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Disclosure of Medical Information in Health Insurance[1]

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Abstract

Disclosure of private medical information allows insurance companies to better predict medical expenditures. The premiums the companies charge the insured employees reflect these expenditures. This paper studies incentives of employees to disclose their medical information. I find that healthier employees prefer to disclose medical information that results in a disclosure plan having a lower premium than a non disclosure plan. Furthermore, I find that if health plans have few employees and the employee turnover rate is high, it makes the incentive to disclose (or conceal) information stronger and the sorting of employees according to their health status more pronounced.

JEL classification numbers: D82, D83, G22, I11, J32.
Keywords: health insurance, disclosure, information, screening, plan choice

1 Introduction

Almost all individuals and most employees of small firms who purchase of health insurance have to disclose their medical information to insurance companies [28]. This information affects the insurance premiums and may restrict the insurance coverage.

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[1] The views expressed here are those of the author and cannot be attributed to the Economic Research Service or the U.S. Department of Agriculture.

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The disclosure[3] is designed to solve the asymmetric information problem in insurance markets where the purchasers of insurance naturally have better information about their health than providers of insurance. A large body of economic research has been devoted to asymmetric information in insurance [5], with some research on the predictive power of medical information. However, there has been no research on incentives to disclose medical information, due partly to the lack of data and partly to the involuntarily nature of most disclosures.

To address this research gap, I study employee incentives to disclose medical information in firms that offer a choice between disclosure and non disclosure health insurance plans. The premium of the disclosure plans is closely aligned to actual expected expenditures, and I expect healthy employees to choose these plans. I test whether this sorting mechanism of employees according to their health status is less costly than the sorting by quality a-la [24].[4] I develop and empirically test predictions of a theoretical model that explains how health status affects the sorting of employees between disclosure and non disclosure plans in a firm.

I use the 1997 survey of employers by the Robert Wood Johnson Foundation to test these predictions and to estimate the discount offered for disclosure. The model predicts that healthy employees will disclose their medical history and unhealthy employees will not. This sorting lowers average medical expenditures of the disclosure plan relative to the non disclosure plan, which translates into a lower premium for the disclosure plan, termed the disclosure discount. I find that insurers provide discounts for the disclosure of medical histories, at an average of $35 per month or 41 percent of an out-of-pocket premium.

The model also predicts that the turnover rate of employees in the firm increases the disclosure discount, while the number of employees in a plan decreases it. Insurance companies learn the health status of the employees enrolled in the disclosure plans sooner than the status of the employees in the non disclosure plans. Employees in the firms with high turnover rates expect to have a short employment duration, so that the insurance company will not have enough time to access their health status if they choose the non-disclosure plan. Hence, a high turnover rate exacerbates the selection based on health status and increases the disclosure discount. A large number of employees in a plan decreases the disclosure discount because the disclosure of even a very bad health status will not change the plan's average level of expenditures, and hence the disclosure will not change the premium an employee pays. The empirical results confirm the predictions of the model.

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[3] This process is often called medical underwriting.

[4] Insurance company can offer high and low quality health plans. Healthy employees have lower demand for insurance and they will choose the low quality plan. This separation method is detrimental to employees because the quality of one of the plans is artificially lowered to attract healthy employees.

2 Background

Sixty percent of the US population obtains health insurance through employers. Employers can lower their taxes by offering insurance instead of paying a comparable sum as a wage [25]. In addition, for employers, purchasing insurance for many employees reduces administrative costs and increases bargaining power with the insurers. A third reason for relatively cheap employer-provided insurance is the adverse selection that takes place if the decision to buy insurance is positively correlated with an individuals private information on expected medical expenditures. For example, sicker individuals buy more insurance than healthier ones [5]. Some individuals can also wait until they become sick and purchase insurance only then. Insurance companies try protect themselves from individuals with private health information by requiring disclosure of this information when the contract is signed.

Insurance companies use the disclosed medical history to predict future claims and to adjust premiums [1, 19 and 29].[5] The use of medical information produces better predictions of medical expenditures than the traditional models that use only demographic information [5, 11, 20, 29]. The disclosure requirement is almost universal in the individual health insurance market and is common in health insurance plans offered to small firms.[6]

Insurance companies use medical information to set insurance premiums based on the health risks of enrolled employees. This process can potentially solve the adverse selection problem, as individuals and firms with high expected medical expenditures pay higher premiums. The law prohibits insurance companies from charging individually adjusted premiums to employees enrolled in the same employer-provided plan; however, in firms with few employees, the disclosed health status of an individual employee may have a large effect on premiums. Insurance premiums of small firms can increase by more than 100% a year as a response to the increase of the expected medical costs [21].

Health insurance coverage can affect sorting of employees across firms as well as across health plans. Offering insurance reduces the turnover rate of employees, but it also attracts less healthy employees to the firm [18]. A disclosure requirement may discourage some employees from working for a firm. Employees working for firms that offer a disclosure plan have generally lower medical expenditures for the first 2 years of coverage [17].

If insurance companies offer both disclosure and non disclosure plans, it may induce healthy employees to select the disclosure plan and sick employees to select the non disclosure plan (see Section 3). There is extensive literature discussing how employees select health plans [3, 14, 15, 26, 27], but none of it considers a choice between disclosure and non disclosure health plans.

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[5] Many states regulate the ability of insurers to use medical information to set the premium for small employers [8, 19, 22].

[6] Most insurers and regulators classify firms with less than 50 employees as small.

Medical history is usually disclosed through questionnaires filled out by employees. These questionnaires may be accompanied by urine and blood tests, electrocardiograms, and height, weight, and blood pressure measurements. In some cases, past medical records are obtained from primary care physicians [11]. Insurance companies may further clarify the answers in the questionnaires by telephone interviews with employees. Besides being collected directly from employees, medical information can also be obtained from the Medical Information Bureau (MIB).[7] Also, insurance companies can obtain information on prescription drug usage from health care providers [23].

Insurance companies hold employees liable for any inaccurate information resulting from employee misinterpretation of quaestiones in the application. This misinterpretation can result in rescission of coverage or even refusal to pay for the pending claims [23]. Hence, employees have a strong incentive to fill out the application correctly, but it is a costly and time-consuming task for the employees because they need to contact their medical providers and look through many medical documents. The applications may be long and complex (an example of such application is in the appendix), while the consequences of making a mistake are severe. The cost of filling out an application may discourage some employees from choosing a disclosure plan if they are given an option of a non disclosure plan.

3 Model

This section presents a private information model describing how employees sort between disclosure and non disclosure plans. The model identifies a separating equilibrium at which relatively healthy employees choose to disclose and relatively sick employees choose not to. This sorting results in the disclosure plan having a lower premium, the disclosure discount mentioned earlier. The only differences between plans are premiums and disclosure requirement. In reality, a health plan is a complicated product with multiple features, and employees can sort between the plans across several dimensions.

3.1 Separating Equilibrium

The employee has two types of medical expenditures: the costs of pre-existing conditions, θ, and the costs from the future random health shocks not known to the employee. Future health shocks are assumed to have a mean of zero. θ is assumed to be drawn from distribution $G(\theta)$, which is bounded between 0 and θ_{max}. For simplicity, I assume that the employee has perfect information on θ that is not available to the insurance company.

[7] MIB is the corporation owned by insurance companies with the primary mission detecting insurance fraud.

The insurance company learns θ immediately if the employee selects the disclosure plan. If an employee chooses the non-disclosure plan, the insurance company learns θ at the period r and has no information about θ before r. The employee who chooses the disclosure plan incurs a cost F, the time and effort spent on obtaining and properly disclosing medical information.[8]

The utility of having insurance is denoted as V.[9] If the employee with the expected pre-existing medical expenditures θ (i.e., type θ) selects the disclosure plan, his/her insurance premium is $P_d(\overline{\theta}_d, \theta, N)$. This premium depends on the average medical expenditure of the other employees in the disclosure plan $\overline{\theta}_d$, the employee's type θ, and the number of employees in the plan, N. The model assumes that the insurance company updates the premium immediately after the companies receives the information on θ.[10]

If the employee selects the non-disclosure plan, the premium prior to period r, $(P_n(\overline{\theta}_n))$, depends on the expected expenditures of the other employees who are already in the plan, as well as on the expectation of medical expenditures of the joining employee.[11] For simplicity, we assume that this expectation, $\overline{\theta}_n$, is the mean of the medical expenditures of the employees in the non disclosure plan. After period r, the premium for the non-disclosure plan, $P_n(\overline{\theta}_n, \theta, N)$, also depends on the employee's health status and the number of employees in the plan.

The employment contract continues into the next period with probability t and so does the insurance coverage. The utility level associated with not being employed at the company is normalized to zero. The model assumes that the premium is equal to the expected average expenditures of the employees in the plan. When the insurance company learns about the employee's type (immediately in the disclosure plan and after period r in the non-disclosure plan), the company updates the premium in the following way:

$$P_i(\overline{\theta}_i, \theta, N) = \frac{N\overline{\theta}_i + \theta}{N+1}.$$

Employee θ's utility from choosing the disclosure and non-disclosure plans are as

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[8] In reality, F is likely to be an increasing function of θ. Allowing F to vary with θ would not change the separating equilibrium nor the model's comparative statics.

[9] For simplicity, I assume that all employees purchase insurance. If one makes V vary with θ, it does not change the results.

[10] Relaxing this assumption by allowing premiums to be updated only once a year does not change the model's the separating equilibrium nor the models comparative statics.

[11] If we assume the expectation to be different from the average, then we need to specify how and why newly enrolled employees are systematically different from the rest of employees in the plan. This exercise requires a dynamic model that is beyond the scope of this paper.

follows:

$$U_d = \sum_{j=0}^{\infty} t^j (V - P_d(\overline{\theta}_d, \theta, N)) - F$$

and

$$U_n = \sum_{j=0}^{r} t^j (V - P_n(\overline{\theta}_n)) + \sum_{k=r}^{\infty} t^k (V - P_n(\overline{\theta}_n, \theta, N)).$$

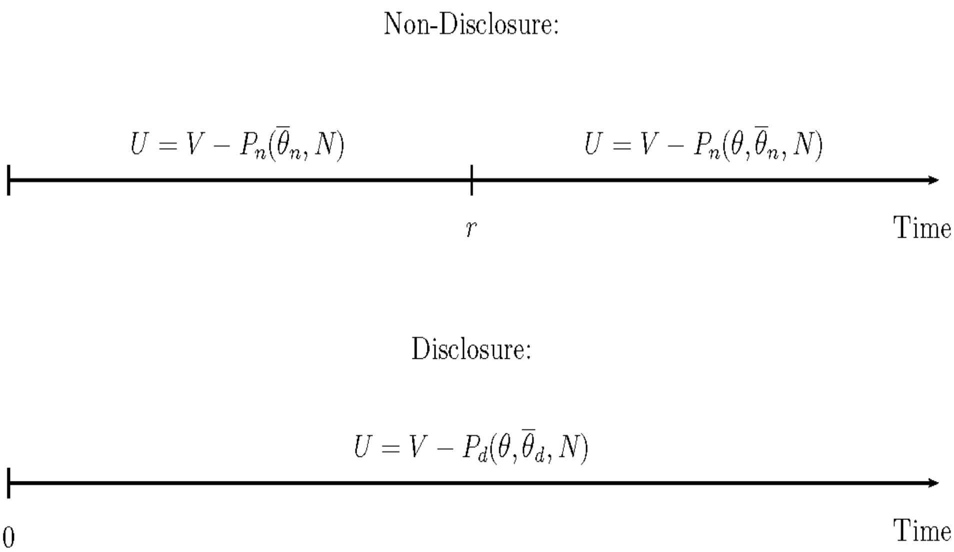

Figure 1: Utility of the disclosure and non-disclosure plans

The net benefit of the disclosure plan is

$$U_d(\theta) - U_n(\theta) = -\frac{1-t^{r+1}}{1-t}\left[\frac{N\overline{\theta}_d+\theta}{N+1} - \frac{N\overline{\theta}_n}{N}\right] - \frac{t^{r+1}}{1-t}\left[\frac{N(\overline{\theta}_d-\overline{\theta}_n)}{N+1}\right] - F.$$

This net benefit is the sum of the difference in the premiums prior to period r+1 and the difference in premiums after period r, minus the fixed cost associated with disclosure. Equation 4 indicates that the difference in premiums after period r does not depend on θ because the marginal effect of θ on these premiums is the same, while the difference in the premiums prior to period r+1 does vary with θ. Formally, the net benefits of disclosure decrease as θ increases (i.e., disclosure is more costly to unhealthy employees):

$$\frac{\partial U_d - \partial U_n}{\partial \theta} = \frac{t^{r+1}-1}{(1+N)(1-t)} < 0.$$

The above expression indicates that the slope of the utility function of the disclosure plan with respect to θ is steeper than the slope of the non-disclosure plan. There exists an employee with $\theta = \hat{\theta}$ who is indifferent to the choice between the two plans. This employee forms the single-crossing of the utility functions, so that relatively unhealthy employees with $\theta > \hat{\theta}$ choose the non disclosure plan and relatively healthy with $\theta < \hat{\theta}$ choose the disclosure plan.[12] Intuitively, the marginal cost of disclosure F is the same for all employees; however, the marginal benefit of disclosure – the difference in premiums between non-disclosure and disclosure plans after the employee joins them – is decreasing in the θ of the employee. A necessary condition for a separating equilibrium is $0 < \hat{\theta} < \theta_{max}$. Proposition 1 shows conditions necessary for a separating equilibrium to exist.

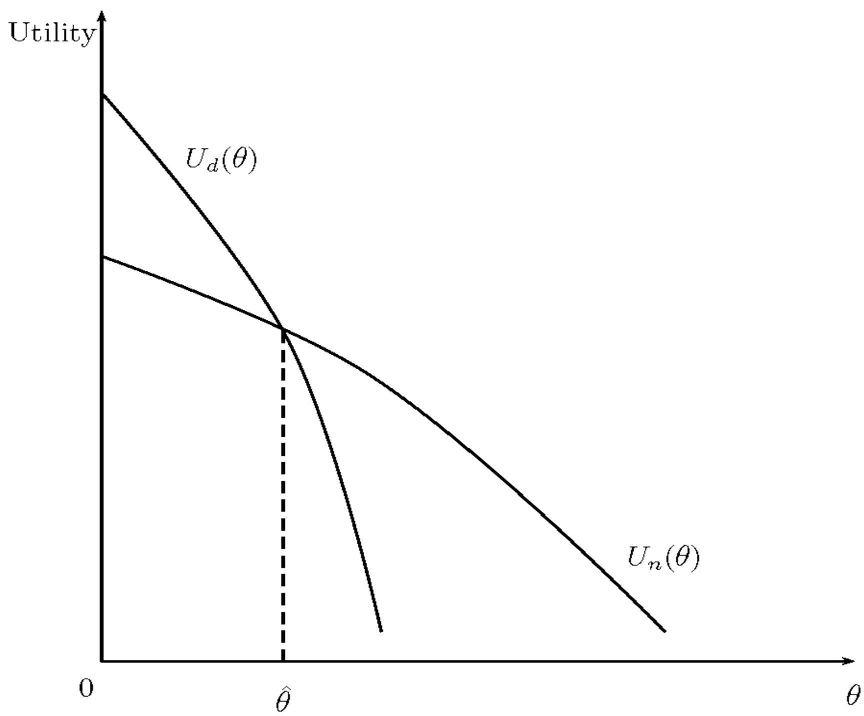

Figure 2: Single Crossing of the Utility functions

Proposition 1 *$\hat{\theta}$ is an interior point in $G(\theta)$ if*

$$\frac{\widetilde{\theta}(N+1-t^{r+1})}{(1-t)(N+1)} > F > \frac{\theta_{\max}N-N\widetilde{\theta}}{(1-t)(N+1)},$$

where $\tilde{\theta}$ is the average medical expenditures of the employees in the firm.

The fixed cost of disclosure (F) should be large enough for the least healthy

[12] For simplicity, I assume that there is only one crossing point between the $U_d(\theta)$ and $U_n(\theta)$.

employees ($\theta = \theta_{max}$) to choose the non-disclosure plan and small enough for the healthiest employees ($\theta = 0$) to choose the disclosure plan. The conditions in Proposition 1 are less likely to be satisfied if medical expenditures of the most unhealthy employees are much larger than the average (θ is highly dispersed). In this case, the unhealthy employees always prefer to join in with healthier employees, even though they have to disclose their bad health status.

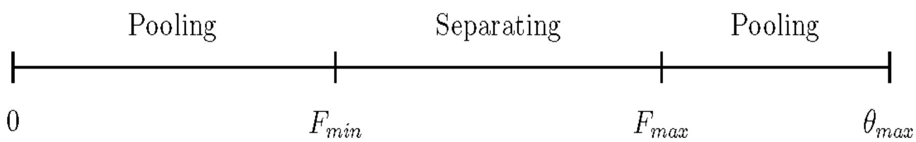

Figure 3: Fixed costs of disclosure and equilibrium types

3.2 Comparative Static and Insurance Premiums

Changes in the number of employees in a plan (N) and the probability of remaining employed in a firm (t) affect the expected medical expenditures of the indifferent employee $\hat{\theta}$, while the changes in $\hat{\theta}$ affect average medical expenditures of the plans and premiums $P_d = E(\theta |\, \theta < \hat{\theta})$ and $P_n = E(\theta |\, \theta > \hat{\theta})$. To find explicitly how premiums and conditional expectation of θ changes with t and N is very difficult.[13] Instead, I determine the comparative static of $\hat{\theta}$ implicitly.

Proposition 2 *A factor that increases the difference between the utility from the disclosure and non-disclosure plans ($U_n(\theta) - U_d(\theta)$) also increases the difference between the premiums of the two plans ($P_n(\hat{\theta}) - P_d(\hat{\theta})$), if the factor has the minimum necessary effect on the difference of the expected average medical expenditures of the two plans. If the factor does not have sufficient effect on the difference in expenditures, then the effect of the factor on the difference in premiums is well approximated by zero.*

[13] We need to know the distribution of θ and the location of $\hat{\theta}$ in this distribution. Medical costs in the US population are well approximated by a log-normal distribution [12, 19, 10]. The approximated distribution is for actual rather than more relevant expected medical expenditures [7]. Furthermore, the distribution in a particular firm depends on factors such as the type of industry, the number of employees, and their age and gender [13]. Finally, most of the distributions have expectations non-linear in $\hat{\theta}$, which makes comparative static results difficult to obtain.

Next I determine how the disclosure discount changes with respect to the probability of staying employed (t) and the number of employees in a plan (N).

I use the Lemmas 1 and 2 proved in the appendix to shows that the turnover rate and the number of employees in a plan have the following effects on the disclosure discount:

1. Probability of staying employed decreases discount: $(\partial P_n - \partial P_d)/\,\partial t < 0$.
2. Number of employees in a plan decreases discount: $(\partial P_n - \partial P_d)/\,\partial N < 0$.

The condition necessary for the comparative statics results is that the rate of change in the difference between expected medical expenditures of the two plans will increase in the medical expenditures of the indifferent employee ($\frac{\partial^2 \overline{\theta}_n}{\partial \hat{\theta}^2} - \frac{\partial^2 \overline{\theta}_d}{\partial \hat{\theta}^2} > 0$). The condition implies that the difference in average expenditures reaches a maximum when all but the sickest employees are enrolled in the disclosure plan. This condition is likely to be satisfied in the skewed-to-the-right distributions (log-normal, exponential) commonly assumed for medical expenditures.

The model's predictions for a separating equilibrium can be summarized as following:

• Healthy employees choose to disclose their medical information and sick employees do not, resulting in a lower premium for the disclosure plan.

• A larger number of employees and higher probability of remaining employed in a firm decrease the disclosure discount.

4 Disclosure and Coverage Rate

This section presents the firm-level data and tests a proposition that employees in a firm that offers both disclosure and non disclosure plans are more likely to sign up for health insurance.

4.1 Data Description

The Robert Wood Johnson Foundation conducted a survey of employers in the 48 contiguous states and the District of Columbia. This 1997 survey was based on geographical and firm size strata, with random selection within each stratum. In total, 22,465 employers were included in the survey, and 14,582 of them were offering medical insurance in the form of 33,549 health plans. Smaller employers were asked whether their employees have to disclosure their medical histories. In total, there were 7345 employers (with 18,524 plans) who provided this information.

4.2 Firm-Level Data

Table 1 presents the descriptive statistics for the firms that offer only disclosure, only non disclosure, and both types of plans. The firms with both plans have to offer at least two plans, so to make the comparison meaningful, I have omitted firms that offer only one health plan. The remaining sample of 1,304 firms is further reduced by missing observations of firm-control variables to the 1,062 firms that are used for analysis.

The firms with both plans were much smaller than the rest; 99% of these firms have fewer than fifty employees. As with other small firms, they offered fewer health plans and are more likely to join a purchasing agreement to buy insurance. These agreements are designed to increase the firm's bargaining power and to reduce the insurer's risks associated with providing insurance to small firms.

Table 1: Firm Level Descriptive Statistics

	Non-Disclosure	Both	Disclosure
Insurance Coverage Rate	0.79	0.75	0.74
Small Firm	0.71 ***	0.99	0.92 **
Number of employees in US per plan	1989.43	12.9	38.95***
Union	0.09	0.04	0.04
Permanent employees eligible, %	91.76 *	95.6	91.37 *
Number of insurance plans offered	2.68 ***	2.20	2.26
Purchasing arrangement	0.35	0.41	0.37
Age of the firm	37.53 ***	15.3	23.13 **
Turnover rate	0.23	0.17	0.20
Percent working >39 hr/wk	0.83	0.73	0.73
Percent working 35-39 hr/wk	0.09	0.13	0.12
Percent working 20-34 hr/wk	0.05 *	0.12	0.10
Percent working less than 20 hr/wk	0.03 *	0.01	0.05 ***
Percent of workers younger than 30 years	0.25	0.33	0.21 ***
Percent of aged 30-39 workers	0.32	0.26	0.33
Percent of aged 40-49 workers	0.24	0.23	0.20
Percent of workers older than 50	0.19	0.17	0.26
Percent Female	0.45	0.51	0.48
$5/hour workers	0.03	0.11	0.06
$5-7/hour workers	0.07 **	0.17	0.15
$7-10/hour workers	0.15	0.21	0.18
$10-15/hour workers	0.29	0.26	0.25
More than $15/hour workers	0.46 ***	0.26	0.35
Construction	0.04	0.07	0.06
Mining, Manufacturing	0.11 **	0.04	0.13 **

Transport, Communications	0.05	0.06	0.04
Wholesale	0.05	0.08	0.07
Retail	0.07	0.11	0.12
Financial Service	0.22	0.31	0.24
Professional Service	0.40	0.28	0.30
Other Service	0.05	0.05	0.04
Observations	670	61	331

The means are weighted using the firm weights provided in the survey. The unit of observation is a firm. Numbers in the brackets are the standard errors. Stars indicate statistical significant difference with the means of the firms that offer both types of plans; *, ** and *** indicate statistically significant difference at the 10, 5 and 1 percent level in a two-tail Wald test.

The firms with both plans had more employees who were eligible to purchase insurance, but this did not result in a higher coverage rate. This result may be due to the fact that the firms with both plans have younger employees, who receive lower wages and are more likely to work part-time. Such employees have a lower demand for insurance and require a low-cost disclosure plan, because they may not purchase insurance otherwise.

4.3 Disclosure and Coverage Rate

A major problem associated with private health information is adverse selection, when high-cost employees increase the price of health insurance beyond the low cost employees' willingness to pay for it [16]. Employers can mitigate this problem by offering different plans for low- and high-cost employees. This solution may not be successful if high-cost employees can choose the plan designated for low-cost employees to enjoy lower prices. Employers can reduce the incentive for high-cost employees to choose the low-cost plan if this plan provides lower quality insurance. Lowering the quality of the plan reduces the welfare of these employees, who would prefer to obtain high-quality insurance and to pay the price that reflects their lower medical costs [24]. This welfare loss explains the lower insurance participation rate of healthy employees [2].

A requirement to disclose private medical information may be a way to achieve the separation of low- and high-cost employees without lowering the quality of insurance. If this proposition is correct, then firms that carry both disclosure and non-disclosure plans should have a higher insurance participation rate. To test this, I regress the participation rate on the indicator of both plans controlling for the firm-level variables described in the Table 1 and on disclosure configuration indicators (only disclosure plans, only non-disclosure plans, or both types of plans). Table 2 presents estimated coefficients of how disclosure configurations affect the participation rate. The estimated coefficients are small and statistically insignificant. Therefore, I find no evidence that offering both disclosure and non-disclosure plans increases employees' insurance participation rate.

Table 2: Regression of Insurance Coverage Rate (percentage points)

	OLS	County Fixed Effects
Both types offered	-.3	1.26
	(4.37)	(4.49)
Only disclosure plans offered	.07	1.1
	(2.5)	(2.9)
Observations	1,062	1,062
R^2	.38	.69

The regression results are weighted by the firm weights provided in the survey. Numbers in the brackets are the standard errors. *, ** and *** indicate statistical significant difference between means at the 10, 5 and 1 percent level in a two-tail test. The omitted category is the firms with only non-disclosure plans. The regression uses controls described in the table 3 for small firm indicator, number of employee in the US, unionization of employees, percent of eligible employees, number of plans offered, purchasing agreement, age of the firm, turnover rate, firm's industry, and distributions of wage, age and hours of work.

5 Estimating Disclosure Discount

5.1 Plan-Level Data

My theoretical model considers the sorting of employees between disclosure and non-disclosure plans in a firm. The source of the discount is the lower expected medical expenditures of the disclosure plan. These lower expenditures can be alternatively transmitted to the employees through higher quality of the disclosure plan. It is difficult to compare premiums for disclosure and non-disclosure plans across firms because there are many unobservable firm characteristics that affect the price of insurance, including, for example, the health of the employees and the risk associated with their work.

It is not possible to assess how much an employee values the utility from the non-disclosure of medical history in a firm if we don't know the wage this employee would have received in an identical firm with a disclosure plan. The available data lacks both the individual wage an employee receives from the current employer and information about counterfactual employment in a similar firm with a different disclosure requirement. If a firm offers both plans, it is easier to measure the demands for these plans because the choice of a disclosure or non-disclosure plan is not bundled with employment in different firms.

As noted, low medical expenditures of employees in a disclosure plan can be reflected not only through lower premiums, but also through a higher quality of insurance. Therefore, it is very important to have a good measure of insurance quality. There are 76 firms (394 plans) in the study sample that offer both disclosure and non-disclosure plans. Of these firms, 57 have enough non-missing control variables to be useful for analysis. These firms offer 108 unique plans, 104 of which offer both single and family coverage for different prices. That gives us 212 plan price observations.

The fact that only 57 firms offered both types of plans can be explained by Proposition 1. The proposition finds the minimum difference between θ_{max} (expenditures of the sickest employee) and $\tilde{\theta}$ (mean expenditures in a firm) for a separating equilibrium to exist. Most firms in the sample may have a larger difference between θ_{max} and $\tilde{\theta}$ (a larger variance of medical expenditures), making a separating equilibrium in these firms impossible.

A disclosure discount obtained by the employees is measured as a difference between quality-adjusted premiums for disclosure and non-disclosure plans. I use the monthly out-of-pocket premium paid by employees to measure this discount. The out-of-pocket premium is equal to the difference between the premium set by insurance companies and the premium subsidy paid by employers.[14] A plan that offers both family and single coverage has two distinct premiums for these coverages.

Table 2 includes a set of covariates to control for insurance plan quality. Due to the small sample size, very few means of the variables for disclosure and non-disclosure plans are statistically different. Total premium is the premium charged by the insurance company, and the employee premium is the part of the premium paid by the employees. Disclosure plans are less expensive, but they are less likely to cover services such as mental health or vision care. Sometimes former employees can be enrolled in the health plans along with the active employees; hence, there are two variables measuring total and active employees enrollment. Disclosure plans have longer waiting periods than non-disclosure plans during which insurance does not cover the medical expenses associated with pre-existing conditions.

The main measure of insurance is the actuarial value of a plan. This value, which measures the share of the expected medical expenditures covered by the insurance, was calculated by the designers of the survey in the following manner: First, they estimated expected medical expenditures of an employee using the demographic information and geographical location. Then they estimated the share of the expenditures covered by insurance, linking expected medical expenditures with the insurance contract information. The actuarial value is bounded between 0 and 1. For example, if an actuarial value is 0.83, then 83% of the expected medical

[14] Insurance companies have no direct control over the out-of-pocket-premium, but they can influence it knowing how the firm subsidizes the plans. Most of the firms have some system that determines the amount of subsidy. A firm can contribute a fixed dollar amount to each plan or it can pay a certain share of the premium.

expenditures will be covered by the insurance. Disclosure plans have slightly higher actuarial values.

Table 3: Descriptive statistics of the plans in the firms with both plans

	Non-disclosure	Disclosure
Employees premium, $	92.14	78.08
Total premium, $	346.81	285.32
Family Coverage	0.48	0.47
Indicator of coverage of hospital stays	0.90	1.00
Indicator of coverage of prescription drugs	0.99	0.88
Indicator of coverage of mental health	0.94	0.82
Indicator of coverage of vision care	0.45	0.32
Indicator of coverage of dental care	0.26	0.26
Employees enrolled	4.00	3.35
Active employees enrolled	4.00	3.29
Indicator of offering family coverage	0.96	0.93
Waiting period, days	50.41 *	83.12
Deductable, $	140.97	189.40
Copayment, $	10.31	10.49
Coinsurance rate, %	20.50	20.96
Coinsurance rate varies	0.29	0.40
Indicator of maximum out-of-pocket expense	0.71	0.73
HMO	0.40	0.50
POS	0.06	0.05
PPO	0.44 *	0.22
Indemnity Plan	0.09 *	0.24
Actuarial value	0.78	0.81
Observations	104	108

The means are weighted using the firm weights provided in the survey. The unit of observation is a firm. Numbers in the brackets are the standard errors. *, ** and *** indicate statistically significant difference between means at the 10, 5, and 1 percent levels in a two-tail Wald test.

A less aggregated measures of insurance are deductibles, coinsurance rates, and copayments. A deductible is the portion of the claim not covered by the insurance company. Coinsurance rate is the share of the claim that is paid by the insured. The coinsurance rates applies to claims after the deductible is exceeded, but before the maximum out-of-pocket expenditure is reached. Employees incur no additional costs for the expenditures that exceed maximum-out-of-pocket expenditures.[15] Copayment is a fixed dollar amount the insurer pays toward each medical claim. Disclosure plans have higher deductibles than non-disclosure planes, although nonpayments and coinsurance rates are similar.

There are four major types of health plans offered to employees in the survey data set: Indemnity Plan, Health Maintenance Organization (HMO), Point of Service Plan (POS), and Preferred Provider Organization (PPO). These types vary in the degree they restrict the choice of medical providers and utilization of medical services (see [Bundorf, 2002] for further discussion). Additionally, I include an indicator that measures whether coinsurance rates differ depending on the medical services.[16] The demand for some services such as mental health and substance abuse treatment is strongly correlated with high medical expenditures. Insurers try to discourage the employees who demand these services from choosing some plans, so these plans feature higher coinsurance rates for these services. For example, the coinsurance rate for mental health treatments may be 50% and the coinsurance rate for general hospital visits may be 95%. Disclosure plans are more likely to vary the coinsurance rates. Overall, it is not clear whether disclosure or non-disclosure plans provide more coverage.

5.2 Econometric Specification

Premium and quality determine the choice of a health plan. I regress plan premiums on the plan qualities and disclosure requirement to estimate the price assigned to the disclosure of medical information:

$$premium = \beta X + \beta_1 D + u$$

The set of variables X includes firm fixed effects and the variables controlling the quality of the plan presented in Table 3. The variable (D) indicates whether the insurer requires disclosure of medical history and β_1 estimates the disclosure discount. To test the comparative static results of the model, I include interactions of the turnover rate and the number of employees per plan with D in the estimation.

5.3 Results

This section presents the estimates of the disclosure discount and discusses how turnover rates and number of employees in the plan affect the discount. Table 4

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[15] A minority of plans also set a lifetime maximum of medical expenditures that insurance will cover, but the survey does not provide information about this restriction.

[16] Coinsurance rate is the percentage of the claim an employee pays after the deductible is exceeded.

presents the regression results for employers that offered a choice between disclosure and non-disclosure plans. Specifications 1 and 3 have no firm fixed effects; the estimated coefficients are different from those in specifications 2 and 4 that feature firm fixed effects. This difference underlines the importance of unobserved firm characteristics such as health of the employees.

I test the model's predications using specifications with firm fixed effects. I expect to see negative coefficient estimates associated with $Disclosure$ showing that a disclosure requirement decreases the premium. I find that the disclosure of medical information decreases the out-of-pocket premium by $34.97 (41% of the mean out-of-pocket premium). The coefficient is statistically significant at the 5% level.

Table 4: Regression of employee premium for the firms with both plans

	(1)	(2)	(3)	(4)
Disclosure Indicator	-11.02	-34.97 **	2.47	-14.76
	(21.4)	(15.78)	(29.42)	(20.12)
Turnover rate × D	.	.	-213.07 ***	-153.36 ***
			(66.88)	(44.48)
Number of employees in US per plan × D	.	.	1.59 ***	1.08 *
			(.51)	(.56)
Observations	212	212	212	212
R^2	.42	.51	.48	.53
Fixed Effects	No	Firm	No	Firm

The regression results are weighted by the firm weights provided in the survey. Note: *, ** and *** indicate statistical significance at the 10, 5 and 1 percent level in a two-tail test. Standard errors are in brackets below the coefficients. Omitted categories include: Indemnity plan type, single coverage. Standard errors are robust to heteroscedasticity and county-cluster serial correlation. Estimated coefficients of control variables are not presented in the table. These variables include third degree polynomial of actuarial value, second-degree polynomials of deductable, coinsurance and copayment, indicators of coverage of hospital stays, vision care, prescription drugs, mental health and dental care. I also do not report indicators of offering family coverage, variability of coinsurance rates, maximum out-of-pocket expense, HMO, PPO, POS, and family coverage, number of enrolled employees, number of active enrolled employees, waiting period.

The model predicts that the turnover rate increases the disclosure discount, so I expect to see negative coefficient estimates associated with $Turnover \times D$. I find that turnover rate significantly increases the discount for disclosure, with the estimated coefficient of 153.4 significant at the 1% level. One standard deviation increase in turnover rate (0.51) increases disclosure discount by $77.8 (91% of the mean out-of-pocket premium). The model also predicts that the expected number of employees in a plan decreases the disclosure discount, so I expect the estimate of the *Number of employees in US per plan*$\times D$ coefficient to be positive. The coefficient is estimated to be 1.08 and is significant at the 10% level. Increasing the number of employees per plan by one standard deviation (16.2) decreases the disclosure discount by $17.5 (20.5% of the mean out-of-pocket premium).

5.4 Sensitivity Analysis

The analysis is based on the premise that the disclosure discount is a result of the different costs insurers incurs of providing disclosure and non-disclosure plans because of the sorting of employees between these plans. The lower costs of providing disclosure plans should translate into lower premiums for employees. There is a complication because in reality employees are not purchasing insurance directly from insurance companies. They use employers as intermediaries. Besides their role as an intermediary, employers also subsidize premiums of the health insurance plans, and they may subsidize disclosure plans more than they do the non-disclosure plans. This would create an artificial discount that does not reflect the difference in the costs of providing the plans.

Table 5: Regression of Total Insurance Premiums

	(1)	(2)	(3)	(4)
Disclosure Indicator	-43.67	-67.01 **	-35.2	-79.4 **
	(27)	(28.33)	(35.64)	(33.88)
Turnover rate $\times$ D			-159.02 **	-88.73
			(68.04)	(77.65)
Number of employees in US per plan $\times$ D			1.29 *	2.87 ***
			(.68)	(.91)
Observations	212	212	212	212
R^2	.69	.81	.7	.83
Fixed Effects	No	Firm	No	Firm

The regression results are weighted by the firm weights provided in the survey. Note: *, ** and *** indicate statistical significance at the 10, 5 and 1 percent level in a two-tail test. Standard errors are in brackets below the coefficients. Omitted categories include: Indemnity plan type, single coverage. Standard errors are robust to heteroscedasticity and county-cluster serial correlation. Estimated coefficients of control variables are not presented in the table. These variables include third degree polynomial of actuarial value, second-degree polynomials of deductable, coinsurance and copayment, indicators oftive enrolled employees, waiting period.

To determine the relationship between plans' costs and employees' premium, I measure the disclosure discount using the total premium insurance companies charge employers rather than the out-of-pocket premium employees pay. The employers usually subsidize plans using simple rules; for example, employers may pay fifty percent of the premium or the first $100.[17] If such simple rules are used, then one would expect the disclosure discount of the total premium to be larger than or equal to the disclosure discount of the out-of-pocket premium. On the other hand, if the discount is only due to the large subsidies of the disclosure plans by employers, then one would expect to see no difference in the total premiums of the disclosure and non-disclosure plans.

Table 5 shows the disclosure discount obtained using the total premium. The estimated disclosure discount using total premium is $67.01 (21% of the mean total premium), with the coefficient statistically significant at the 5% level, whereas the discount using the out-of-pocket premium is $34.97 (statistically significant at the 1% level). These results indicate that the discount is the result of the prices that insurance companies charge, rather than the subsidies employers provide.

6 Discussion

The goal of my research was to study the disclosure of personal medical information to insurance companies. There are very few employees who can choose whether to disclose their medical information; most of employees work in the firms that offer only disclosure or only non-disclosure plans. The theoretical model of health plan choice shows that employers are able to offer the choice only if the variation of medical expenditures of the employees is very low, otherwise, all employees will flock into one of the plans and there will be no employees in the other.

I find that a disclosure requirement is an effective mechanism to separate employees by their health status. Usually, this separation is achieved via offering low- and high-quality health plans. Despite the fact that the separation on disclosure is less costly to the employees – one does not have to choose a low-quality plan to prove that one is healthy – it does not lead to a higher insurance participation rate. Hence, I cannot recommend separation through disclosure as a superior alternative to separation though difference in the quality of the plans.

In the paper, I assess the incentives of employees to disclose their health information. The disclosure of favorable health information leads to lower health plan rates for the enrolled employees, while the disclosure of unfavorable information lead to higher rates. There are two factors that affect the employee incentive to disclose: expected employment duration and the number of employees in a plan. Because in the non-disclosure plan this information is eventually

[17] Employers cannot subsidize insurance by more than the total premium, although some employers offer vouchers to the employees who do not purchase insurance.

disclosed, expected long employment duration makes the non-disclosure plan relatively less attractive to sick employees. On the other hand, expected short employment duration ensures that the information will not be disclosed, making the non-disclosure plan more attractive. The paper finds that a high turnover rate, which makes expected employment duration shorter, increases the disclosure discount.

A large number of employees in a plan decreases both costs and benefits of disclosure. Sick employees in a plan with few employees are afraid to disclose their medical information because insurers may set premiums reflecting their high expected medical expenditures. Therefore, these employees demand a larger discount for disclosure in cases where the employee's health status can significantly affect the premiums. On the other hand, in the plans with a large number of employees, the premium is minimally affected by an employee's health status, and a smaller discount is required to induce unhealthy employees to select the disclosure plan.

In recent years, there has been rapid development of new genetic screening methods, as well as improvements in medical information technologies, enabling more precise prediction of future diseases. These developments increase the value to insurers of learning private medical information. Currently, insurance companies are prohibited from using genetic information and are restricted in the use of regular medical information. However, it is important to study this topic so that the public can be aware of possible changes in the legal environment of information disclosure, given the rising attractiveness of this information. Our findings regarding the incentives to disclose medical information contributes to this task.

There are other markets besides health insurance where firms try to induce individuals to disclose their personal information, including firms involved in finance, retail, and internet commerce. These markets share with the health insurance markets that firms can gradually learn important information about consumers even in the absence of formal disclosure. The finding that the expected length of a customer-firm relationship have a profound effect on incentives to disclose information is important for the understanding of information disclosure in these markets.

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Appendix

Proof of Proposition 1 First, I consider conditions necessary for $\hat{\theta} < \theta_{max}$. Due to the fact that $(\partial U_d - \partial U_n)/\partial\theta < 0$, the lower bound on the net benefit of disclosure F_{min} to sustain the separating equilibrium only the employees with $\theta = \theta_{max}$ need choose the non-disclose plan and all employees with $\theta < \theta_{max}$ need to choose the disclosure plan, i.e., $U_d(\theta_{max}, F_{min}) - U_n(\theta_{max}, F_{min}) = 0$ and $\hat{\theta} = \overline{\theta}_n = \theta_{max}$. This implies that:

$$U_d(\theta_{max}) - U_n(\theta_{max}) = \theta_{max}\big((N+1)(1-t^{r+1}) + t^{r+1}N + t^{r+1} - 1\big)$$
$$-NE(\theta) - F_{min}(1-t)(N+1) = 0$$

and $F_{min} = \frac{\theta_{max}N - NE(\theta)}{F(1-t)(N+1)}$.

Next, I consider conditions necessary for $\hat{\theta} > 0$. The upper bound on the cost of disclosure is F_{max}. Then to sustain a separating equilibrium we need employees with $\theta = 0$ to choose the non-disclosure plan and all employees with $\theta > 0$ to choose the disclosure plan, i.e., $U_d(\theta = 0, F_{max}) - U_n(\theta = 0, F_{max}) = 0$ and $\hat{\theta} = \overline{\theta}_d = 0$. This implies that:

$$U_d(\theta = 0, F_{max}) - U_n(\theta = 0, F_{max}) =$$
$$(N+1)(1-t^{r+1})E(\theta) + t^{r+1}NE(\theta) - F_{max}(1-t)(N+1) = 0$$

and $F_{max} = \frac{E(\theta)(N+1-t^{r+1})}{F(1-t)(N+1)}$. ❑

Proof of Proposition 2 I need to show that for any X the sign of $\frac{\partial P_n - \partial P_d}{\partial X}$ is equal to the sign of $-\frac{\partial U_d - \partial U_n}{\partial X}$ if $\frac{\partial P_n - \partial P_d}{\partial X} \neq 0$. If

$$\frac{\partial P_n - \partial P_d}{\partial X} = \frac{\partial\overline{\theta}_n - \partial\overline{\theta}_d}{\partial X} = \frac{\partial\overline{\theta}_n - \partial\overline{\theta}_d}{\partial\hat{\theta}} \times \frac{-(\partial U_d - \partial U_n)}{\partial\hat{\theta}} \times \frac{\partial U_d - \partial U_n}{\partial X}$$

and $D = \frac{\partial\overline{\theta}_n - \partial\overline{\theta}_d}{\partial\hat{\theta}} \times \frac{-(\partial U_d - \partial U_n)}{\partial\hat{\theta}}$. I can represent D as

$$D = \left(\frac{\partial\overline{\theta}_n}{\partial\hat{\theta}} - \frac{\partial\overline{\theta}_d}{\partial\hat{\theta}}\right) \times \left(-N\left(\frac{\partial\overline{\theta}_n}{\partial\hat{\theta}} - \frac{\partial\overline{\theta}_d}{\partial\hat{\theta}}\right) - \left(\frac{\partial\overline{\theta}_n}{\partial\hat{\theta}} - 1\right)(1-t^{r+1})\right).$$

To determine the sign of D, I consider two cases: (i) if $(\partial\overline{\theta}_n - \partial\hat{\theta}_d)/\partial\hat{\theta} > 0$, then:

$$-N\left(\frac{\partial\overline{\theta}_n}{\partial\hat{\theta}} - \frac{\partial\overline{\theta}_d}{\partial\hat{\theta}}\right) - \left(\frac{\partial\overline{\theta}_n}{\partial\hat{\theta}} - 1\right)(1-t^{r+1}) \approx< 0.$$

In this case $D < 0$ if

$$\left|\frac{\partial\overline{\theta}_n - \partial\overline{\theta}_d}{\partial X}\right| > \frac{\left(\frac{\partial\overline{\theta}_n}{\partial\hat{\theta}} - 1\right)(1-t^{r+1})}{N}.$$

(ii) if $(\partial\overline{\theta}_n - \partial\overline{\theta}_d)/\,\partial\hat{\theta} < 0$ then:

$$-N\left(\frac{\partial\overline{\theta}_n}{\partial\hat{\theta}} - \frac{\partial\overline{\theta}_d}{\partial\hat{\theta}}\right) - \left(\frac{\partial\overline{\theta}_n}{\partial\hat{\theta}} - 1\right)(1 - t^{r+1}) >\approx 0.$$

In this case D<0 if

$$\left|\frac{\partial\overline{\theta}_n - \partial\overline{\theta}_d}{\partial X}\right| > \frac{\left(\frac{\partial\overline{\theta}_n}{\partial\hat{\theta}} - 1\right)(1 - t^{r+1})}{N}.$$

Therefore, the sufficient condition for $\mathrm{Sign}(\partial P_n - \partial P_d/\,\partial X) = -\mathrm{Sign}\left(\frac{\partial U_d - \partial U_n}{\partial X}\right)$ is:

$$\left|\frac{\partial\overline{\theta}_n - \partial\overline{\theta}_d}{\partial X}\right| > \left|\frac{\left(\frac{\partial\overline{\theta}_n}{\partial\hat{\theta}} - 1\right)(1 - t^{r+1})}{N}\right|.$$

The sign of $\frac{\partial P_n - \partial P_d}{\partial X}$ is undetermined if $\frac{\partial\overline{\theta}_n - \partial\overline{\theta}_d}{\partial X}$ is small. It is not a serious problem because $\frac{\partial P_n - \partial P_d}{\partial X}$ is a product of $\frac{\partial\overline{\theta}_n - \partial\overline{\theta}_d}{\partial X}$ and $\frac{\partial\hat{\theta}}{\partial X}$ (see equation 10). Therefore, if $\frac{\partial\overline{\theta}_n - \partial\overline{\theta}_d}{\partial X}$ is small, then $\frac{\partial P_n - \partial P_d}{\partial X}$ is close to zero. ❑

Lemma 1 *I need to show that* $(\partial P_n - \partial P_d)/\partial t > 0$. *The change of the net benefit from disclosure with* t *is*

$$\frac{\partial U_d(\hat{\theta}) - \partial U_n(\hat{\theta})}{\partial t} = \frac{N(\overline{\theta}_d - \overline{\theta}_n)}{(N+1)(1-t)^2} - \frac{((r+1)t^r(1-t) + t^{r+1})(\hat{\theta} - \overline{\theta}_n)}{(1-t)^2(N+1)}.$$

For reasonable values of t (from 0 to 1) and r (1 - 20 years), the expression $(r+1)t^r(1-t) + t^{r+1}$ is bounded between 0 and 1, then:

$$\frac{\partial U_d(\hat{\theta}) - \partial U_n(\hat{\theta})}{\partial t} < \frac{N(\overline{\theta}_d - \overline{\theta}_n)}{(N+1)(1-t)^2} - \frac{(\hat{\theta} - \overline{\theta}_n)}{(1-t)^2(N+1)} < 0.$$

Then, using Proposition 2, I can state that $(\partial P_n - \partial P_d)/\,\partial t > 0$.

Lemma 2 *I need to show that the difference in premiums of the two plans increases in* $(\partial P_n - \partial P_d)/\partial N > 0$. *First, I find the sign of* $\frac{\partial U_d(\hat{\theta}) - \partial U_n(\hat{\theta})}{\partial t}$:

$$\begin{aligned}\frac{\partial U_d(\hat{\theta}) - \partial U_n(\hat{\theta})}{\partial t} &= \frac{(1-t^{r+1})(\hat{\theta} - \overline{\theta}_n)}{(1-t)(N+1)^2} - \frac{N(\overline{\theta}_d - \overline{\theta}_n)}{(N+1)^2(1-t)} \\ &< \frac{(\hat{\theta} - \overline{\theta}_n)}{(1-t)(N+1)^2} - \frac{N(\overline{\theta}_d - \overline{\theta}_n)}{(N+1)^2(1-t)} \\ &< \frac{N(\overline{\theta}_d - \hat{\theta})}{(N+1)^2(1-t)} < 0.\end{aligned}$$

Then using Proposition 2, *I can state that* $(\partial P_n - \partial P_d)/\partial N > 0$.

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