**	-	-0.071***
network (n_i)		[0.029]		[0.029]		[0.028]		[0.026]
d_i × External social	-	-	0.005	0.022	-	-	-0.019	0.002
network ($\tilde{n}_i$)			[0.027]	[0.028]			[0.039]	[0.040]
Unwilling to disclose to	-0.018	-0.019	-	-	-0.065***	-0.067***	-	-
non-colleagues ($\tilde{d}_i$)	[0.020]	[0.022]			[0.023]	[0.023]		
$\tilde{d}_i$ × Internal social	-0.000	-0.017	-	-	0.041	0.029	-	-
network (n_i)	[0.026]	[0.027]			[0.033]	[0.034]		
Male	-0.172***	-0.173***	-0.173***	-0.174***	-0.173***	-0.174***	-0.173***	-0.174***
	[0.019]	[0.019]	[0.019]	[0.019]	[0.019]	[0.019]	[0.019]	[0.019]
Aged 30-39	0.027	0.027	0.029	0.029	0.028	0.028	0.029	0.029
	[0.022]	[0.022]	[0.022]	[0.022]	[0.022]	[0.022]	[0.022]	[0.022]
Aged 40-49	-0.053**	-0.055**	-0.051**	-0.050*	-0.054**	-0.055**	-0.051*	-0.051*
	[0.026]	[0.026]	[0.025]	[0.026]	[0.026]	[0.026]	[0.026]	[0.026]
Aged 50 or above	-0.097***	-0.101***	-0.095***	-0.093***	-0.096***	-0.099***	-0.095***	-0.092***
	[0.033]	[0.033]	[0.032]	[0.032]	[0.033]	[0.033]	[0.032]	[0.032]
Education								
Lower primary	0.020	0.021	0.029	0.025	0.017	0.021	0.031	0.026
	[0.153]	[0.153]	[0.156]	[0.154]	[0.150]	[0.150]	[0.156]	[0.154]
Higher primary	-0.054	-0.053	-0.048	-0.054	-0.053	-0.050	-0.047	-0.054
	[0.160]	[0.161]	[0.162]	[0.160]	[0.158]	[0.159]	[0.163]	[0.161]
High school	-0.028	-0.029	-0.023	-0.034	-0.026	-0.024	-0.021	-0.033
	[0.142]	[0.142]	[0.143]	[0.142]	[0.140]	[0.141]	[0.143]	[0.142]
Tertiary	0.045	0.043	0.052	0.036	0.045	0.045	0.054	0.037
	[0.147]	[0.147]	[0.148]	[0.147]	[0.145]	[0.145]	[0.148]	[0.147]
Master	0.092	0.096	0.108	0.084	0.098	0.099	0.109	0.082
	[0.159]	[0.159]	[0.159]	[0.158]	[0.156]	[0.156]	[0.159]	[0.158]
Other	-0.009	0.003	0.004	-0.005	-0.011	-0.004	0.003	-0.011
	[0.175]	[0.176]	[0.177]	[0.175]	[0.173]	[0.173]	[0.176]	[0.173]
Tenure (upper 50%)	0.006	0.006	0.006	0.005	0.007	0.007	0.006	0.006
	[0.021]	[0.022]	[0.022]	[0.022]	[0.021]	[0.022]	[0.022]	[0.022]
Internal social network	0.066***	0.083***	-	0.068***	0.055***	0.067***	-	0.066***
(upper 50%) (n_i)	[0.018]	[0.019]		[0.019]	[0.017]	[0.017]		[0.018]
External social network	-	-	0.053***	0.036*	-	-	0.057***	0.039**
(upper 50%) ($\tilde{n}_i$)			[0.015]	[0.018]			[0.015]	[0.016]
Commuting time	-0.000	0.000	0.000	0.000	-0.000	0.000	0.000	0.000
(minutes)	[0.000]	[0.000]	[0.000]	[0.000]	[0.000]	[0.000]	[0.000]	[0.000]
Have Mobile	-0.026	-0.026	-0.025	-0.036	-0.025	-0.026	-0.026	-0.036
	[0.033]	[0.033]	[0.036]	[0.034]	[0.033]	[0.033]	[0.035]	[0.034]
Married	0.040**	0.039**	0.041**	0.039**	0.039**	0.038**	0.041**	0.039**
	[0.018]	[0.018]	[0.018]	[0.018]	[0.018]	[0.018]	[0.018]	[0.018]
No. of children aged	0.001	0.000	0.001	0.000	0.000	0.001	0.001	0.001
15 below	[0.006]	[0.006]	[0.006]	[0.006]	[0.006]	[0.006]	[0.006]	[0.006]
Having HIV-positive colleagues								
× Treated badly	0.045	0.049	0.046	0.045	0.045	0.046	0.046	0.042
	[0.050]	[0.050]	[0.049]	[0.049]	[0.050]	[0.050]	[0.049]	[0.049]
× Supported	0.076***	0.076***	0.072***	0.071***	0.077***	0.078***	0.073***	0.071***
	[0.025]	[0.026]	[0.026]	[0.026]	[0.025]	[0.025]	[0.026]	[0.026]
× Nothing changed	0.091***	0.090***	0.089***	0.087***	0.089***	0.088***	0.089***	0.088***
	[0.021]	[0.021]	[0.021]	[0.021]	[0.021]	[0.021]	[0.021]	[0.021]
× Don't know	0.104***	0.104***	0.103***	0.099***	0.104***	0.104***	0.103***	0.100***
	[0.037]	[0.037]	[0.036]	[0.037]	[0.037]	[0.037]	[0.036]	[0.037]
Having HIV-positive relatives								
× Treated badly	0.062	0.062	0.063	0.060	0.064	0.067	0.064	0.062
	[0.049]	[0.049]	[0.049]	[0.050]	[0.050]	[0.049]	[0.049]	[0.050]
× Supported	0.047***	0.048***	0.048***	0.047***	0.049***	0.049***	0.048***	0.045***
	[0.012]	[0.012]	[0.012]	[0.012]	[0.012]	[0.012]	[0.012]	[0.012]
× Nothing changed	0.077***	0.077***	0.082***	0.078***	0.076***	0.075***	0.081***	0.076***
	[0.021]	[0.022]	[0.021]	[0.021]	[0.021]	[0.021]	[0.020]	[0.021]
× Don't know	0.035	0.036	0.035	0.030	0.035	0.035	0.034	0.031
	[0.047]	[0.047]	[0.046]	[0.047]	[0.047]	[0.046]	[0.046]	[0.046]
Having HIV-positive neighbors								
× Treated badly	-0.017	-0.014	-0.013	-0.012	-0.013	-0.011	-0.014	-0.013
	[0.048]	[0.047]	[0.048]	[0.047]	[0.048]	[0.048]	[0.048]	[0.048]
× Supported	-0.028	-0.027	-0.030*	-0.029*	-0.027	-0.026	-0.029*	-0.029*
	[0.017]	[0.017]	[0.016]	[0.016]	[0.017]	[0.017]	[0.016]	[0.016]
× Nothing changed	-0.037	-0.037	-0.038	-0.037	-0.037	-0.037	-0.038	-0.036
	[0.023]	[0.024]	[0.023]	[0.024]	[0.023]	[0.023]	[0.023]	[0.024]
× Don't know	-0.045	-0.045	-0.049	-0.046	-0.042	-0.042	-0.048	-0.046
	[0.029]	[0.029]	[0.029]	[0.030]	[0.029]	[0.028]	[0.029]	[0.029]
HIV knowledge	0.022***	0.022***	0.022***	0.022***	0.022***	0.022***	0.022***	0.022***
(test scores)	[0.003]	[0.003]	[0.003]	[0.003]	[0.003]	[0.003]	[0.003]	[0.003]
Constant	0.447***	0.452***	0.440***	0.443***	0.456***	0.454***	0.434***	0.439***
	[0.139]	[0.138]	[0.140]	[0.138]	[0.136]	[0.136]	[0.140]	[0.138]
Area FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
R-squared	0.110	0.111	0.108	0.112	0.111	0.112	0.108	0.112
No. of obs.	4959	4959	4959	4959	4959	4959	4959	4959

Notes: (1) Figures [ ] are standard errors. *** denotes significance at 1%, ** at 5%, and * at 10%. (2) Standard errors are robust to heteroskedasticity and clustered residuals within each working area. (3) A reference group associated with HIV/AIDS-related social environment is 'not having HIV-positive people'.

Table 7: Impacts on HIV Testing with Base Outcome of Not Testing (Multinomial Logit: Marginal Effects)

Dependent variable:	One if tested in 2008-2010			
	HIV-positive status		HIV-test experience	
Location of clinics:	on-site	off-site	on-site	off-site
	(a)	(b)	(c)	(d)
Unwilling to disclose to	0.017	-0.013	0.045**	-0.036
colleagues (d_i)	[0.017]	[0.018]	[0.020]	[0.026]
d_i × Internal social	-0.056*	0.002	-0.111***	0.040
network (n_i)	[0.029]	[0.030]	[0.030]	[0.035]
Male	-0.063***	-0.120***	-0.063***	-0.120***
	[0.018]	[0.016]	[0.018]	[0.015]
Aged 30-39	0.009	0.017	0.009	0.018
	[0.023]	[0.014]	[0.022]	[0.014]
Aged 40-49	-0.026	-0.029	-0.028	-0.028
	[0.022]	[0.021]	[0.022]	[0.020]
Aged 50 or above	-0.012	-0.091***	-0.012	-0.090***
	[0.038]	[0.030]	[0.038]	[0.030]
Education				
Lower primary	-0.047	0.079	-0.050	0.083
	[0.066]	[0.161]	[0.065]	[0.163]
Higher primary	-0.095	0.057	-0.099	0.061
	[0.065]	[0.135]	[0.064]	[0.137]
High school	-0.120**	0.107	-0.123**	0.110
	[0.057]	[0.131]	[0.056]	[0.132]
Tertiary	-0.141**	0.194	-0.144**	0.197
	[0.066]	[0.130]	[0.065]	[0.131]
Master	-0.173**	0.270*	-0.177**	0.270*
	[0.081]	[0.149]	[0.081]	[0.150]
Other	-0.100	0.118	-0.105	0.117
	[0.142]	[0.136]	[0.137]	[0.136]
Tenure (upper 50%)	0.012	-0.005	0.013	-0.005
	[0.022]	[0.019]	[0.022]	[0.019]
Internal social network	0.037**	0.036***	0.042**	0.030***
(upper 50%) (n_i)	[0.018]	[0.012]	[0.018]	[0.011]
Commuting time	-0.000	0.000	-0.000	0.000
(minutes)	[0.000]	[0.000]	[0.000]	[0.000]
Have mobile	0.008	-0.034	0.007	-0.034
	[0.035]	[0.029]	[0.035]	[0.029]
Married	0.002	0.036**	0.002	0.036**
	[0.015]	[0.015]	[0.015]	[0.014]
No. of children aged	0.003	-0.002	0.003	-0.002
15 below	[0.004]	[0.004]	[0.004]	[0.004]
Having HIV-positive colleagues				
× Treated badly	0.070	-0.028	0.067	-0.028
	[0.045]	[0.040]	[0.044]	[0.040]
× Supported	0.090***	-0.017	0.091***	-0.017
	[0.021]	[0.015]	[0.021]	[0.015]
× Nothing changed	0.072***	0.021	0.073***	0.020
	[0.024]	[0.018]	[0.024]	[0.018]
× Don't know	0.080*	0.027	0.081**	0.027
	[0.041]	[0.040]	[0.040]	[0.040]
Having HIV-positive relatives				
× Treated badly	0.102**	-0.047	0.105**	-0.047
	[0.048]	[0.050]	[0.047]	[0.050]
× Supported	0.045***	0.002	0.044***	0.002
	[0.011]	[0.013]	[0.010]	[0.013]
× Nothing changed	0.061***	0.016	0.058**	0.017
	[0.022]	[0.022]	[0.022]	[0.022]
× Don't know	0.053	-0.019	0.054	-0.020
	[0.037]	[0.039]	[0.036]	[0.039]
Having HIV-positive neighbors				
× Treated badly	-0.044	0.032	-0.043	0.030
	[0.042]	[0.035]	[0.043]	[0.036]
× Supported	-0.019	-0.008	-0.019	-0.008
	[0.017]	[0.020]	[0.017]	[0.021]
× Nothing changed	-0.034*	0.000	-0.033*	-0.000
	[0.019]	[0.017]	[0.018]	[0.017]
× Don't know	-0.056**	0.011	-0.056**	0.010
	[0.025]	[0.022]	[0.025]	[0.022]
HIV knowledge	0.011***	0.010***	0.011***	0.010***
(test scores)	[0.003]	[0.002]	[0.003]	[0.002]
Area FE	Yes	Yes	Yes	Yes
No. of obs.	4948	4948	4948	4948

Notes: (1) Figures [ ] are standard errors. *** denotes significance at 1%, ** at 5%, and * at 10%. (2) Standard errors are robust to heteroskedasticity and clustered residuals within each working area. (3) A reference group associated with HIV/AIDS-related social environment is 'not having HIV-positive people'.

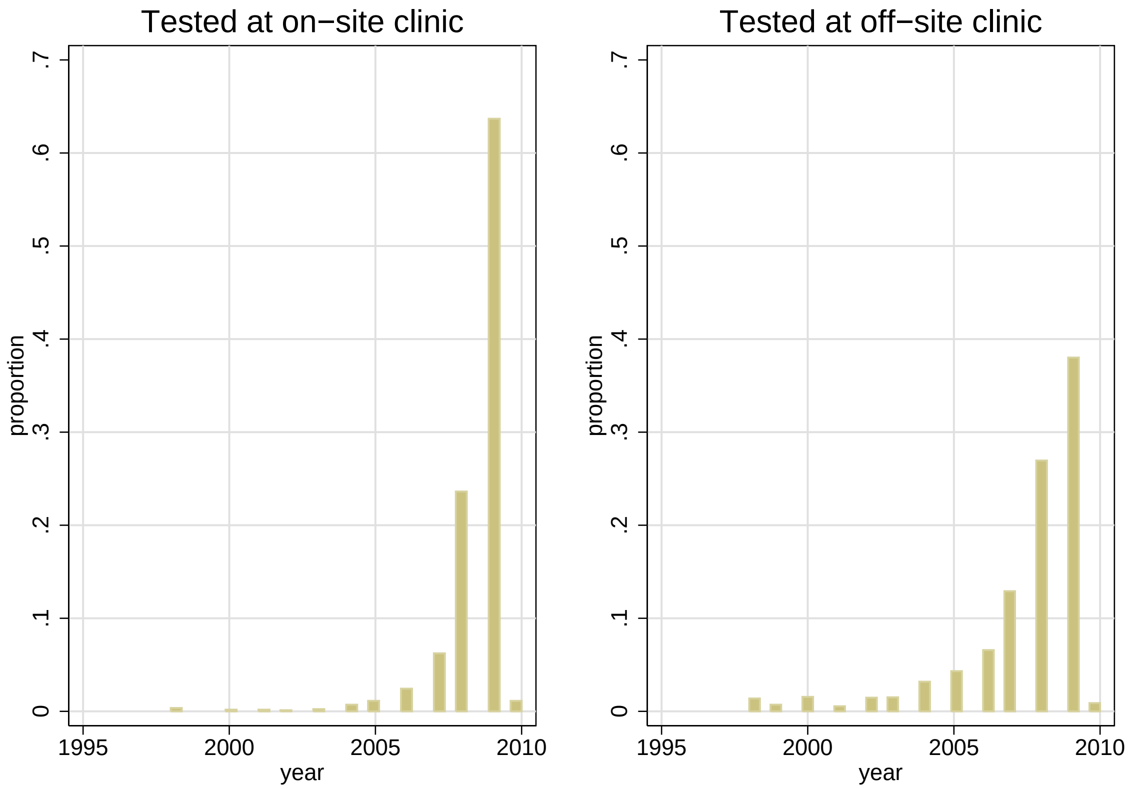

Figure 1: Year of the Last HIV-Test Experience

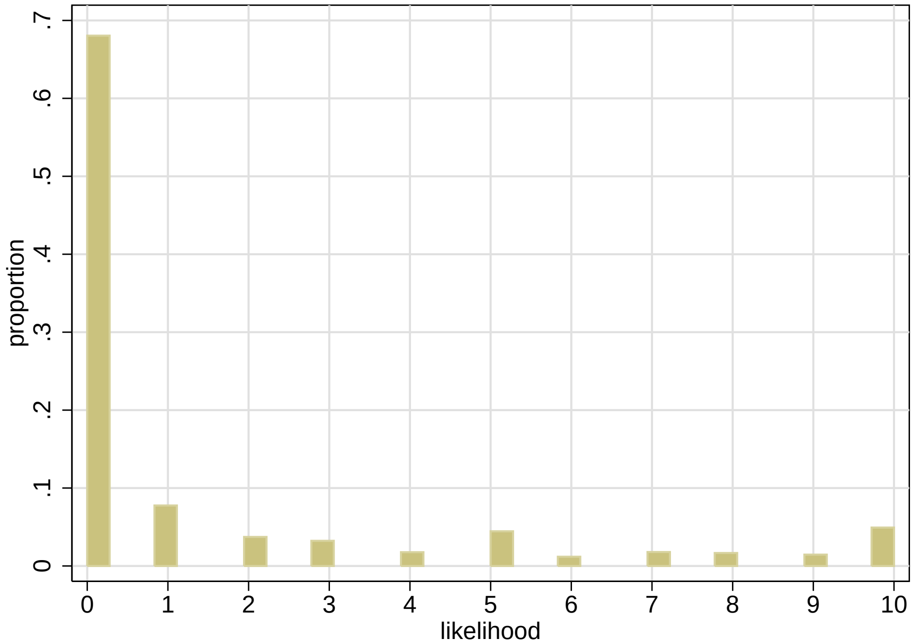

Figure 2: Distribution of Beliefs about Confidentiality

Note: The survey team asked employees how likely they think non-medical personnel in the enterprise may know their test result if they go for a HIV-test at an on-site clinic. The scale '0' means 'no likelihood' with '10' meaning 'certain.'

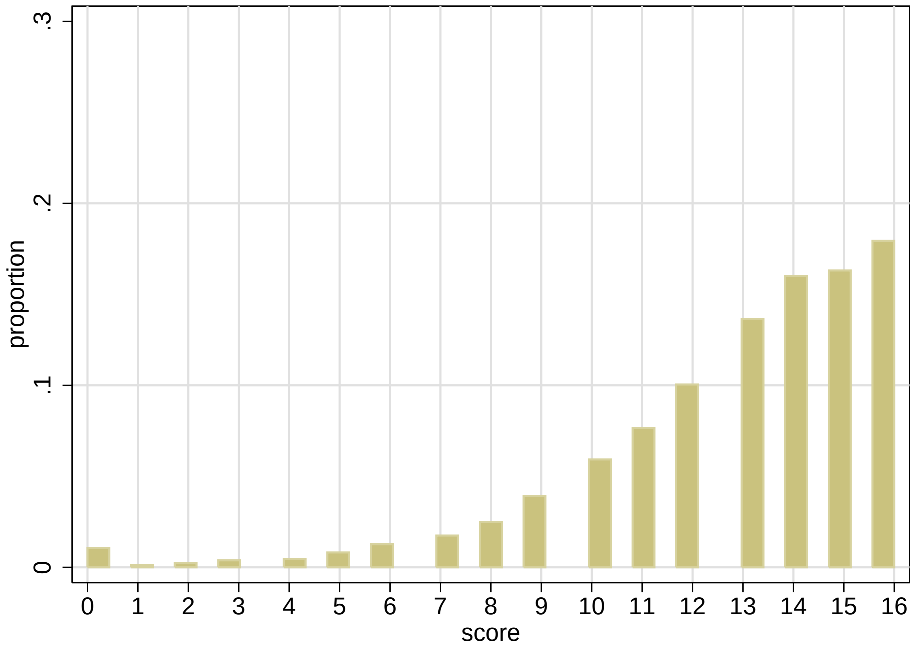

Figure 3: Appendix: Distribution of HIV Knowledge Test Scores