Labor Market Screening and Social Insurance Program Design for the Disabled *

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Abstract

We evaluate social insurance programs for disabled workers in an equilibrium model, accounting for firm-side responses in the labor market. We develop a frictional labor market screening model where firms post a contract consisting of wage and job amenity, and workers with different levels of disability make labor supply decisions. To study the empirical relevance of labor market screening in the U.S., we first examine which job amenities are used to screen workers. By using policy variations on hiring subsidies for the disabled, we show suggestive evidence that firms use the option to reduce work hours to avoid hiring disabled workers. We then estimate our equilibrium model via indirect inference exploiting the policy variations. Using the estimated model, we explore the optimal mix of disability insurance (DI) and firm subsidies for hiring the disabled. Our findings suggest an important role of firm subsidies in improving welfare. These subsidies encourage firms to provide more job amenities, attracting disabled workers to the labor market, thereby mitigating the labor supply disincentives of DI. Finally, we show that the presence of a firm's screening incentives significantly affect the effectiveness of the policies: the optimal level of DI should be higher to ameliorate contract distortions caused by the firm's screening activities.

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1 Introduction

Most advanced countries implement various social insurance programs to support individuals with disabilities. First of all, there are large-scale public disability insurance (DI) programs, which provide income supports to disabled individuals who cannot work much.[1] Second, there are employment protection policies for the disabled, such as the Americans with Disabilities Act (ADA) and the Work Opportunity Tax Credit (WOTC) in the U.S. These policies aim to provide more job opportunities to the disabled by prohibiting firms from discriminating against workers based on disability and giving tax credits to firms hiring the disabled. The key difference between these policies is whether the government provides support to the disabled outside or inside the labor market. DI provides insurance to individuals outside labor markets, while employment protection policies insure the disabled within the labor markets. There have been a number of active policy debates on how to choose this balance.[2]

Because these policy interventions directly affect both workers and firms, understanding their *equilibrium* labor market effects is essential to evaluating the efficacy of these social insurance programs. Although there has been extensive literature investigating the impact of the DI program on individual labor supply and welfare, only a handful of studies have investigated the response of firms to either labor supply side or labor demand side policies. Acemoglu and Angrist (2001) argue that the introduction of the ADA substantially raised the cost of hiring disabled workers, lowering the labor demand for these workers. Thus, firms have incentives to screen (or avoid hiring) possibly costly disabled workers. However, to date, little is known about *whether* and *how* firms screen disabled workers when they cannot explicitly discriminate against workers based on their disability statuses. Although it is possible for firms to screen disabled workers in many different ways, finding the major screening tool is a crucial step in evaluating the social cost of labor market screening. More importantly, there have been few studies analyzing how the government *should* design subsidies for the disabled when firms' incentives for recruiting disabled workers are endogenously adjusted. Although additional spending on DI or employment (or wage) subsidies may distort employment levels, it may, at the same time, reduce labor market inefficiencies created to screen out disabled workers.

In this paper, we study the efficient subsidy design for the disabled, incorporating the

[1]In 2016, the U.S. government paid $220 billion to insure nearly nine million disabled people through public disability insurance, and the size of this program has been growing substantially in the last several decades.

[2]For example, Autor and Duggan (2010) discuss the need for shifting the government spending toward employment protection policies, by proposing a private disability insurance program, which assists firms in accommodating disabled workers.

firms' incentives to screen workers with different disability statuses. We develop an equilibrium screening model of the labor market with heterogeneous workers, in which job amenities are used to screen workers. We then empirically examine the quantitative relevance of screening for evaluating and designing policies. Toward that goal, we first examine which job amenity is used for screening by exploiting policy variations that differentially affect firms' profits from recruiting disabled workers relative to non-disabled workers. Then, we structurally estimate the equilibrium model, utilizing the policy variation for identification. Using the estimated model, we quantitatively analyze the optimal combination of disability insurance and hiring subsidies for the disabled.

Our model builds on labor market screening models such as Akerlof (1976), Guerrieri et al. (2010), and Stantcheva (2014). In the model, there is a continuum of workers with different disability statuses and with different observed skill levels. A worker's disability status affects his productivity, disutility from work, and preference on job characteristics that consist of wages and job amenities (non-wage benefits). Workers optimally choose their job search activities by deciding whether to search for a job (i.e., the labor force participation decision is endogenous) and what type of job to search for (i.e., the search process is directed). There is also a continuum of firms that decide to recruit workers. They choose wage and non-wage benefits to maximize their profits. We assume that these contracts cannot explicitly depend on the worker's disability status, consistent with the U.S. regulatory structure (like the ADA), although they can still depend on the observed skill levels. As a result, firms may adjust their contracts to screen workers with different degrees of disability in equilibrium. Lastly, the government in the economy implements policies, but it is not able to perfectly verify the disability status of the worker. Thus, the policies, when implemented, are only imperfectly risk-adjusted.

Following Guerrieri et al. (2010), we introduce a labor market search friction, which leads to the following two desirable features. First, employment rates are determined endogenously in equilibrium, which differs from standard frictionless screening models with full employment among all workers. This feature is necessary because the policy instruments explicitly depend on employment statuses and they directly influence the decisions of both workers and firms. Second, we can guarantee the existence and the uniqueness of equilibrium, which may not be guaranteed in frictionless screening models. Within this framework, we explicitly introduce the key features of disability insurance and employment subsidies: the former affects the worker's value of non-employment and the latter affects the firms' profits and workers' value from work.

This framework provides several new insights into understanding disability policy designs in an equilibrium context. First, both DI and employment subsidies can be important policies to achieve redistribution (or insurance) between people with different disability (or disability risks) and employment statuses. While DI provides income insurance for individuals who cannot work, employment subsidies for disabled workers can smooth the value of employment across workers with different disability statuses. Second, it naturally links the degree of inefficiency in job amenities, arising due to screening incentives, with the labor force participation decisions of disabled workers. Firms in the model offer an inefficiently small amount of job amenities to non-disabled workers, to discourage disabled workers from applying to the job (screen disabled workers). However, such an incentive depends on whether those disabled workers prefer working to staying out of the labor force. If the disabled people do not participate in the labor market, firms no longer need to screen disabled workers, reducing contract inefficiencies of non-disabled workers. This dependence of screening incentives on labor force participation margin creates room for the government to jointly choose DI and various firm subsidies to improve efficiency in the labor market allocation. Third, by introducing additional skill heterogeneity among workers, the model characterizes rich predictions in screening distortions: the degree of contract distortion may substantially differ by workers with different observed skill types.

Next, we empirically implement our model to study the importance of labor market screening for evaluating the policy effects and optimally designing them. To do so, we first need to examine which job amenity is used for screening disabled workers.[3] The Health and Retirement Study (HRS) data provides information on various job amenities that are applicable to all workers. To show that an amenity is used as a screening tool, one must show that (i) workers with different disability statuses have heterogeneous preferences on the job amenity and (ii) firms' choice of job amenity is responsive to the differential profitability from recruiting workers with different disability statuses. After categorizing workers into severely disabled, moderately disabled, and non-disabled workers,[4] we observe that workers who are less healthy tend to select into jobs with the option to reduce hours, which is consistent with the heterogeneous worker preferences.[5] Then, we show empirical evidence that firms might be screening these workers using that job amenity (option to reduce hours). This result is established by exploiting the Amendment of the WOTC in 2004[6] and the

[3]Since the passage of the ADA, which mandates the provision of reasonable accommodations, it has become difficult for firms to explicitly discriminate against workers by choosing different levels of accommodations (e.g., not providing physical equipment to support the disabled). However, firms are exempt from providing accommodations if it creates an undue hardship to firms or if workers cannot perform the essential function of a job. These amenities include the option to reduce work hours or sick leaves.

[4]We construct three disability status categories based on the binary work limitation information and self-reported health status (five categories from excellent to poor).

[5]In a related context, Ameriks et al. (2017) also show empirically that work incentives of older workers depend on whether the job offers flexible working hours.

[6]The WOTC provides subsidies to firms employing workers in a targeted group. In 2004, the eligibility

ADA Amendments Act of 2008[7] as policy variations affecting firms' profitability from hiring workers with different disability statuses.

With the empirical analysis, we are able to map the job amenity variable in the model to the fraction of workers with the option to reduce hours in the data. The next identification challenge in estimation is in that the degree of labor market screening is endogenously determined in equilibrium, affected by both the labor supply (resource cost of providing the amenity benefit) and labor demand side (worker's utility from job amenities) parameters. To separately identify these parameters, we exploit the effects of the WOTC Amendment, which mainly affected the labor demand side parameters. We then estimate our model through an indirect inference procedure. Based on our estimates, the inefficiencies in job amenities due to firms' screening can be sizable: for example, we find that the fraction of moderately disabled and non-disabled workers with the option to reduce work hours can be 3% and 22% lower, respectively, relative to under the economy without screening.

With the estimated model, we conduct counterfactual analyses using the combination of two policy instruments—generosity of disability insurance and firm subsidies towards costs of job amenities—to evaluate their equilibrium and welfare impacts.[8] We first show that introducing an amenity subsidy increases the provision of amenities, attracting more individuals to work. This effect is most pronounced for severely disabled workers, who have higher preferences for job amenities.[9] However, in the presence of generous DI, an amenity subsidy may not be sufficient to encourage work. Second, which is novel in our framework, these policies impact the distortions generated by firms' screening incentives. While both policies affect the equilibrium contract distortions, their mechanisms are distinct from each other. With a high amenity subsidy, severely disabled workers find their labor market attractive, lowering the incentive to enter healthier workers' labor markets. On the other hand, if DI is generous, severely disabled workers find the outside option attractive, and their dropping out of the labor force lowers the firms' need for screening. These results highlight important interdependence of each policy instrument due to the labor market equilibrium adjustment.

We then examine the optimal combination of generosity of disability insurance and firm subsidies towards costs of job amenities that maximizes the utilitarian social welfare subject

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of qualified disability groups substantially expanded. The detail is discussed in Section 4.1.2.

[7]ADA was amended in 2008 to substantially increase eligible disabled workers who are subject to the ADA requirements. The detail is discussed in Section 4.1.2.

[8]Under all counterfactual policy reforms, we ensure budget-neutrality (to the benchmark economy) using a proportional wage tax.

[9]This is further intensified by the government's imperfect verifiability of a worker's disability status: firms hiring a severely disabled worker are more likely to receive the subsidies than those hiring a moderately disabled or a non-disabled worker.

to the government's budget balance condition. We find that introducing a job amenity subsidy is effective in increasing welfare in the aggregate, and for workers of all health statuses, whereas a generous DI benefits disabled workers at the expense of non-disabled workers. Further, the optimal generosity of DI is higher when the government provides amenity subsidies, as the labor supply disincentive effects of DI can be mitigated by the use of amenity subsidies. Lastly, in order to isolate the effects of screening on optimal policies, we conduct counterfactual analysis in the absence of firms' screening incentives (by assuming that firms can write health-dependent contracts). Because both DI and amenity subsidies are able to ameliorate contract distortions in the screening economy, we find that the optimal DI benefit may be higher in the screening economy than in the no-screening economy. We thus emphasize the importance of incorporating the firms' screening incentives into optimal policy design analyses.

Related Literature. First of all, this paper contributes to the literature in disability insurance and labor market policies targeted at disabled workers. There has been extensive literature that focuses on measuring the labor supply effects of disability insurance, early contributions of which are summarized in Bound and Burkhauser (1999). Although this literature has made substantial progress by utilizing rich worker-side data with cutting-edge empirical techniques (including French and Song, 2014), there are still a limited amount of studies investigating the labor demand side responses and equilibrium labor market implications. Acemoglu and Angrist (2001) examine the impact of ADA on employment rate by focusing on the labor demand channel. More recently, Michaud and Wiczer (2018) argue that more generous DI can improve the labor market allocations by inducing workers to work at risky occupations. To the best of our knowledge, this paper is the first paper providing a formal analysis of joint designs of disability policies in an equilibrium labor market context. We substantially expand the scope of analysis by incorporating intensive and extensive labor supply margins; by explicitly characterizing firms' decisions to create job positions using a richer employment contract space; and by incorporating firms' screening incentives motivated by labor market regulations. Within this framework, we show that accounting for labor demand side responses to screening incentives is crucial to determine the optimal structure of policies for the disabled.

More broadly, our paper contributes to the literature analyzing screening problems in the labor market. A pioneering work in this literature is Akerlof (1976), who shows that there are distortions in employment contracts if firms cannot offer contracts contingent on worker types. More recently, Guerrieri et al. (2010) develop a general screening framework with search frictions. Theoretically, our framework extends theirs by endogenizing the labor force participation (extensive job search margin) of workers and allowing the value of being non-employed (the outside option of workers) to be heterogeneous. With this structure, the model is able to capture how firms' screening incentives are affected by workers' labor supply decisions. More importantly, our contribution is mainly empirical, whereas this literature has been largely theoretical. Specifically, we apply the labor market screening framework to the context of disability, empirically estimate the model, and consider the optimal policy design in this context.[10]

Finally, our paper is related to the public finance literature investigating the optimal disability insurance (e.g., Diamond and Sheshinski, 1995; and Golosov and Tsyvinski, 2006). The main departure of our paper from these papers is that we consider labor demand side incentives. Conceptually, our exercise is most closely related to Stantcheva (2014), who theoretically studies the optimal income taxation in an Akerlof (1976) labor market screening model. One of the important insights from the paper is that the optimal structure cannot be summarized by reduced-form sufficient statistics, mainly because it depends on the endogenous responses of the market equilibrium. Thus, in order to quantitatively characterize the optimal policy design, specifying and credibly recovering the full structure of the model is a crucial step, which we implement in this paper. Our choice of policy instruments, i.e., subsidies that are dependent on employment status, is also related to Golosov et al. (2013), which studies the optimal social insurance design in a frictional labor market model; this paper is distinct from theirs in the sources of information friction.

In the next section, we present a search-frictional labor market model with screening. Then, we discuss the data that we use in Section 3. Our procedures detailing the empirical implementation of the model to be mapped to the U.S. economy are contained in Section 4, which first discusses how we map the amenity variable in the model to the data and how we identify and estimate the full model. We use the estimated model to conduct quantitative policy analysis in Section 5, where we first analyze the equilibrium impacts of the policies, then discuss implications for designing optimal policies. We conclude in Section 6.

[10] Davoodalhosseini (2015) theoretically studies the efficiency property of the directed search equilibrium with adverse selection and the optimal sales tax in the framework. Recently, Lester et al. (2017) propose a tractable framework that incorporates the screening problem into a random search model. Relative to theirs, one advantage of the current framework is that it endogenizes the employment rate and allows its dependence on firms' labor demand. This feature will be crucial in our application where we evaluate the impact of disability policies on equilibrium employment rate.

2 An Equilibrium Labor Market Model with Screening

This section develops an equilibrium labor market model. Our model is an extension of Guerrieri et al. (2010), which studies a search-frictional equilibrium model with asymmetric information.

2.1 Model Environment

Workers. Labor market is populated by a continuum of workers and firms. There is a measure one of workers who value consumption and leisure. Workers are heterogeneous in their health statuses, which we denote by $h \in \mathcal{H} \equiv \{1, 2, \cdots, H\}$ and their *observed* skill types $x \in \mathcal{X}$. The share of each type $i \equiv (h, x) \in \mathcal{I}$ is denoted by $\pi_i > 0$, with $\sum_i \pi_i = 1$. Given the menu of employment contracts offered, workers decide whether to look for a job (extensive margin) and which job to apply for (intensive margin).

Each employed worker produces $f_{h,x}$, and we assume that healthier individuals produce (weakly) more than less healthy individuals so that $f_{h+1,x} \geq f_{h,x}$. In the model, $f_{h,x}$ represents the *net* productivity of a worker. Thus, the heterogeneity in $f_{h,x}$ in terms of h might be either due to productivity differences driven by health status, or due to the expected accommodation costs which vary with h mandated under the ADA.

The workers' preferences are represented by the utility function

$$\begin{aligned} U_{h,x}(c, a) &= u(c) - \tilde{\varphi}(h, a)\,\mathbb{I}(\text{employed}) \\ &= u(c) - (\eta_h - \beta_h \varphi(a))\,\mathbb{I}(\text{employed}), \end{aligned}$$

where c denotes consumption and $\eta_h - \beta_h \varphi(a)$ captures the disutility from work with a, the amount of job amenities provided by the firm.[11] The worker derives utility from consumption through $u(c)$, which is strictly increasing ($u' > 0$) and concave ($u'' \leq 0$). The disutility from work consists of type-dependent fixed utility cost η_h, and utility from job amenities $\beta_h \varphi(a)$. The job amenities increase utility from work (or lowers disutility from work) through function $\varphi(a)$, which is strictly increasing ($\varphi' > 0$), strictly concave ($\varphi'' < 0$), and satisfies $\lim_{a \to 0} \varphi'(a) = \infty$ and $\lim_{a \to \infty} \varphi'(a) = 0$. Furthermore, the type-specific preference is represented by β_h, where we assume $\beta_h > \beta_{h+1}$, so that unhealthy (low type) workers value a more than their healthier (high type) counterparts.[12] Workers pay taxes on wages, so that

[11] In our theoretical model, we consider job amenity a as a continuous variable with support $\mathbb{R}_+$. In our empirical specification, we consider it as the probability that firms offer a job amenity, so that it is restricted over the interval $[0, 1]$.

[12] We only model health-specific preference heterogeneity. We could add heterogeneity in preferences driven by other characteristics. However, if this multi-dimensional heterogeneity leads to violation of as-

$c = w - \tau(w)$, where $\tau(w)$ represents a tax (or subsidy) function. If an individual does not work, his consumption consists of home production b and disability insurance amount d from the government, which is awarded *probabilistically* (we discuss this further below). We denote the utility from not working as $U^N_{h,x}(b,d)$.

Firms. There is a continuum of ex-ante homogeneous, risk-neutral firms that have a production technology translating a type-(h,x) worker into output $f_{h,x}$. To hire a worker, a firm posts a contract by paying κ. A contract consists of wage w and job amenity a. Firms can observe worker's skill x and are allowed to post contracts based on it. However, the contract cannot be contingent on a worker's health type h, either due to information friction (h is unobservable), or as they are prohibited from doing so under the ADA regulation.[13] When a worker type $i = (h,x)$ is hired, the firm's payoff is $v_i(w,a) = f_i - w - C(a)$, where $C(a)$ denotes the (net) cost of providing job amenities. The cost function is assumed to be strictly increasing ($C' > 0$) and convex ($C'' \geq 0$).[14]

Labor Market Environment. Labor market is subject to search frictions, and firms and workers direct their search. The match is bilateral, i.e., one firm and one worker form a match and produce. The labor market is indexed by a contract $y_x \equiv (w,a) \in Y_x$, where the set of feasible contract space Y_x is compact and nonempty. Note that these submarkets are indexed by skill x, due to our assumption that firms can directly offer the observed skill-dependent contracts.

The market tightness, the ratio of firms' vacancy to unemployed workers associated with a contract y_x, is denoted by $\theta(y_x) \equiv v/u$. A worker who applies to a submarket indexed by a contract y_x finds a job with probability $\mu(\theta(y_x))$ *regardless of* his health type, and the job-

sumption 1 (introduced later), then it will create a number of complications in equilibrium analysis (see Azevedo and Gottlieb (2017) and Chang (2017) for their theoretical analyses). In our empirical analysis, we address the potential bias from this modeling assumption.

[13]Note that in practice firms can, without violating the ADA, offer lower wages if individuals take leaves of absence due to the disability. In our current framework, these effects are essentially captured by job amenities (a) in a reduced form way, i.e., workers are allowed to receive exemptions from work with reduced wages. Alternatively, one can formulate firm's contract space as offering a combination of wages (w_N,w_S) where w_N is the salary if the individual works without any absences and w_S is the one if (s)she experiences absence from work. We can consider that firms may offer low w_S to screen disabled workers. We think that the economic intuition is the same as offering lower a (job amenity).

[14]It is plausible to consider that there are ex-ante heterogeneity among firms in terms of the efficiency in providing job amenities. In such case, one can characterize the heterogeneity of screening incentives across firms. For example, firms which are more efficient in providing job amenities (i.e., facing lower cost of providing job amenities) may create jobs and attract any type of workers. As such, they would still screen disabled workers. However, firms which are less efficient in providing job amenities (i.e., facing higher cost of providing job amenities) may create jobs which are only filled by non-disabled workers. Although these rich predictions will be useful, our main qualitative findings will remain as long as certain firms still have incentives to engage in screening. We leave this extension as an interesting future work.

finding rate $\mu : [0, \infty] \rightarrow [0, 1]$ is a strictly increasing and concave function of θ ($\mu^{'}(\theta) > 0$ and $\mu^{''}(\theta) \leq 0$). Similarly, a firm posting a vacancy characterized by a contract y_x finds its employee with probability $\eta(\theta(y_x))$, where the worker-finding probability $\eta : [0, \infty] \rightarrow [0, 1]$ is a decreasing function of θ. Assuming a constant-returns-to-scale matching function, we have $\theta\eta(\theta) = \mu(\theta)$.

Let the share of type-h worker applying to a contract y_x-submarket be $g_h(y_x)$, with $g_h(y_x) \geq 0$ and $\sum_h g_h(y_x) = \sum_h \pi_{h,x}$. Then, conditional on a match, the probability of hiring a type-h worker is $g_h(y_x)$. The payoff of firms not posting a vacancy is normalized to zero. We denote $\bar{Y}_{h,x}$ as the set of contracts that can generate non-negative profits in most favorable market tightness toward firms (i.e. $\theta = 0$) subject to type-(h, x) worker's participation.

$$\bar{Y}_{h,x} \quad = \quad \left\{ y_x \in Y_x | \, \eta(0) \, v_{h,x}(y_x) \geq \kappa \quad \text{and} \quad U_{h,x}(y_x) \geq U_{h,x}^{N}(b, d) \right\}.$$

where $\bar{Y}_x \equiv \cup_{h \in \mathbb{H}} \bar{Y}_{h,x}$. Contracts that are not included in this set cannot be an equilibrium. The second inequality ensures that the worker's utility from participating in the labor market with a contract y is greater than his outside option of $U_{h,x}^{N}(b, d)$.

Assumption 1. *(Monotonicity) For all* $y_x \in \bar{Y}_x$, $v_{1,x}(y_x) \leq v_{2,x}(y_x) \leq \cdots \leq v_{H,x}(y_x)$.

For a given x, if we assume away from the productivity difference across health types, then the firm is indifferent in terms of payoff and $v_{h,x}(y_x) = v_{h',x}(y_x)$ for $\forall h \neq h'$. If the productivity (weakly) increases with health-type index, then the monotonicity assumption also holds with (weak) inequality.

Government Policies. Government can set the following three sets of policy instruments: (a) disability insurance; (b) subsidies to firms; and (c) wage tax (subsidy). We assume that the government imperfectly verifies the true type of workers (similar to Low and Pistaferri (2015)) when providing disability insurance benefits and firm subsidies. The probability of identifying health type h as disabled is denoted by ψ_h and we assume $\psi_h \geq \psi_{h+1}$, i.e., the lower one's type is, the more likely it is for the government to verify that (s)he is disabled. Although it is interesting to endogenize the government screening ability ψ_h, we assume that it is an exogenous technological constraint faced by the government. Thus, for a given disability benefit level d, a type-(h,x) individual's expected utility from not working is $U_{h,x}^{N}(b, d) = \psi_h u(b + d) + (1 - \psi_h) u(b)$. Similarly, firms hiring a worker with health status h receive subsidy with probability ψ_h. As a result, the expected subsidy given to a firm hiring a worker with health status h is $T_h(w, a) = \psi_h T(w, a)$, which we flexibly denote as a function of both wage and job amenity. Lastly, we denote the wage tax (subsidy) by $\tau(w)$.

2.2 Competitive Search Equilibrium (Given Policy Parameters)

Given the disability insurance program, firm subsidies, and wage tax, a competitive search equilibrium should satisfy that firms post profit-maximizing contracts and earn zero profit; that conditional on the contracts posted and search behaviors of others, each type-i worker maximizes the expected utility by searching for a job in the optimal submarket; and that market clears. Along with these three conditions, we also need to specify reasonable beliefs about the market tightness off the active submarkets (Y^p) in equilibrium. We formally define the equilibrium of the economy below following Guerrieri et al. (2010).

Definition 1. A Competitive Search Equilibrium is a vector $\bar{U} = \{U_{h,x}\} \in \mathbb{R}$, a measure λ on Y_x with support Y_x^p, a function $\Theta : Y_x \to [0, \infty]$, and a function $G : Y_x \to \Delta^H$ that satisfy the following conditions for all x:

1. Firms' Profit Maximization and Free Entry: For any $y_x \in Y_x$,

$$\eta\left(\Theta\left(y_x\right)\right) \sum_h g_h\left(y_x\right) v_{h,x}\left(y_x\right) \quad \leq \quad \kappa,$$

   with equality if $y_x \in Y_x^p$.

2. Workers' Optimal Job Search: Let

$$\bar{U}_{h,x} \quad = \quad \max\left\{U_{h,x}^N\left(b,d\right), \max_{(w,a)\in Y_x^p}\left\{\mu\left(\Theta\left(y_x\right)\right) U_{h,x}^E\left(w,a\right) + \left(1-\mu\left(\Theta\left(y_x\right)\right)\right) U_{h,x}^N\left(b,d\right)\right\}\right\}$$

   where Y_x^p is the set of active submarkets for type-x workers, $U_{h,x}^E(w,a)$ is the utility from working at job with (w,a), given by

$$U_{h,x}^E\left(w,a\right) = u\left(w-\tau\left(w\right)\right) - \left(\eta_h - \beta_h \varphi\left(a\right)\right),$$

   and $U_{h,x}^N(b,d)$ is the utility from not working, given by

$$U_{h,x}^N\left(b,d\right) = \psi_h u\left(b+d\right) + \left(1-\psi_h\right) u\left(b\right).$$

   If $Y_x^p = \emptyset$, $\bar{U}_{h,x} = U_{h,x}^N(b,d)$. For any contract $y_x' = (w', a') \in Y_x$ and (h,x),

$$\bar{U}_{h,x} \quad \geq \quad \max\left\{U_{h,x}^N\left(b,d\right), \mu\left(\Theta\left(y_x'\right)\right) U_{h,x}^E\left(w',a'\right) + \left(1-\mu\left(\Theta\left(y_x'\right)\right)\right) U_{h,x}^N\left(b,d\right)\right\},$$

   with equality if $\Theta(y_x) < \infty$ and $g_h(y_x) > 0$. If $U_{h,x}^E(w,a) < U_{h,x}^N(b,d)$, either $\Theta(y_x) = \infty$ or $g_h(y_x) = 0$.

3. Market Clearing: For $\forall(h,x)\in\mathcal{I}$,

$$\int_{Y_x^p}\frac{g_h\left(y_x\right)}{\Theta\left(y_x\right)}d\lambda\left(\{y_x\}\right)\quad\leq\quad\pi_{h,x}$$

with equality if $\bar{U}_{h,x}>U^N_{h,x}\left(b,d\right)$.

Note that the market tightness function Θ is defined over the set of feasible contract space for each type x, Y_x, unlike the distribution of active contracts λ over Y_x^p. This distinction comes from the fact that our equilibrium concept requires the workers to have reasonable beliefs about their payoffs from potential deviations from the equilibrium outcome. We show the existence and the uniqueness of screening equilibrium, which is a fully separating equilibrium, following Guerrieri et al. (2010).

2.3 Characterizing Equilibrium Allocations

In this section, we first describe the contract in the absence of screening, i.e., the equilibrium contract when firms are allowed to post health-dependent contracts (or firms have full information about the type of workers). This contract will serve as a benchmark allocation, allowing us to characterize the sources of inefficiencies and the potential role of government policies in the screening economy. To simplify the notation, we assume in this section that $\tau(w)=0$ and $T(w,a)=0$. These restrictions will be relaxed later in our empirical and policy design analyses.

Equilibrium without Anti-Discrimination Laws. Given the set of policy parameters, the no-screening equilibrium contract ("NS") solves

$$\max\quad\left\{U^N_{h,x}\left(b,d\right),\max_{w,a,\theta}\left\{\mu\left(\theta\right)U^E_{h,x}\left(w,a\right)+\left(1-\mu\left(\theta\right)\right)U^N_{h,x}\left(b,d\right)\right\}\right\}$$

$$\begin{aligned}\text{s.t.}\quad(\text{FE})\quad&\mu\left(\theta\right)\left\{f_{h,x}-w-C\left(a\right)\right\}=\theta\kappa\\&\theta\in[0,\infty]\,,\;w\in[0,f_{h,x}]\,,\;a\in\left[0,C^{-1}\left(f_{h,x}\right)\right],\end{aligned}$$

for each type. That is, the equilibrium contract of type-(h,x) maximizes the worker's utility subject to a free entry condition (FE), independent from other types. By the first order condition (FOC) with respect to a, we get the equilibrium amenity level for type $i=(h,x)$ determined by

$$\beta_h\varphi'\left(a_i^{NS}\right)\quad=\quad u'\left(\Delta\left(a_i^{NS},\theta_i^{NS}\right)\right)C'\left(a_i^{NS}\right),\tag{1}$$

where $\Delta\left(a_i^{NS},\theta\right) \equiv f_i - C\left(a_i^{NS}\right) - \theta\kappa/\mu(\theta)$. From the FOC with respect to θ, we obtain the equilibrium market tightness of a type-i worker:

$$\begin{aligned} & \mu'\left(\theta_i^{NS}\right)\left[u\left(\Delta(a_i^{NS},\theta_i^{NS})\right) - \left(\eta_i - \beta_i\varphi\left(a_i^{NS}\right)\right) - U_i^N(b,d)\right] \\ = \; & \mu\left(\theta_i^{NS}\right)u'\left(\Delta(a_i^{NS},\theta_i^{NS})\right)\left.\frac{d\left(\theta\kappa/\mu(\theta)\right)}{d\theta_i}\right|_{\theta=\theta_i^{NS}}. \end{aligned}$$

It is difficult to establish theoretical properties of the no-screening outcomes under general class of preferences. However, under risk-neutral individuals, one can establish monotonic relationships in equilibrium outcomes across health statuses. By assumption on the preference parameter β_h and concavity of φ, we have $a_{h+1,x}^{NS} < a_{h,x}^{NS}$: since the marginal benefit of job amenities is higher for the low types, they receive more of them. By strict concavity of $\mu(\cdot)$, and as long as the net productivity $(f_{h,x} - C\left(a_{h,x}^{NS}\right))$ of high types are higher, the equilibrium market tightness is increasing in type h, i.e., $\theta_{h+1,x}^{NS} > \theta_{h,x}^{NS}$. Moreover, wages are higher for high types, i.e., $w_{h+1,x}^{NS} > w_{h,x}^{NS}$, which is driven by higher productivity and lower job amenity costs of healthier workers.

Screening Contract. Suppose firms are prohibited from posting health-dependent contracts (or that they do not observe the health status of workers). Then, firms offer screening contracts ("S") to ensure that unhealthy worker do not mimic healthy workers. Similar to the results in Guerrieri et al. (2010), the lowest type participating in the labor market receives the no-screening contract. Let us denote his utility from entering his own submarket with contract $\left(w_{1,x}^{NS}, a_{1,x}^{NS}\right)$ as $\bar{U}_{1,x}$, which is expressed as

$$\bar{U}_{1,x} \equiv U_{1,x}^N(b,d) + \mu\left(\theta_{1,x}^{NS}\right)\left\{u\left(w_{1,x}^{NS}\right) - \left(\eta_1 - \beta_1\varphi\left(a_{1,x}^{NS}\right)\right) - U_{1,x}^N(b,d)\right\}.$$

We can then solve for the equilibrium contracts sequentially by solving the following problem for each health type $h \geq 2$ (given skill level x):

$$\max_{\theta,w,a} \quad \left\{\mu(\theta)\,U_{h,x}^E(w,a) + (1-\mu(\theta))\,U_{h,x}^N(b,d)\right\} \tag{2}$$

$$\begin{aligned} \text{s.t.} \quad & \text{(FE)} \quad \mu(\theta)\left\{f_{h,x} - w - C(a)\right\} = \theta\kappa \\ & \text{(IC)} \quad \mu(\theta)\,U_{h-1,x}^E(w,a) + (1-\mu(\theta))\,U_{h-1,x}^N(b,d) \leq \bar{U}_{h-1,x} \\ & \qquad\quad \theta \in [0,\infty],\; w \in [0, f_{h,x}],\; a \in \left[0, C^{-1}(f_{h,x})\right] \end{aligned}$$

In this case, we need to take into account the incentive compatibility (IC) constraint. It states that the utility of a type-$(h-1,x)$ worker from entering the submarket for type-(h,x) should be less than or equal to the utility he receives from entering his own submarket, $\bar{U}_{h-1,x}$. For types $h>2$, $\bar{U}_{h-1,x}$ is the utility from solving problem 2, and thus we can solve the equilibrium sequentially.

One can establish various theoretical properties under the environment with risk-neutral workers. Using the optimality conditions, we can show that if (IC) binds for type-(h,x), his non-wage benefits in the screening contract are inefficiently low, i.e., $a^{S}_{h,x}<a^{NS}_{h,x}$. This is a standard result in adverse selection models (even without search frictions), and it is designed to keep the less healthy from entering the healthy workers' submarkets. Another useful feature of a search-frictional labor market is the equilibrium determination of the market tightness, and thus the employment rates. We can further show that $\theta^{S}_{h,x}>\theta^{NS}_{h,x}$, if $\beta_h\varphi(a)-U^{N}_{h,x}(b,d)<0$ holds.[15]

Lastly, we emphasize that if the contract that satisfies the zero-profit condition for firms is less attractive than the outside option (or outside option value is relatively high), some types prefer to stay out of the labor force completely. This occurs if the value of staying out of the labor force, $U^{N}_{h,x}(b,d)$, is higher than $\mu(\theta)\{u(w)-(\eta_h-\beta_h\varphi(a))\}+(1-\mu(\theta))U^{N}_{h,x}(b,d)$, or equivalently, $u(w)-(\eta_h-\beta_h\varphi(a))<U^{N}_{h,x}(b,d)$ (this was part of the workers' optimal job search condition in the definition of competitive search equilibrium states in the previous section). In this case, the worker type that receives the no-screening contract may not be the lowest type in the health status space.

Discussion on the Effects of Policies. Before setting up the government's problem, we discuss the effects of the policies on labor market equilibrium with screening. For now, assume that the government can perfectly detect whether a worker is disabled or not, i.e., $\psi_{disabled}=1$ and $\psi_{non-disabled}=0$.[16]

First, we consider the effects of an increase in d, the generosity of disability insurance, which is paid to non-working disabled workers. The direct effect of the policy is that it increases the outside option of disabled workers. Thus, disabled workers now prefer to stay out of the labor force, the well-known labor supply disincentive effects of DI. In this screening model, however, the low participation rate of disabled workers also affect non-disabled workers in the labor market. When the outside option increases, the disabled now

[15] With linear utility, $\beta_h\varphi(a)-U^{N}_{h,x}(b,d)<0$ implies that the worker prefers the outside option if his wage in the market is 0.

[16] Under perfect verification, the government can undo all distortions in the labor market driven by screening by providing health-dependent lump-sum transfers. While we rule this out in our model and quantitative policy evaluations, for clarify, we discuss the role of policies with this assumption. Qualitative properties of policy impacts hold under imperfect risk-adjustment, $0<\psi_h\leq\psi_{h+1}<1$.

has less incentives to mimic the non-disabled. This indirect effect relaxes the incentive compatibility constraint, therefore mitigating the distortions in the non-disabled workers' non-wage benefits (and other equilibrium outcomes). Another interpretation is that firms' incentives to screen workers are now lower. At the extreme, it is possible that DI payments are so generous that there does not exist a contract satisfying both the firms' zero-profit condition and the disabled workers' participation condition. In this case, all disabled workers leave the labor force, with only the non-disabled workers remaining in the market. Then, the non-disabled workers' contracts may be equivalent to their contracts in the absence of screening, removing distortionary effects of screening. It is worth noting however, that despite the non-participation of disabled workers, contracts still could be distorted relative to the no-screening economy, to deter disabled workers from entering the labor market. The generous DI also serves as a means to redistribute income between the employed and non-employed disabled workers (or insure against employment risks).

Second, we consider policies that impact workers who participate in the labor market. Specifically, we study the role of firm subsidies $T(w, a)$, which can potentially be flexible enough to depend on both terms of the employment contract (wage and job amenity). These firm subsidies may result in higher wages, job amenities, or employment rates of disabled workers, relative to the no-screening economy. Similar to DI, it also affects the extent of screening in the labor market, but through a different mechanism. With the subsidies, disabled workers' incentives to mimic healthier workers decrease, because they enjoy better terms of trade in their own submarket, not because they have higher outside option as is the case with generous DI benefit. It is worth noting that both wage-dependent or amenity-dependent subsidies increase the value of employment for disabled workers. Importantly, however, the efficacy of policies and the effects on welfare can be different, depending on the relative magnitudes in the marginal utility gain from wages and job amenities. Further, the employment subsidies provide redistribution between the values of employment across workers of different health statuses (or insure against disability risks in the labor market).[17]

These discussions highlight that the optimal policy design requires the joint analysis of these policy instruments. The next section first formally defines the government problem, and in the following sections, we answer the question quantitatively.

[17] The wage tax $\tau(w)$ further serves as a potential source of redistribution across workers of different health statuses and across employment statuses, but our analysis focuses on the role of (risk-adjusted) DI and firm subsidies. We use wage tax as a tool to conduct budget-neutral policy reform in the quantitative counterfactual analyses.

2.4 Optimal Policy Design in the Screening Economy

Let government policies be denoted by $\boldsymbol{p} \equiv \{d, T(w,a), \tau(w)\}$. Given welfare weights by type ω_i and the government's type-verification technology ψ_i for $i = (h,x)$, the government maximizes social welfare subject to the budget constraint:

$$\max_{d,T,\tau} \sum_{i \in I} \omega_i \left[\mu\left(\theta_i^*\left(\boldsymbol{p}\right)\right) U_i^E\left(w_i^*\left(\boldsymbol{p}\right), a_i^*\left(\boldsymbol{p}\right)\right) + \left(1 - \mu\left(\theta_i^*\left(\boldsymbol{p}\right)\right)\right) U_i^N\left(b,d\right) \right]$$

$$\text{s.t.} \quad \sum_{i \in I} \pi_i \left[\left(1 - \mu\left(\theta_i^*\left(\boldsymbol{p}\right)\right)\right) \psi_i d + \mu\left(\theta_i^*\left(t_h, d\right)\right) \psi_i T\left(w_i^*\left(\boldsymbol{p}\right), a_i^*\left(\boldsymbol{p}\right)\right) \right] = \sum_{i \in I} \pi_i \mu\left(\theta_i^*\left(\boldsymbol{p}\right)\right) \tau\left(w_i^*\left(\boldsymbol{p}\right)\right) w_i^*\left(\boldsymbol{p}\right),$$

where $\{w_i^*\left(\boldsymbol{p}\right), a_i^*\left(\boldsymbol{p}\right), \mu_i^*\left(\theta_i^*\left(\boldsymbol{p}\right)\right)\}_{i=\mathcal{I}}$ are derived from labor market equilibrium conditions. We assume that the government sets and commits to the policies, after which workers and firms make their decisions.[18]

In the full information benchmark with linear utilities and restricted policies, we can prove that $\tau^* = 0$, so that $T^*(w,a) = 0$ and $d^* = 0$.

Proposition 2. *The optimal tax rate is zero under full information (in a no-screening economy), if utility is linear.*

Proof. See Appendix A.2. □

This result is not surprising: given the linear utility function of workers, the decentralized equilibrium outcome is the efficient allocation and there is no welfare gain from either redistribution or insurance through disability benefits or subsidy to firms.

With the presence of screening in the labor market (and risk-averse workers), there is some room for policy interventions. To think about this issue, it is useful to start from the standard adverse selection model (Akerlof, 1976; Rothschild and Stiglitz, 1976) that characterizes inefficiencies in equilibrium contracts. One approach to correct this distortion is to provide risk-adjusted subsidies to firms (Glazer and McGuire, 2000). Importantly, in our setup, these subsidies can also impact the employment rates by affecting the equilibrium labor market tightness. This is important because not every worker is employed in our context

[18] Although the government commits to the policy ex-ante, it can possibly learn the worker's health status ex-post, because employment contracts are perfectly separated by health types. Given the model is static, we do not consider such case. However, as long as the worker types change over time, and only static contracts are allowed (no long-term contracts), similar economic problem arises even in the dynamic model. The dynamic extension of the framework is left as a future research.

(which is in contrast to the environment in Glazer and McGuire, 2000). Thus, we consider both the labor market (e.g., firm subsidies) and social insurance policies (e.g., disability insurance) jointly to evaluate their equilibrium and welfare impacts. Understanding and evaluating these joint mechanisms are the goal of our counterfactual policy analyses to be conducted in the following.

3 Data

Our primary data source is the Health and Retirement Study (HRS). The HRS is a biennial panel survey developed in 1992 as an effort to understand the economic implications of aging. The survey consists of more than 20,000 individuals representing the U.S. population over the age of 50. In our empirical analysis, we focus on individuals aged between 51 and 65 as labor supply decisions after the full-retirement age can be affected by social insurance programs such as Medicare and Social Security. For those who work, observations are limited to paid workers in private sectors. We also restrict the sample years from 1996 to 2008 so that our results are less confounded by the effects from the Great Recession. The overall sample size (individual-year combination) is 46,331. More details on our sample selection criteria can be found in Appendix B.1.

3.1 Health Measures

We categorize the degree of disability based on two variables: the work limitation and the self-reported health evaluation. Interviewers ask respondents, "*Do you have any impairment of health problem that limits the kind or amount of paid work you can do?*," which we denote as the work limitation. While this binary variable is commonly used in the literature as a measure of disability, we still observe vast variation in health statuses among respondents within the same work limitation category. This observation leads us to define a finer measure of disability by combining the work limitation with the health evaluation, which records self-reported health status in scale from 1 (excellent) to 5 (poor).[19]

We consider an individual to be *non-disabled* if he does not have a work limitation and reports to have either good, very good, or excellent health status. On the other hand, an individual is defined to be *severely disabled* if he has a work limitation and fair or poor health status. We define all others, either who have a work limitation but report to be healthy (good,

[19]One may concern that our disability measure is based on subjective measures, which rely on respondents' self-evaluation. Using objective health variables available in the HRS, we evaluate their relationship with our disability measure and confirm that the severity of objective health is positively related with the degree of disability. Results are reported in Appendix B.2.

very good or excellent), or who does not have a work limitation but report to be relatively unhealthy (fair or poor) to be *moderately disabled*. According to our categorization, 16% of workers are severely disabled, 20% are moderately disabled, and the rest (64%) are non-disabled.

Table 1: The Work Limitation and the Self-reported Health Evaluation

		Work limitation		Total
		No	Yes	
Self-reported health	1 (excellent)	**6,339**	266	6,605
	2 (very good)	**12,884**	1,283	14,167
	3 (good)	**10,630**	3,248	13,878
	4 (fair)	3,707	**4,313**	8,020
	5 (poor)	529	**3,132**	3,661
Total		34,089	12,242	46,331

Note: Table 1 is based on individuals aged between 51 and 65 from 1996 to 2008.

3.2 Job Amenity Variables

Another benefit of using the HRS is that the data provides detailed information on a respondent's labor market outcomes. It not only reports standard measures such as employment status, working hours, and wages, but also non-wage benefits that we refer to as "*job amenities*." This information is particularly important for our analysis because firms might be exploiting these amenities to screen workers with different health statuses. This section documents job amenity variables that are available in the HRS and their summary statistics by disability statuses.

First, the HRS asks employed respondents with a reported work limitation whether they receive any types of accommodations from their employer. These accommodation measures include, but are not limited to, access to special equipment, special transportation, help in learning new skills, and changes in job duties or tasks. Under the Americans with Disabilities Act (ADA), employers are required to provide reasonable accommodations to qualified employees with disabilities, unless doing so would create significant losses to their firms.

This data on accommodation measures may be directly associated with unhealthy workers' disutility from work. However, as we are interested in job amenities firms use to screen workers, it is important to consider a broader set of job amenities that benefit workers of all health statuses. Thus, we confine our definition of job amenities to the kinds of non-wage benefits that are applicable to both the disabled *and* the non-disabled workers.

Table 2: Descriptive Statistics by Health Status

Category	Variable	Health status		
		Non-disabled	Moderately disabled	Severely disabled
Demographics	Age	58.5	59.1	59.0
	Female (%)	54.6	56.4	56.6
	Years of schooling	13.7	12.1	11.4
Labor market	Employment (%)	71.7	45.9	13.9
	Hours per week	40.4	38.8	36.0
	Hourly wage ($2014)	17.7	14.3	13.6
Job amenities	Option to reduce working hours (%)	31.9	32.2	35.8
	Available sick leaves (days)	10.0	16.5	26.5
	Allow to change from full- to part-time (%)	56.8	69.2	65.5

Note: Table 2 reports the mean statistics based on individuals in age between 51 and 65 from 1996 to 2008, weighted by the individual-level survey weight. Observations are limited to paid workers in private sector with full-time position. Hourly wage is written in 2014 U.S. dollar using the CPI. Top 5% of wage observations are truncated.

Table 2 documents descriptive statistics of demographics, labor market outcomes, and job amenities by disability statuses. While the average ages are similar across disability statuses, those with severe disabilities are, on average, less-educated. Their labor market performance, as measured by employment, hours worked, and hourly wage, are worse than their healthier counterparts. Further, certain job amenity variables, such as the number of available sick days, the option to reduce working hours, and possibility to change from full- to part-time positions, exhibit a robust pattern: Those who work despite their disability conditions tend to receive more generous job amenities than healthier workers (the bottom panel of Table 2). This correlation between job amenities and disability statuses does not necessarily indicate that these job amenities are used as screening devices. Instead, we consider these types of non-wage benefits as *possible* candidates of screening devices. In the next section, we explain our empirical strategies for finding the screening device.

4 Empirical Analysis

This section describes our approach to empirically implement the model. In order to estimate the model, we first need to find and measure the job amenity that is used to screen disabled workers. In the first part of this section, we provide an empirical analysis to show that certain job amenities are likely to be used as a screening tool. Then, in the second part of the section, we discuss how to identify and estimate our structural model.

4.1 Firm's Screening Instruments

To examine which job amenities may be used as screening instruments, we exploit the effects of policy variations that differentially affect firms' incentives to hire disabled workers relative to non-disabled workers. If a certain job amenity was indeed used as a screening device, then we expect the policy changes to influence the amount of job amenities received by workers.

4.1.1 Potential Screening Instruments

We specifically consider the option to reduce working hours and paid sick days as potential tools for firms to screen workers with disabilities in the labor markets. As discussed in Section 3, people with adverse health conditions tend to work in jobs with more generous amenities, which may be consistent with the view that disabled individuals prefer these job characteristics more than their healthier counterparts.

Moreover, importantly, these job amenities are not necessarily mandated under the ADA. Although the ADA requires employers to provide "reasonable" accommodations to their employees with disabilities, firms are exempted from this accommodation clause if provision of accommodations would impose undue hardship on their business operation (Equal Employment Opportunity Commission, 1992). The term "undue hardship" is an action that is "*requiring significant difficulty or expense"* determined based on factors including *"the type of operation ... including the composition, structure, and functions of the workforce.*"[20] This definition indicates that the accommodation exemptions are based on factors beyond financial burden.

According to the law, firms are not required to modify regular work schedules or to provide medical leaves if they can prove the nature of their business requires employees to follow regular working hours or to avoid taking extensive sick leaves.[21] Indeed, recent court decisions ruled that *regular and in-person attendance* is an essential function for most jobs, and disabled workers' requests for telecommunication, medical leaves, additional breaks, or flexible starting or ending time for medical reason are rarely considered as reasonable accommodations under the ADA.[22] Thus, firms can potentially exploit this preference heterogeneity

[20] Americans With Disabilities Act of 1990, Pub. L. No. 101-336, § 1, 104 Stat. 331, retrieved from the U.S. House Library (http://library.clerk.house.gov/) on November 2018.

[21] It is true that employees are guaranteed to take up to 12 weeks of unpaid medical leaves under the Family and Medical Leave Act of (FMLA). However, the accommodation clause of the ADA requires a firm to provide (possibly longer than 12 weeks of) leave to an employee without fixed date of return, unless the lack of a fixed return date causes an undue hardship (Equal Employment Opportunity Commission, 2002).

[22] *The Equal Employment Opportunity Commission (EEOC) v. Ford Motor Company*, 2015: An unidentified employee with bowel syndrome requested telecommunication as a reasonable accommodation under the ADA. The Federal Court of Appeals for the Sixth Circuit ruled in favor of Ford because "predictable on-site job attendance" was essential to complete her task as steel buyer.

in job amenities in designing employment contracts to screen disabled workers.

4.1.2 Policy Variations

In order to find and measure the screening tools used by firms, we study the effects of policy reforms that changed firms' relative profits from hiring a disabled worker compared to a non-disabled worker. This section explains the two policy changes used in our empirical analysis: the 2004 amendment of the Work Opportunity Tax Credit and the ADA Amendment Act of 2008.

Work Opportunity Tax Credit and Its 2004 Amendments. The Work Opportunity Tax Credit (WOTC) is a federal tax credit program which was implemented in 1996 in an effort to improve labor market outcomes of economically disadvantaged individuals.[23] Under the WOTC, firms receive tax credits when they hire workers from "target groups" that include individuals with disabilities. Employers can receive tax credit of up to $9,600 per eligible employee with disabilities.

In 2004, an amendment was passed that modified the eligibility of the WOTC's disability-related target group. The main change in the amendment was the expansion of qualifications for vocational rehabilitation referrals. Prior to the amendment, business owners were qualified for the WOTC program when their employees got hired through a *state-run* vocational rehabilitation's job referrals. With the enactment of the Ticket to Work and Work Incentives Improvement Act of 1999 (Ticket Act), the Social Security Administration started allowing non-government entities called employment networks (EN) to provide training and referral services. Thus, the 2004 amendment effectively expanded the disability-eligible target group to include workers hired through ENs beyond traditional state agencies.

We consider the passage of the 2004 Amendment as a plausible exogenous shock affecting the firm's profit from hiring a disabled worker and use this variation to study their impacts on job amenities workers receive.[24]

Williams v. AT&T Mobility Services LLC, 2017: Kristen Williams was working for AT&T call center as Customer Service Representative (CSR) and suffered from depression and anxiety attacks. She requested for medical leaves and flexible work schedules under the ADA. The Sixth Circuit ruled in favor of AT&T and decided that these proposals are not reasonable accommodations under the ADA because her unexpected absence would decrease performance of other CSRs.

[23] According to the government survey between 1997 and 1999, most employers in California and Texas reported changes in their recruitment, hiring, or training practices to secure the WOTC tax credits (U.S. Government Accountability Office, 2001).

[24] Technically, we could also interpret the introduction of the WOTC in 1996 as an exogenous labor demand shock generating differential profitability from recruiting workers with and without disabilities. Unlike the 2004 Amendment, however, there were simultaneous major changes in other welfare programs due to the Personal Responsibility and Work Opportunity Reconciliation Act of 1996. As a consequence, it is hard to disentangle the impact of the WOTC separate from others in this timeframe.

ADA Amendment Act of 2008. In 2008, the ADA Amendments Act (ADAAA) was passed to broaden and clarify the definition of disabilities. The ADA does not specifically name all of the impairments that are covered. Instead, under the ADAAA, a person is considered disabled if (s)he (i) has a physical or mental impairment that substantially limits one or more major life activities, (ii) has a history or record of such an impairment, or (iii) is perceived by others as having such an impairment. For instance, after 2008, individuals with health conditions such as mental illness, cancer, diabetes, and HIV/AIDS became eligible to claim protection under the ADAAA. This policy change can plausibly increase the firm's expected cost of hiring disabled workers, by allowing more disabled workers to be subject to the ADA.

4.1.3 Empirical Specification and Findings

We now describe our strategy to examine which job amenity is used to screen disabled workers. Our hypothesis is that if certain job amenities are used to screen workers, then they would be responsive to changes in a government policy that differentially affects the profit of recruiting workers of different disability statuses. As discussed in Section 4.1.2, we consider the two set of policy variations which plausibly affect the firm's profit.

First, we consider the WOTC Amendment in 2004. Specifically, we examine the following empirical specification:[25]

$$y_{it} = \beta_1 \mathbb{I}_{\{t \geq 2004\}} + \sum_{h \in \{\text{mod, sev}\}} \beta_{2h} \mathbb{I}_h + \sum_{h \in \{\text{mod, sev}\}} \beta_{3h} \mathbb{I}_{\{t \geq 2004\}} \mathbb{I}_h + \boldsymbol{\gamma} \mathbf{X_{it}} + \boldsymbol{\nu} \boldsymbol{Z_t} + \varepsilon_{it}. \quad (3)$$

The dependent variables (y_{it}) include job amenities of individual i in year t. The independent variables are $\mathbf{X_{it}}$, which include individual-level control variables (e.g., gender, education, polynomial in age, firm size, occupation, and industry) and $\boldsymbol{Z}_t$, which include macroeconomic controls (e.g., aggregate employment rates, GDP, and labor productivity).[26] Our parameter of interest is β_{3h}, which is the coefficient on the interaction term between the disability status dummy and the WOTC-amendment (post-WOTC) dummy. This coefficient captures the disability-specific effect of the WOTC-amendment.

The coefficients in this regression are informative in detecting relevant screening devices. First, we consider that the expansion of WOTC in 2004 is mainly available to severely dis-

[25] Our specification does not include the individual-level fixed effect because disability status of an individual is a persistent variable with limited variation in data.

[26] Annual output data are from the Bureau of Economic Analysis (BEA) website. We use real GDP (all industry total) in millions of chained 2005 dollars. Employment data are taken from Current Employment Statistics program surveys of the Bureau of Labor Statistics (BLS). We define the measure of labor productivity as output per worker.

abled workers. We view that this is plausible because the WOTC expansion are available to individuals who are already identified by the government as disabled, i.e, those who had experiences of receiving DI.[27] We now consider the impact of WOTC within the standard screening models (Akerlof, 1976 and Rothschild and Stiglitz, 1976), including ours. If the expansion of WOTC in 2004 is mainly available to severely disabled workers, then we should expect that the job amenities used as screening instruments should increase for moderately disabled workers. The lump-sum transfer firms receive for hiring severely disabled workers increases the relative profitability of hiring severely disabled. Thus, firms have less incentive to screen severely disabled workers; or severely disabled workers have less incentive to enter the market designed for healthier workers. The resulting relaxation of the incentive compatibility constraint for moderately disabled workers' contracts increases their equilibrium provision of job amenities. Moreover, we should expect that the effect of WOTC on job amenities for severely disabled should be small, or even zero, i.e., $\beta_1 + \beta_{3,\text{severe}} \approx 0$, if these job amenities are used as screening tools. In this class of models, the amount of job amenity received by the lowest type (severely disabled workers) are chosen to equalize its marginal benefit (e.g., worker's marginal utility gain from the amenity) and marginal cost (e.g., firm's marginal cost of providing the amenity). Specifically, if workers are *risk-neutral*, the lump-sum transfer (which does not directly change the marginal costs of providing amenities) does not affect the magnitude of equilibrium job amenities for them ($\beta_1 + \beta_{3,\text{severe}} = 0$).[28] It is important to point out that these predictions are unique in screening models: in standard models without screening in which firms can offer health-dependent employment contracts, we expect that $\beta_1 + \beta_{3,\text{mod}} \approx 0$, because the incentive compatibility condition is no longer a determinant of job amenities.[29]

Table 3 summarizes our regression results on job amenities.[30] We find that the lump-sum transfer (tax credits) provided by the government for hiring disabled workers led to an increase in the provision of option to reduce working hours for moderately disabled workers. The effect, however, is statistically insignificant for severely disabled workers. Thus, this

[27]As discussed later in this subsection, we also consider a robustness exercise by addressing the possibility that moderately disabled workers may also receive tax credit through WOTC.

[28]If individuals are risk averse, the marginal benefit from additional job amenity depends on the marginal utility from consumption that may be affected by WOTC. As long as this effect is small, i.e., if individuals are not too risk averse or if consumption increase due to WOTC is small, the prediction still holds.

[29]Note that our regression model takes the form of a standard difference-in-difference specification. However, there is one non-standard aspect: although the WOTC itself is only available to severely disabled, through labor market *equilibrium* effect, any type of workers can be affected. Thus, based on the economic theory behind the regression model, both treatment and control groups can be affected due to the WOTC amendment.

[30]In Appendix C, we show that the parallel trend assumption holds for the option to reduce working hours by introducing year-specific $\beta_{3,h}$ coefficients.

Table 3: Effects of the WOTC-Amendment on Job Amenities

		Option to Reduce Working Hours	Available Paid Sick Days
Post-Amendment		0.000	4.736*
(β_1)		(0.001)	(2.857)
Health Status	Severe	0.187***	5.378
(β_{2h})		(0.054)	(3.433)
	Moderate	0.088***	1.536
		(0.038)	(1.907)
Health Status	Severe	0.017	2.085
× Post-Amendment		(0.051)	(4.621)
(β_{3h})	Moderate	0.051***	-2.765
		(0.021)	(2.464)

Note: The additional covariates used in the regression include age, age-squared, female dummy, self-reported health status dummy, firm-size categories dummy, union dummy, and annual growth rate of GDP. Standard error is clustered at individual-level. *** p<0.01, ** p<0.05, * p<0.1

evidence is consistent with the possibility that the option to reduce work hours is used as a screening device. We, on the other hand, find that the effect of the WOTC expansion on the number of available sick days is not significant, implying that it may not serve as a screening component in employment contracts.

One important caveat of our result is that it may be driven by potential composition bias among workers. It is possible that there is heterogeneity in health status within each disability category of our definition, and marginally disabled individuals in the moderate group start working in jobs with an option to reduce working hours. If this is the driver of the above result, the prediction is consistent with a competitive labor market equilibrium without screening (or adverse selection). However, we find that the result is robust to having additional controls on individual characteristics related to health status (e.g., income and gender), which alleviates this concern, as shown in Table 14 in Appendix C.4. We also directly control for health quality of an individual using additional health-related variables from the HRS and find that our results are robust.

In Appendix C.2, we also describe our main result of the ADA Amendments Act of 2008. Unlike the 2004 amendment of the WOTC program, the expansion of the eligibility for the ADA can adversely affect firms' profit from hiring workers with disabilities, increasing firms' incentives to screen the disabled. In this case, if the labor market is subject to screening, then the job amenities for healthier workers after 2008 would decline in response to the policy change. Consistent with this view, we find that the option to reduce work hour decreases for moderate and non-disabled workers after the policy implementation.

Overall, these findings suggest that screening might be present in the labor market, and that firms might be strategically using the option to reduce hours as a screening tool. Given this suggestive evidence, we use the empirical measure of the option to reduce working hours as the model counterpart of job amenities (a) for the purpose of our estimation.

4.2 Identification and Estimation of the Model

Our empirical analysis and discussion in the previous section implied that the option to reduce hours may be used to screen workers. The remaining key challenge lies in separately identifying the cost of providing the job amenity ($C(a)$) and the utility value of these benefits to workers ($\psi(a)$). To address this, we utilize the policy variation introduced in Section 4.1.2, the 2004 Amendment of WOTC. This directly affects the firm's profit function but not worker's utility, and therefore helps us to separately identify these key parameters. Using the actual data variation in the HRS, we estimate the model through indirect inference procedure.

For the benchmark model, given the current policy parameters (some of which are derived from the literature), we find the equilibrium of the model, which are used as cross-sectional moments. Moreover, we find the equilibrium effects of WOTC, which we model as a lump-sum transfer to firms hiring disabled workers, within the simulated model. The variations in the outcomes of the model before and after WOTC expansion (as presented in Section 4.1) serve as additional targets of the model.[31]

4.2.1 Functional Forms and Parameters

Functional Forms. The production function of a worker with health type h and observed skill type x is represented by $f_{h,x} = f_h \times x$, which assumes complementarity between health and skill type. We assume that there are three health types of workers consistent with our empirical analysis, where $h = 1$ denotes severely disabled workers and $h = 3$ denotes non-disabled workers. We consider that observed skill type x, is drawn from a log-Normal distribution with mean $-\sigma_h^2/2$ and health-dependent variance σ_h^2. We discretize the distribution into N_x grids, implying that there are up to $3 \times N_x$ submarkets in the labor market.

We assume that workers' preferences on consumption is represented by a log utility function $u(c) = \log c$. Utility from job amenities is specified by $\varphi(a) = \left(1 - (a-1)^2\right)^\delta$ with $\delta \in (0.1)$, which is concave. Further, it satisfies $\lim_{a\to 0} \varphi'(a) = \infty$ and $\lim_{a\to 1} \varphi'(a) =$

[31] We identify the cost function of job amenities, by exploiting the effects of WOTC expansion, which only affected the firms' differential profitability across health statuses. This relieves concerns on the potential bias from the estimating the model without multiple dimensions of worker heterogeneity.

0, which is useful as the measure of job amenities used in estimation is the availability of the option to reduce hours. The cost function for non-wage benefits is represented by $C(a) = c_0 + c_1 a \left(1/\left(1-a\right)-1\right)^{c_2}$. The parameter c_0 represents the fixed cost of providing the job amenities, c_1, the scale, and c_2, the convexity of the cost function. Under this parametric assumption, the marginal cost of amenities converges to 0 as a approaches 0 ($\lim_{a\to 0} C'(a) = 0$), and ∞ as a approaches 1 ($\lim_{a\to 1} C'(a) = \infty$). We assume a constant elasticity of substitution (CES) function for the job finding rate with parameter γ, so that $\mu(\theta) = \theta\left(1+\theta^{\gamma}\right)^{-1/\gamma}$.

Exogenously Calibrated Parameters. For estimation, we restrict our attention to workers who are high school graduates, who are more likely to benefit from disability policies. The health distribution in the economy for high school graduates is $\pi_h = \{0.22, 0.24, 0.54\}$. The health-skill type distribution of workers therefore is determined jointly by π_h and σ_h^2. The parameter governing the job-finding elasticity γ is chosen to be 0.4. In the CES matching function, the elasticity of the job-finding rate with respect to the market tightness depends on both γ and θ. Given our choice of γ, the weighted average of the elasticities across health types is around 0.25, which is the widely-used target in the literature. The value of home production (b) is set at 10% of average productivity of the skill type x.

Following Low and Pistaferri (2015) (who also considers high school graduates), we set the government's disability verification probability (ψ_h) to be 0.62 for the severely disabled, 0.18 for the moderately disabled, and 0.075 for the non-disabled workers. These parameters represent the probability of receiving DI upon applying for benefits for old population (as is consistent with our sample) in their paper. For the benchmark economy, the DI benefits are assumed to be 50% of average productivity of the skill type, reflecting the fact that DI benefits are determined by the average of the worker's previous earnings. Thus, the expected benefit of non-employment for the severely disabled worker is 41% of the average productivity of his skill level ($b + \psi_h d = 0.1 + 0.62 \times 0.5$). For the moderately disabled and non-disabled workers, these correspond to 19% and 14%, respectively. In modeling WOTC for the indirect inference approach in estimation, we assume that a firm hiring a severely disabled worker receives a lump-sum transfer amounting to 20% of the income of severely disabled workers, consistent with the average amount of transfers allowed to firms.[32]

Estimation within the Model. The parameters to be estimated within the model are health-specific productivity $\{f_h\}$; health-specific preferences for job amenities $\{\beta_h\}$; curva-

[32] On average, a firm gets \$4,560 for hiring a disabled worker, and the average annual earning of the severely disabled workers are \$13.70(per hour) $\times$ 35.9(hours per week) $\times$ 52(weeks in a year) = \$25,575.16 (this is in line with CBO numbers \$25,452 in 2012 dollar).

ture of the non-wage benefit utility function δ; health-specific fixed disutility from work $\{\eta_h\}$; health-dependent variance of observed skill (x) distribution $\{\sigma_h^2\}$; parameters governing the level and curvature of the cost of providing job amenities $\{c_0, c_1, c_2\}$; and the vacancy posting cost κ. We normalize the non-disabled workers' fixed disutility from work to zero ($\eta_3 = 0$) and their preference for amenities to one ($\beta_3 = 1$), leaving 15 parameters to be estimated.

We estimate these parameters via indirect inference by considering the following set of moments in auxiliary models: (i) mean and coefficient of variation of wages by disability status; (ii) employment rate by disability status; (iii) the proportion of individuals with the option to reduce work hours; (iv) regression coefficients on the option to reduce work hours presented in Section 4.1 (i.e., coefficients reported in Table 3).

4.2.2 Estimation Results

Our estimates of structural parameters are summarized in Table 4[33], and the model fit in Table 5. Our estimates indicate that disability has significant effects on worker productivi-

Table 4: Parameters

Parameter	Description	Value
	Exogenously Calibrated Parameters	
π_h	Distribution of health	{0.22, 0.24, 0.54}
γ	Matching function	0.4
h	Home production, % average productivity by skill	10%
	Government Policies (Benchmark)	
ψ_h	Disability verification probability	{0.62, 0.18, 0.075}
d	DI replacement rate, % average productivity by skill	50%
	Parameters Estimated within the Model	
f_h	Productivity by health	{2.316,2.632,3.114}
β_h	Preference for job amenities	{7.589,2.707,1.000}
δ	Curvature on utility from job amenities	0.752
η_h	Fixed cost of work	{5.567,2.359,0.000}
σ_h^2	Variance of skill-distribution by health	{1.701,0.332,0.244}
$\{c_0, c_1, c_2\}$	Cost of job amenities	{1.413,1.057,1.562}
κ	Vacancy cost	0.002

ties and their preferences for job amenities. Thus, in order for the severely disabled workers

[33]Standard errors will be reported in the next version of the paper.

to participate in the labor market, it is essential for them to receive sufficient amounts of job amenities. The model is able to fit the most salient qualitative features in both cross-sectional heterogeneity of wage and employment, and the regression coefficients on job amenities documented in Table 3. Importantly, similar to the empirical analyses, the simulated model generates a smaller effect of the WOTC amendment on severely disabled workers' job amenities (coefficient Post × Sev.) relative to moderately disabled workers (coefficient Post × Mod). Other coefficients also lie within the ranges of the confidence intervals from the empirical analysis.

Table 5: Model Fit

	Data	Model
Wage		
Severely Disabled	1.000	0.917
Moderately Disabled	1.051	1.102
Non-Disabled	1.274	1.250
Coefficient of Variation of Wage		
Severely Disabled	0.304	0.123
Moderately Disabled	0.343	0.326
Non-Disabled	0.401	0.403
Employment		
Severely Disabled	0.111	0.114
Moderately Disabled	0.449	0.411
Non-Disabled	0.672	0.725

	Data	Model
Average Job Amenities		
Aggregate	0.333	0.357
WOTC Coefficients on Amenities		
Severe	0.187***	0.247
	(0.05)	
Moderate	0.088***	0.140
	(0.04)	
Post	0.000	0.001
	(0.01)	
Post × Severe	0.017	0.007
	(0.05)	
Post × Moderate	0.051**	0.022
	(0.02)	

4.2.3 External Validation of the Model

While our model is able to match the targeted moments well, it is important to ensure that the model also generates an empirically plausible response to policy changes. In particular, as one of our key policies of interest is the generosity of DI, we first evaluate the labor supply effects of DI in the estimated model (which were not targeted) and compare the results to those in the empirical studies.

Recent developments in the DI literature have uncovered the labor supply effects of DI using exogenous variations in DI application processes. Among them, Maestas et al. (2013) finds a 28 percentage point (*pp*) decline in labor supply among marginal applicants. Further, these effects are heterogeneous across agents, and range from no effect to 50*pp*. Given the estimated parameters, we simulate the economy without disability insurance and compare the labor supply effects of the model to empirical estimates from Maestas et al. (2013).

Our findings suggest that the removal of DI leads to an aggregate employment rate decline of 2.42*pp*. If we use the results from Maestas et al. (2013) and conduct a back-of-the-envelope calculation, the average employment in the economy without DI is 2.68*pp* lower, which is similar in magnitude to our findings. Furthermore, depending on the skill and health statuses, the labor supply effects in our model also similarly range between 0.2*pp* and 52*pp*. This result thus shows our model's ability to predict the empirically estimated DI impacts on labor supply.

4.2.4 Mechanisms

While in the absence of screening, contracts are independently determined for each skill and health type of worker, it is not the case in the presence of screening incentives of firms. In Table 6, we compare the equilibrium outcomes in the economy without screening (equivalently, when firms can write health-dependent contracts) and with screening under the estimated parameters. As predicted by the model, in the screening economy, job amenities are under-provided to moderately disabled and non-disabled workers. However, these workers are compensated with higher employment rates and wages than in the economy without screening.

Table 6: Equilibrium in the Model without Screening (No-Scr.) vs. with Screening (Scr.)

	Job Amenities		Wage		Employment	
	No-Scr.	Scr.	No-Scr.	Scr.	No-Scr.	Scr.
Severely Disabled	0.524	0.524	0.913	0.913	0.112	0.112
Moderately Disabled	0.432	0.419	1.073	1.107	0.409	0.410
Non-Disabled	0.342	0.268	1.220	1.255	0.712	0.724

While Table 6 documents the aggregate outcomes by health statuses (averaged over skill distribution within the health status), the degree of distortions may vary with a worker's skill level and participation decisions of disabled workers. In 7, we report job amenity levels by skill and health statuses under different economies. When we focus on a low-skilled worker, severely disabled workers may choose not to participate in the labor market. In this case, moderately disabled workers of the same skill level may receive the efficient amount of amenities.[34] The left columns of Table 6 (labeled Low Skill) correspond to this case.

[34]When severely disabled workers do not participate in the labor market, moderately disabled workers are the lowest type in the labor market. However, even in such cases, moderately disabled workers might receive less-than-efficient amount of job amenities to deter the severely disabled workers from entering the moderately disabled workers' labor market.

Table 7: Skill Heterogeneity and Screening

	Job Amenities			
	Low Skill		High Skill	
	No-Screening	Screening	No-Screening	Screening
Severely Disabled	-	-	0.498	0.498
Moderately Disabled	0.364	0.364	0.438	0.420
Non-Disabled	0.305	0.238	0.370	0.281

On the other hand, severely disabled workers may decide to participate in the labor market if their market productivity is high (high-skilled). When they do, they receive the efficient contract in the screening economy, creating firms' incentives to screen these workers. Thus, we observe that the high-skilled moderately disabled workers receive lower amenities relative to under the economy without screening (as shown in right columns of Table 6, labeled High Skill). These heterogeneous effects on moderately disabled workers further trickle down to non-disabled workers. While low-skilled non-disabled workers receive 6.7*pp* (22% lower) less amenities than under the no-screening contract, the distortionary effect is larger for high-skilled non-disabled workers at 8.9*pp* (24%). These results suggest substantial heterogeneity in the extent of screening frictions across worker types, which depend on the participation decisions of disabled workers.

5 Counterfactual Policy Analyses

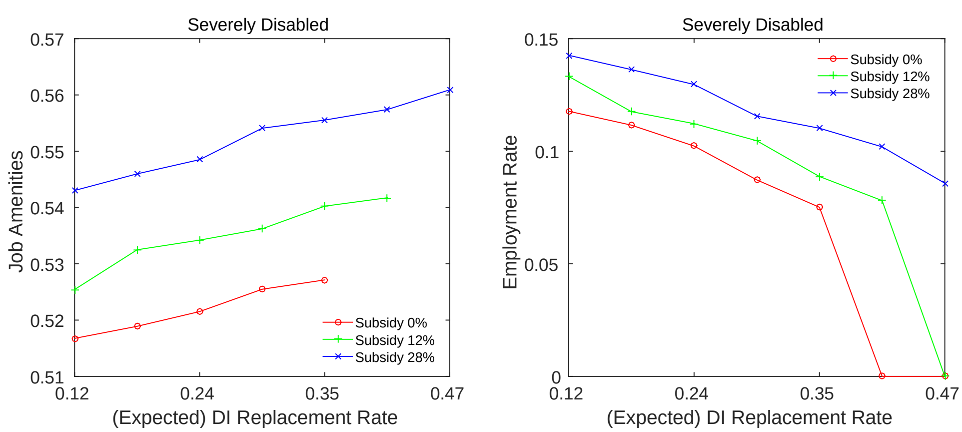
Using the estimated structural model, we now conduct counterfactual analyses. We take as exogenous the government's disability verification technology (ψ_h), and consider varying the DI replacement rate d. We also jointly experiment with an employment subsidy policy, in particular, proportional subsidy towards the costs of providing amenities s, motivated by the fact that the amenities are distorted in the presence of screening. Under the amenity subsidy, the firm's net cost of providing amenities equals $(1 - s) C(a)$, effectively lowering the marginal cost of amenities. We ensure that these policy reforms are budget-neutral (relative to the benchmark economy) by allowing the government to use a proportional wage tax (subsidy). In the following, we discuss the equilibrium and welfare effects of the policy reform, and the role of screening on optimal policy structure.

5.1 Equilibrium Effects of Policies

Allocative Effects. In Figure 1, we plot labor market equilibrium allocations for severely disabled workers under different policy combinations. The x-axis is the expected DI replacement rate for disabled workers[35], and the three lines in each plot correspond to subsidy rates (s) of 0%, 12%, and 28%.[36] On the left panel of Figure 1, we plot the amount of job amenities provided to severely disabled workers under the joint policy parameters; and on the right panel, we plot the employment rates of severely disabled workers. We observe, first, that as the subsidy rate increases (moving from ∘-line to +-line to ×-line), severely disabled workers' contracts feature higher job amenities. Consequently, the employment rates of severely disabled workers increase as shown in the right panel of Figure 1; higher job amenities make work more attractive for severely disabled workers.

On the other hand, as DI becomes more generous (moving from left to right along the x-axis), the labor supply disincentives increase, reducing their employment rates, sometimes driving severely disabled workers completely out of the labor force (where the amenity plots are truncated). Not surprisingly, the cutoff level of DI, after which severely disabled workers do not participate in the labor market is lower when amenity subsidy rates are smaller. Further, even though the amenity subsidies can be effective in increasing the employment rates of severely disabled workers, when DI is very generous, it is not enough to bring the workers back into the labor market: Severely disabled workers do not work even when subsidy is introduced when the expected DI replacement rate reaches 47% in this economy.

Figure 1: Labor Market Equilibrium for Severely Disabled Workers

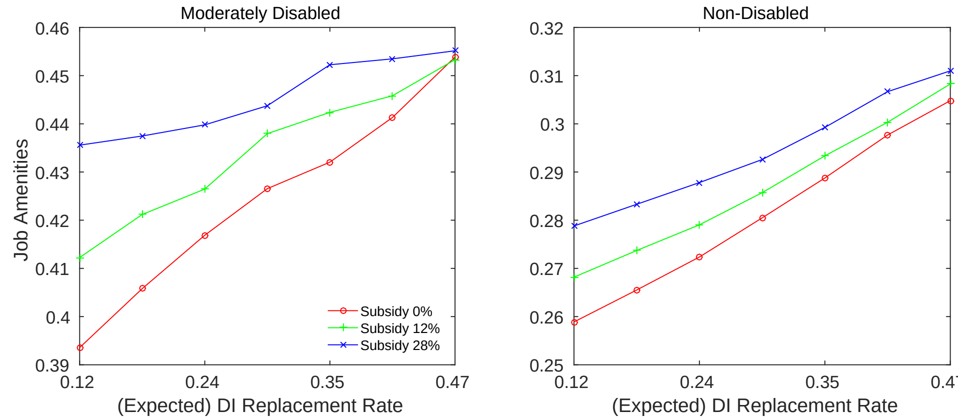


In Figure 2 are the equilibrium job amenities for moderately disabled (left panel) and non-disabled (right panel) workers. We observe that because the government subsidy directly lowers the marginal cost of amenity, healthier workers in the labor market also benefit from higher amenities.

[35]This is calculated as $d \times [(\pi_{\text{sev}}\psi_{\text{sev}} + \pi_{\text{mod}}\psi_{\text{mod}}) / (\pi_{\text{sev}} + \pi_{\text{mod}})]$. Under the benchmark economy with $d = 0.5$, this corresponds to 0.22.

[36]Due to the imperfect verifiability, firms only probabilistically receive these subsidies, i.e., they expect to receive these subsidies with probability ψ_h.

Figure 2: Labor Market Equilibrium for Moderately and Non-Disabled Workers



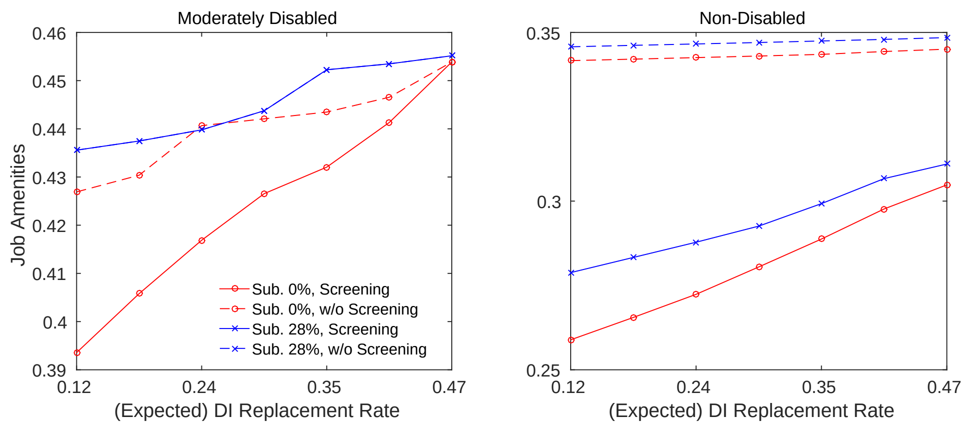
Effects on Screening Distortions. As discussed in 4.2.4, because firms have screening incentives, the decisions of disabled workers have consequences on equilibrium outcomes of other workers in the labor market. Here, we discuss how policies affect the screening incentives of firms, and thus the degree of distortions in the contracts of moderately and non-disabled workers in equilibrium.

In Figure 3, we plot the equilibrium level of job amenities in an economy without screening along with the equilibrium job amenities in the screening economy, for moderately disabled workers (left) and non-disabled workers (right).[37] The amenities when subsidy rate is zero (○-line) without screening are plotted as a dashed line and with screening, a solid line. We observe that when DI replacement rate is low (left), the contract distortions for moderately disabled workers are high: the difference between the level of amenity in an economy without screening (dashed) and the amenity in an economy with screening (solid) is large. Fixing the subsidy rate (to zero, for example), as DI becomes more generous (moving from left to right), the distortionary effects on amenities decrease. While DI reduces the work incentives of severely disabled workers (as shown in Figure 1), it simultaneously relaxes the incentive compatibility constraint on moderately disabled workers' contracts. Put it differently, severely disabled workers have less incentives to mimic because they have higher outside option (DI). Thus, DI affects moderately disabled workers contracts, by not only increasing their own outside option, but through the change in the contracts and labor force participation incentives of severely disabled workers. At the extreme, when the expected DI replacement rate reaches 47%, we observe that moderately disabled workers' amenities in the screening economy are equivalent to the level they would have received in the absence of screening, because severely disabled workers are driven out of the labor force. We would

[37]For severely disabled workers who are the lowest type in the labor market, their labor market contracts are equivalent in the presence and absence of screening, upon participation.

also like to note that for DI replacement rate of 41%, even though severely disabled workers are not working, moderately disabled workers' contracts are still distorted, which occurs to ensure that severely disabled workers do not enter the submarket for moderately disabled workers. This effect of DI on labor market is novel in our framework, where we specifically model and estimate the role of screening in equilibrium.

Figure 3: Labor Market Equilibrium: Without Screening vs. With Screening



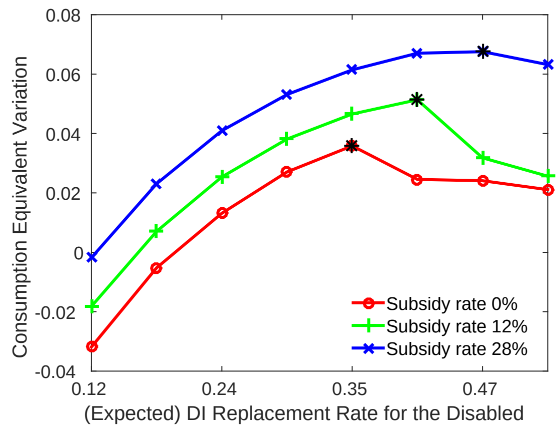
Now, consider the case with the amenity subsidy rate of 28% (×-line). In this case, the amenities in economies with screening and without screening are equivalent for moderately disabled workers (the reason why there is only one line). When the amenity subsidy rate is high, severely disabled workers' utility from working under their own contract increases, and thus, they have no incentive to mimic moderately disabled workers. That is, the contract for severely disabled workers is incentive compatible, and therefore, the incentive compatibility constraint in moderately disabled workers' problem becomes irrelevant (non-binding). We observe similar effects on job amenity provision of non-disabled workers in the right panel of Figure 3: the size of distortions are smaller with higher DI (left to right) and higher subsidy rates (○-line to ×-line).

Overall, we observe two ways in which the screening distortions are affected by policies. First, if DI becomes more generous, severely disabled workers' outside option increases, lowering their labor force participation and incentive to mimic (the firms' screening needs). Second, if amenity subsidy is high, severely disabled workers' contracts are attractive enough that they do not want to enter the market designed for moderately disabled workers. Both policy interventions therefore affect the degree of screening distortions in equilibrium, but through different channels. In the next, we analyze the welfare implications of these policy designs.

5.2 Welfare Effects of Policies

In Figure 4, we plot the aggregate welfare effects of policy reform, calculated using the consumption equivalent variation (CEV). For each worker of a certain skill and health type, we compute the CEV as the percentage of consumption in the benchmark economy (s)he is willing to give up to be in the new policy equilibrium. Then, we take the weighted averages of the CEVs to obtain the values in the plot.

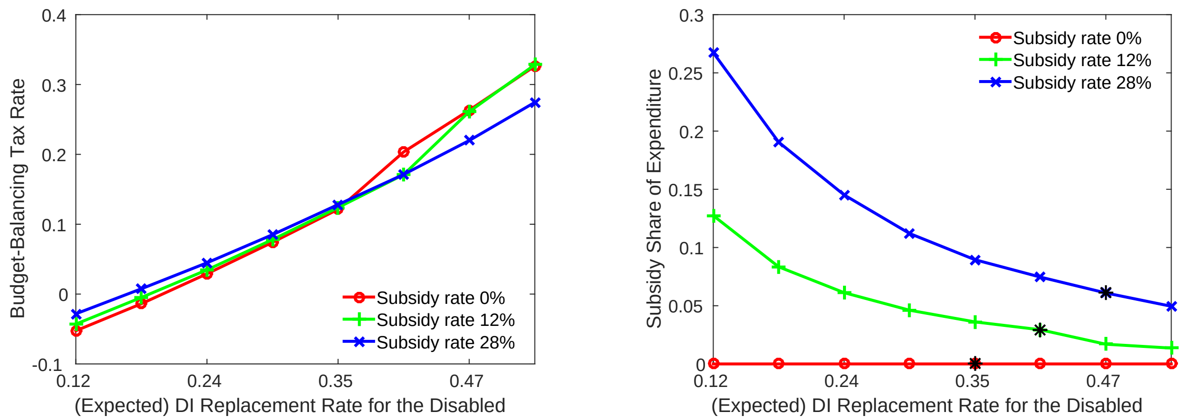
Figure 4: Aggregate Welfare Effects of Policy Reform



The aggregate welfare effects of the policy reforms range between −3%, when DI becomes less generous than the benchmark economy, to around 7%, when DI and amenity subsidies are more generous. In general, we observe that starting from a zero amenity subsidy rate, introducing amenity subsidy (○-line to ×-line) improves welfare in the aggregate. Making DI more generous (left to right) is also welfare-improving initially, but starts to become too costly at higher replacement rates.

An interesting property is the interdependence between DI and amenity subsidy. When the government does not provide any amenity subsidies (○-line), aggregate welfare is maximized at DI replacement rate of 35% (marked with a $*$). On the other hand, the optimal DI replacement rate is higher at 41% and 47%, when subsidy rates are 12% and 28% respectively. As discussed in detail in Section 5.1, subsidy rates and DI replacement rates both affect the labor force participation decisions of workers, especially, of severely disabled workers who are most affected by them (as $\psi_{\text{sev}} > \psi_{\text{mod}} > \psi_{\text{non}}$). In particular, when amenity subsidy rate is low, severely disabled workers drop out of the labor force at lower DI replacement rate than they would under a high amenity subsidy rate. For the case of a zero subsidy rate, at the optimal DI (35%), the employment rate of severely disabled workers is 7.5%. Thus, it becomes very costly for the government to implement a generous DI program. These labor supply disincentive effects are mitigated when the government simultaneously enacts the employment (amenity) subsidies. At 28% subsidy rate, the government finds it optimal to provide more insurance through DI, while still sustaining the severely disabled workers' employment rate of 8.6%.

Figure 5: Equilibrium Tax Rates and Government Expenditures



These endogenous employment responses further have fiscal consequences. As discussed, we find the wage tax rate to ensure budget-neutrality of all policy reforms. In Figure 5, we plot the tax rate for corresponding policy regimes. In our counterfactual analysis, the government spends resources either for non-employed workers (DI) or for employed workers (amenity subsidy). Thus, under high (low) employment rates, its spending on amenity subsidy increases (decreases), but spending on DI decreases (increases). Depending on the magnitude of these cost differences, the government might be able to fund the expenditures at lower or higher tax rates.

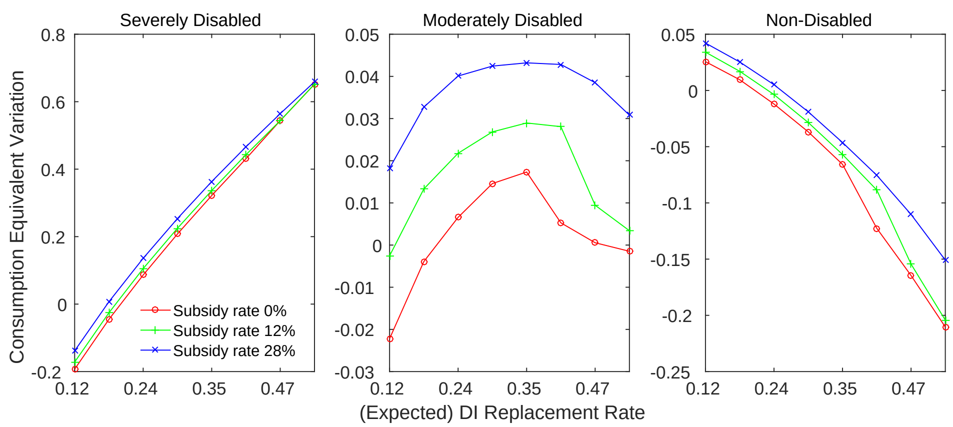
In policy equilibria discussed, under less generous DI (left), higher amenity subsidy requires higher tax rates; whereas under generous DI (right), higher amenity subsidy rate leads to lower tax rates. Increasing amenity subsidy in the presence of a generous DI effectively reduces the financial burden of the government, by attracting more workers thus saving DI costs (which outweigh the higher amenity costs). When we plot the government expenditure shares on subsidies (right panel of Figure 5), the optimal share of expenditures under generous DI is around 10%.

Welfare Effects by Health Status. There are large heterogeneities underlying the aggregate welfare effects of policy reforms reported in Figure 4. In Figure 6, we plot the health-specific CEV's under the policy combinations, and in Table 8, we document the CEV's at the optimal DI replacement rate for a given amenity subsidy rate.

First, we note that job amenity subsidies benefit all workers. In particular, even though firms hiring non-disabled workers receive amenity subsidies with a relatively low probability

($\psi_{\text{non}} = 0.075$), non-disabled workers still benefit from amenity subsidies. When DI replacement rate is low (12%), their CEV increases 2*pp*: from 2% when subsidy rate is zero to 4% when subsidy rate is 28%. When DI replacement rate is high (47%), the benefit of subsidy is higher at 6*pp*: CEV's are −17% and −11%, respectively for subsidy rate of zero and 28%. These are driven by both the direct benefit (from lower marginal cost of amenities), but also from the relaxation of screening incentives (as discussed and plotted in Figure 3). Furthermore, when DI is generous, the budget-balancing wage tax rate is lower despite higher amenity subsidies (Figure 5), benefiting (among other workers) non-disabled workers even more.

Figure 6: Welfare Effects of Policy Reform by Health Status



On the other hand, there are stark differences in preferences for the generosity of DI: while severely disabled workers are willing to give up 60% of their consumption in the benchmark economy for a 47% DI replacement rate, non-disabled workers need to receive more than 10% of consumption to be indifferent. The welfare benefits for moderately disabled workers lie in between these two types of workers. Thus, the insurance benefit of DI, mostly enjoyed by severely disabled workers, is largely achieved at the expense of higher taxes for non-disabled workers (Figure 5). At the optimal DI replacement rate (from the aggregate perspective)

Table 8: Welfare Effects of Policy Reform by Health Status

Policies	Amenity Subsidy Rate	0%	12%	28%
	DI Replacement Rate (optimal)	35%	41%	47%
CEV	Severely Disabled	0.322	0.443	0.565
	Moderately Disabled	0.017	0.028	0.039
	Non-Disabled	-0.067	-0.089	-0.110
	Aggregate	0.036	0.051	0.068

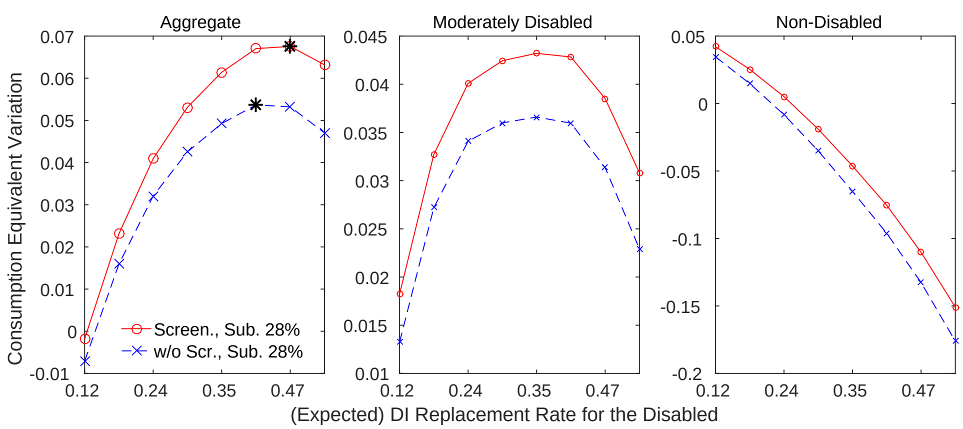
for each amenity subsidy rate in consideration, the CEVs range between 32% (zero subsidy rate) and 57% (28% subsidy rate) for severely disabled workers, and −7% and −11% for non-disabled workers (Table 8).

Overall, our counterfactual results show that the amenity subsidy is effective in improving welfare not only in the aggregate, but also for workers of all health statuses. It encourage more workers to supply labor by lowering their disutility of work, and directly lowers the contract distortions driven by the firms' screening incentives. Thus, with a higher amenity subsidy mitigating the labor supply disincentive effects of DI, the government gains the ability to afford a generous DI, thereby providing more insure to workers in the economy. The two policies when used jointly are effective in increasing welfare and allocative efficiencies in the labor market with disabled workers.

5.3 Effects of Screening on Optimal Policy Design

Lastly, we discuss how the presence of screening affects the optimal policy structure in the economy. To do so, we conduct the same counterfactual analyses, now assuming that firms can write health-dependent contracts, and compare the welfare effects under the two economies.

Figure 7: Welfare Effects of Policy Reform in Economics with vs. without Screening



In Figure 7, we plot welfare consequences of policy reforms when subsidy rate is 28% for varying generosity of DI, in the aggregate (left), for moderately disabled workers (middle), and non-disabled workers (right). The welfare effects for severely disabled workers are similar under the two screening regimes, as their contracts in the screening economy are the same as those in the no-screening economy. We find that the benefit from more generous DI is higher for moderately and non-disabled workers in the screening economy, because these are the workers whose contracts are affected by the firms' screening incentives. In the screening economy, a generous DI provides more insurance, just like in the no-screening economy, and reduces screening incentives, giving more benefits to healthier workers. These factors make a "more" generous DI optimal in the presence of screening relative to in the absence of screening as shown in the left panel of Figure 7. This result, therefore, suggests the importance of taking into account the firms' screening incentives in the labor market for optimal policy analyses.

6 Conclusion

In this paper, we study the impacts of policies for disabled workers, incorporating the U.S. regulation that prohibits explicit discrimination against workers based on their disability statuses. We develop an equilibrium model in which the anti-discrimination law leads the firms to offer screening contracts, which consist of wage and job amenities. To map the model to data, we examine which job amenity is used for screening exploiting policy variations, and we structurally estimate the model targeting the empirically estimated impacts of the WOTC amendment. The results from our quantitative policy analyses advocate the importance of using firm subsidies in conjunction with disability insurance. Firm subsidies that increase the provision of job amenities mitigate the labor supply disincentive effects of disabled workers from DI and directly lower contract distortions (due to screening) on healthier workers. Such interactions imply that DI and employment subsidies, when used jointly, are able to provide insurance across employment statuses and across disability statuses in the labor market. Moreover, this finding highlights a potential need to expand subsidizing of firms to hire disabled workers. While the U.S. spends close to 220 billion dollars annually providing DI benefits, firm subsidies that support the hiring of disabled workers are extremely limited. In light of our model, subsidies to promote a more generous provision of job amenities to reduce disabled workers' disutility from work may be effective in improving efficiency in the labor market and increasing the welfare of workers in the aggregate.

The framework in this paper provides an important foundation for understanding the joint effects of social insurance and labor market policies for disabled workers in the presence of adverse selection (or firms' screening incentives). There are several promising avenues for future work. First of all, in order to focus on the firm-side responses to government policies, we made a simplistic assumption on the worker side by assuming that workers solve a static labor supply problem. It is desirable to add life-cycle features to the model with a consumption and savings margin to characterize the labor supply effects of DI. Second and relatedly, it is important to consider firms' dynamic screening problem in an environment where workers' health statuses change over time. We leave these interesting extensions for future research.

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A Proofs

A.1 Equilibrium Contracts in the Screening Economy (with Risk-Neutral Workers and Linear Policies)

We show properties of the equilibrium contracts under screening economy, in comparison with the first-best economy. Here, we also incorporate (for use in our quantitative analysis), F_i type-dependent fixed cost of work and tr_i, type-dependent lump-sum transfers from the government. Also assume, for simplicity, income taxes are proportionate at rate t, and firm subsidies are given specifically for the provision of job amenities with the amount $sC\left(a\right)$. Moreover, we allow for the incorporation of multiple non-wage benefit measures. We denote a_k, the non-wage benefit of type k, and $c\left(a_k\right)$, the cost function of the specific non-wage benefit. Thus, the total costs are now denoted as $\sum_k c\left(a_k\right)$, and utility, $\sum_k \varphi\left(a_k\right)$The latter policy corresponds to the WOTC program that we use to identify the firm costs of providing non-wage benefits. The problem of the screening economy then reads,

$$
\begin{aligned}
& d_2 + \max_{\theta,w,a} \mu\left(\theta\right)\left[\left(1-t\right)w + \beta_2\left(\sum_k \varphi\left(a_k\right)\right) - F_2 - d_2\right] \\
& \text{s.t.} \\
& \text{(FE)} \quad \mu\left(\theta\right)\left\{y_2 - w - \left(1-\psi_i s\right)\sum_k c\left(a_k\right) + tr_2\right\} \geq \theta\kappa \\
& \text{(IC)} \quad \mu\left(\theta\right)\left\{\left(1-t\right)w + \beta_1\left(\sum_k \varphi\left(a_k\right)\right) - F_1\right\} + \left(1-\mu\left(\theta\right)\right)\left(b + \varphi_i d_1\right) \leq \bar{U}_1
\end{aligned}
$$

Let Lagrange multipliers with respect to (FE) and (IC) be $\nu$and λ. Then, from the FOC with respect to the wage rate, we get

$$
\begin{aligned}
\mu\left(\theta\right)\left(1-t\right) - \nu\mu\left(\theta\right) - \lambda\mu\left(\theta\right)\left(1-t\right) &= 0 \\
\left(1-t\right)\left(1-\lambda\right) &= \nu
\end{aligned}
$$

With $t < 1$, for ν to be positive, the multiplier $\lambda \in [0,1)$. The FOC with respect to the non-wage benefit of type k, reads

$$
\begin{aligned}
\mu\left(\theta\right)\beta_2\varphi'\left(a_k\right) - \nu\mu\left(\theta\right)\left(1-\psi_i s\right)c'\left(a_k\right) - \lambda\mu\left(\theta\right)\beta_1\varphi'\left(a_k\right) &= 0 \\
\left(\beta_2 - \lambda\beta_1\right)\varphi'\left(a_k\right) &= \left(1-t\right)\left(1-\lambda\right)\left(1-\psi_i s\right)c'\left(a_k\right)
\end{aligned}
$$

Rearranging,

$$\lambda = \frac{\beta_2 \varphi'(a_k) - (1-t)(1-\psi_i s) c'(a_k)}{\beta_1 \varphi'(a_k) - (1-t)(1-\psi_i s) c'(a_k)},$$

and combining with the FOC with respect to wage rate,

$$\nu = (1-t)(1-\lambda) = (1-t)\frac{\beta_1 \varphi'(a_k) - \beta_2 \varphi'(a_k)}{\beta_1 \varphi'(a_k) - (1-t)(1-\psi_i s) c'(a_k)}.$$

Since by assumption $\beta_1 > \beta_2$, numerator of ν is positive, thus, the denominator must be positive. This implies that for λ to be positive, the numerator must be positive, i.e., $\beta_2 \varphi'(a_k) > (1-t)(1-\psi_i s) c'(a_k)$. Note that in the first-best, the optimality condition for a_k reads $\beta_2 \varphi'\left(a_k^{FB}\right) = (1-t)(1-\psi_i s) c'\left(a_k^{FB}\right)$. Thus, by concavity of ψ function (and convexity of $c(\cdot)$ function; holds with linear function too), $a_k^{AS} < a_k^{FB}$ when $\lambda > 0$ (i.e., when (IC) is binding).

Lastly, the FOC with respect to θ reads

$$\begin{aligned}
\mu'(\theta)\left[(1-t)w + \beta_2\left(\sum_k \varphi(a_k)\right) - F_2 - d_2\right] + \\
\nu\mu'(\theta)\left\{y_2 - w - (1-\psi_i s)\sum_k c(a_k) + tr_2\right\} - \nu\kappa - \\
\lambda\mu'(\theta)\left\{(1-t)w + \beta_1\left(\sum_k \varphi(a_k)\right) - F_1 - d_1\right\} = 0 \\
\left\{\beta_2\left(\sum_k \varphi(a_k)\right) - F_2 - d_2\right\} - \lambda\left\{\beta_1\left(\sum_k \varphi(a_k)\right) - F_1 - d_1\right\} \\
+(1-t)(1-\lambda)\left\{y_2 - (1-\psi_i s)\sum_k c(a_k) + tr_2\right\} = (1-t)(1-\lambda)\frac{\kappa}{\mu'(\theta)}
\end{aligned}$$

Denote $\varphi(a) \equiv \sum_k \varphi(a_k)$, $c(a) = \sum_k c(a_k)$and $\tilde{d}_i \equiv F_i + d_i$. For now, assume no policy. Then, the last equation from FOC with respect to θ:

$$\begin{aligned}
\left\{\beta_2\varphi(a) - \tilde{d}_2\right\} - \lambda\left\{\beta_1\varphi(a) - \tilde{d}_1\right\} + (1-\lambda)\left\{y_2 - c(a)\right\} = (1-\lambda)\frac{\kappa}{\mu'(\theta)} \\
\left\{\beta_2\varphi(a) - \tilde{d}_2 + y_2 - c(a)\right\} - \lambda\left\{\beta_1\varphi(a) - \tilde{d}_1 + y_2 - c(a)\right\} = (1-\lambda)\frac{\kappa}{\mu'(\theta)}
\end{aligned}$$

Let $\beta_1 = \chi\beta_2$, and $\tilde{d}_2 = \xi\tilde{d}_1$. Note also that

$$\begin{aligned}
1-\lambda &= \frac{(\beta_1-\beta_2)\varphi'(a)}{\beta_1\varphi'(a)-c'(a)} = \frac{(\chi-1)\varphi'(a)}{\chi\beta_2\varphi'(a)-c'(a)} \\
1-\lambda\chi &= \frac{\beta_1\varphi'(a)-c'(a)-\chi\beta_2\varphi'(a)+\chi c'(a)}{\beta_1\varphi'(a)-c'(a)} = \frac{(\chi-1)c'(a)}{\chi\beta_2\varphi'(a)-c'(a)} \\
\frac{1-\lambda\chi}{1-\lambda} &= \frac{c'(a)}{\beta_2\varphi'(a)}
\end{aligned}$$

(similar calculations hold with ξ). So, simplifying, the FOC with respect to θ can be expressed as

$$\mu'(\theta)\left\{y_2 - c(a) + \frac{c'(a)}{\beta_2\varphi'(a)}\left(\beta_2\varphi(a)-\tilde{d}_2\right)\right\} = \kappa. \tag{4}$$

In the FB, the following hold:

$$\begin{aligned}
\mu'\left(\theta^{FB}\right)\left[y_2 - c\left(a^{FB}\right) + \beta_2\varphi\left(a^{FB}\right) - \tilde{d}_2\right] &= \kappa \\
\beta_2\varphi'\left(a^{FB}\right) &= c'\left(a^{FB}\right)
\end{aligned}$$

which implies that the $\left(a^{FB},\theta^{FB}\right)$ satisfies equation (4).

Since we know that $a^{FB} > a^{AS}$, then we need to know how θ^{AS} should adjust so that the equation (4) holds. So, we want to know the sign of $\frac{\partial}{\partial a}\left\{y_2 - c(a) + \frac{c'(a)}{\beta_2\varphi'(a)}\left(\beta_2\varphi(a)-\tilde{d}_2\right)\right\}$.

$$\begin{aligned}
\frac{\partial}{\partial a}\left\{-c(a) + \frac{c'(a)\varphi(a)}{\varphi'(a)} - \frac{\tilde{d}_2 c'(a)}{\beta_2\varphi'(a)}\right\} &= \left\{\frac{c''(a)}{\varphi'(a)} - \frac{c'(a)\varphi''(a)}{(\varphi'(a))^2}\right\}\left\{\varphi(a) - \frac{\tilde{d}_2}{\beta_2}\right\} \\
&= (+)\times\begin{cases} + & \text{if } \beta_2\varphi(a)-\tilde{d}_2 > 0 \\ - & \text{if } \beta_2\varphi(a)-\tilde{d}_2 < 0 \end{cases}
\end{aligned}$$

The first term is positive with convex cost ($c''(a) > 0$) and concave utility (and $\varphi''(a) < 0$). The second term is positive if $\beta_2\varphi(a)-\tilde{d}_2 > 0$. Think of a labor force participation constraint. Workers' utility from work is $w+\beta_2\varphi(a)$ and utility from not working, $\tilde{d}_2$. If $\beta_2\varphi(a)-\tilde{d}_2 > 0$, utility from non-wage benefits is so high that even at wage rate of 0, the worker would be willing to work, which is unlikely. Thus, under reasonable parameters, it will be the case that $\beta_2\varphi(a)-\tilde{d}_2 < 0$. If so, when a is lower ($a^{AS} < a^{FB}$), the term in the bracket is higher; to satisfy the FOC (given that the RHS is a constant, κ), it must be that $\mu'\left(\theta^{AS}\right) < \mu'\left(\theta^{FB}\right)$, which implies with a concave matching function, $\theta^{AS} > \theta^{FB}$.

Lastly,

$$\begin{aligned} w &= y_2 - c(a) - \frac{\theta\kappa}{\mu(\theta)} \\ &= y_2 - c(a) - \frac{\theta\mu'(\theta)}{\mu(\theta)} \left\{ y_2 - c(a) + \frac{c'(a)}{\beta_2 \psi'(a)} \left(\beta_2 \varphi(a) - \tilde{d}_2 \right) \right\} \end{aligned}$$

If $(a, \theta) = \left(a^{FB}, \theta^{FB}\right)$, then $w = w^{FB}$. If $a^{AS} < a^{FB}$, then from our assumption that $\beta_2 \varphi(a) - \tilde{d}_2 < 0$, $\left\{ y_2 - c(a) + \frac{c'(a)}{\beta_2 \varphi'(a)} \left(\beta_2 \varphi(a) - \tilde{d}_2 \right) \right\}$ is higher. With $\theta^{AS} > \theta^{FB}$, $\frac{\theta\mu'(\theta)}{\mu(\theta)}$ is lower.

A.2 Optimal Policy under Full-Information Benchmark

From the government's budget constraint,

$$d = \frac{\mu(\theta^*(t,s,d))}{1 - \mu(\theta^*(t,s,d))} \left[t \left\{ f_i - (1-s) a^*(t,s) - \frac{\theta^*(t,s,d)\kappa}{\mu(\theta^*(t,s,d))} \right\} - s a^*(t,s) \right]$$

Substituting d,

$$\begin{aligned} G^F &= \max_{t,s,d} \mu(\theta^*(t,s,d)) \left[t \left\{ f_i - (1-s) a^*(t,s) - \frac{\theta^*(t,s,d)\kappa}{\mu(\theta^*(t,s,d))} \right\} - s a^*(t,s) \right] \\ &\quad + \mu(\theta^*(t,s,d)) \left[(1-t) \left\{ f_i - (1-s) a^*(t,s) - \frac{\theta^*(t,s,d)\kappa}{\mu(\theta^*(t,s,d))} \right\} + \beta_i \varphi(a^*(t,s)) \right] \\ &= \max_{t,s,d} \mu(\theta^*(t,s,d)) \left[f_i - a^*(t,s) + \beta_i \varphi(a^*(t,s)) \right] - \theta^*(t,s,d)\kappa \end{aligned}$$

The first-order condition with respect to d reads:

$$\frac{dG^F}{dd} = \left[\mu'(\theta^*) \left\{ f_i - a^* + \beta_i \varphi(a^*) \right\} - \kappa \right] \frac{d\theta^*}{dd} = 0.$$

As $\frac{d\theta^*}{dd} < 0$, it must be the case that $\mu'(\theta^*) \left\{ f_i - a^* + \beta_i \varphi(a^*) \right\} = \kappa$. Moreover,

$$\begin{aligned} \frac{dG^F}{ds} &= \mu(\theta^*) \left[\beta_i \varphi'(a^*) - 1 \right] \frac{da^*}{ds} \\ &\quad + \left[\mu'(\theta^*) \left\{ f_i - a^* + \beta \varphi(a^*) \right\} - \kappa \right] \frac{d\theta^*}{ds} \\ &= \mu(\theta^*) \left[\beta_i \varphi'(a^*) - 1 \right] \frac{da^*}{ds} = 0, \end{aligned}$$

and

$$\begin{aligned}\frac{dG^F}{dt} &= \left[\mu'(\theta^*)\left\{f_i - a^*(t,s) + \beta_i\varphi(a^*(t,s))\right\} - \kappa\right]\frac{d\theta^*}{dt} \\ &\quad + \mu(\theta^*)\left[\beta_i\varphi'(a^*) - 1\right]\frac{da^*}{dt} \\ &= \mu(\theta^*)\left[\beta_i\varphi'(a^*) - 1\right]\frac{da^*}{dt} = 0.\end{aligned}$$

These two equations imply that

$$\begin{aligned}\beta_i\varphi'(a^*) - 1 &= \beta_i\alpha\left[\left\{\frac{\beta_i\alpha}{(1-t)(1-s)}\right\}^{\frac{1}{1-\alpha}}\right]^{\alpha-1} - 1 \\ &= \beta_i\alpha\left\{\frac{\beta_i\alpha}{(1-t)(1-s)}\right\}^{-1} - 1 \\ &= (1-t)(1-s) - 1 = 0\end{aligned}$$

or $t^* = s^* = d^* = 0$.

B Data Appendix: Health and Retirement Study

B.1 Sample Selection

The main data source used in our empirical analysis is the Health and Retirement Study (HRS), a longitudinal dataset providing socioeconomic circumstances of individuals above the age of 50. For our empirical analysis, we impose the following sampling restrictions:

1. Exclude self-employed individuals: Our main research interest is to understand the determinants of firms' non-wage benefit packages to screen workers, and we don't observe these variables for self-employed individuals.

2. Exclude public sector employees.

3. Focus on the 1996-2008 period: The U.S. introduced a major welfare reform in 1996 that there could be discontinuity in disabled workers' behavior in labor markets before and after 1996. Also, the U.S. economy had experienced severe recession after 2008. Even though we control for macroeconomic condition of the economy using the aggregate indices, this unusually huge economic downturn might affect our empirical analysis.

4. Exclude individuals below 50 or above 65: Individuals participating beyond their full retirement age may have different characteristics from the rest. We also exclude observations younger than 50 as the number of these observations are too small.

5. Exclude observations with missing health or other important demographic information.

The original HRS dataset includes 429, 350 observations. The number of dropped observations are documented in Table 9.

Table 9: Sample Selection

	Sample size
Original sample	429,350
Number of drops	
(1) Self-employed	18,559
(2) Public sector employees	1,954
(3) Year before 1996 or after 2008	159,454
(4) Age below 50 or over 65	198,899
(5) Missing health information	4,149
(6) Missing demographic data	4
Total number of sample dropped	383,019
Remaining sample	46,331

Note: Table 9 summarizes the sample restrictions we imposed to the HRS dataset and the outcomes.

B.2 Summary Statistics by Disability Measures

Since these two variables that we used to construct the degree of disability are subjective measures relying on the respondents self-evaluation, one may worry that our disability measure may not correctly reflect the respondents' health conditions. Thus, we looked into the relationship between our disability measure with other objective health variables available in the HRS. Table 10 confirms that our disability measure indeed has positive relationship with the severity of health conditions.

Table 10: Other Measures of Health: Sample Means

Objective health measures	Non-disabled	Moderately disabled	Severely disabled
Body Mass Index	27.6	29.4	30.4
Hospital utilization during the past 12 months			
Out-of-pocket medical spending ($2014)	2,194	3875	5,039
Any doctor's visit (%)	88.2	91.1	96.2
Any overnight stay in hospital (%)	11.9	24.3	44.2
Doctor's diagnoses (%)			
Experiencing back problems	23.4	46.7	64.5
Arthritis or rheumatism	38.6	64.3	76.2
High blood pressure or hypertension	38.3	55.8	66.1
Emotional, nervous, or psychiatric problems	10.2	23.0	44.7
Diabetes or high blood sugar	9.2	22.5	33.4
Heart attack, congestive heart failure, or other heart problems	9.1	20.6	37.9
Cancer or a malignant tumor of any kind (except skin cancer)	6.7	10.7	14.2
Chronic lung disease (except asthma)	3.6	10.7	24.5
Stroke or transient ischemic attack (TIA)	1.3	4.7	12.3

Note: Table 10 documents the sample mean of objective health measures by the degree of disability. The sample includes individuals in age between 50 and 65 from 1996-2008. The nominal out-of-pocket medical expenditure is adjusted using the Consumer Price Index (CPI) in 2014 U.S. dollar.

C Empirical Analysis

In this section, we documents additional robustness results of our benchmark empirical analysis reported in Section 4.1.

C.1 Testing for the common-trend assumption

We test for the common-trend assumption for the option to reduce working hours by introducing time-specific health dummies:

$$y_{it} = \alpha_h + \sum_{j=1998}^{2008} \beta_t^h \mathbb{I}_{\{\text{health}=h\}} + \boldsymbol{\gamma}\mathbf{X_{it}} + \boldsymbol{\nu}\boldsymbol{Z_t} + \epsilon_{it}. \tag{5}$$

Table summarizes the estimated coefficients.

Table 11: Testing for the Common-Trend Assumption

Dependent variable: Option to reduce working hours

Sample Restriction:	All workers		Newly hired workers		Non-College Graduates	
	Severely disabled	Moderately disabled	Severely disabled	Moderately disabled	Severely disabled	Moderately disabled
Health status	-0.019	-0.109	-0.040	-0.087	-0.146	-0.116
	(0.113)	(0.070)	(0.120)	(0.073)	(0.149)	(0.085)
Pre-WOTC expansion						
β_{1998}	-0.078	0.082	-0.045	0.051	0.098	0.141
	(0.155)	(0.088)	(0.165)	(0.092)	(0.195)	(0.104)
β_{2000}	0.121	0.012	0.044	0.003	0.244	0.030
	(0.146)	(0.084)	(0.175)	(0.099)	(0.178)	(0.102)
β_{2002}	0.299*	0.147	0.187	0.042	0.109	0.056
	(0.177)	(0.097)	(0.204)	(0.103)	(0.225)	(0.125)
Post-WOTC expansion						
β_{2004}	0.276*	0.204*	0.109	0.213*	0.345	0.319**
	(0.158)	(0.108)	(0.239)	(0.123)	(0.217)	(0.149)
β_{2006}	0.016	0.267***	0.109	0.246**	0.025	0.257*
	(0.157)	(0.093)	(0.163)	(0.101)	(0.195)	(0.133)
β_{2008}	0.040	0.116*	0.078	-0.020	0.204	0.257*
	(0.129)	(0.077)	(0.167)	(0.098)	(0.167)	(0.133)
R^2	0.098		0.103		0.136	
Number of observations	4,530		2,495		2,070	

Note: Table 11 reports the coefficient estimates of a regression equation (5). The sample is individuals in age between 50 and 65 from 1996-2008 and is weighted by individual-level survey weight. Newly hired workers are respondents who reported to work for a new employer within 2 years. A Non-college graduate is an individual with less than 12 years of schooling. Other regressors include age, age square, gender, average annual GDP, and dummy variables for industry, occupation, firm size, and union. Standard error is clustered at individual level. *** p<0.01, ** p<0.05, * p<0.1

C.2 ADA Amendment Act of 2008

We describe our empirical specification to examine the effects of labor market screening using the ADA Amendments Act in 2008. The empirical specification is similar to our specification for the WOTC Amendment in 2004:

$$y_{it} = \beta_1 \mathbb{I}_{\{t>2008\}} + \sum_{h \in \{\text{mod, sev}\}} \beta_{2h} \mathbb{I}_h + \sum_{h \in \{\text{mod, sev}\}} \beta_{3h} \mathbb{I}_{\{t>2008\}} \mathbb{I}_h + \boldsymbol{\gamma} \mathbf{X_{it}} + \boldsymbol{\nu} \boldsymbol{Z_t} + \varepsilon_{it}.$$

The dependent variable y_{it} indicates whether an individual i in time t has an option to reduce working hours or not. The definition of other regressors remains the same as those described in Equation (3). It is worth mentioning that even though we control for the aggregate economic conditions by including macroeconomic variables in Z_t, our results could be confounded by the Great Recession whose impact was unprecedented. Finally, we consider the sample period up to 2012 in this analysis. Table 12 summarizes the regression results.

Table 12: Effects of the ADA Amendment on Option to Reduce Working Hours

Dependent variable: Option to reduce working hours

Sample restriction:	2004-2014	
	Severely disabled	Moderately disabled
Health status (β_{2h})	0.057	0.115*
	(0.104)	(0.059)
Health Status×	0.079	-0.126*
Post-Amendment (β_{3h})	(0.113)	(0.064)
R^2	0.096	
Number of observations	3,299	

Note: Table 12 reports the coefficient estimates of the regression based on sample period 2004-2014. The sample includes individuals in age between 50 and 65 and is weighted by individual-level survey weight. Other regressors include age, age square, gender, average annual GDP, and dummy variables for industry, occupation, firm size, and union. Standard error is clustered at individual level. *** p<0.01, ** p<0.05, * p<0.1

For moderately disabled workers, the expansion of the ADA-eligible workers led to a *decrease* in the provision of option to reduce working hours. However, we find that there was no significant change among the severely disabled workers's amenity level after 2008. Again, these findings are consistent with the standard screening model's predictions as described in Section 4.1. While the severely disabled workers' contracts are unaffected, the employment contract for the moderately disabled depends on firms' screening incentives. These observations are suggestive evidence for our hypothesis that the option to reduce working hours can serve as a firm's screening device against workers with disabilities.

C.3 The Effects of WOTC on Employment

Table 13 documents the empirical results from the empirical analysis on employment.

Table 13: Effects of the WOTC-Amendment on Other Labor Market Outcomes

		Employment
WOTC_{2004}		0.034***
(β_1)		(0.004)
Health Status	Severe	-0.841***
(β_2)		(0.013)
	Moderate	-0.384***
		(0.009)
Health Status	Severe	-0.018
$\times$ WOTC_{2004}		(0.011)
(β_3)	Moderate	-0.016
		(0.011)

C.4 Robustness Analysis

We conduct robustness analyses with additional controls (Table 14) and under restricted sample (Table 15).

Table 14: Effects of the WOTC-Amendment with Additional Controls

		Option to reduce hours	
Health Status	Severe	0.229***	0.229***
(β_{2h})		(0.007)	(0.001)
	Moderate	0.118***	0.118***
		(0.003)	(0.003)
Health Status	Severe	0.021	0.021
$\times$ WOTC_{2004}		(0.792)	(0.797)
(β_{3h})	Moderate	0.107**	0.107**
		(0.025)	(0.026)
Additional Controls		Wage, Wage×Post	Wage, Wage×Post Gender×Post

Note: Sample in this regression analysis is restricted to high school graduates. The additional covariates used in the regression include age, age-squared, female dummy, self-reported health status dummy, firm-size categories dummy, union dummy, and annual growth rate of GDP. Standard error is clustered at individual-level.

Table 15: Effects of the WOTC-Amendment on Male Workers

		Option to Reduce Working Hours
Health Status	Severe	0.170*
(β_{2h})		(0.095)
	Moderate	0.045
		(0.051)
Health Status	Severe	−0.013
× Post-Amendment		(0.101)
(β_{3h})	Moderate	0.111**
		(0.052)
Sample Restriction		Male