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

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Abstract

We evaluate social insurance program designs for the disabled by empirically implementing a frictional labor market model with screening employment contracts. In the model, firms post a screening contract consisting of wage and job amenities, and workers with different levels of disability make labor supply decisions. We first theoretically analyze the optimal structure of disability insurance (DI) and employment subsidies to firms with disabled workers. Then, by exploiting labor-demand-side policy changes for the disabled in the United States, we empirically examine which job amenities may be used by firms to screen out the disabled, and we structurally estimate our equilibrium model. Using the estimated model, we quantitatively explore the optimal joint design of DI and employment subsidies. We find a welfare-improving role for employment subsidies that encourage firms to provide more job amenities, mitigating the labor supply disincentives of DI and labor market distortions induced by firms' screening contracts. Finally, we show that the presence of a firm's screening incentive significantly affects 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

Today, one in seven people in the working-age population in OECD countries regard themselves as having a disability (OECD, 2010). To support individuals with disabilities, the governments in these countries implement various social insurance policies. First, public disability insurance (DI) programs provide income support to disabled individuals who cannot work very much. Second, labor market policies for the disabled, such as the Americans with Disabilities Act (ADA) in the United States, aim to provide better job opportunities for disabled workers by prohibiting firms from discriminating against workers based on disability and by subsidizing firms to accommodate the disabled. Recently, there has been growing interest in reforming social insurance programs for disabled workers, especially because of concerns about the financial sustainability of the DI program, which is one of the largest government expenditure programs.[1] This interest has spurred discussions among economists and policy makers to consider more actively utilizing labor market policies to incentivize firms to employ the disabled, which may reduce DI expenditures.[2] These discussions suggest the need to understand the interactions between policy instruments for devising social insurance programs. Specifically, how should we jointly design DI and labor market policies for the disabled?

To address this question, it is essential to first understand how these policies affect both labor supply and labor demand with respect to the disabled. Although an extensive literature investigates the impact of the DI program on individual labor supply and welfare, only a few studies have investigated the response of firms to policies on either the labor demand side or the labor supply side. DeLeire (2000) and Acemoglu and Angrist (2001) argue that the introduction of the ADA substantially raised the cost of hiring disabled workers, thereby lowering the labor demand for these workers. These studies suggest that firms may have incentives to screen out (or avoid hiring) possibly costly disabled workers. However, to date, little is known about whether and how firms screen out disabled workers when they cannot explicitly discriminate against workers based on their disability statuses. Quantifying these behavioral responses is central to understanding how the government should design DI or employment subsidies.

This paper studies the efficient design of social insurance programs for disabled workers in an empirical equilibrium labor market model in which firms offer screening employment

[1] Currently, the U.S. government spends \$140 billion annually for cash benefits to DI recipients. On average, the OECD countries spend 2.1% of their GDP on disability- and incapacity-related social policy programs (OECD, 2016).

[2] For example, Autor and Duggan (2010) propose to expand employer-based disability insurance to make more firms accommodate the disabled in the United States. Moreover, many other OECD countries have gradually expanded labor market policies for the disabled to increase their employment rates (OECD, 2010).

contracts. Consistent with a long-held theoretical view that firms may screen workers using employment contracts (Akerlof, 1976), we hypothesize that firms may design job amenities (or non-wage benefits) to avoid hiring disabled workers. We think that a screening contract is a plausible screening mechanism in the presence of the ADA, which prohibits firms from explicitly discriminating against workers based on disability and mandates the provision of certain accommodations. In the first part of the paper, we develop an equilibrium screening model of the labor market with disability and disability policies and theoretically analyze the optimal design of disability policies. Then, by exploiting labor-demand-side policy changes for the disabled in the United States, we empirically examine which job amenity could be used to screen out disabled workers and structurally estimate the equilibrium model. Using the estimated model, we quantitatively analyze the optimal combination of DI and employment subsidies to firms with disabled workers.

Our model is based on labor market screening models, such as those of Akerlof (1976), Guerrieri et al. (2010), and Stantcheva (2014). We depart from these papers by incorporating disability and disability policies. In our model, workers differ by their disability statuses and by skill levels. A worker's disability status affects his disutility from work, output, and preference for job amenities. Workers optimally choose 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). Similarly, once deciding to recruit workers, firms choose wage and job amenities to maximize their profits. We assume that these contracts cannot explicitly depend on a worker's disability status, although they can still depend on the skill level. As a result, firms may adjust their contract terms (wage and job amenities) to screen workers with different degrees of disability, the extent of which may depend on workers' skill types.

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 and depend on the ex post profitability of firms, 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. Second, we can guarantee the existence and uniqueness of equilibrium, which may not be guaranteed in frictionless screening models. Within this framework, we introduce the key features of DI and employment subsidies: the former affects the worker's value of non-employment, and the latter affects the firm's profit.

Using this framework, we first analytically characterize the optimal structure of disability policies. We consider the government problem that maximizes social welfare subject to a revenue requirement. We show that the optimal policies are essentially determined by three channels. First, the optimal policy must reflect the redistribution (or insurance) channel:

DI provides income insurance for individuals who cannot work, while employment subsidies to firms with disabled workers can smooth the value of employment across workers with different disability statuses. Second, the optimal policy depends on behavioral distortions, which consist of distortions in job amenities (intensive margins of contracts) and employment rates. Third, the optimal policy depends on the strength of firms' screening incentives. Firms in the model offer an inefficiently small amount of job amenities to the non-disabled to discourage the disabled from applying for the job. Importantly, employment subsidies can mitigate the screening distortion by increasing the value of employment for disabled workers, while DI can mitigate it by increasing the value of non-employment. Thus, the government designs these policies to account for their impacts on firms' screening incentives.

Next, we use the Health and Retirement Study (HRS) to provide evidence of labor market screening, exploiting labor-demand-side policy changes for disabled workers. To begin with, we hypothesize that firms use flexibility in working hours, such as whether the job offers the option to reduce working hours, to screen out disabled workers. The provision of this job amenity is not necessarily mandated under the ADA. Compared with other job amenities such as employer-based health insurance, flexibility in working hours is often determined at each employee level, not at a firm level. Moreover, we find that the disabled tend to work at jobs that provide more flexibility in working hours, indicating their preferences for this job amenity.[3] Then, in order to examine whether the option to reduce working hours is used as a tool for screening out the disabled, we design our empirical strategy that exploits labor-demand-side policy changes, including the amendment to the Work Opportunity Tax Credit (WOTC) program in 2004 and the ADA Amendments Act of 2008.[4] These policies differentially affect firms' profits from recruiting disabled workers relative to non-disabled workers, inducing a plausibly exogenous variation in firm's screening incentives. By using these variations, we show suggestive evidence that the option to reduce working hours is responsive to firms' screening incentives for the disabled, implying that it may be the relevant screening tool (job amenity) that firms use in our model.

We then structurally estimate our equilibrium model using the option to reduce working hours as our job amenity measure, and we conduct an external validation of our estimated model. The main identification challenge in estimation is that the degree of labor market screening is endogenously determined in equilibrium, affected by parameters on both the labor supply side (the resource cost of providing the amenity benefit) and labor demand side

[3]In a related context, Ameriks et al. (2019) also show empirically that the work incentives of older workers depend on whether the job offers flexible working hours.

[4]The WOTC provides subsidies to firms employing workers in target groups; in 2004, the eligibility of qualified disability groups substantially expanded. The ADA was amended in 2008 to expand the eligibility of disabled workers for the ADA. A detailed description of the policies is discussed in Section 4.1.1.

(the worker utility from job amenities). To separately identify these parameters, we utilize the variation in the data induced by the labor-demand-side policy change for the disabled (the 2004 WOTC amendment). We estimate our model through an indirect inference procedure. Then, we conduct a model validation exercise and show that the model is able to produce an empirically plausible employment effect of DI, similar to those in the literature exploiting quasi-experiments (Maestas et al., 2013). From our estimates, we find that the inefficiencies in job amenities due to firms' screening contracts can be sizable: compared with the estimated screening model, the share of employees with the option to reduce working hours is 13% lower on average, if firms were allowed to offer disability-dependent contracts (i.e., in the economy without screening contracts).

Using the estimated model, we conduct various counterfactual analyses, including deriving the optimal combination of DI and employment subsidies. We specifically consider subsidizing the costs of providing job amenities related to the flexibility of working hours, which is implemented in several European countries.[5] We find that introducing a job amenity subsidy is effective in increasing welfare for workers of all disability statuses: these subsidies provide better consumption insurance among the employed against disability status and also ameliorate screening distortions in the labor market. Therefore, our finding suggests a potential welfare gain from subsidizing firms that hire disabled workers, which is not very prevalent in the United States, particularly relative to large expenditures on DI.

Interestingly, we also find that 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. Thus, the total spending on DI may decrease despite an increase in its generosity. Overall, we find that the increase in social welfare from the optimal structure can be equivalent to a 1.6% increase in consumption. 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 disability-dependent contracts). Because both DI and amenity subsidies are able to alleviate contract distortions in the screening economy, we find that the optimal DI benefit may be higher in the presence of screening than in its absence. This suggests the importance of incorporating firms' screening incentives in optimal policy design analyses.

Related Literature. First, this paper contributes to the literature studying disability in the labor market and disability insurance. An extensive literature focuses on measuring the labor supply effects of disability insurance, the early contributions of which are summarized

[5]Sweden, Norway, Great Britain, and Luxembourg provide financial incentives for employers to offer part-time positions to their disabled employees (OECD, 2010).

in Bound and Burkhauser (1999). This literature has made substantial progress by utilizing rich worker-side data with cutting-edge empirical techniques (e.g., French and Song, 2014; Maestas et al., 2013; and Autor et al., 2018).[6] Among them, Kostøl and Mogstad (2014) use Norwegian data to show that the partial availability of DI benefits to employed workers increases the work incentives of the disabled. The labor supply response is also the key ingredient in the literature theoretically analyzing the optimal disability insurance (e.g., Diamond and Sheshinski, 1995; and Golosov and Tsyvinski, 2006) and the literature quantitatively evaluating various DI designs (e.g., Low and Pistaferri, 2015; French and Song, 2017; and Michaud and Wiczer, 2018). Compared with this huge literature, there are still only a handful of studies investigating firm-side regulations or the labor-demand-side responses (see, e.g., DeLeire, 2000 and Acemoglu and Angrist, 2001, which evaluate the impact of the ADA on labor demand). To the best of our knowledge, this paper is the first to provide a formal analysis of disability policy designs incorporating both firm- and worker-side responses in an equilibrium labor market context. We substantially expand the scope of the 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 modeling firms' screening incentives motivated by labor market regulations. We show both theoretically and empirically that accounting for labor-demand-side responses to screening incentives is crucial in determining the optimal structure of policies for the disabled.

Second, our paper contributes to the large literature analyzing screening problems in the labor market. A pioneering work in this literature is the rat-race model developed by Akerlof (1976), who shows that a distortion in employment contracts arises in equilibrium if firms cannot observe workers' ability. Guerrieri et al. (2010) and Auster and Gottardi (2018) develop a general screening framework with search frictions.[7] More recently, Stantcheva (2014) theoretically studies optimal income taxation in the labor market screening model of Akerlof (1976). The key premise of this literature is that firms screen workers through labor contracts rather than through more direct means such as ability tests. Despite the wealth of this theoretical literature, few studies provide empirical evidence of the presence and characteristics of screening contracts in labor markets. A few exceptions are Landers et al. (1996) and Autor (2001): Landers et al. (1996) show that lawyers may work inefficiently long hours to reveal their abilities in large law firms, and Autor (2001) shows evidence that

[6]See also Deshpande (2016) that studies the long term effects of the access to DI.

[7]Davoodalhosseini (2017) theoretically studies the efficiency property of the directed search equilibrium with adverse selection and the optimal sales tax in that 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 for its dependence on firms' labor demand. This feature will be crucial in our application where we evaluate the impact of disability policies on the equilibrium employment rate.

training may be used as a screening tool for temporary help firms. This paper focuses on screening by disability statuses, where the firm's inability to write a type-dependent contract arises not only because of asymmetric information but also because of anti-discrimination laws. In this context, we develop an empirical strategy to detect the potential screening tool. Moreover, we quantify the degree of distortion in contracts and explore the optimal policy design by developing an empirical equilibrium screening model, which endogenizes employment through both labor supply and labor demand margins and allows heterogeneity in the value of being non-employed (the outside option of workers). With this structure, the model is able to capture the dependence of screening distortions on employment rates.

Finally, our paper contributes to the large literature analyzing designs of social insurance policies within an equilibrium labor market model. From a theoretical perspective, Acemoglu and Shimer (1999), Blanchard and Tirole (2008), and Golosov et al. (2013) emphasize the need for modeling the labor demand side to understand the determinants of the optimal social insurance program. From a quantitative standpoint, Mitman and Rabinovich (2015), Lise et al. (2016), Braxton et al. (2018), and Chodorow-Reich et al. (2019) investigate the equilibrium labor market implications of unemployment insurance systems. The literature emphasizes search frictions in the labor market as a source of welfare loss. Our paper advances this literature by determining the optimal joint design of worker-side and firm-side social insurance policies in an environment in which the information friction in the labor market is also a central ingredient.[8]

The rest of the paper is organized as follows. In Section 2, we present a search-frictional labor market model with screening and establish several theoretical results. Then, we discuss the main dataset in Section 3. Section 4 explains the main empirical strategies and findings. In section 5, we conduct counterfactual policy experiments. Finally, Section 6 concludes.

2 An Equilibrium Labor Market Screening Model

2.1 Model Environment

Workers. The 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 disability statuses (or health statuses that we use interchangeably), which we denote by $h \in \mathcal{H} \equiv \{1, 2, \cdots, H\}$ and their 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

[8] See also Corbae and Glover (2018), who study the impact of a policy that restricts pre-employment credit screening in a search-bargaining-matching model of the labor market with adverse selection.

decide whether to look for a job (extensive margin) and which job to apply for (intensive margin).

When workers are employed, they produce output denoted by $f_{h,x}$. 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* output of a worker *perceived by* firms. The heterogeneity in $f_{h,x}$ regarding h could be from productivity differences driven by health, due to the expected costs of mandated accommodation under the ADA, which vary with h, or from firms' discrimination against the disabled for taste reasons, as in Becker (1971). That is, firms might consider that they could incur additional costs in hiring disabled workers—a belief that arises from their prejudice.

Workers' preferences are represented by the utility function

$$U_{h,x}(c, a) = u(c) - (\chi_h - \beta_h \varphi(a))\, \mathbb{I}(\text{employed}),$$

where c denotes consumption and $\chi_h - \beta_h \varphi(a)$ captures the disutility from work, with a denoting the amount of job amenities provided by the firm. The worker derives utility from consumption through $u(c)$, which satisfies $u' > 0$ and $u'' \leq 0$. The disutility from work consists of a type-dependent fixed utility cost χ_h, and utility from job amenities $\beta_h \varphi(a)$. The job amenities increase the utility from work (or lower the disutility from work) through function $\varphi(a)$, which satisfies $\varphi' > 0$, $\varphi'' < 0$, $\lim_{a \to 0} \varphi'(a) = \infty$, 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.[9] Workers pay taxes on wages, so that $c = w - \tau(w)$, where $\tau(w)$ represents a tax (or subsidy) function. If an individual does not work, his consumption consists of home production b_x and the amount of disability insurance D_x from the government, which is awarded *probabilistically* (we discuss this further below). We flexibly allow these variables to be dependent on skill x and denote the utility from not working as $U^N_{h,x}(b_x, D_x)$.

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 the 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 because they are prohibited from

[9]Note that if there is multi-dimensional heterogeneity in individuals that are unobserved or not conditioned by firms, and that leads to a violation of Assumption 1 (introduced later), then it creates 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. See footnote 43 in Section 4.2.2 for details.

doing so under the ADA regulation or because of information friction (h is unobservable)[10,11]. When a worker type-(h, x) is hired, the firm's payoff is $v_{h,x}(w, a) = f_{h,x} - w - C(a)$, where $C(a)$ denotes the (net) cost of providing job amenities that satisfy $C' > 0$ and $C'' \geq 0$.[12]

Labor Market. The labor market is subject to search frictions, and firms and workers direct their search. The match is bilateral, that is, one job 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 because of our assumption that firms can directly offer skill-dependent contracts.

Market tightness, the ratio of firm vacancy to job applicants associated with a contract y_x is denoted by $\theta(y_x)$. 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-finding rate $\mu : [0, \infty] \to [0, 1]$ 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 $\eta : [0, \infty] \to [0, 1]$ 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 workers among those who apply to a contract y_x-submarket be $g_h(y_x)$, with $g_h(y_x) \geq 0$. From the firm's perspective, the probability of filling a vacant job in y_x-submarket with a type-h worker is $\eta(\theta(y_x))\, g_h(y_x)$. 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 the most favorable market tightness toward firms (i.e., $\theta = 0$) subject

[10]Strictly speaking, whether the ADA prohibits firms from offering health type-h dependent contracts depends on the interpretation of the monotonicity of $f_{h,x}$ in h. Specifically, the ADA does not strictly force firms to explicitly offer the same employment contract to workers with different disability statuses as long as their *true* productivity is different even after the workers are provided with the mandated accommodations. In this case, one should consider such a productivity difference as skill heterogeneity that firms can explicitly depend on in their employment contracts. However, firms' ability to offer these contracts became more limited after the ADA: the number of court cases has significantly increased, in which workers filed lawsuits claiming discrimination based on the ADA. Moreover, the ADA is strictly enforced if differential treatments among workers with different h are purely due to firms' misperception or discrimination (Acemoglu and Angrist, 2001). This indicates that $f_{h,x}$ itself may be endogenous to the ADA. In the rest of our analysis, we take the ADA as given and take $f_{h,x}$ as a primitive of the model.

[11]In practice, firms can, without violating the ADA, offer lower wages if individuals take leaves of absence because of the disability. We capture this with a in a reduced-form way. Alternatively, we can interpret the contract as a combination of wages $\{w_N, w_S\}$, where w_N is the salary if the individual works without any absences and w_S if he experiences absences. Firms may offer low w_S to screen disabled workers, yielding the same economic intuition as offering lower a.

[12]There might be ex ante heterogeneity among firms in terms of the efficiency in providing job amenities. While this might lead to heterogeneity in the degree of screening incentives across firms, it will not eliminate all screening incentives. Although richer firm-level predictions will be useful, the main qualitative findings should be similar to our simple model. We leave this extension to future work.

to the type-(h, x) worker's participation:

$$\bar{Y}_{h,x} = \Big\{ y_x \in \bar{Y}_x \Big| \, \eta(0) \, v_{h,x}(y_x) \geq \kappa \quad \text{and} \quad U_{h,x}(y_x) \geq U^N_{h,x}(b_x, D_x) \Big\},$$

where $\bar{Y}_x \equiv \cup_{h \in \mathcal{H}} \bar{Y}_{h,x}$. 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_x, $U_{h,x}(y_x)$, is greater than his outside option of $U^N_{h,x}(b_x, D_x)$.

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 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 the health-type index, then the monotonicity assumption also holds with (weak) inequality.

Government Policies. The government can choose the following three sets of policy instruments: (i) disability insurance, (ii) employment subsidies to firms, and (iii) wage tax (subsidy). We assume that the government imperfectly verifies the true type of workers (similar to Low and Pistaferri, 2015) when providing DI benefits and employment subsidies. The probability of identifying health type h as disabled is denoted by ψ_h. We assume $\psi_h \geq \psi_{h+1}$ so that the verification probability is increasing in one's severity of disability. This assumption of imperfect verification is empirically plausible and has been widely accepted in the disability literature. Moreover, this approach allows us to investigate an interesting policy design problem: if the government perfectly identifies the true disability type, it can undo all labor market distortions due to screening contracts by providing health-dependent lump-sum transfers. 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.[13]

Thus, for a given disability benefit level D_x, a type-(h,x) individual's expected utility from not working is $U^N_{h,x}(b_x, D_x) = \psi_h u(b_x + D_x) + (1 - \psi_h) u(b_x)$. Although our model abstracts from DI application decision, the DI status is still endogenously determined by the (extensive margin) labor supply decision and the probability of finding jobs, the latter of which depends on firms' labor demand. In Section 4.2.2, we show that the estimated model is able to generate empirically plausible predictions on the number of DI beneficiaries and employment effects of DI, which are important margins for counterfactual experiments. Similar to DI, firms hiring a worker with health status h receive a subsidy with probability

[13] One can, for example, model ψ_h as a policy instrument similar to costly verification models, that is, government decides how much resources to expend to correctly verify the true disability statuses of workers. In this paper, we focus on policy instruments for DI and employment subsidies.

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. Under the government policies, the firm's payoff from hiring a type-(h,x) worker is $v_{h,x}(w,a) = f_{h,x} - w - C(a) + T_h(w,a)$. Lastly, we denote the wage tax (subsidy) by $\tau(w)$.

2.2 Competitive Search Equilibrium (Given Policy Parameters)

Given the policy parameters, a competitive search equilibrium can be defined following Guerrieri et al. (2010).[14] First, in the equilibrium, firms maximize their profits and the free-entry condition, $\eta(\Theta(y_x)) \sum_h g_h(y_x) v_{h,x}(y_x) \leq \kappa$, holds with equality if $y_x \in Y_x^p$, where Y_x^p is the set of active submarkets for type-x workers and Θ represents a function of the market tightness over the contract $\Theta : Y_x \to [0,\infty]$. Second, conditional on the contracts posted and the search behaviors of others, each type-i worker maximizes the expected utility by searching for a job in the optimal submarket by solving

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

Note that this includes the possibility that if an active submarket does not exist, the worker chooses to stay out of the labor force. Lastly, the market clears; that is, for $\forall(h,x)$, $\int_{Y_x^p} \frac{g_h(y_x)}{\Theta(y_x)} d\lambda(\{y_x\}) \leq \pi_{h,x}$ is satisfied with equality if $\bar{U}_{h,x} > U_{h,x}^N(b_x, D_x)$.[15]

The equilibrium is a fully separating one; that is, given the same skill x, workers with different disability statuses apply to distinct submarkets that are characterized by a unique employment contract. There are two main issues in using this equilibrium concept in our context. First, to prove the existence and uniqueness of a separating equilibrium, we need to impose the monotonicity condition on the firm's profit in the worker's disability type, which is stated in Assumption 1. This constrains the range of employment subsidies that can be considered as they directly affect the firm's profit from hiring disabled workers. However, as long as the government does not want to make disabled workers more profitable for firms than non-disabled workers, it will not have an impact on our policy analyses.

Second, although the separating equilibrium is a standard feature in many screening models (e.g., Akerlof, 1976; Rothschild and Stiglitz, 1976), it has a very strong empirical

[14] We relegate the formal definition of the equilibrium of the economy to Appendix A.1. The proof of the existence and uniqueness of the equilibrium is a relatively straightforward extension of Guerrieri et al. (2010) and thus is omitted.

[15] In this model, we also need to specify reasonable beliefs about the market tightness off the active submarkets (Y^p) in equilibrium. Note that the market tightness function Θ is defined over Y_x, the set of feasible contract space for each type x, unlike the distribution of active contracts λ over Y_x^p. This distinction comes from the fact that our equilibrium concept requires workers to have reasonable beliefs about the payoffs of potential deviations from the equilibrium outcome.

implication in that workers with different disability levels receive different contracts. Our model is designed to address this concern by incorporating the skill heterogeneity x. It allows us to generate heterogeneity in observed employment contracts between workers of the same disability status while allowing for the possibility that workers of different disability statuses might receive the same employment contract. Thus, the model generates rich predictions that can be mapped to the data for an empirical application. Moreover, as shown in Sections 3 and 4, we observe that workers with different disability statuses tend to sort into jobs with distinctive features in their employment contracts, even after conditioning on many observed characteristics. Therefore, we think that the separating equilibrium is a plausible feature in our context.

2.3 Characterizing Equilibrium Allocations

In this section, we first describe the contract in the absence of screening, that is, the equilibrium contract when firms are allowed to post health-dependent contracts. We denote such an economy (contract) as a "no-screening economy (contract)" or "economy (contract) without screening."[16] 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 with Health-Dependent Contracts. Given the set of policy parameters, the no-screening equilibrium contract ("NS") solves

$$\begin{aligned} (P1) \quad \max \quad & \left\{ U^N_{h,x}\left(b_x, D_x\right), \max_{w,a,\theta} \left\{ \mu\left(\theta\right) U^E_{h,x}\left(w, a\right) + \left(1 - \mu\left(\theta\right)\right) U^N_{h,x}\left(b_x, D_x\right) \right\} \right\} \\ \text{s.t.} \quad & \text{(FE)} \quad \mu\left(\theta\right) \left\{ f_{h,x} - w - C\left(a\right) \right\} = \theta\kappa \\ & \theta \in [0, \infty], \; w \in [0, f_{h,x}], \; a \in \left[0, C^{-1}\left(f_{h,x}\right)\right], \end{aligned}$$

for each type-(h, x). 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 determined by

$$\beta_h \varphi'\left(a^{NS}_{h,x}\right) = u'\left(w\left(a^{NS}_{h,x}, \theta^{NS}_{h,x}\right)\right) C'\left(a^{NS}_{h,x}\right), \tag{1}$$

[16] This terminology is meant to emphasize that when firms are not allowed to write health-dependent contracts (or workers have private information), firms strategically use contracts to "screen" certain types of workers. We acknowledge, however, that in a broader sense, one can say that firms may screen workers at no cost (i.e., without using contracts as screening tools) under the "no-screening" economy.

where $w\left(a_{h,x}^{NS},\theta_{h,x}^{NS}\right) \equiv f_{h,x} - C\left(a_{h,x}^{NS}\right) - \theta_{h,x}^{NS}\kappa/\mu\left(\theta_{h,x}^{NS}\right)$ from (FE). Using the FOC with respect to θ, we obtain the equilibrium market tightness of a type-i worker:

$$\mu'\left(\theta_{h,x}^{NS}\right)\left[U_{h,x}^{E}\left(w_{h,x}^{NS},a_{h,x}^{NS}\right) - U_{h,x}^{N}\left(b_x,D_x\right)\right] = \mu\left(\theta_{h,x}^{NS}\right)u'\left(w(a_{h,x}^{NS},\theta_{h,x}^{NS})\right)\left.\frac{d\left(\theta\kappa/\mu\left(\theta\right)\right)}{d\theta}\right|_{\theta=\theta_{h,x}^{NS}}.$$

It is difficult to establish theoretical properties of the no-screening outcomes under general classes of preferences. However, with 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 $\varphi\left(\cdot\right)$, 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 $\mu\left(\cdot\right)$, and as long as the term $f_{h,x} - C\left(a_{h,x}^{NS}\right)$ of healthier types is 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 healthier types ($w_{h+1,x}^{NS} > w_{h,x}^{NS}$), which is driven by higher productivity and lower job amenity costs of healthier workers.

Equilibrium with Screening Contracts. 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 workers do not mimic healthy workers. Similar to the results in Guerrieri et al. (2010), the least healthy workers participating in the labor market receive the no-screening contract. Consider the least healthy worker and denote his utility from entering a submarket with contract $\left(w_{1,x}^{NS},a_{1,x}^{NS}\right)$ as $\bar{U}_{1,x}$, which is expressed as

$$\bar{U}_{1,x} \equiv U_{1,x}^{N}\left(b_x,D_x\right) + \mu\left(\theta_{1,x}^{NS}\right)\left\{u\left(w_{1,x}^{NS}\right) - \left(\chi_1 - \beta_1\varphi\left(a_{1,x}^{NS}\right)\right) - U_{1,x}^{N}\left(b_x,D_x\right)\right\}.$$

We then solve for the equilibrium contracts sequentially for each health type $h \geq 2$ (given skill level x), by solving a problem similar to that in Problem (P1) but taking into account the incentive compatibility (IC) constraint:

$$\text{(IC)} \qquad \mu\left(\theta\right)U_{h-1,x}^{E}\left(w,a\right) + \left(1-\mu\left(\theta\right)\right)U_{h-1,x}^{N}\left(b_x,D_x\right) \leq \bar{U}_{h-1,x}. \tag{2}$$

The (IC) constraint (Equation (2)) 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 the optimization problem with the (IC) constraint, which is used to obtain the equilibrium sequentially.[17]

One can establish various theoretical properties in the environment with risk-neutral workers. Using the optimality conditions, we can show that if the (IC) binds for type-(h,x), his job amenity in the screening contract is 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. A useful feature of a search-frictional labor market is the equilibrium determination of the market tightness, and thus the employment rates. By imposing certain parametric assumptions, we can further show that $\theta^S_{h,x} > \theta^{NS}_{h,x}$ and $w^S_{h,x} > w^{NS}_{h,x}$ if (IC) binds for type-(h,x). These results are proved in Appendix A.2.

Lastly, we emphasize that if the contract that satisfies the zero-profit condition for firms is less attractive than the outside option, some types prefer to stay out of the labor force completely. This occurs if the value of staying out of the labor force, $U^N_{h,x}(b_x, D_x)$, is greater than $\mu(\theta)\{u(w) - (\chi_h - \beta_h\varphi(a))\} + (1-\mu(\theta))\,U^N_{h,x}(b_x, D_x)$. In this case, the worker type that receives the no-screening contract may not be the lowest type in the health status space.

2.4 Optimal Policy Design in a Simplified Model

Let government policies be denoted by $\boldsymbol{p} \equiv \{D_x, T(w,a), \tau(w)\}$. Given welfare weights for 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:

$$\begin{aligned}
&\max_{\boldsymbol{p}} \sum_{i\in I} \omega_i \left[\mu\left(\theta^*_i(\boldsymbol{p})\right) U^E_i\left(w^*_i(\boldsymbol{p}), a^*_i(\boldsymbol{p})\right) + \left(1-\mu\left(\theta^*_i(\boldsymbol{p})\right)\right) U^N_i(b_i, D_x)\right] \\
\text{s.t.}\quad &\sum_{i\in I} \pi_i \left[\left(1-\mu\left(\theta^*_i(\boldsymbol{p})\right)\right)\psi_i D_x + \mu\left(\theta^*_i(\boldsymbol{p})\right)\psi_i T\left(w^*_i(\boldsymbol{p}), a^*_i(\boldsymbol{p})\right)\right] = \sum_{i\in I} \pi_i \mu\left(\theta^*_i(\boldsymbol{p})\right)\tau\left(w^*_i(\boldsymbol{p})\right),
\end{aligned}$$

where $\{w^*_i(\boldsymbol{p}), a^*_i(\boldsymbol{p}), \mu^*_i(\theta^*_i(\boldsymbol{p}))\}_{i=\mathcal{I}}$ 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]

[17] It is important to note that the difference between the equilibrium with and without screening contracts does not capture the effect of the ADA. As mentioned before, the ADA itself may affect $f_{h,x}$. For example, if the ADA decreases (increases) $f_{1,x}$, then it implies that the employment rate of the most disabled may decrease (increase) as well.

[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 in equilibrium. As the model is static, we do not consider such a case. However, even in a dynamic framework, if the workers' disability types change over time and the employment contract in the previous period does not fully predict the realization of disability status this period, the government cannot implement disability-dependent policies. This intuition is similar to the intuition in the dynamic public finance literature. The dynamic extension of the framework is left for future research.

To understand the determinants of optimal policies, we first theoretically analyze the optimal conditions for two specific policies: (i) a proportional job amenity subsidy to firms, that is, $T_h(w,a) = SC(a)$, where S denotes the subsidy rate; and (ii) public disability insurance with benefit amounts of D_x, both of which are financed by lump-sum taxes on employed workers. To make the analysis tractable, we consider a simplified version of the model. We assume that workers are homogeneous in their skill levels x (so that $D_x = D$), and all the workers choose to participate in the labor market. Moreover, to find the optimal subsidy S, we also assume that the verification probability of the disability statuses of workers is binary, that is, $\psi_h \in \{0,1\}$ with $\psi_h \geq \psi_{h+1}$. This assumption is not essential but allows us to simplify the mathematical expression. We show the determinants of the optimal policy in an economy without and with labor market screening, following the approach by Saez (2001) and Chetty (2006), with proofs relegated to Appendix A.3. This helps us to understand the mechanisms determining the optimal policies using economically interpretable variables, before the numerical implementation of the model.

Proposition 1. ***Optimal Employment Subsidies.***
(a) The optimal amenity subsidy rate in an economy without labor market screening satisfies

$$\frac{S}{1-S} = \frac{1-\overline{C}(\boldsymbol{a},\boldsymbol{\theta})}{\widetilde{\epsilon}_{C(\boldsymbol{a}),1-S} + \widetilde{\epsilon}_{\mu(\boldsymbol{\theta}),1-S}},$$

where $\overline{C}(a,\theta) = \left[\frac{\sum_i \omega_i \mu(\theta_i) u'(c_{e,i}) \varphi_i C(a_i)}{\sum_i \omega_i \mu(\theta_i) u'(c_{e,i})}\right] / \left[\frac{\sum_i \pi_i \mu(\theta_i) \varphi_i C(a_i)}{\sum_i \pi_i \mu(\theta_i)}\right]$ *with* $c_{e,i}$ *denoting the consumption of employed workers of type-i; and* $\left(\widetilde{\epsilon}_{C(a),1-S}, \widetilde{\epsilon}_{\mu(\theta),1-S}\right) \equiv \left(\sum_i \alpha_i \epsilon_{C(a_i),1-S}, \sum_i \alpha_i \epsilon_{\mu(\theta_i),1-S}\right)$ *are the weighted averages of elasticities defined as* $\epsilon_{C(a_i),1-S} = \frac{d\log C(a_i)}{d\log(1-S)}$*;* $\epsilon_{\mu(\theta_i),1-S} = \frac{d\log\left(\frac{\pi_i\mu(\theta_i)}{\sum_k \pi_k \mu(\theta_k)}\right)}{d\log(1-S)}$*; and* $\alpha_i = \frac{\pi_i \mu(\theta_i)\psi_i C(a_i)}{\sum_k \pi_k \mu(\theta_k)\psi_k C(a_k)}$.
(b) The optimal amenity subsidy rate in an economy with labor market screening satisfies

$$\frac{S}{1-S} = \frac{1-\overline{C}(\boldsymbol{a},\boldsymbol{\theta})}{\widetilde{\epsilon}_{C(\boldsymbol{a}),1-S} + \widetilde{\epsilon}_{\mu(\boldsymbol{\theta}),1-S}} + \sum_i \omega_i \mathbb{I}_i^{IC} \left(\frac{\mu(\theta_i) \frac{a_i}{1-S} \epsilon_{a_i,1-S} \left(-\xi_{a,i}\right) + \frac{\theta_i}{1-S} \epsilon_{\theta_i,1-S} \left(-\nu_{\theta,i}\right)}{\widetilde{C}(\boldsymbol{a},\boldsymbol{\theta}) \bar{U}'(\boldsymbol{c}_e) \left(\widetilde{\epsilon}_{C(\boldsymbol{a}),1-S} + \widetilde{\epsilon}_{\mu(\boldsymbol{\theta}),1-S}\right)} \right),$$

where $\widetilde{C}(\boldsymbol{a},\boldsymbol{\theta}) = \frac{\sum_j \pi_j \mu(\theta_j) \varphi_j C(a_j)}{\sum_j \pi_j \mu(\theta_j)}$*;* $\bar{U}'(\boldsymbol{c}_e) = \sum_i \omega_i \mu(\theta_i) u'(c_{e,i})$*;* $\xi_{a,i} = u'(c_{e,i})(1-S\varphi_i)C'(a_i) - \beta_i \varphi'(a_i)$*;* $\nu_{\theta,i} = -\mu'(\theta_i)(u(c_{e,i}) - u(c_{u,i})) - \mu(\theta_i) u'(c_{e,i}) \frac{\partial \frac{\kappa\theta_i}{\mu(\theta_i)}}{\partial \theta_i}$*;* $\epsilon_{a_i,1-S} = \frac{d\log a_i}{d\log(1-S)}$*;* $\epsilon_{\theta_i,1-S} = \frac{d\log\theta_i}{d\log(1-S)}$*; and* $\mathbb{I}_i^{IC} = 1$ *if the (IC) binds with* $c_{u,i}$ *denoting the consumption of non-employed workers of type-i.*

Proposition 1 (a) shows that the optimal amenity subsidy in an economy without screening is determined by the usual two mechanisms. First, it depends on the redistributive motive and the insurance role of the government, which is captured by $\overline{C}(\boldsymbol{a},\boldsymbol{\theta})$. This term measures the concentration of amenity spending per employed worker[19] relative to the redistributive preference and insurance benefit captured by the welfare weight ω_i and the marginal utility of consumption of a type-i employed individual, $u'(c_{e,i})$. If the government is utilitarian and the individual is risk-neutral, then $\overline{C}\left(\boldsymbol{a},\boldsymbol{\theta}\right) = 1$ and the optimal subsidy should be zero. Second, the optimal subsidy depends on the magnitudes of its distortionary effects on firm's, represented by the elasticities $\widetilde{\epsilon}_{C(a),1-S}$ and $\widetilde{\epsilon}_{\mu(\theta),1-S}$. The term $\widetilde{\epsilon}_{C(a),1-S}$ is the average elasticity of the costs of amenities $(C\left(a\right))$ with respect to the amenity's effective (net-of-subsidy) marginal cost $(1-S)$, weighted by the share of amenity costs on type-i (α_i). The term $\widetilde{\epsilon}_{\mu(\theta),1-S}$ is the average elasticity of employment $(\mu\left(\theta\right))$ analogously defined. These two terms capture policy-driven changes in both the contracts of employed workers and employment levels. Higher subsidies may lead firms to offer more amenities and job positions. This contributes to increasing government expenditures, which may be inefficient. The government balances these two effects—the redistributional and behavioral effects—to optimally determine the subsidy rate. Thus, in an economy without screening, amenity subsidies play the role of redistributing resources from the non-disabled to the disabled.

Proposition 1 (b) then shows that the optimal amenity subsidy in an economy with screening reflects an additional channel, which we call the screening effect. This effect is analogous to the "rat-race" effect in the environment of Stantcheva (2014). In our model, there are two margins to be considered—the amenity margin $(\xi_{a,i})$ and the employment margin $(\nu_{\theta,i})$—both of which are only operable if the incentive compatibility constraint is binding $(\mathbb{I}_i^{IC} = 1)$.[20] The point is that a change in the subsidy rate also affects the firm's incentive to screen workers with worse disability conditions. Intuitively, higher subsidies make it more profitable for firms to hire severely disabled workers who value job amenities more. As a result, the incentive compatibility constraint can be relaxed as more subsidies are provided. This is also beneficial to healthier workers, whose job amenities tend to be under provided. Thus, the presence of screening distortions may generate an additional rationale for increasing subsidies.

Next, we characterize the optimal DI in a similar approach.

Proposition 2. ***Optimal Disability Insurance.***

[19]The relevant cost is the total expected (weighted by ψ_i) cost of amenities, $\sum_i \pi_i \mu\left(\theta_i\right) \varphi_i C(a_i)$, divided by the measure of employed workers, $\sum_i \pi_i \mu\left(\theta_i\right)$, reflecting that tax is only paid by employed workers. If taxes are paid regardless of employment statuses, the relevant cost measure is $\sum_i \pi_i \mu\left(\theta_i\right) \varphi_i C(a_i)$. Similar effects are present in both $\bar{C}(\boldsymbol{a},\boldsymbol{\theta})$ and $\widetilde{C}(\boldsymbol{a},\boldsymbol{\theta})$.

[20]These effects are adjusted by the product of average amenity spending $\tilde{C}\left(\boldsymbol{a},\boldsymbol{\theta}\right)$, weighted average of marginal utility of employed workers $\bar{U}'\left(\boldsymbol{c}_e\right)$, and elasticities $\widetilde{\epsilon}_{C(\boldsymbol{a}),1-S} + \widetilde{\epsilon}_{\mu(\boldsymbol{\theta}),1-S}$.

(a) The optimal DI benefit in an economy without labor market screening satisfies $\overline{E}(\boldsymbol{\theta}) = \widetilde{\epsilon}_{E,D} + 1$*, where* $\overline{E}(\boldsymbol{\theta}) = \left[\frac{\sum_i \omega_i(1-\mu(\theta_i))u'(c_{u,i})\psi_i}{\sum_i \omega_i \mu(\theta_i) u'(c_{e,i})}\right] / \left[\frac{\sum_j \pi_j(1-\mu(\theta_j))\psi_j}{\sum_j \pi_j \mu(\theta_j)}\right]$*; and* $\widetilde{\epsilon}_{E,D} = \frac{d\log \tilde{E}(\boldsymbol{\theta})}{d\log D}$ *with* $\widetilde{E}(\boldsymbol{\theta}) = \frac{\sum_j \pi_j(1-\mu(\theta_j))\psi_j}{\sum_j \pi_j \mu(\theta_j)}$ *is the elasticity of the fraction of DI recipients over the employed with respect to the disability benefit.*

(b) The optimal DI benefit in an economy with labor market screening satisfies

$$\overline{E}(\boldsymbol{\theta}) + \sum_i \omega_i \mathbb{I}_i^{IC} \left(\frac{\mu(\theta_i) \frac{a_i}{D} \epsilon_{a_i,D} \xi_{a,i} + \frac{\theta_i}{D} \epsilon_{\theta_i,D} \nu_{\theta,i}}{\bar{U}'(\boldsymbol{c}_e)\, \widetilde{E}(\boldsymbol{\theta})\, \widetilde{\epsilon}_{E,D}} \right) = \widetilde{\epsilon}_{E,D} + 1,$$

where $\epsilon_{a_i,D} = d\log a_i / d\log D$ *and* $\epsilon_{\theta_i,D} = d\log \theta_i / d\log D$*.*

The basic intuition of Proposition 2 is similar to that of Proposition 1. Proposition 2 (a) states that optimal DI is set in order to balance the redistributional-insurance channel ($\overline{E}(\boldsymbol{\theta})$) with the distortionary behavioral effect ($\widetilde{\epsilon}_{E,D}$). Essentially, the government wants to smooth the welfare-weighted marginal utility of consumption across individuals with different employment statuses and different disability types.[21] However, such incentives should be balanced by noting that they may distort the size of DI recipients: a higher DI benefit reduces workers' utility gain from employment, which induces firms to offer either higher wages or more job amenities, thereby lowering their profits and leading them to post fewer jobs.

Proposition 2 (b) captures the additional screening channel, as in the optimal employment subsidy case. Higher DI increases the utility from non-employment for the disabled. Because, for the disabled, the employment probability is relatively lower in his own submarket, the net benefit from entering the non-disabled worker's submarket decreases. Moreover, higher DI increases wages in his own submarket for the disabled by increasing the outside option. These channels discourage the disabled to apply to other submarkets, relaxing the (IC) constraint and reducing screening distortions. Finally, it is important to note that these economic forces can be strengthened if we also endogenize the labor force participation decision of workers. Higher DI makes the disabled more likely to leave the labor market, amplifying the employment distortion. However, such an effect may relieve the contract distortions on other workers, as they are less likely to enter the labor market intended for other types.[22]

It is important to point out the differential role of DI and job amenity subsidies. First,

[21] Note that if there is no labor market response (i.e., $\widetilde{\epsilon}_{E,D} = 0$), then the optimal policy is designed so that $\frac{\sum_i \omega_i(1-\mu(\theta_i))u'(c_{u,i})\psi_i}{\sum_i \omega_i \mu(\theta_i) u'(c_{e,i})} = \frac{\sum_j \pi_j(1-\mu(\theta_j))\psi_j}{\sum_j \pi_j \mu(\theta_j)}$. Specifically, if there is only one type of worker, then the utilitarian preference implies that $u'(c_{u,i}) = u'(c_{e,i})$.

[22] Although we decided to leave out the endogenous labor force participation in our theoretical analysis for simplification, it is still certainly possible to examine this margin by applying the generalized envelope theorem established by Milgrom and Segal (2002).

they play different roles in redistribution: the DI benefit redistributes resources from employed workers to the "non-employed" disabled. On the other hand, job amenity subsidies induce redistribution from employed workers to the "employed" disabled. Second, they have differential employment effects: while job amenity subsidies may increase the employment of disabled workers, the DI benefits may decrease it.[23] These considerations highlight the fact that optimal policy design requires the joint analysis of these two policy instruments. Moreover, these propositions highlight the need for recovering the full structure of the model for quantitative evaluations of the optimal policies. If screening is present, optimal policies depend not only on easily measurable sufficient statistics, but also on other economic variables, such as the marginal utility from job amenities, among others. Our goal in the remainder of the paper is to conduct such a joint quantitative analysis.

3 Data

Our primary data source is the Health and Retirement Study (HRS). The HRS is a biennial panel survey developed in 1992 and consists of more than 20,000 individuals representing the U.S. population over the age of 50. Among readily available datasets, the HRS is an appealing one for our purposes for the following two reasons. First, it covers relatively older individuals, who are more likely to be disabled compared with younger individuals. Second, it provides a wealth of information on disability and job amenities that are offered to employed workers. This allows us to examine a number of robustness checks. In our main empirical analysis, we focus on individuals between ages 51 and 64 to focus on the population whose labor market outcomes are less affected by other 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 to the period 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 42,352.

Health Measures. We categorize the degree of disability based on two variables: the self-reported work limitation and the self-reported health evaluation (see Table 7 in Appendix C). 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 a commonly used measure of disability in the literature, we still

[23] In an environment in which the verification probability of disability status ψ_i is interior, subsidizing the firm can potentially be welfare enhancing compared to DI. Because firms are risk-neutral, they can insure the risk of imperfect verification when they determine employment contracts. On the other hand, risk-averse workers face the full risk of verification errors when they are offered the disability benefit.

find 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 measure with the health evaluation, which records self-reported health status on a scale from 1 (excellent) to 5 (poor).

We consider an individual as *non-disabled* if he does not have a work limitation and reports his health status as good, very good, or excellent. On the other hand, an individual is defined as *severely disabled* if he has a work limitation and reports his health status as fair or poor. We define all others, those who either have a work limitation but report being healthy (good, very good, or excellent) or do not have a work limitation but report being relatively unhealthy (fair or poor), as *moderately disabled.* According to our categorization, 15% of workers are severely disabled, 18% are moderately disabled, and the rest (67%) are non-disabled. In Appendix C, we show that our disability measures are highly positively correlated with a variety of objective health variables in the HRS. Moreover, we discuss the robustness of our results with respect to the choice of disability measures in Section 4.1.2.

Job Amenity Variables. Another benefit of using the HRS is that it provides detailed information on respondents' labor market outcomes. It reports not only standard measures (such as employment status, working hours, and wages) but also non-wage benefits that we call "job amenities." This information is particularly important for our analysis because firms might exploit these amenities to screen workers with different disability statuses.

In this section, we document the job amenity variables that are available in the HRS and their summary statistics by the degree of disability. To begin with, we focus on job amenities that could be related to the work preferences of the disabled but are not mandated under the ADA. We impose such restrictions mainly because it is less plausible to assume that the accommodations mandated under the ADA could be used as screening tools. This concern eliminates accommodation measures such as physical equipment for the disabled from the possible data counterparts of job amenities within our model framework.[24]

Summary Statistics. Table 1 documents descriptive statistics for our sample 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, is worse than their healthier counterparts.

[24]The HRS asks employed respondents with a reported work limitation whether they receive any types of accommodations from their employers. 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. However, individuals who do not report a work limitation are not asked about these accommodation measures.

Table 1: Descriptive Statistics by Disability Status

Category	Variable	Disability status: Non-disabled	Moderately disabled	Severely disabled
Fraction of disability type		0.67	0.18	0.15
Demographics	Age	58.1	58.6	58.6
	Female (%)	54.5	56.5	56.8
	Years of schooling	13.7	12.1	11.4
Labor market	Employment rate (%)	73.6	47.9	14.3
	Working hours per week	40.6	39.2	37.0
	Hourly wage ($2014)	17.8	14.5	13.7
	Weekly Earnings ($2014)	744.1	582.8	524.7
Job amenities	Option to reduce working hours (%)	32.6	32.6	38.2
	Available sick leaves (days)	9.2	16.7	27.6
	Option to change from full- to part-time (%)	57.5	69.2	67.2
	Employer-sponsored DI coverage (%)	53.2	42.0	42.2

Note: This table reports the summary statistics by disability status, weighted by the individual-level survey weight. Observations are limited to individuals between ages 51 and 64 from 1996 to 2008, employed in the private sector with a full-time position. The hourly wage rate is written in 2014 U.S. dollars using the CPI. Wage rates lower than $4 are dropped, and the top 5% of wage observations are truncated. Earnings are constructed using the individual-level information on hourly wage and working hours.

Importantly, we find that workers with different disability statuses sort into jobs with different job amenities. In general, disabled workers tend to work at jobs that provide more flexible working hour arrangements. For example, disabled workers are more likely to work at jobs that provide the option to reduce working hours, that allow them to change from full- to part-time positions, or that have more sick leaves. They are, however, less likely to work at jobs providing employer-sponsored disability insurance. Although these summary statistics do not control for worker or firm characteristics, we view the correlation between job amenities and disability status as indicative of the preference heterogeneity between disabled and non-disabled workers.

4 Empirical Analysis

This section describes our empirical approach to detect a relevant screening tool and estimate our equilibrium model. In the first part of this section, we introduce our empirical design that exploits policy changes and discuss the results along with the theoretical predictions from screening models to show suggestive evidence that firms use the option of reduce working hours to screen the disabled. Then, in the second part of the section, we discuss how to identify and estimate our equilibrium model.

4.1 Firm Screening Devices

To investigate how firms screen disabled workers, we hypothesize that firms may use the job amenity of flexible working hours as a major screening tool. As shown in Section 3, more severely disabled workers tend to work at a job that provides more flexibility in their work schedule. If this captures their preference heterogeneity relative to non-disabled workers, firms can possibly exploit this margin to screen disabled workers. Moreover, providing flexibility in working hours is often determined at each worker level, whereas the provision of other job amenities such as employer-based health insurance or employer-based private DI is determined at the firm level. Therefore, compared to other amenities, firms may have more discretion in designing the job amenity to attract certain types of workers.

Importantly, this job amenity is not necessarily mandated under the ADA. Although the ADA requires employers to provide "reasonable" accommodations for their employees with disabilities, firms are exempted from this accommodation clause if the provision of the accommodation would impose undue hardship on their business operations (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."[25] This definition indicates that the accommodation exemptions are based on factors beyond a financial burden. According to court cases, firms are not required to modify regular work schedules or provide extensive sick leaves if they can prove that the nature of their business requires employees to follow regular working hours or that these accommodations cause undue hardship.[26] Thus, it is likely that compared to other mandated accommodations (such as special equipment), there are fewer legal restrictions preventing firms from using flexibility in working hours to screen disabled workers.

In our empirical analysis, we use the option to reduce working hours as the main outcome variable. While the HRS reports several measures related to working hour flexibility (e.g., the option to change from full- to part-time, paid sick leaves), a particular attribute of the option to reduce working hours is that it is more broadly defined than other measures. Thus, this variable may capture different practices that firms use to engage in screening. Furthermore, in our dataset, the number of respondents who record a valid response to the

[25]The 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/) in November 2018.

[26]Recently, several court decisions—*e.g., The Equal Employment Opportunity Commission v. Ford Motor Company* (2015) and *Williams v. AT&T Mobility Services LLC* (2017)—ruled that *regular and in-person attendance* is an essential function for the job, and in those decisions, disabled workers' requests for additional breaks, flexible starting or ending times for medical reasons, telecommunication, or medical leaves were not considered as reasonable accommodations under the ADA.

survey question asking whether their job offers the option to reduce working hours is three to five times that of other amenities. Thus, using the option to reduce working hours as our candidate screening tool will allow for statistically more precise estimation of whether it is used as a screening tool. Although we still report the estimates from other variables in Appendix D.3, the rest of our analysis in the main text focuses on the option to reduce working hours. Finally, it is important to note that the provision of flexibility in working hours is affected by many other factors unrelated to the issue of screening. As discussed in Section 4.1.2, we design our empirical strategy to address these concerns.

4.1.1 Policy Changes for the Disabled

To examine how firms screen workers, we utilize policy changes which lead to a plausibly exogenous variation in firms' relative profits from hiring a disabled worker compared to a non-disabled worker. Two main labor-demand-side policy changes for the disabled we consider are the 2004 amendment to the Work Opportunity Tax Credit and the ADA Amendments Act of 2008.

Work Opportunity Tax Credit and Its 2004 Amendments. The Work Opportunity Tax Credit (WOTC) is a federal tax credit program that was implemented in 1996 in an effort to improve the labor market outcomes of economically disadvantaged individuals (Scott, 2013). Under the WOTC, firms can receive tax credits when they hire workers from certain "target groups." These target groups include workers with disabilities who are hired through state-run vocational rehabilitation agencies and former disabled Social Security Income (SSI) recipients. For eligible hires with disabilities, employers receive an annual tax credit, which usually amounts to $2,400. In 2004, the WOTC expanded the eligibility criteria for people with disabilities. Importantly, the WOTC certificates are issued to firms hiring the disabled through Employment Networks, non-government entities providing job training and referral services, instead of restricting qualification to disabled workers who receive job referrals through state-run vocational rehabilitation agencies. We think that this WOTC amendment has a meaningful impact on the utilization of hiring subsidies not only because of a direct effect that expanded the eligibility of the program[27], but also because of an indirect effect that increased the visibility of the program. Indeed, U.S. Government Accountability Office

[27]The disabled workers who newly became qualified after the WOTC amendment are essentially SSI or SSDI beneficiaries participating in the Ticket-to-Work (TtW) program. As discussed by Autor and Duggan (2006), the participant rate in the TtW program was very low before 2003 at less than 1% among concurrent SSDI and SSI beneficiaries. However, it has gradually increased from 2004, reaching at about 6.4% in 2010 (Schimmel et al., 2013). Although whether the TtW program successfully increases the disabled workers' labor market attachment is still debated, we think that the expansion of the eligibility of the WOTC made it more accessible for firms to receive subsidies by hiring disabled workers.

(2002) and Hamersma (2003) discussed the limited utilization of the WOTC between 1997 and 2001 and the need for raising firms' awareness of the program. Possibly due to these government efforts, we find that after 2004, the average number of WOTC certificates for the disabled increased by 35%.[28]

We consider that the passage of the 2004 amendment generates a plausible exogenous variation in the firms' profits from hiring a disabled worker.[29] The size of the tax credit is comparable with the wage difference between the severely disabled and moderately disabled: if we assume that both work full-time, their annual wage difference is approximately \$2,900 ($\approx$ (\$582.8 − \$524.7) $\times$ 50), given the statistics reported in Table 1. Moreover, the expected employment duration of new hires with ages older than 50 tend to be very short at less than 3 years on average in our data. Thus, the expansion of the eligibility of the WOTC can have a meaningful impact on firms' profits from hiring disabled workers.

ADA Amendments Act of 2008. In 2008, the ADA Amendments Act (ADAAA) was passed to broaden and clarify the definition of disabilities. The ADAAA does not specifically name all of the impairments that are covered. Instead, under the ADAAA, a person is considered disabled if 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 could plausibly increase the firm's expected cost of hiring disabled workers by allowing more disabled workers to be subject to labor market protection.

4.1.2 Empirical Specification and Findings

We now describe our approach for testing whether the option to reduce working hours is used to screen disabled workers. We hypothesize that if a certain job amenity is used to screen workers, then it would be responsive to the screening incentive, as is consistent with

[28] The average number of WOTC certificates for the disabled remained stable in 2002 and 2003 (Levine, 2005). After the 2004 amendment, the issued certificates for the vocational rehabilitation job referral target group increased by 35% (from 18,300 to 24,600 annually). Similarly, the average number of certificates for SSI recipients increased by 30% (from 25,900 to 33,800). We compute the post-amendment average using years 2005 and 2007 because the data for years 2004 and 2006 do not reflect the accurate size of the program due to 9-month and 13-month hiatuses, respectively (Employment and Training Administration, WOTC Certifications by Target Group 2002 to 2013).

[29] While the introduction of the WOTC could serve as an exogenous labor demand shock, in the same year, the Personal Responsibility and Work Opportunity Reconciliation Act of 1996 was enacted, making it difficult to disentangle the impact of the WOTC.

the predictions from screening models. We now explain our empirical design, which utilizes two policy changes discussed in Section 4.1.1.

The 2004 Amendments of the WOTC. We first examine whether firms use the option to reduce working hours to screen the disabled by exploiting the WOTC amendment. We use the following empirical specification:

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

The dependent variable (y_{it}) is whether the job provides the option to reduce working hours for an individual i in year t, which is a binary variable in our data ($y_{it} \in \{0, 1\}$). The independent variables X_{it} consist of individual-level control variables such as demographics (e.g., gender, education, age), employees' firm and occupation characteristics (e.g., firm size, occupation), and workers' objective health status (e.g., diagnosis type, such as arthritis or diabetes, and number of limitations in activities of daily living).[30] Moreover, the vector $\boldsymbol{Z}_t$ includes macroeconomic controls (e.g., the aggregate employment rates and the growth rates of GDP).[31] We control for these individual and firm characteristics to account for many factors affecting the variation in job amenities unrelated to disability. In particular, by including the health-related measures, we are able to control for the within-disability-group heterogeneities. 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-amendment) dummy. This coefficient captures the disability-specific effect of the WOTC amendment.

We leverage this empirical design to test whether the option to reduce working hours is used as a screening device. Before analyzing the empirical results, we discuss the theoretical predictions of the impacts of 2004 WOTC Amendment within the standard screening models (Akerlof, 1976 and Rothschild and Stiglitz, 1976), including ours. To begin with, we consider that the expansion of the WOTC in 2004 particularly increases the chances for firms to receive lump-sum transfers when they hire severely disabled workers relative to moderately disabled workers. We view that this interpretation is plausible because the WOTC expansion is available to individuals who are already identified by the government as disabled (i.e, those who have received financial or medical support from the government). This implies that after the amendment, firms face higher relative profits from hiring severely disabled workers. It will then relax the incentive compatibility constraint for moderately disabled workers'

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

[31]We use the all-industry total real GDP in chained 2005 dollars from the Bureau of Economic Analysis to compute annual GDP growth rates. Employment data are from the Bureau of Labor Statistics.

contracts, leading to an increase in their equilibrium provision of job amenities.

Moreover, we should expect that the effect of the WOTC on job amenities for the severely disabled is 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 amenities received by the lowest type (severely disabled workers) is chosen to equalize its marginal benefit (e.g., the worker's marginal utility gain from the amenity) and marginal cost (e.g., the 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 ($\beta_1 + \beta_{3,\text{severe}} = 0$). If individuals are risk-averse, the marginal benefit from additional job amenities depends on the marginal utility from consumption that may be affected by the WOTC. As long as this effect is small, that is, if individuals are not too risk-averse or if the consumption increase from the WOTC is small, the prediction still holds.

It is important to point out that these predictions are unique in screening models: in standard competitive equilibrium models in which firms can offer health-dependent employment contracts (i.e., an economy without screening contracts in Section 2.3), we expect that $\beta_1 + \beta_{3,\text{mod}} \approx 0$ because the incentive compatibility condition is no longer a determinant of job amenities. Specifically, these models predict that the WOTC should have no impact on job amenities for *any* type of worker if workers are risk-neutral.

Table 2: Effects of the WOTC Amendment on the Option to Reduce Working Hours

Coefficients		Option to reduce working hours			
		(1) All employed		(2) New hires	
Post-amendment (β_1)		-0.014	(0.058)	0.032	(0.069)
Disability status (β_{2h})	Severe	0.206***	(0.056)	0.215***	(0.082)
	Moderate	0.080***	(0.031)	0.048	(0.046)
Disability status	Severe	0.014	(0.064)	0.025	(0.103)
× Post-amendment (β_{3h})	Moderate	0.068**	(0.034)	0.126**	(0.055)
Sample size		8,541		3,329	

Note: We estimate equation (3) with the linear probability model. The additional covariates used in the regression are age, age-squared, years of education, annual growth rate of GDP, annual employment rates, firm-size category dummies, and health outcomes. See the Online Appendix D.6 for the complete list of variables and their coefficient estimates. Standard errors are clustered at the individual level. *** p<0.01, ** p<0.05, * p<0.1

Table 2 summarizes our main regression results on the option to reduce working hours.[32] Column (1) reports the main estimates from the linear probability model for equation (3) based on all employed workers.[33] First, there are significant differences in the provision of

[32]Similar to the standard difference-in-differences estimation, it is important to check whether the common trend assumption (across disability status) is satisfied for our empirical design. In Appendix D.4, we show the suggestive evidence that pre-trend common assumption holds.

[33]See Online Appendix D.6 for the complete list of variables and coefficient estimates.

the option to reduce working hours across disability statuses (coefficient β_{2h}). This pattern is much more significant compared with that in Table 1, which documents the raw data. Thus, after controlling for various individual and firm characteristics, a worker's disability status seems to be an important determinant of the job amenity, consistent with preference heterogeneities. Second, we find that the lump-sum transfer (tax credit) provided by the government for hiring disabled workers led to an increase in the provision of the option to reduce working hours for moderately disabled workers (coefficient β_{3h}). The effect, however, is statistically insignificant for severely disabled workers. Column (2) reports the results from the analysis after restricting the sample to newly employed workers, whose compensation packages may be more affected by firms' screening incentives. Interestingly, we find that the change in job amenities among the moderately disabled due to the WOTC is much larger among these newly hired workers.[34] Overall, this evidence is consistent with the possibility that the option to reduce working hours is used as a screening device.[35]

We conduct a number of robustness analyses with respect to these findings. First, to address the concern that the policy impact might be driven by compositional change within disability groups, we additionally allow for an interaction between observable health and the post-amendment dummy. Second, we construct an alternative categorization of disability statuses to check the sensitivity of the results with respect to the definition of disability. Third, as the preferences for working hours flexibility might differ by gender, we additionally allow for an interaction between gender with disability and the WOTC amendment dummies. Fourth, we also discuss whether the trend increase in DI enrollment over the years (Autor and Duggan, 2006 and Liebman, 2015) might explain the observed changes. We show in Appendix D.1 that our findings are robust to these analyses.

Although Table 2 only reports the effect on job amenities, we also examine the impact of the WOTC on employment and wages, which is reported in Appendix D.2. We find that the WOTC itself has a statistically insignificant impact on employment; however, it increases wages among the severely disabled. Thus, the employer tax credit paid to employers hiring severely disabled workers made severely disabled workers' contracts more attractive, reducing their incentives to mimic moderately disabled workers.

[34] We define a subsample of newly hired workers using a binary variable indicating whether the respondent continuously worked with the same employer. As the HRS is a biennial dataset, this implies that the subsample includes workers with less than two years of employment tenure.

[35] In Appendix D.3, we report the results from the same regression analyses using other amenity measures. As discussed in Section 4.1, because of the small sample size problem, we do not find statistical significance in our estimates for other job amenity measures related to flexible working hours (available part-time work and available sick days). Moreover, for vacation days and ESDI coverage, even at the cross-section, we do not see the monotonicity of job amenities in disability statuses, captured by coefficients β_{2h}, after controlling for individual and firm characteristics.

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' profits from hiring workers with disabilities, thereby increasing firms' incentives to screen the disabled. In this case, one would expect that job amenities for healthier workers after 2008 would decline to screen out disabled workers in response to the policy change. Consistent with this view, we find that the option to reduce working hours decreases for moderately disabled and non-disabled workers after the policy implementation. We describe the details in Appendix D.5.

Overall, these findings suggest that firms might be strategically using the option to reduce working 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

We now discuss the identification and estimation of our equilibrium screening model. As discussed in the previous section, we consider the option to reduce working hours as a measure of job amenity used for screening in our equilibrium model. The key challenge in our estimation lies in separately identifying the cost of providing the job amenity ($C\left(a\right)$) and the utility value of these benefits to workers ($\psi\left(a\right)$). To address this, we utilize the variation in data induced by the policy change introduced in Section 4.1.1, the 2004 amendment to the WOTC. This policy change directly affects the firm's profit function but not worker's utility, and therefore it helps us to separately identify these key parameters. Using the actual data variation in the HRS, we estimate the model through an indirect inference procedure.

4.2.1 Functional Forms and Parameters

Functional Forms. The production function of a worker with health type h and skill type x is represented by $f_{h,x} = f_h \times x$, which assumes complementarity between health and skill type. Consistent with our empirical analysis, there are three health types of workers, where $h = 1$ denotes severely disabled workers and $h = 3$ denotes non-disabled workers. We assume that the skill types, which are assumed to be *observable* by firms, are assumed to be *unobservable* by econometricians. The 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 the support with five grid points, $N_x = 5$, implying that there are up to $3 \times N_x$ submarkets in the labor market.

We assume that workers' preferences over consumption are represented by a log utility function $u(c) = \log c$. To specify the primitives related to job amenities, we first assume that each firm chooses a *probability* to offer an option to reduce working hours, implying $a \in [0,1]$. This makes the moments from the model comparable to those in the data: while the model treats a as a continuous variable, the option to reduce working hours in the data is based on the respondent answers to a binary question. Utility from job amenities is specified by $\varphi(a) = \left(1-(a-1)^2\right)^{\delta}$ with $\delta \in (0,1)$, which is concave and satisfies $\lim_{a \to 0} \varphi'(a) = \infty$ and $\lim_{a \to 1} \varphi'(a) = 0$. The cost function for amenities is represented by $C(a) = c_0 + c_1 a \left(1/(1-a) - 1\right)^{c_2}$. The parameter c_0 represents the fixed cost of providing the job amenities,[36] 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 $\mu(\theta) = \theta\left(1+\theta^{\gamma}\right)^{-1/\gamma}$.

Externally Calibrated Parameters. The health distribution in the economy (π_h) is 15%, 18%, and 67% for severely, moderately, and non-disabled workers, respectively. The health-skill type distribution of workers therefore is determined jointly by π_h and σ_h^2, the latter of which is estimated within the model. We set the parameter γ in the job-finding rate to 0.4 to produce an empirically reasonable job-finding elasticity. In the CES matching function, the elasticity of the job-finding rate with respect to market tightness depends on both γ and θ. Given our choice of γ, the weighted average of the elasticities across health types is around 0.2, which is within the range of values used in the literature.[37]

Following Low and Pistaferri (2015), 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 non-disabled workers. These parameters represent the probability of receiving DI upon applying for benefits for old workers (as is consistent with our sample) in their paper. Using these probabilities, the model predicts that about 11% of workers receive DI, roughly consistent with the DI recipient share among older workers in the United States.[38] We assume

[36] Note that the parameter c_0 can also be interpreted as a fixed hiring cost by imposing boundary conditions. We incorporate this parameter to improve the model fit, as discussed in footnote 42.

[37] Menzio and Shi (2011) adopt the same CES function in a directed search environment and calibrate the parameter γ by targeting the empirical elasticity of the unemployment-to-employment transition with respect to the vacancy-to-unemployment ratio (θ). In a model with no search by employed workers (which is a similar environment to ours, among the models considered in their paper), their calibrated value for γ is 0.25. Alternatively, using the Cobb-Douglas function, Shimer (2005) calibrates the elasticity parameter to the estimated coefficient 0.28 from a regression of (log) job-finding probability on (log) θ.

[38] Low and Pistaferri (2015) structurally estimates the DI receipt probability using the Panel Study of Income Dynamics, and we use their values estimated for old workers (between ages 45 and 62). They categorize disabled workers using the work limitation and the degree of limitation, among which the latter is missing in the HRS. However, these are the most relevant estimates for the parameter in the literature. In

that DI benefit amounts are determined as a constant fraction (or a replacement rate) d of the average productivity among workers of the same skill level, reflecting that DI benefits depend on the average of the worker's previous earnings. We use $d = 0.6$ as the benchmark replacement rate, but using a lower replacement rate does not affect our overall qualitative and quantitative results.[39] We further set the value of home production (b_x) externally, due to the difficulty of separately identifying this parameter from the disutility of work χ_h that is estimated within the model. We choose b_x to be 10% ($b = 0.1$) of the average productivity of the worker's skill level, which is lower than the value typically used in the search and matching literature (e.g., $b = 0.4$ in Shimer, 2005 and $b = 0.7$ in Lise and Robin, 2017). Although this choice will not be crucial to our main results, we do so because we also model other components affecting the value of non-employment, such as the DI benefit and the disutility of work, which are usually considered as the elements of the value of home production in this literature. Under these parameters, the expected consumption of non-employed severely disabled individual is 47% ($b + \psi_h d = 0.1 + 0.62 \times 0.6$) of the average productivity of his skill. In modeling the WOTC amendment for structural estimation, we assume that a firm hiring a severely disabled worker, after being qualified with probability ψ_h, receives a lump-sum transfer amounting to 30% of the income of severely disabled workers, consistent with the average amount of transfers allowed to firms.[40] This implies that any post-amendment changes in the job amenities of workers who are not severely disabled are driven solely by screening in our model.[41]

2016, DI recipients in the United States ranged between 6.4% and 14.5% among workers between ages 50 and 64, according to a report by the Social Security Advisory Board. While we take these values exogenously as they yield empirically reasonable DI recipient rates, we are able to conduct robustness analysis with respect to ψ_h.

[39]We do not explicitly model that the DI benefits depend on the equilibrium wages determined within the model. Doing so requires solving a fixed point problem, as the DI benefit amounts are determined endogenously as equilibrium objects, and would be computationally demanding. By using the HRS survey years of 1992 through 2012, Khan et al. (2017) find a large variation in effective replacement rates: the average replacement rate of SSDI is between 55 and 77%, with the standard deviation between 17 and 57%, depending on whether to account for other sources of income.

[40]The minimum hours worked to qualify for $2,400 tax credit is 400 hours, and the average annual working hours in the U.S. is 1,780 hours. Given the hourly wage of severely disabled workers from the data, $2,400 is between 10% and 40% of their income.

[41]Although this may be a stronger assumption on the policy than the one in Section 4.1.2, we make this assumption for the following reasons. First, we can avoid overestimating the role of screening in our counterfactual experiments. By explaining all the variation of amenities for these workers through the screening mechanism, the estimated degree of preference heterogeneities, the key driver of screening contracts, is smaller. Thus, our counterfactual experiments will be implemented with a lower bound on the role of screening. Second, it makes the mapping between the model and data clearer, as elaborated in Section 4.2.2.

4.2.2 Identification

We now describe our strategy for identifying the rest of the model. Our identification strategy is parametric, making use of functional form assumptions. The parameters to be estimated within the model are the worker's health effect on output perceived by firms $\{f_h\}$; the health-specific preferences for job amenities $\{\beta_h\}$; the curvature of the amenity utility function δ; the health-specific fixed disutility from work $\{\chi_h\}$; the health-dependent variance of the skill (x) distribution $\{\sigma_h^2\}$; the 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 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.

As discussed in Section 2.3, the magnitude of the job amenity is set to reflect the IC constraint if it binds (Equation (2)); and if not, it is determined by the marginal utility and the marginal cost of job amenities (Equation (1)). Note that the cross-sectional distribution of job amenities across disability statuses is not sufficient to separately identify the worker-side preference parameters on job amenities ($\{\beta_h\}$ and δ) and the firm-side job amenity cost parameters ($\{c_0, c_1, c_2\}$). We exploit the variation in data induced by the policy change of the 2004 WOTC amendment, as discussed in Section 4.1.1. Importantly, the lump-sum tax credit given to firms, tr, only affects the firm's profitability of hiring disabled workers, inducing changes in job amenities driven by the labor demand side through a screening mechanism.[42] Thus, we separately identify these primitives via the cross-sectional moments and changes in job amenities induced by this policy across disability statuses.[43]

Next, we exploit the variation in wages and employment rates across workers with different disability statuses to identify the health-specific productivity (f_h) and fixed costs of work (χ_h). Our normalization of the fixed cost of work for the non-disabled allows us to identify the vacancy posting cost κ, the parameter that also affects employment rates. Lastly, we identify the variance of the skill distribution$\{\sigma_h^2\}$ by fitting the variance of the wage conditional on disability type, as the skill heterogeneity is the only source of wage variation among workers with the same disability status.

[42]We can identify the parameter c_0 through this variation because changes in job amenities due to the WOTC in the model are affected by the marginal utility of consumption (due to risk aversion) and the incentive compatibility constraints.

[43]In practice, the provisions of the option to reduce working hours may be affected by several factors, such as additional (unobserved) worker heterogeneity, which we do not explicitly model. Without explicitly accounting for these heterogeneities, our estimates of the cost of job amenity provisions may be biased. However, importantly, the main source of the variation in the data we use to identify the cost parameters is the labor-demand-side policy change for disabled workers. Therefore, as long as we focus on policy design exercises similar to the actual policies used in the estimation, the impact of the misspecification is likely to be minimal.

4.2.3 Estimation Strategy

We estimate these parameters via indirect inference by considering the following set of moments in the auxiliary model: (i) the 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 working hours; and (iv) regression coefficients on the option to reduce working hours presented in Section 4.1 (i.e., the coefficients reported in Table 2). These moments are chosen to reflect our identification discussion. We form the objective function for our estimation as

$$\hat{\boldsymbol{\omega}} = \arg\max_{\boldsymbol{\omega}} \left[\hat{\beta}\left(\boldsymbol{\omega}\right) - \overline{\beta}\right]' W \left[\hat{\beta}\left(\boldsymbol{\omega}\right) - \overline{\beta}\right],$$

where W is the weighting matrix, $\overline{\beta}$ is a vector of auxiliary model parameters computed from the data, and $\hat{\beta}\left(\boldsymbol{\omega}\right)$ is a vector of the corresponding auxiliary model parameters obtained from simulating datasets from the model (parameterized by a particular structural parameter vector $\boldsymbol{\omega}$).[44] We obtain the standard errors of our estimators based on the asymptotic variance, following Gourieroux et al. (1993).[45]

4.2.4 Estimation Results

Our estimates of structural parameters are summarized in Table 3, and the model fit is presented in Table 4. Our estimates indicate that disability affects worker productivities and their preferences for job amenities. For example, we find that there is a 25% $(1 - \frac{2.343}{3.107})$ output loss perceived by firms for the severely disabled relative to the non-disabled, conditional on the skill type x. Moreover, the severely disabled have a higher fixed cost of work and have a greater preference for job amenities compared to the non-disabled. Thus, in order for severely disabled workers 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 the cross-sectional heterogeneity of wage and employment and

[44] Because of the small sample size concern, we do not use the optimal weighting matrix in our estimation (Altonji and Segal, 1996). Our weighting matrix on the estimators W is essentially based on the inverse of the variance-covariance matrix of empirical moments, assigning zero to all the off-diagonal elements. As there are substantial differences between the weights on moments from the regression analysis and weights on cross-sectional moments, we put additional weights on cross-sectional moments to ensure similarity in their magnitudes. Finally, we assign the weight of one to the coefficient of variation of earnings.

[45] We calculate the variance-covariance moments of $\overline{\beta}$ through bootstrapping. Note that our equilibrium model is not necessarily *globally* smooth with respect to the structural parameters because of the discreteness of outcomes induced by labor force participation decisions and incentive compatibility constraints in the optimal employment contracts. We do, however, find that our objective function is *locally* smooth near the estimated parameters and thus decide to obtain the standard errors by calculating the score function of $\hat{\beta}\left(\boldsymbol{\omega}\right)$ numerically.

Table 3: Parameters Estimated within the Model

	Estimate	(Std. Err.)	Estimate	(Std. Err.)	Estimate	(Std. Err.)
Panel A: Health (h) Dependent Worker-side Parameters						
	Severely Disabled		Moderately Disabled		Non-Disabled	
Effect of h on output: f_h	2.343	(0.016)	2.700	(0.035)	3.107	(0.043)
Preference for job amenities: β_h	8.712	(0.227)	2.892	(0.395)	1.0 (normalized)	
Fixed cost of work: χ_h	5.313	(0.139)	2.325	(0.226)	0.0 (normalized)	
Variance of skill distribution: σ_h^2	1.773	(0.105)	0.361	(0.004)	0.417	(0.068)
Panel B: Other Worker-side Parameters						
Curvature in utility from job amenities: δ	0.762	(0.134)				
Panel C: Firm-side Parameters						
Const. in the cost $C(a)$: c_0	1.341	(0.128)				
Coeff. on a in the cost $C(a)$: c_1	1.115	(0.062)				
Curvature in the cost $C(a)$: c_2	2.031	(0.596)				
Vacancy cost: κ	0.001	(0.0003)				

the regression coefficients on job amenities documented in Table 2. Importantly, the auxiliary model generates an insignificant effect of the WOTC amendment on severely disabled workers' job amenities (coefficient Post $\times$ Severe), but a significant change in the provision of amenities for moderately disabled workers (coefficient Post $\times$ Moderate), consistent with the results from the empirical analysis. Other coefficients also lie within the ranges of the confidence intervals from the empirical analysis.

4.2.5 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 employment 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 the DI application processes. Among them, Maestas et al. (2013) find a 28 percentage point (*pp*) decline in employment among marginal DI applicants. Further, these effects are heterogeneous across DI applicants and range from no effect to 50*pp*. Given the estimated parameters, we simulate the economy without DI and compare the employment effects of the model to empirical estimates from Maestas et al. (2013).

Our findings suggest that the removal of DI leads to an employment rate decline of 1.36*pp* overall. In Appendix B, we conduct a back-of-the-envelope calculation to estimate the overall

Table 4: Model Fit

(a) Labor market outcomes by disability

Statistics	Data	Model
Employment		
Severely Disabled	0.143	0.148
Moderately Disabled	0.479	0.508
Non-Disabled	0.736	0.740
Average wage		
Severely Disabled	1.000	0.916
Moderately Disabled	1.111	1.215
Non-Disabled	1.418	1.330
Coefficient of wage variation		
Severely Disabled	0.703	0.258
Moderately Disabled	0.646	0.366
Non-Disabled	0.611	0.530

(b) Job amenities

Statistics	Data	Model
Average job amenities		
All workers	0.329	0.338
WOTC coefficients on job amenities		
Post	-0.014	0.010
Severe	0.206	0.218
Moderate	0.080	0.092
Post × Severe	0.014	-0.010
Post × Moderate	0.068	0.046

Note: This table compares the model-generated statistics to their empirical counterparts. We normalize the average wage of the severely disabled to 1.

employment effect of DI implied from the estimates of Maestas et al. (2013) and find that the average employment in the economy without DI is 2.68*pp* lower. Furthermore, depending on the skill and health statuses, the employment effects in our model also similarly range between 0.3*pp* and 47*pp*. This result thus shows the model's ability to generate empirically plausible DI impacts on the employment rate.

4.2.6 Mechanisms

Equilibrium contracts in the economy without screening contracts are independently determined for each skill level and health type. However, this is not the case when firms offer screening contracts. In Table 5, we compare the equilibrium outcomes in the economy without screening contracts and with screening contracts under the estimated parameters. As predicted by the model, in the screening economy, job amenities are underprovided 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 5: Equilibrium in the Model without Screening (No-Scr.) and with Screening (Scr.)

	Job Amenities		Wage		Employment	
	No-Scr.	Scr.	No-Scr.	Scr.	No-Scr.	Scr.
Severely Disabled	0.506	0.506	0.916	0.916	0.148	0.148
Moderately Disabled	0.432	0.400	1.144	1.215	0.506	0.508
Non-Disabled	0.347	0.283	1.269	1.330	0.738	0.740

While Table 5 documents the outcomes by health statuses averaged over the 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 Table 6, we report job amenity levels by skill and health statuses. Given our estimates, we find that both severely and moderately disabled workers near the bottom tail of the skill distribution (labeled as Lowest-Skilled Worker in Table 6) choose not to participate in the labor market. In this case, non-disabled workers are the lowest type in the labor market. However, even in such case, they receive fewer job amenities to deter the moderately disabled workers from entering the non-disabled workers' labor market.

Table 6: Skill Heterogeneity and Screening

	Job Amenities					
	Lowest-Skilled Worker		Average Worker		Highest-Skilled Worker	
	No-Scr.	Scr.	No-Scr.	Scr.	No-Scr.	Scr.
Severely Disabled	-	-	0.460	0.460	0.523	0.523
Moderately Disabled	-	-	0.414	0.384	0.469	0.429
Non-Disabled	0.285	0.269	0.351	0.276	0.402	0.316

On the other hand, workers may decide to work regardless of their disability statuses if their market productivities are high. For these skill groups (labeled Average Worker and Highest-Skilled Worker in Table 6), firms' incentives to screen disabled workers are higher, and thus contract distortions may be larger: moderately disabled workers receive between 3*pp* (7%) and 4*pp* (9%) fewer amenities relative to workers in the economy without screening. These heterogeneous effects on moderately disabled workers further trickle down to non-disabled workers. While low-skilled non-disabled workers receive 1.6*pp* (5.5%) fewer amenities than the amount they would have received in the no-screening economy, the distortionary effect is larger for workers with higher skills that ranges between 7.5*pp* (21%) and 8.6*pp* (21%). These results suggest the presence of heterogeneity in the labor market effects of screening frictions across worker types, which depends on the participation decisions of disabled workers.

5 Counterfactual Policy Experiments

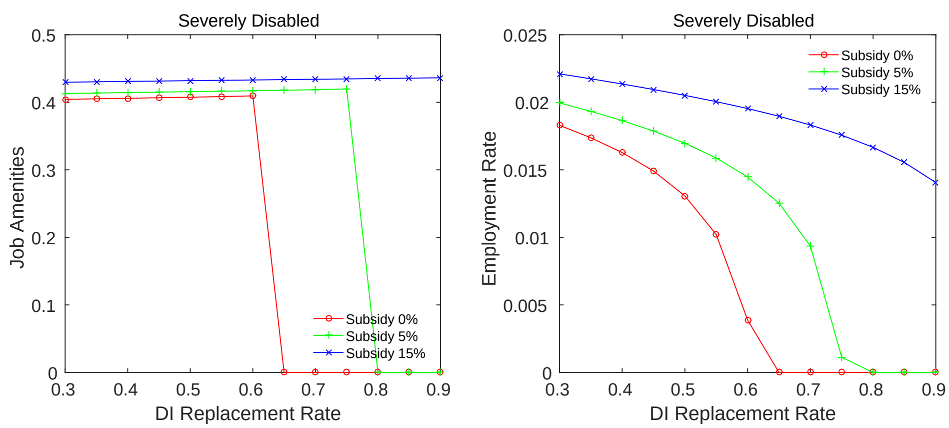
Using the estimated structural model, we conduct counterfactual policy experiments. Given the exogenous disability verification technology (ψ_h) of the government, we consider the effects of both independently and jointly varying the generosity of DI replacement rate (d) and the employment subsidy that proportionately subsidizes firms' costs of providing amenities

(S). The policy parameters under the benchmark economy are a 60% DI replacement rate and a 0% amenity subsidy rate. We ensure that our counterfactual policy experiments are implemented as budget-neutral policy reforms (relative to the benchmark economy) within similar skill groups by allowing the government to use a proportional wage tax (subsidy). This approach better captures the role of policies in providing redistribution across workers of different disability statuses, rather than providing redistribution across disability statuses *and* skills.[46] In the following, we discuss the equilibrium and welfare effects of the policy reforms 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

Figure 1: Labor Market Equilibrium for Severely Disabled Workers



disabled workers under different policy combinations. The x-axis represents the DI replacement rate (d), and the three lines in each plot correspond to subsidy rates (S) of 0%, 5%, and 15%.[47] Under the amenity subsidy rate of S, the firm's net cost of providing amenities equals $(1-S)\,C\,(a)$, effectively lowering the marginal cost of amenities. In the left panel of Figure 1, we plot the amount of job amenities provided to severely disabled workers under the joint policy parameters, and in the right panel, we plot the employment rates of severely disabled

[46]We group the two lowest skill types (among five) together, totaling about 48% of workers in the model. We focus on the results from the low-skill groups as they are more likely to be affected by disabilities and related policies, which is often the approach taken in the disability literature (e.g., Low and Pistaferri, 2015). The qualitative results are consistent with our benchmark findings when we use all workers.

[47]In the current model under the benchmark policy, firms have incentives to screen out disabled workers. If subsidies for disabled workers are very generous, however, it is possible that firms might prefer hiring disabled workers over non-disabled workers (the monotonicity assumption discussed in Section 2.2). We restrict the employment subsidy parameter in the counterfactual analyses so that firms' incentives (to screen out disabled workers) are similarly aligned with those in the benchmark economy.

workers. We observe, first, that as the subsidy rate increases, severely disabled workers' contracts feature higher job amenities, increasing their value of employment. Consequently, the employment rates of severely disabled workers increase, as shown in the right panel of Figure 1. On the other hand, as DI becomes more generous, the labor supply disincentives increase, which reduces employment rates and sometimes drives severely disabled workers completely out of the labor force at high replacement rates. Importantly, the cutoff level of DI above which severely disabled workers do not participate in the labor market is lower when the amenity subsidy rate is smaller.

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

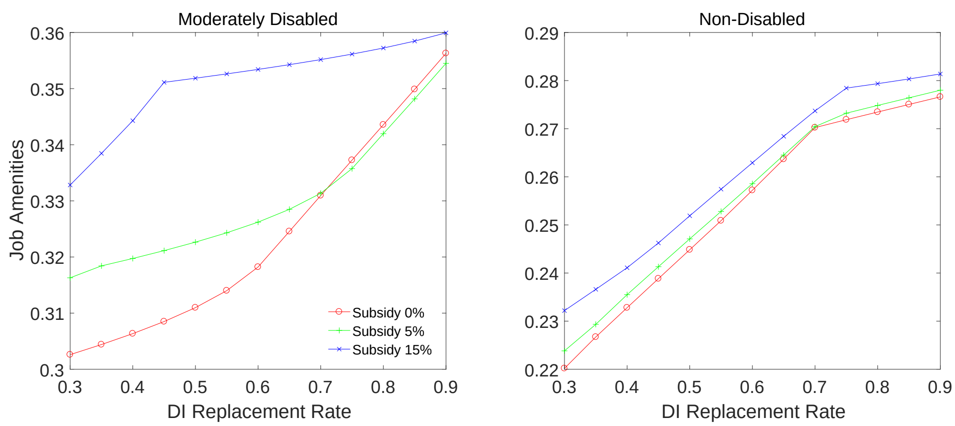


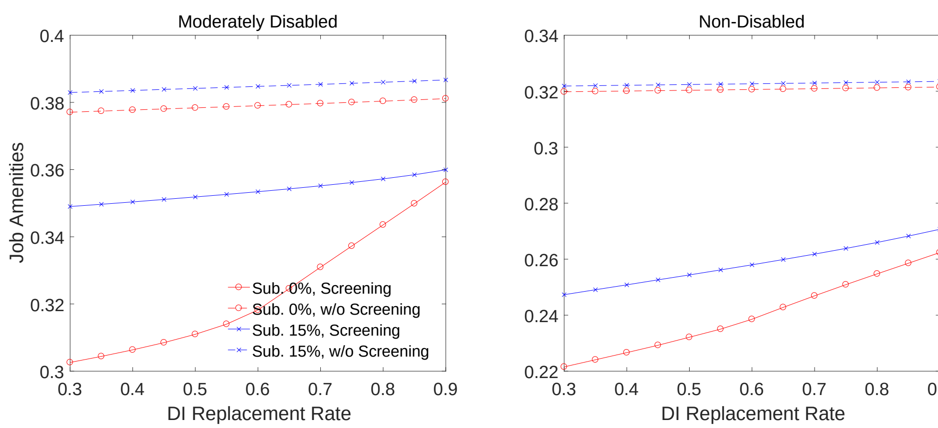
Figure 2 illustrates the equilibrium job amenities for moderately disabled (left panel) and non-disabled (right panel) workers. As the amenity subsidy directly lowers the marginal cost of amenities (albeit at lower expected rates due to verification probabilities), healthier workers in the labor market are also likely to benefit from higher amenities.[48] Further, as DI becomes more generous, the combination of a higher outside option and the relaxation of the IC constraint induces an increase in job amenities (for a fixed subsidy rate). These equilibrium changes are driven by both the skill-compositional effects and intensive responses of contracts to policy reforms. For example, under 15% subsidy rate, moderately disabled workers of all skill types decide to work if DI replacement rate is lower than 45%. However, as DI becomes more generous (higher than 45%), lower-skilled workers decide to drop out of the labor force. As the relatively higher-skilled workers remain in the labor market, the average job amenities of moderately disabled workers increases. Similar effects are present for non-disabled workers.

[48]Note that the monotonic relationship between amenities and subsidy rates (for a fixed DI) may not hold for moderately disabled workers. Several factors are in play for the determination of the equilibrium job amenity on top of its marginal cost, which include the marginal utility of consumption (due to risk aversion in the utility function) and the firm's incentives to screen (the strength of the IC constraint). These combined effects lie behind the job amenities of workers in the economy.

Effects on Screening Distortions. In the presence of screening contracts, the decisions of disabled workers have an effect on the 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 job amenities in an economy without screening along with those in the screening economy, for moderately disabled workers (left panel) and non-disabled workers (right panel) of the higher skill type.[49] The amenities without screening are plotted as a dashed line, and with screening, a solid line. We observe that when the DI replacement rate is low, the contract distortions for moderately disabled workers are high: the difference between the level of amenities in an economy without screening and with screening is large. Fixing the subsidy rate, as DI becomes more generous, 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 IC constraint on moderately disabled workers' contracts. Put differently, severely disabled workers have less of an incentive to mimic healthier workers because they have a higher outside option (DI). Thus, DI affects contracts for the moderately disabled, not only by increasing their own outside option, but also through the change in the contracts and labor force participation incentives of severely disabled workers.[50] This effect of DI on the labor market is novel in our framework because we specifically incorporate and estimate the role of screening in equilibrium.

Figure 3: Labor Market Equilibrium: Without Screening and With Screening



Now, we study the effect of increasing job amenity subsidies by setting the amenity subsidy rate to be 15%. In this case, the contract distortions on moderately disabled workers

[49]The labor market contracts of severely disabled workers are equivalent in the presence and absence of screening upon participation.

[50]For the lowest skill type, the effects of policies on screening distortions are larger. In the absence of amenity subsidies, even the moderately disabled workers drop out of the labor force as DI becomes more generous, removing all distortions on non-disabled workers' employment contracts within that skill group.

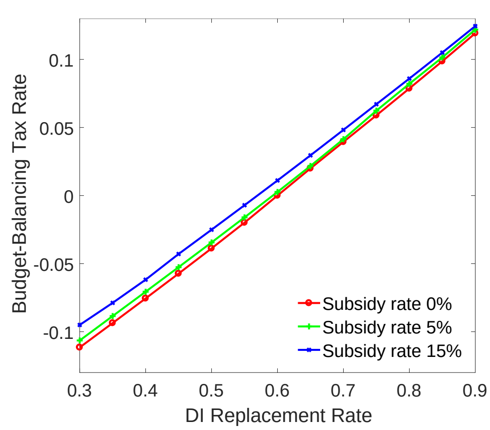
are smaller. For a fixed DI replacement rate (e.g., 30%), the difference between screening and no-screening lines is smaller under a 15% subsidy rate compared to a no-subsidy rate. When the amenity subsidy rate is high, the utility that the severely disabled obtain from working under their own contract increases, relaxing the IC constraint in the moderately disabled worker's problem. From the firm's perspective, a generous amenity subsidy for disabled workers lowers its screening needs, resulting in fewer distortions in other workers' contracts. We observe similar effects on the job amenity provision for non-disabled workers in the right panel of Figure 3: the size of the distortions is smaller with higher DI (left to right) and higher subsidy rates ($\circ$-line to $\times$-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 reducing their incentive to mimic healthier workers. Second, if the amenity subsidy is high, severely disabled workers' contracts are attractive enough that they have fewer incentives to enter the market designed for moderately disabled workers (firms' relative profits from hiring disabled workers increase). Both policy interventions therefore affect the degree of screening distortions in equilibrium, but through different mechanisms with heterogeneous equilibrium effects. In the next section, we analyze the welfare implications of these policy designs.

5.2 Optimal Joint Policy Design

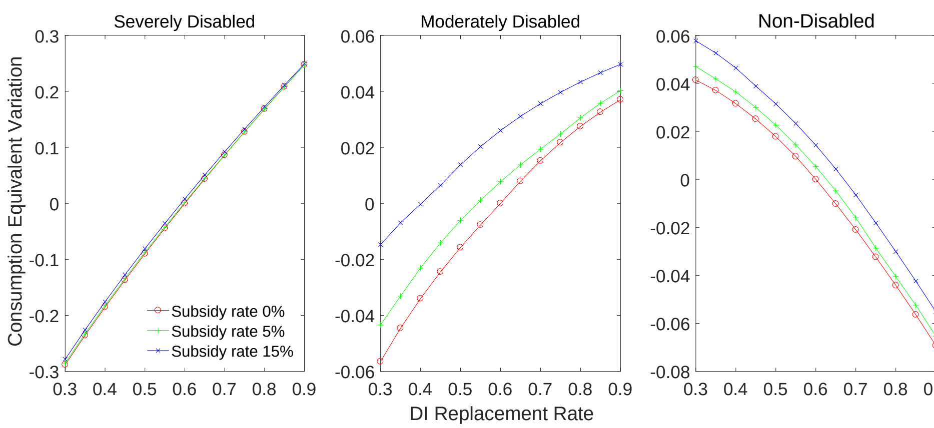
In this section, we consider the welfare effects of the joint policy reforms. To understand the quantitative results, we first show the equilibrium budget-balancing tax rate, the welfare effects by health statuses, and finally the average welfare implications of the reforms.

Figure 4: Fiscal Effects of Policy Reforms



In Figure 4, we plot the equilibrium wage tax rate. As is evident, the tax rate is increasing in the generosity of DI and the amenity subsidy. However, as DI becomes more generous, the expansion of the amenity subsidy requires a smaller increase in the tax rate. Under a 30% DI replacement rate, the tax rate needs to increase by 2*pp* to introduce a 15% amenity subsidy, whereas an increase of 0.5*pp* is sufficient under a 90% replacement rate. The provision of amenity subsidies is costly as the government's expenditures on employed workers increase. At the same time, employment subsidies induce more disabled workers to participate in the labor force by increasing the value of work. This latter effect may add to subsidy expenditures, but it simultaneously lowers DI expenditures as there are fewer non-employed individuals. In the model, increasing the amenity subsidy in the presence of a generous DI has negligible fiscal consequences (or may even reduce the financial burden of the government), as it attracts more workers, thus alleviating the fiscal burden from the DI program.

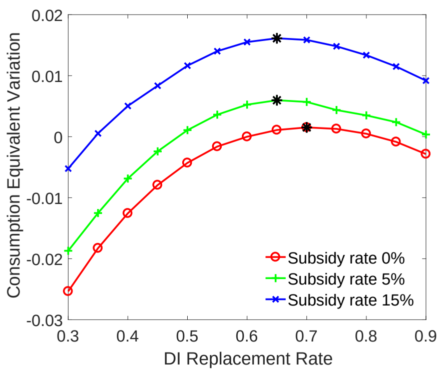
Figure 5: Welfare Effects of Policy Reform by Health Status



We now evaluate the welfare consequences measured by the consumption equivalent variation (CEV)—the percentage of consumption in the benchmark economy necessary for a worker to be indifferent between the benchmark economy and the counterfactual economy—for each worker of a certain skill and health type. Figure 5 displays the CEVs by health statuses, and Figure 6 displays the average CEVs.

First, we note that there are large differences in preferences for a generous DI policy. While severely disabled workers are willing to give up 24% of their consumption in the benchmark economy for a 90% DI replacement rate, non-disabled workers need to receive around 7% of consumption to be indifferent. The welfare of moderately disabled workers is increasing in the DI replacement rate, although the magnitudes are smaller relative to those of severely disabled workers. Thus, the insurance benefit of DI, mostly enjoyed by severely disabled workers, is largely achieved at the expense of non-disabled workers who pay higher taxes. On the other hand, introducing job amenity subsidies benefits workers of all types. In particular, even though firms hiring moderately disabled or non-disabled workers receive

Figure 6: Welfare Effects of Policy Reforms



Amenity Subsidy	0%	5%	15%
DI Rep. Rate	70%	65%	65%
Tax Rate	3.9%	2.2%	3.0%
Sev. Disabled	8.6	4.5	5.1
Mod. Disabled	1.5	1.4	3.1
Non-Disabled	-2.1	-0.5	0.4
Average	0.2	0.6	1.6

Note: For each amenity subsidy rate, the DI replacement rate is the average welfare-maximizing rate, and the tax rate, the budget-balancing tax rate. The CEVs are expressed in percentages.

amenity subsidies with low probabilities, worker welfare increases with amenity subsidies. This is driven by both a direct effect (from the lower marginal cost of amenities) and an indirect effect through the relaxation of screening incentives (as shown in Figure 3).

The average welfare effects of the policy reforms are plotted and summarized in Figure 6. The CEV's range lies between -3%, when DI becomes less generous than the benchmark economy, and around 2%, when DI and amenity subsidies are more generous. In general, we observe that introducing amenity subsidies improves welfare on average, as is consistent with the health-specific welfare results. Making DI more generous is also welfare-improving initially, but starts to become too costly at higher replacement rates. A noticeable feature is the interdependence between DI and amenity subsidies. We find that it is not necessarily the case that optimal DI is lower when the subsidy rate increases: with a 5% or 15% amenity subsidy, the optimal DI is constant at 65%.[51] The government finds it optimal to implement generous policies in both DI and amenity subsidies, as the labor supply disincentive effects from DI are mitigated when the government simultaneously enacts the employment subsidies. As shown in the table in the right panel of Figure 6, while these policies benefit disabled workers more, non-disabled workers may also be better off when policies are jointly implemented. Under a 15% amenity subsidy rate and a 65% replacement rate, the average CEV is 1.6%, indicating a significant welfare gain.

Overall, our counterfactual results show that the amenity subsidy is effective in improving welfare not only on average but also for workers of all health statuses. It encourages more workers to supply labor by lowering their disutility of work, and directly lowers the contract distortions driven by firms' screening incentives. Thus, with a higher amenity sub-

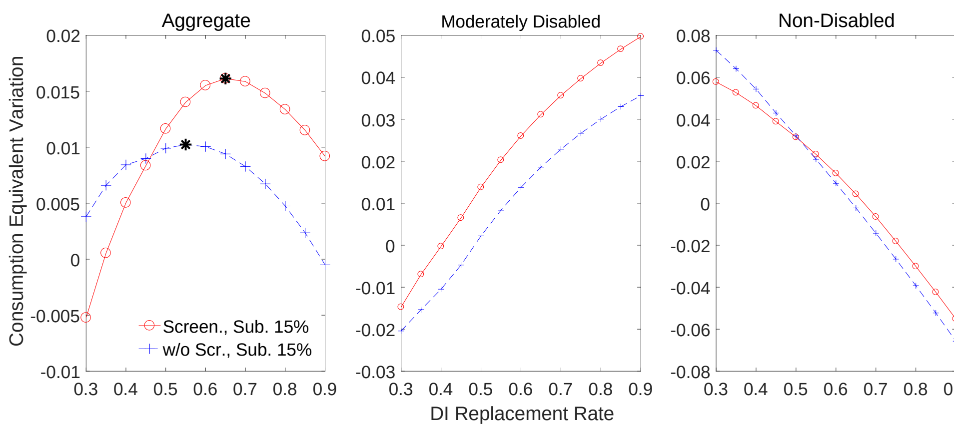
[51] When we conduct policy reforms with workers of all skill levels, the optimal DI replacement rate is higher, as the government uses DI as a means of redistributing resources across workers of heterogeneous skills as well as health statuses. Further, we find that the optimal DI is higher when the subsidy rate is higher.

sidy mitigating the labor supply disincentive effects of DI, the government gains the ability to implement a generous DI policy, providing more insurance during employment (using amenity subsidies) and across employment statuses (using DI). Thus, 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 contracts affects the optimal policy structure in the economy. To do so, we conduct the same counterfactual analyses, but now assuming that firms can offer health-dependent contracts, and we compare the welfare effects under the two economies.

Figure 7: Welfare Effects of Policy Reform in Economies with and without Screening



In Figure 7, we plot the welfare consequences of policy reforms when the subsidy rate is 15% for varying generosity levels of DI, on average (left panel), for moderately disabled workers (middle panel), and for non-disabled workers (right panel).[52] The optimal DI replacement in the no-screening economy is 55%, 10*pp* lower than the optimal DI replacement rate in the screening economy.[53] This difference mostly stems from the welfare benefits enjoyed by moderately disabled workers. As discussed, moderately disabled workers are those whose contracts are most affected by firms' screening incentives. In the screening economy, a generous DI policy provides more insurance, just as it does in the no-screening economy,

[52] As severely disabled workers receive no-screening contracts even in the screening economy, their welfare differences between the two economies are only due to tax rate differences and are negligible. Further, for brevity, we report results under the 15% subsidy rate, but the results are qualitatively similar under 0% or 5% subsidy rates.

[53] We also find a similar magnitude of differences in optimal policies in the no-screening and screening economies in counterfactual analyses with workers of all skill levels.

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 the economy without screening contracts, 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 have studied designs of social insurance programs for the disabled by developing an equilibrium labor market model in which firms offer screening contracts. By exploiting labor-demand-side policy changes for the disabled, we empirically examine which job amenity is used for screening and then structurally estimate the model. Our counterfactual policy experiments suggest a potential need to expand employment subsidies that support the hiring of disabled workers in the United States, which are currently very small compared with the expenditure of DI. In light of our model, subsidies to promote a more generous provision of job amenities to reduce disabled workers' disutility from work, which have recently been implemented in several European countries (OECD, 2010), may be effective in improving efficiency in the labor market and increasing welfare.

This research topic offers several promising avenues for future work. First of all, it would be worthwhile to explore the effectiveness of other disability policies, such as regulating or mandating certain employment contracts, in our framework. Second, the model could also be extended considerably. One interesting area is to consider a firm's dynamic employment contract problem in an environment in which workers' health statuses change over time and workers choose consumption and savings over their life cycle. We leave these interesting extensions for future research.

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Online Appendix (Not for Publication)

A Theoretical Appendix

A.1 Competitive Search Equilibrium

We formally define the equilibrium of the economy below following Guerrieri et al. (2010).

Definition 3. 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

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

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

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

   and $U_{h,x}^N\left(b_x, D_x\right)$ is the utility from not working, given by

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

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

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

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

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 $\bar{U}_{h,x} > U_{h,x}^N\left(b_x, D_x\right)$.

A.2 Equilibrium Characterizations under Risk-Neutral Preferences

We compare properties of the equilibrium contracts with and without screening. To simplify notation, without loss of generality, we assume that the number of observable types $x = 1$. For simplicity, we also assume $\tau(w) = 0$ and $T(w,a) = 0$ and denote the expected DI benefits by $\tilde{D}_i = \psi_i D$. We show the main result for type $h = 2$, but the result can be generalized for $h > 2$. The problem of the screening economy then reads

$$\begin{aligned} & \max_{\theta,w,a} && \left\{\mu(\theta)\left[c - (\chi_2 - \beta_2\varphi(a))\right] + (1-\mu(\theta))\tilde{D}_2\right\} \\ \text{s.t.} \quad & \text{(FE)} && \mu(\theta)\left\{f_2 - w - C(a)\right\} = \theta\kappa \\ & \text{(IC)} && \mu(\theta)\left[c - (\chi_1 - \beta_1\varphi(a))\right] + (1-\mu(\theta))\tilde{D}_1 \le \bar{U}_1. \end{aligned}$$

Let the Lagrange multipliers with respect to (FE) and (IC) be ν and λ. Then, from the FOC with respect to the wage rate (w), we get $1 - \lambda = \nu$. From the FOC with respect to amenity a, we also obtain $\lambda = \dfrac{\beta_2\varphi'(a) - C'(a)}{\beta_1\varphi'(a) - C'(a)}$. Combining the two optimality conditions,

$$\nu = \frac{\beta_1\varphi'(a) - \beta_2\varphi'(a)}{\beta_1\varphi'(a) - C'(a)}.$$

Since $\beta_1 > \beta_2$, the numerator of ν is always positive. Thus, for ν to be positive, the denominator must be positive too. This implies that for λ to be positive, the numerator must be positive: $\beta_2\varphi'(a) > C'(a)$. Note that in the no-screening economy, the optimality condition for a^{NS} reads $\beta_2\varphi'\left(a^{NS}\right) = C'\left(a^{NS}\right)$. Thus, by concavity of the φ function (and weak convexity of the $C(\cdot)$ function), $a_2^S < a_2^{NS}$ when $\lambda > 0$ (that is, when (IC) is binding).

Lastly, we take the FOC with respect to θ. In the no-screening economy, the following optimality condition holds:

$$\left\{f_2 - C\left(a_2^{NS}\right) + \beta_2\varphi\left(a_2^{NS}\right) - \chi_2 - \tilde{d}_2\right\} = \frac{\kappa}{\mu'\left(\theta_2^{NS}\right)}. \tag{4}$$

Note that the expression within the bracket is equivalent to the standard definition of match surplus, where the level of job amenity is determined by the FOC, $\beta_2\varphi'\left(a^{NS}\right) = C'\left(a^{NS}\right)$, so that the match surplus can be maximized. In this no-screening economy, the equilibrium market tightness θ_2^{NS} is determined in socially efficient level in the sense that the expected gain of additional vacancy is equivalent to its cost, κ. In contrast, the FOC in the economy with screening reads

$$\frac{\kappa}{\mu'\left(\theta_2^S\right)} = f_2 - C\left(a_2^S\right) + \frac{C'\left(a_2^S\right)}{\beta_2\varphi'\left(a_2^S\right)}\left(\beta_2\varphi\left(a_2^S\right) - \beta_2\frac{\Delta\tilde{D}}{\Delta\beta}\right) - \tilde{d}_2\left(1 - \frac{\beta_2}{\tilde{D}_2}\frac{\Delta\tilde{D}}{\Delta\beta}\right), \tag{5}$$

where $\Delta\beta \equiv \beta_1 - \beta_2$ and $\Delta\tilde{D} \equiv \tilde{D}_1 - \tilde{D}_2$. The difference between the two FOC illustrates that there exist opposite forces on the match surplus with the presence of screening effectively shifts down the utility from amenity by $\beta_2\frac{\Delta\tilde{D}}{\Delta\beta}$, and the marginal utility is also rescaled with $\frac{C'\left(a_2^S\right)}{\beta_2\varphi'\left(a_2^S\right)} < 1$. On the other hand, reduction in costs for providing $a_2^S < a_2^{NS}$ increases the surplus.

To know how θ_2^S should adjust in the economy with screening in net, we apply the implicit function theorem on Equation (5) and find the relationship between θ_2^S and of a_2^S. Since $a^{NS} > a^S$

when $\lambda > 0$, $\theta_2^{NS} < \theta_2^S$ if $\frac{d\theta_2^S}{da_2^S} < 0$:

$$\frac{d\theta_2^S}{da_2^S} = -\left\{\varphi\left(a_2^S\right) - \frac{\Delta\tilde{D}}{\Delta\beta}\right\}\left(\frac{C''\left(a_2^S\right)\varphi'\left(a_2^S\right) - C'\left(a_2^S\right)\varphi''\left(a_2^S\right)}{\left\{\varphi'\left(a_2^S\right)\right\}^2}\right) \times \frac{\left\{\mu'\left(\theta_2^S\right)\right\}^2}{\kappa\mu''\left(\theta_2^S\right)} < 0.$$

This inequality holds when $\varphi\left(a_2^S\right) < \frac{\Delta\tilde{D}}{\Delta\beta}$. We solve for the equilibrium wage using the (FE):

$$\begin{aligned} w_2^S &= f_2 - C\left(a_2^S\right) - \frac{\theta_2^S\kappa}{\mu\left(\theta_2^S\right)} \\ &= \left(1 - \frac{\theta_2^S\mu'\left(\theta_2^S\right)}{\mu\left(\theta_2^S\right)}\right)\frac{\kappa}{\mu'\left(\theta_2^S\right)} - \frac{C'\left(a_2^S\right)}{\varphi'\left(a_2^S\right)}\left(\varphi\left(a_2^S\right) - \frac{\Delta\tilde{D}}{\Delta\beta}\right) + \tilde{D}_2\left(1 - \frac{\beta_2}{\tilde{d}_2}\frac{\Delta\tilde{D}}{\Delta\beta}\right) \\ &\equiv \frac{\left(1 - \varepsilon_{\mu,\theta}\right)\kappa}{\mu'\left(\theta_2^S\right)} + \frac{C'\left(a_2^S\right)}{\varphi'\left(a_2^S\right)}\left(\frac{\Delta\tilde{D}}{\Delta\beta} - \varphi\left(a_2^S\right)\right) + \tilde{D}_2\left(1 - \frac{\beta_2}{\tilde{d}_2}\frac{\Delta\tilde{D}}{\Delta\beta}\right). \end{aligned}$$

Note that the wage compensates the decline in amenity (second term). If $\theta_2^S > \theta_2^{NS}$, then $w_2^S > w_2^{NS}$ as long as the matching function elasticity ($\varepsilon_{\mu,\theta}$) is non-increasing in θ.

A.3 Proof of Proposition 1

A.3.1 Proof of (a): Optimal Employment Subsidies without Labor Market Screening

To begin with, we first specify the government's problem:

$$\max_s \sum_i \omega_i \Big(\left(1 - \mu\left(\theta_i\right)\right) U_i^N\left(b, D\right) + \mu\left(\theta_i\right)\left(u(w_i - T) - \left(\chi_i - \beta_i\varphi\left(a_i\right)\right)\right)\Big)$$

$$s.t.\ \frac{\mu\left(\theta_i\right)}{\theta_i}\left(f_i - w_i - (1 - S\psi_i)C(a_i)\right) = \kappa$$

$$T = \frac{\sum_i \pi_i\mu\left(\theta_i\right) S\psi_i C(a_i)}{\sum_i \pi_i\mu\left(\theta_i\right)}.$$

Now, we incorporate these two constraints into the objective function:

$$\sum_i \omega_i \left(\left(1 - \mu\left(\theta_i\right)\right) U_i^N\left(b, D\right) + \mu\left(\theta_i\right)\left(u\left(f_i - (1 - S\psi_i)C(a_i) - \frac{\kappa\theta_i}{\mu\left(\theta_i\right)} - \frac{\sum_j \pi_j\mu\left(\theta_j\right) S\psi_j C(a_j)}{\sum_j \pi_j\mu\left(\theta_j\right)}\right) - \left(\chi_i - \beta_i\varphi\left(a_i\right)\right)\right)\right).$$

We can apply the first-order condition and characterize the optimal policy, exploiting the envelope condition (Chetty, 2006). To provide intuition, we apply the perturbation approach following Saez (2001), to decompose the optimal policy into three components. First, the government takes into account the standard mechanical revenue effect from a Δs change in the subsidy rate, which is determined as

$$\Delta M = -\sum_i \omega_i\mu\left(\theta_i\right) u'(c_{e,i})\frac{\sum_j \pi_j\mu\left(\theta_j\right)\psi_j C(a_j)}{\sum_j \pi_j\mu\left(\theta_j\right)}\Delta S \equiv -\bar{U}'\left(\boldsymbol{c}_e\right)\widetilde{C}(\boldsymbol{a}, \boldsymbol{\theta})\Delta S,$$

where $c_{e,i}$ is the consumption of the employed worker, $\bar{U}'(\boldsymbol{c}_e) = \sum_i \omega_i \mu(\theta_i) u'(c_{e,i})$ is the welfare-weighted marginal utility of consumption of employed workers, and $\widetilde{C}(\boldsymbol{a}, \boldsymbol{\theta})$ is the average expected (i.e., incorporating eligibility probabilities, ψ_j) job amenity cost per employed worker (the total expected job amenity cost divided by the measure of employed workers):

$$\widetilde{C}(\boldsymbol{a}, \boldsymbol{\theta}) = \frac{\sum_j \pi_j \mu(\theta_j) \psi_j C(a_j)}{\sum_j \pi_j \mu(\theta_j)}.$$

The term in the denominator reflects that the tax is imposed only on employed workers. If for example, all workers are subject to the tax regardless of their employment statuses, the value of the denominator would be 1.

Second, an increase in the subsidy rate has a welfare effect, which is expressed as

$$\Delta W = \sum_i \omega_i \mu(\theta_i) u'(c_{e,i}) \psi_i C(a_i) \Delta S = \bar{U}'(\boldsymbol{c}_e) \widetilde{C}(\boldsymbol{a}, \boldsymbol{\theta}) \overline{C}(\boldsymbol{a}, \boldsymbol{\theta}) \Delta S,$$

where $\overline{C}(\boldsymbol{a}, \boldsymbol{\theta})$ is the concentration of job amenity (subsidy) spending among the subsidy-eligible disabled population relative to the redistributive preference, captured by the welfare weights and the marginal utility of consumption:

$$\overline{C}(\boldsymbol{a}, \boldsymbol{\theta}) = \frac{\frac{\sum_i \omega_i u'(c_{e,i}) \mu(\theta_i) \psi_i C(a_i)}{\sum_i \omega_i u'(c_{e,i}) \mu(\theta_i)}}{\frac{\sum_i \pi_i \mu(\theta_i) \psi_i C(a_i)}{\sum_i \pi_i \mu(\theta_i)}}.$$

Note that if $\pi_i = \omega_i u'(c_{e,i})$, which is the case under the utilitarian social welfare function and risk-neutral individuals, $\overline{C}(\boldsymbol{a}, \boldsymbol{\theta}) = 1$.

Finally, we have the behavioral effect:

$$\begin{aligned}
\Delta B = & -\sum_i \omega_i \mu(\theta_i) u'(c_{e,i}) \sum \pi_j \psi_j S \frac{\partial \frac{C(a_j)\mu(\theta_j)}{\sum_k \pi_k \mu(\theta_k)}}{\partial S} \Delta S \\
= & \bar{U}'(\boldsymbol{c}_e) \sum_j \mathbf{1}_{(\boldsymbol{\varphi_j = 1})} \left(\frac{\frac{SC(a_j)\pi_j \mu(\theta_j)}{\sum_k \pi_k \mu(\theta_k)}}{1-S} \frac{\frac{\partial C(a_j)}{\partial (1-S)}}{\frac{C(a_j)}{1-S}} + \frac{\frac{SC(a_j)\pi_j \mu(\theta_j)}{\sum_k \pi_k \mu(\theta_k)}}{1-S} \frac{\frac{\partial \frac{\pi_j \mu(\theta_j)}{\sum_k \pi_k \mu(\theta_k)}}{\partial(1-S)}}{\frac{\frac{\pi_j \mu(\theta_j)}{\sum_k \pi_k \mu(\theta_k)}}{1-S}} \right) \Delta S \\
= & \bar{U}'(\boldsymbol{c}_e) \sum_j 1_{(\varphi_j = 1)} \frac{\frac{SC(a_j)\pi_j \mu(\theta_j)}{\sum_k \pi_k \mu(\theta_k)}}{1-S} \left(\epsilon_{C(a_j),1-S} + \epsilon_{\mu(\theta_j),1-S} \right) \Delta S \\
= & \frac{S}{1-S} \bar{U}'(\boldsymbol{c}_e) \widetilde{C}(\boldsymbol{a}, \boldsymbol{\theta}) \sum_j \frac{1_{(\varphi_j = 1)} \frac{C(a_j)\pi_j \mu(\theta_j)}{\sum_k \pi_k \mu(\theta_k)}}{\widetilde{C}(a, \theta)} \left(\epsilon_{C(a_j),1-S} + \epsilon_{\mu(\theta_j),1-S} \right) \Delta s \\
= & \frac{S}{1-S} \bar{U}'(\boldsymbol{c}_e) \widetilde{C}(\boldsymbol{a}, \boldsymbol{\theta}) \sum_j \alpha_j \left(\epsilon_{C(a_j),1-S} + \epsilon_{\mu(\theta_j),1-S} \right) \Delta S \\
= & \frac{S}{1-S} \bar{U}'(\boldsymbol{c}_e) \widetilde{C}(\boldsymbol{a}, \boldsymbol{\theta}) \left(\widetilde{\epsilon}_{C(a),1-S} + \widetilde{\epsilon}_{\mu(\theta),1-S} \right) \Delta S,
\end{aligned}$$

where α_j is the contribution of amenities costs by type j:

$$\alpha_j = \frac{1_{(\varphi_j=1)} \frac{C(a_j)\pi_j\mu(\theta_j)}{\sum_k \pi_k\mu(\theta_k)}}{\widetilde{C}(\boldsymbol{a},\boldsymbol{\theta})} = \frac{\pi_j\mu\left(\theta_j\right)\psi_j C(a_j)}{\sum_k \pi_k\mu\left(\theta_k\right)\psi_k C(a_k)};$$

$\epsilon_{C(a_j),1-S}$ and $\epsilon_{\mu(\theta_j),1-S}$ are elasticities of total cost of amenities and employment with respect to the net-of-subsidy marginal cost of amenities, $(1-S)$:

$$\epsilon_{C(a_j),1-S} = \frac{d\log C(a_j)}{d\log\left(1-S\right)} \quad \text{and} \quad \epsilon_{\mu(\theta_j),1-S} = \frac{d\log\left(\frac{\pi_j\mu(\theta_j)}{\sum_k \pi_k\mu(\theta_k)}\right)}{d\log\left(1-S\right)};$$

and $\left(\widetilde{\epsilon}_{C(a),1-S}, \widetilde{\epsilon}_{\mu(\theta_j),1-S}\right)$ are the α_j-weighted sums of these elasticities. Note that this channel clarifies the two margins in which the subsidy rate can affect the equilibrium outcomes: its effect on the provision of amenities in the employment contract and its effect on the employment level of workers.

The optimal policy is determined by the sum of these three effects: importantly, we do not need to consider any changes in other endogenous variables, such as labor market tightness or job amenities due to the envelope condition (Saez, 2001). Then, the optimal policy is

$$\bar{U}'\left(\boldsymbol{c}_e\right)\left(-\widetilde{C}(\boldsymbol{a},\boldsymbol{\theta}) + \widetilde{C}(\boldsymbol{a},\boldsymbol{\theta})\overline{C}(\boldsymbol{a},\boldsymbol{\theta}) + \frac{S}{1-S}\widetilde{C}(\boldsymbol{a},\boldsymbol{\theta})\left(\widetilde{\epsilon}_{C(a),1-S} + \widetilde{\epsilon}_{\mu(\theta),1-S}\right)\right)\Delta S = 0,$$

or

$$\frac{S}{1-S} = \frac{1-\overline{C}(\boldsymbol{a},\boldsymbol{\theta})}{\widetilde{\epsilon}_{C(a),1-S} + \widetilde{\epsilon}_{\mu(\theta),1-S}}.$$

This completes the proof. Note that if the government is utilitarian and workers are risk-neutral, one can easily show that the optimal subsidy should be zero. □

A.3.2 Proof of (b): Optimal Employment Subsidies with Labor Market Screening

Importantly, we now need to consider the incentive compatibility constraint in the firm's problem, which affects the optimal employment contracts. An immediate implication is that the envelope theorem no longer applies: that is, the optimal contract must not only maximize the worker's utility subject to the free-entry condition but also satisfy the incentive compatibility constraint. This requires some modification in the perturbation argument.

First, we have the identical mechanical revenue effect and behavioral effects, as in the case in the absence of labor market screening (a). The mechanical revenue effect is denoted by $\Delta M = -\bar{U}'\left(\boldsymbol{c}_e\right)\widetilde{C}(a,\theta)\Delta S$, and the behavioral effect is denoted by

$$\Delta B = \frac{S}{1-S}\bar{U}'\left(\boldsymbol{c}_e\right)\widetilde{C}(\boldsymbol{a},\boldsymbol{\theta})\left(\widetilde{\epsilon}_{C(a),1-S} + \widetilde{\epsilon}_{\mu(\theta),1-S}\right)\Delta S.$$

Now, the inability to apply the envelope condition leads to a different form of welfare effect:

$$
\begin{aligned}
\Delta W = & \bar{U}'(\boldsymbol{c}_e)\,\overline{C}(\boldsymbol{a},\boldsymbol{\theta})\widetilde{C}(\boldsymbol{a},\boldsymbol{\theta})\Delta S \\
& + \sum_i \omega_i \mathbb{I}_i^{IC}\left(\mu(\theta_i)\frac{\partial a_i}{\partial S}\left(-u'(c_{e,i})(1-S\psi_i)\frac{\partial C(a_i)}{\partial a_i} + \frac{\partial \beta_i \varphi(a_i)}{\partial a_i}\right)\right)\Delta S \\
& + \sum_i \omega_i \mathbb{I}_i^{IC}\frac{\partial \theta_i}{\partial S}\left(\frac{\partial \mu(\theta_i)}{\partial \theta_i}\left(u(c_{e,i}) - u(c_{u,i})\right) - \mu(\theta_i)\,u'(c_{e,i})\frac{\partial \frac{\kappa\theta_i}{\mu(\theta_i)}}{\partial \theta_i}\right)\Delta S.
\end{aligned}
$$

The screening effects on worker utility are given by

$$
\xi_{a,i} = -\left(-u'(c_{e,i})(1-S\psi_i)\frac{\partial C(a_i)}{\partial a_i} + \frac{\partial \beta_i \varphi(a_i)}{\partial a_i}\right);
$$

$$
\nu_{\theta,i} = -\frac{\partial \mu(\theta_i)}{\partial \theta_i}\left(u(c_{e,i}) - u(c_{u,i})\right) - \mu(\theta_i)\,u'(c_{e,i})\frac{\partial \frac{\kappa\theta_i}{\mu(\theta_i)}}{\partial \theta_i},
$$

both of which are zero in an equilibrium without screening. They are non-zero when firms' incentive compatibility constraint $\mathbb{I}_i^{IC}$ is binding, that is,

$$
\mathbb{I}_i^{IC} = 1 \quad \text{if} \quad \mu(\theta_i)\,U_{i-1}^{E}(w_i, a_i) + (1-\mu(\theta_i))\,U_{i-1,x}^{N}(b, D) = \bar{U}_{i-1}.
$$

The optimal subsidy is now determined by summing these three effects and can be expressed as

$$
\begin{aligned}
\frac{S}{1-S} &= \frac{1-\overline{C}(\boldsymbol{a},\boldsymbol{\theta})}{\widetilde{\epsilon}_{C(a),1-S} + \widetilde{\epsilon}_{\mu(\theta),1-S}} + \frac{\sum_i \omega_i \mathbb{I}_i^{IC}\left(\left(\mu(\theta_i)\frac{da_i}{dS}\xi_{a,i}\right) + \frac{d\theta_i}{dS}\nu_{\theta,i}\right)}{\widetilde{C}(\boldsymbol{a},\boldsymbol{\theta})\bar{U}'(\boldsymbol{c}_e)\left(\widetilde{\epsilon}_{C(a),1-S} + \widetilde{\epsilon}_{\mu(\theta),1-S}\right)} \\
&= \frac{1-\overline{C}(\boldsymbol{a},\boldsymbol{\theta})}{\widetilde{\epsilon}_{C(a),1-S} + \widetilde{\epsilon}_{\mu(\theta),1-S}} + \sum_i \omega_i \mathbb{I}_i^{IC}\left[\frac{\mu(\theta_i)\frac{a_i\epsilon_{a_i,1-S}}{1-S}(-\xi_{a,i}) + \frac{\theta_i\epsilon_{\theta_i,1-S}}{1-S}(-\nu_{\theta,i})}{\widetilde{C}(\boldsymbol{a},\boldsymbol{\theta})\bar{U}'(\boldsymbol{c}_e)\left(\widetilde{\epsilon}_{C(a),1-S} + \widetilde{\epsilon}_{\mu(\theta),1-S}\right)}\right],
\end{aligned}
$$

where $\epsilon_{a_i,1-S} = d\log a_i / d\log(1-S)$ and $\epsilon_{\theta_i,1-S} = d\log\theta_i / d\log(1-S)$.$\square$

A.4 Proof of Proposition 2

A.4.1 Proof of (a): Optimal Disability Insurance without Labor Market Screening

To begin with, we specify the government's optimal disability benefit problem as (assume $S = 0$ for simplicity)

$$
\max_d \sum_i \omega_i\left((1-\mu(\theta_i))\left(\psi_i u(D+b) + (1-\psi_i)\,u(b)\right) + \mu(\theta_i)\left(u(w_i - T) - (\chi_i - \beta_i\varphi(a_i))\right)\right)
$$

$$
s.t.\ \frac{\mu(\theta_i)}{\theta_i}\left(y_i - w_i - C(a_i)\right) = \kappa
$$

$$
T = \frac{\sum_i \pi_i(1-\mu(\theta_i))\,\psi_i D}{\sum_i \pi_i \mu(\theta_i)}.
$$

Now, we plug these constraints into the objective function:

$$\sum_i \omega_i \left(\begin{array}{c} (1-\mu(\theta_i))(\psi_i u(d+D) + (1-\psi_i)u(b)) \\ +\mu(\theta_i)\left(u\left(y_i - C(a_i) - \frac{\kappa\theta_i}{\mu(\theta_i)} - \frac{\sum_j \pi_j (1-\mu(\theta_j))\psi_j D}{\sum_j \pi_j \mu(\theta_j)}\right) - \chi_i + \beta_i \varphi(a_i)\right) \end{array} \right).$$

Following the proof in A.3, we can characterize the optimal policy by introducing (i) a mechanical revenue effect, (ii) a welfare effect, and (iii) a behavioral effect.

First, the mechanical effect is

$$\Delta M = -\sum_i \omega_i \mu(\theta_i) u'(c_{e,i}) \frac{\sum_j \pi_j (1-\mu(\theta_j))\psi_j}{\sum_j \pi_j \mu(\theta_j)} \mathit{\Delta} D = -\bar{U}'(\boldsymbol{c}_e)\widetilde{E}(\boldsymbol{\theta})\mathit{\Delta} D,$$

where

$$\widetilde{E}(\boldsymbol{\theta}) = \frac{\sum_j \pi_j (1-\mu(\theta_j))\psi_j}{\sum_j \pi_j \mu(\theta_j)}$$

is the ratio of DI enrollees over the employed.

Second, the welfare effect is

$$\begin{aligned} \Delta W &= \sum_i \omega_i (1-\mu(\theta_i)) u'(c_{u,i})\psi_i \mathit{\Delta} D \\ &= \frac{\frac{\sum_i \omega_i (1-\mu(\theta_i))u'(c_{u,i})\psi_i}{\sum_i \omega_i \mu(\theta_i) u'(c_{e,i})}}{\frac{\sum_j \pi_j (1-\mu(\theta_j))\psi_j}{\sum_j \pi_j \mu(\theta_j)}} \bar{U}'(\boldsymbol{c}_e) \frac{\sum_j \pi_j (1-\mu(\theta_j))\psi_j}{\sum_j \pi_j \mu(\theta_j)} \mathit{\Delta} D \\ &= \bar{U}'(\boldsymbol{c}_e)\overline{E}(\boldsymbol{\theta})\widetilde{E}(\boldsymbol{\theta})\mathit{\Delta} D, \end{aligned}$$

where

$$\overline{E}(\boldsymbol{\theta}) = \frac{\frac{\sum_i \omega_i (1-\mu(\theta_i))u'(c_{u,i})\psi_i}{\sum_i \omega_i \mu(\theta_i) u'(c_{e,i})}}{\frac{\sum_j \pi_j (1-\mu(\theta_j))\psi_j}{\sum_j \pi_j \mu(\theta_j)}}$$

is the concentration of DI spending relative to the redistribution preference of the government.

Finally, the behavioral effect is

$$\begin{aligned} \Delta B &= -D\sum_i \omega_i \mu(\theta_i) u'(c_{e,i}) \frac{\partial \frac{\sum_j \pi_j (1-\mu(\theta_j))\psi_j}{\sum_j \pi_j \mu(\theta_j)}}{\partial D} \mathit{\Delta} D \\ &= -\widetilde{\epsilon}_{E,D}\widetilde{E}(\boldsymbol{\theta})\bar{U}'(\boldsymbol{c}_e)\mathit{\Delta} D, \end{aligned}$$

where $\widetilde{\epsilon}_{E,D}$ is the elasticity of the fraction of DI recipients over the employed with respect to DI benefits.

The optimal disability benefit is such that the sum of these three effects equals zero:

$$\bar{U}'(\boldsymbol{c}_e)\left(-\widetilde{E}(\boldsymbol{\theta}) + \overline{E}(\boldsymbol{\theta})\widetilde{E}(\boldsymbol{\theta}) - \widetilde{\epsilon}_{E,D}\widetilde{E}(\boldsymbol{\theta})\right)\mathit{\Delta} D = 0,$$

or $\overline{E}(\boldsymbol{\theta}) = \widetilde{\epsilon}_{E,D} + 1$, completing the proof. □

A.4.2 Proof of (b): Optimal Disability Insurance with Labor Market Screening

As discussed in the proof of Proposition A.3, we have a mechanical revenue effect and a behavioral effect identical to those in (a); however, the welfare effect now includes a screening effect.

The welfare effect is now expressed as

$$\begin{aligned}\Delta W = & \sum_i \omega_i \mu\left(\theta_i\right) u'(c_{e,i}) \overline{E}\left(\boldsymbol{\theta}\right) \widetilde{E}\left(\boldsymbol{\theta}\right) \Delta D \\ & + \sum_i \omega_i \mathbb{I}_i^{IC} \mu\left(\theta_i\right) \frac{\partial a_i}{\partial D}\left(-u'(c_{e,i}) \frac{\partial C(a_i)}{\partial a_i} + \frac{\partial \beta_i \varphi\left(a_i\right)}{\partial a_i}\right) \Delta D \\ & + \sum_i \omega_i \mathbb{I}_i^{IC} \frac{\partial \theta_i}{\partial D}\left(\frac{\partial \mu\left(\theta_i\right)}{\partial \theta_i}\left(u(c_{e,i}) - u(c_{u,i})\right) - \mu\left(\theta_i\right) u'(c_{e,i}) \frac{\partial \frac{\kappa \theta_i}{\mu(\theta_i)}}{\partial \theta_i}\right) \Delta D\end{aligned}$$

where $\mathbb{I}_i^{IC}$ is defined as in A.3.

So the optimal policy is determined by

$$\bar{U}'\left(\boldsymbol{c}_e\right)\left(-\widetilde{E}\left(\boldsymbol{\theta}\right) + \overline{E}\left(\boldsymbol{\theta}\right) \widetilde{E}\left(\boldsymbol{\theta}\right) - \widetilde{\epsilon}_{E,D} \widetilde{E}\left(\boldsymbol{\theta}\right)\right) - \sum_i \omega_i \mathbb{I}_{i \neq 1}\left(\left(\mu\left(\theta_i\right) \frac{da_i}{dD} \xi_{a,i}\right) + \frac{d\theta_i}{dD} \nu_{\theta,i}\right) \Delta D = 0$$

where $(\xi_{a,i}, \nu_{\theta,i})$ is defined in section A.3 and $\widetilde{E}\left(\boldsymbol{\theta}\right) = \frac{\sum_j \pi_j (1-\mu(\theta_j)) \psi_j}{\sum_j \pi_j \mu(\theta_j)}$. By rearranging terms, we have

$$\overline{E}\left(\boldsymbol{\theta}\right) + \sum_i \omega_i \mathbb{I}_i^{IC}\left(\frac{\mu\left(\theta_i\right) \frac{a_i}{D} \epsilon_{a_i,D} \xi_{a,i} + \frac{\theta_i}{D} \epsilon_{\theta_i,D} \nu_{\theta,i}}{\bar{U}'\left(\boldsymbol{c}_e\right) \widetilde{E}\left(\boldsymbol{\theta}\right) \widetilde{\epsilon}_{E,D}}\right) = \widetilde{\epsilon}_{E,D} + 1,$$

with $\epsilon_{a_i,D} = d \log a_i / d \log D$ and $\epsilon_{\theta_i,D} = d \log \theta_i / d \log D$, which completes the proof. □

B A Back-of-the-Envelope Calculation: DI Removal and Employment Changes

Ideally, we would like to compare labor market statistics from our counterfactual experiment without DI to real-world equivalent measures. While we cannot directly observe labor market outcomes without DI, recent empirical analysis sheds light on labor supply changes caused by DI (Maestas et al., 2013; French and Song, 2014). In this section, we explain how we use these empirical estimates to compute the effects of DI removal on employment for individuals between ages 50 and 64.

According to Maestas et al. (2013), DI applicants can be categorized into three groups: 57% of *truly disabled* applicants receive DI for sure, 20% of applicants are *always rejected*, and the remaining 23% of applicants are classified as *marginal cases*, as their outcomes may vary depending on the judge's leniency. These findings indicate that, roughly speaking, the current DI recipients can be either truly disabled or marginal, and their shares are given by 71.25%(=57/80) and 28.75%(=23/80), respectively.[54]

[54] These DI recipient shares are broad estimates because we ignore possibilities of appeals and reappeals in the DI application process. Our approach does not take into account the heterogeneity of rejection rates within the marginal cases either.

According to the Social Security Administration (2018), there are 6.18 million DI recipients between ages 50 and 64. Using the decomposition explained above, we expect that 4.4 million of them are truly disabled recipients and that the remaining 1.78 million are marginal cases. Among the 59 million of the U.S. population between ages 50-64 (Census population estimates), approximately 37.17 million are employed, yielding an employment rate of 63%.[55]

From the estimation results in Maestas et al. (2013), the employment rate for DI applicants declines after the rejection of application, and the magnitude of this decline varies by the applicant's type; 57% of marginal case applicants return to work once their application is rejected; however, for the truly disabled, only 12% return to work after rejection. Using these numbers, we compute that without DI, we would expect 12% of 4.4 million and 56.6% of 1.78 million DI recipients (or 1.54 million) to return to work. This would result in an increase in employment from 37.17 to 38.71 million out of 59 million workers between ages 50 and 64, or a 2.6*pp* increase in the employment rate of this group.

C Data Appendix: Health and Retirement Study

Table 7 summarizes the work limitation and self-reported health status of individuals in our sample, which we use to categorize workers for our empirical analysis.

Table 7: Work Limitation and Self-reported Health Evaluation

		Work limitation		Total
		No	Yes	
Self-reported health	1 (excellent)	5,881	244	6,125
	2 (very good)	11,872	1,141	13,013
	3 (good)	9,730	2,899	12,629
	4 (fair)	3,372	3,901	7,273
	5 (poor)	479	2,833	3,312
Total		31,334	11,018	42,352

Note: This table reports the number of observations by the work limitation and health evaluation variables. The sample is limited to individuals between ages 51 and 64 from 1996 to 2008.

Because the degree of disability status is constructed based on the two subjective measures relying on the respondent self-evaluation, one may be concerned that our disability measure may not correctly capture the respondent health conditions. To examine how accurately our disability measure reflects the health status of an individual, we looked into the relationship between the disability measure and other objective health variables available in the HRS, as listed in Table 8. We confirm that our disability measure is indeed positively correlated with the severity of health conditions in various types of health outcomes.

D Additional Empirical Results

We document additional results of our empirical analysis reported in Section 4.1.

[55]The number is calculated as the 10-year average of employment rates for workers of ages 50-64 from 2008 to 2010. Data source: BLS statistics, the number of employed for ages 50-54 (LNU02024937Q) and 55-64 (LNU02000095Q).

Table 8: Other Measures of Health: Sample Means

Objective health measures	Non-disabled	Moderately disabled	Severely disabled
Body Mass Index	27.6	29.4	30.4
Missed work due to health issues (days)	3.9	9.3	21.7
Hospital utilization during the past 12 months			
Out-of-pocket medical spending ($2014)	1,819	3,142	4,367
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	65.4
Arthritis or rheumatism	37.8	63.5	75.8
High blood pressure or hypertension	37.7	55.2	65.7
Emotional, nervous, or psychiatric problems	10.3	23.3	44.9
Diabetes or high blood sugar	8.9	22.3	33.1
Heart attack, congestive heart failure, or other heart problems	8.9	20.1	37.4
Cancer or a malignant tumor of any kind (except skin cancer)	6.5	10.5	13.8
Chronic lung disease (except asthma)	3.5	10.5	24.1
Stroke or transient ischemic attack (TIA)	1.3	4.7	12.2

Note: This table documents the sample mean of objective health measures by the degree of disability. The nominal out-of-pocket medical expenditure is adjusted using the Consumer Price Index (CPI) in 2014 U.S. dollars.

D.1 Robustness Analyses

This section describes the robustness analyses and their estimation results.

D.1.1 Interaction of Health Outcomes with the 2004 WOTC Amendment

One potential concern with our analysis is that our results may be driven by changes in worker composition in each disability category. That is, there may be heterogeneity in health status within each disability category, and marginally disabled individuals (with more preference for the option to reduce working hours) in the moderate group started working in jobs with the amenity after the expansion of the WOTC in 2004. If this is the driver of the above result, the prediction is consistent with a competitive labor market equilibrium without screening contracts (or an equilibrium with health-dependent contracts). We include interaction terms of health outcomes with the 2004 WOTC amendment as additional covariates to the benchmark analysis. With this, we can check whether our findings of changes in job amenities after the 2004 WOTC amendment are explained by health heterogeneity within each disability group. As reported in Table 9, the main findings reported in the benchmark analysis are not affected, including the significant increase in the option to reduce working hours among the moderately disabled after the 2004 WOTC amendment. Thus, this finding indicates the robustness of our results with respect to the potential compositional effects induced by heterogeneity in health status within each disability.

Table 9: Results: Robustness Analyses

Dependent variable: Option to reduce working hours

Coefficients		Benchmark	Type of robustness exercise (1) Health outcomes ×post-WOTC	(2) Measure with # of diagnoses	(3) Gender ×post-WOTC
Post amendment (β_1)		-0.014	0.014	0.038**	-0.025
		(0.058)	(0.098)	(0.019)	(0.060)
Disability status (β_{2h})	Severe	0.206***	0.145***	0.134*	0.204***
		(0.056)	(0.054)	(0.082)	(0.056)
	Moderate	0.080***	0.050**	0.053**	0.078**
		(0.031)	(0.029)	(0.024)	(0.031)
Disability status	Severe	0.014	0.079	-0.003	0.012
× Post amendment (β_{3h})		(0.064)	(0.082)	(0.127)	(0.063)
	Moderate	0.068***	0.118**	0.072**	0.068**
		(0.034)	(0.048)	(0.037)	(0.034)
# of observations		8,541	8,280	8,258	8,541

Note: Robustness exercises (1) and (3) contain the covariates with that of the benchmark and also include interaction terms with dummy variables for health outcomes and gender, respectively. Robustness exercise (2) uses the same covariates as in the benchmark, which include age, age-squared, years of education, annual growth rate of GDP, annual employment rates, firm-size categories, and health outcomes. For all analyses, standard errors are clustered at the individual level. *** p<0.01, ** p<0.05, * p<0.1

D.1.2 Results with an Alternative Categorization of Workers

Another potential concern is whether our main findings are robust to alternative choices of disability measures. In this section, we introduce an alternative measure of disability and examine how sensitive our estimation results are with respect to the classification of disability. We construct our alternative disability measure by combining the work limitation measures with the number of reported diagnoses. In the HRS, respondents are asked if they have been diagnosed with any of eight major disease categories since the last survey: (i) arthritis or rheumatism, (ii) high blood pressure or hypertension, (iii) emotional, nervous, or psychiatric problems, (iv) diabetes or high blood sugar, (v) heart attack, congestive heart failure, or other heart problems, (vi) cancer or a malignant tumor of any kind (except skin cancer), (vii) chronic lung disease, and (viii) strokes or transient ischemic attacks. Based on these variables, we construct the number of diagnoses as an index ranging from zero to eight (See Table 10).

Table 10: Summary Statistics: The Number of Diagnoses

Share (%)		Number of diagnoses 0	1	2	3	4	5	6	7	8
Work limitation	no limitation	19.0	23.9	17.6	9.2	3.3	1.0	0.2	0.0	0.0
	limitation	0.9	3.4	5.9	6.3	4.6	2.8	1.3	0.5	0.1

Note: This table reports the share of observations by the number of reported diagnoses and the work limitation measure. The statistics are computed using the individual-level survey weight.

Similar to the benchmark case, non-disabled workers are those who report less than four diagnoses and no work limitation. We define severely disabled workers as those who have more than four diagnoses and have work limitations. The rest are labeled as moderately disabled. Under this specification, 4% are severely disabled, 25% are moderately disabled, and 71% are non-disabled. Thus, we are applying tighter criteria for being severely disabled compared to the benchmark case. Table 9 documents the results. Results suggest that the estimation outcomes are robust to the choice of disability measures.[56]

D.1.3 Including a Gender-Specific Time Dummy

One might be concerned that the increase in amenities among the moderately disabled after the 2004 WOTC amendment could be driven by certain characteristics of workers that are independent from their disability status. In particular, it has been often argued that female workers may have a different preference for work schedule compared to their male counterparts. If the changes in the option to reduce working hours were mainly driven by the compositional change of female workers among the moderately disabled, our result would not be relevant to firms' response in screening the disabled. To address this concern, we introduce a gender-specific time dummy as an additional regressor and estimate Equation (3). We find that there are no significant differences on the effects of the WOTC amendment by gender group (Table 9).

D.1.4 The Trend increase in DI enrollment

As Autor and Duggan (2006) and Liebman (2015) argue, there has been a steady increase in DI enrollment since the early 1990s. One may wonder whether our results may be partially explained by this trend. First, one potential concern is that this change in DI enrollment may lead to changes in worker composition within each disability category. If workers with fewer job amenities among the moderately disabled stop working and receive DI, it may drive our estimate of the interaction term of the moderately disabled and the WOTC amendment dummy. This is essentially the composition effect: as discussed in Appendix D.1.1, our findings are robust with respect to controlling for compositional effects.

Another potential effect is that an increase in DI enrollment may actually increase the job amenities received by the moderately disabled precisely because of the screening mechanism as discussed in Section 2.4. If an increase in DI enrollment is concentrated among severely disabled workers, then firms hiring moderately disabled workers no longer need to reduce job amenities to screen the severely disabled. Because this channel is consistent with the screening mechanism, we view that whether changes in job amenities are induced by the WOTC amendment or by changes in DI enrollment does not matter for detecting screening tools. However, as seen in Table 11, we find a statistically insignificant effect of employment in the interaction between the severely disabled and the WOTC amendment dummy. Thus, at least in our sample, we think that it is unlikely that this channel drives our findings.

[56] We find that regression analyses on other amenity measures and labor market outcomes also deliver similar coefficients when we apply the disability measure instead of the benchmark measure. These results are available upon request.

D.2 The Effects of WOTC on Employment and Wages

Table 11 documents the empirical results on employment and wage rates by disability status.

Table 11: Effects of the WOTC-amendment on Labor Market Outcomes

Coefficients		Dependent variable	
		Employment	(log) Hourly wage
Post -amendment (β_1)		0.109***	-0.011
		(0.014)	(0.072)
Disability status (β_{2h})	Severe	-0.876***	-0.118**
		(0.019)	(0.056)
	Moderate	-0.398***	-0.088**
		(0.013)	(0.035)
Disability status	Severe	-0.012	0.087*
$\times$ Post -amendment (β_{3h})		(0.015)	(0.051)
	Moderate	-0.002	0.050
		(0.015)	(0.037)
# of observations		34,141	8,890

Note: This table reports the coefficient estimates of regressions on employment and hourly wage rate. The sample includes individuals between ages 50 and 64 from 1996 to 2008. The wage regression sample is further restricted to those who recorded an hourly rate of less than $43.75, which is equivalent to the 95th percentile among the observations. The additional covariates used in the regression include age, age-squared, years of education, annual growth rate of GDP, annual employment rates, firm-size categories, and health outcomes. The sample is weighted by individual-level survey weight. Standard errors are clustered at the individual level. *** p<0.01, ** p<0.05, * p<0.1

D.3 The Effects of the 2004 WOTC Amendment on Other Measures of Job Amenities

We estimate Equation (3) in Section 4.1 on other job amenity variables available from the HRS: the availability of switching to a part-time position, the number of paid sick days per year, the number of vacation weeks per year, and the availability of ESDI coverage. Results are reported in Table 12. It is important to note that the sample sizes in regressions for the availability of part-time work and the availability of sick days are much smaller than that for the option to reduce working hours. As a result, we may not have enough statistical power to credibly estimate our regression models. Moreover, we also find that the coefficients for the disability dummies (β_{2h}) are not monotonic in disability status in regressions for vacation days and ESDI coverage, in addition to the lack of the significance of the effect of the WOTC amendment. One possibility is that the provision of these job amenities, especially ESDI, are determined at the firm level. Thus, it may be very difficult for firms to exploit them to screen a particular worker.

Table 12: Effects of the WOTC Amendment on Other Job Amenities

Coefficients		Dependent variable: Available part-time	Available paid sick days	Available vacations (week)	ESDI coverage
Post-amendment (β_1)		-0.015	0.933	-0.348	-0.063
		(0.113)	(3.874)	(0.804)	(0.056)
Disability status (β_{2h})	Severe	0.030	13.496***	-0.833	-0.082
		(0.109)	(4.855)	(0.750)	(0.056)
	Moderate	0.038	9.378***	0.377	0.071**
		(0.058)	(3.107)	(0.558)	(0.035)
Disability status	Severe	-0.076	-2.161	0.183	-0.002
$\times$ Post-amendment (β_{3h})		(0.132)	(6.160)	(0.510)	(0.064)
	Moderate	0.004	-4.035	-0.232	0.034
		(0.064)	(2.774)	(0.458)	(0.037)
# of observations		1,950	3,280	6,331	6,200

Note: The additional covariates used in the regression include age, age-squared, years of education, annual growth rate of GDP, annual employment rates, firm-size categories, and health outcomes. Standard errors are clustered at the individual level. *** p<0.01, ** p<0.05, * p<0.1

D.4 Testing for the Common-Trend Assumption

We examine whether the common-trend assumption for the option to reduce working hours across disability types is satisfied. To do so, we modify our main empirical regression by introducing time-specific dummies for disability status:

$$y_{it} = \beta_1 \mathbb{I}_{\{t \geq 2004\}} + \sum_{h \in \{\text{mod, sev}\}} \beta_{2h} \mathbb{I}_h + \sum_{t=1998}^{2008} \beta_{3ht} \mathbb{I}_{\{\text{health}=h\}} + \boldsymbol{\gamma} \mathbf{X_{it}} + \boldsymbol{\nu} \boldsymbol{Z_t} + \epsilon_{it}. \qquad (6)$$

Our main parameters of interest are β_{3ht}, which allow us to check whether the trend for the option to reduce working hours before the implementation of WOTC is similar across workers with different disability statuses. As the HRS is a biennial survey and our sample starts from 1996, we include time dummies starting in year 1998 with two-year intervals. Importantly, the sample size for individuals who are severely disabled in 2004 is very small. Thus, we combine years 2004 and 2006 to generate the common year dummy for $t \in \{2004, 2006\}$. Table 13 summarizes the estimated coefficients for all employed workers and new hires.

Table 13: Testing for the Common-Trend Assumption

		Dependent variable: Option to reduce working hours			
		(1) All employed		(2) New hires	
		Sev. disabled	Mod. disabled	Sev. disabled	Mod. disabled
Pre-WOTC expansion	$\beta_{3h,1998}$	-0.096	0.035	-0.075	0.006
		(0.115)	(0.063)	(0.136)	(0.075)
	$\beta_{3h,2000}$	-0.085	0.032	-0.108	-0.026
		(0.110)	(0.060)	(0.147)	(0.080)
	$\beta_{3h,2002}$	0.204	0.131	0.201	0.047
		(0.155)	(0.084)	(0.178)	(0.093)
Post-WOTC expansion	$\beta_{3h,2004-2006}$	0.058	0.245***	0.016	0.250***
		(0.134)	(0.076)	(0.147)	(0.084)
	$\beta_{3h,2008}$	-0.077	0.072	-0.028	0.037
		(0.114)	(0.064)	(0.172)	(0.088)

Note: This table reports the coefficient estimates of a regression equation (6). The sample is individuals between ages 50 and 64 from 1996 to 2008 and is weighted by individual-level survey weight. The additional covariates used in the regression include age, age-squared, years of education,firm-size categories, and health outcomes. Standard errors are clustered at the individual level. *** p<0.01, ** p<0.05, * p<0.1

The estimated coefficients on years before the expansion of WOTC (1998 through 2002) are not significant for both severely and moderately disabled workers: the access to option to reduce working hours does not show any distinctive time trends between 1996 and 2002. Therefore, the pre-trend common assumption is likely to be satisfied. Further, the amenities for severely disabled workers are not affected after the amendment. However, the estimated coefficient on years 2004 and 2006 for moderately disabled workers is statistically significant, suggesting that their amenities are impacted due to the policy reform.[57]

[57] We find that the magnitudes of estimates for β_{3ht} are similar and statistically significant for the moderately disabled even if we estimate with the the separate year dummy for 2004 and 2006.

D.5 The ADA Amendments Act of 2008

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

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

The dependent variable y_{it} indicates whether an individual i at time t has an option to reduce working hours or not. The definition of the 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. Table 14 summarizes the regression results.

Table 14: Effects of the ADA Amendment on the Option to Reduce Working Hours

Coefficients		Sample period 2004 to 2014
Post-amendment (β_1)		-0.035
		(0.036)
Disability status (β_{2h})	Severe	0.280***
		(0.108)
	Moderate	0.240***
		(0.064)
Disability status	Severe	0.073
× Post-amendment (β_{3h})		(0.110)
	Moderate	-0.105*
		(0.062)
# of observations		3,458

Note: This table reports the coefficient estimates based on years 2004-2014. The sample includes individuals between ages 50 and 64 and is weighted with individual-level survey weight. The additional covariates used in the regression include age, age-squared, years of education, annual growth rate of GDP, annual employment rates, firm-size categories, and health outcomes. Standard errors are clustered at the 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 the option to reduce working hours. However, we find that there was no significant change among the severely disabled workers' 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.

D.6 Coefficient Estimation Results

We present the regressors and their coefficient estimates that are included in our empirical analysis but omitted from the main text because of space limitations.

Aggregate Variables. At the aggregate level, we use two variables, the growth rate of GDP and the average annual employment rates, to control for macroeconomic conditions. We use the all-industry total real GDP in millions of chained 2005 dollars from the Bureau of Economic Analysis (BEA) to compute the annual GDP growth rates. For annual employment rates, we use data from the Current Employment Statistics program surveys of the Bureau of Labor Statistics (BLS). We convert seasonally adjusted monthly total employment in non-farm sectors into annual data by taking the average of 12 months. Then, we compute the employment rate by dividing this number by the size of the U.S. working-age population (defined as those between ages 18 and 65). We obtained population estimates from the U.S. Census Bureau. All of these data series are public and available online.

The Size of Employment. On the labor demand side, we control for the size of employer. The HRS offers two kinds of variables for employment size: the size of an establishment ("*the number of employees at location*") and the size of a firm ("*the number of employees at all locations*"). We choose the establishment size as the main index for the size of an employer and substitute with the firm size variable if the establishment size is missing.[58] As the range of the employment size vastly varies between zero and 999,999, we introduced five category dummies instead of directly introducing the employer size as a regressor. Employers with fewer than 10 employees are considered as the base group, and we introduce four dummies representing the employment size for 11 to 50, 51 to 200, 201 to 600, and 600 or more. Each category represents 26%, 29%, 23%, 12%, and 10% of the sample observations.

Individual Characteristics. On the labor supply side, we control for age, age-squared, education, and health outcomes. In our benchmark analysis, we further categorize the years of schooling into five subcategories: (i) less than high school, (ii) high school graduates, (iii) some college, (iv) college graduates, (v) and individuals with advanced degrees. Each category represents 21%, 33%, 23%, 11%, and 12%. In our regressions, individuals with less than high school are set as a base group.

For health outcomes, we use the number of reported major diagnoses and include the types of diagnoses as dummy variables. The list of major diagnoses is (i) arthritis or rheumatism, (ii) diabetes or high blood sugar, (iii) heart attack, congestive heart failure, or other heart problems, (iv) stroke or transient ischemic attack, (v) emotional, nervous, or psychiatric problems, and (vi) and high blood pressure or hypertension. We also include annual medical expenditures and the Body Mass Index (BMI).[59] The summary statistics associated with these objective health measures are reported in Table 8 of Section C.

Along with these regressors, we also add two subjective health measures, difficulties with Activities of Daily Living (ADL) and the subjective health evaluation. The ADL asks whether respondents have difficulties with performing the five basic tasks: bathing, eating, dressing, walking across a

[58] In our sample, 2.4% of the observations fall into this category. Our results are unaffected when we exclude these observations from the analysis.

[59] Instead of directly taking BMI as a regressor, one can introduce dummy variables for being overweight (BMI$\geq$ 27) and underweight (BMI$\leq$ 18) to capture nonlinear effects of BMI on one's health. We find that our results are not affected.

room, and getting in or out of bed. We define the number of reported difficult tasks as an ADL index and introduce a dummy variable for each category. In our sample, 87.4% of respondents have no difficulties in performing ADLs, and the share of each category diminishes to 6.3%, 2.9%, 1.7%, 1.1% and 0.6% along with the index. Because of smaller sample size for indices 4 and 5, we merge the last two categories into one. Similarly, the health evaluation score varies from 1 to 5, and we introduce it as a dummy variable. See Tables 15 and 16 for the results.

Table 15: Effects of the WOTC-Amendment: Other Covariates

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
					Sensitivity analysis			
Type of exercise	Using different dependent variables				New hires	2004-14 ADAAA	Gender× WOTC	Health× WOTC
Dependent variable	Option to reduce hours	Available sick days	(log) wage	Employment	Option to reduce working hours			
Panel A. Firm-side characteristics and macro variables								
GDP growth rate	0.00006	-0.002	0.00004	-0.00008***	-0.00002	-0.00001	0.0004	0.00007*
	(0.00005)	(0.003)	(0.00006)	(0.00001)	(0.00005)	(0.00004)	(0.00004)	(0.00004)
Employment rate	-0.00002**	0.0006	4.47e-6	0.00002***	3.93e-7	-2.20e-6	-0.00001**	-0.00002**
	(7.92e-6)	(0.0006)	(0.00001)	(2.16e-6)	(9.94e-6)	(4.64e-6)	(7.47e-6)	(6.46e-6)
Firm size category								
$11 \leq$ size ≤ 50	-0.071***	-0.128	0.079***		-0.049*	-0.075***	-0.071***	-0.051***
	(0.018)	(1.080)	(0.023)		(0.025)	(0.025)	(0.017)	(0.015)
$51 \leq$ size ≤ 200	-0.125***	4.315***	0.159***		-0.093***	-0.141***	-0.120***	-0.105***
	(0.019)	(1.513)	(0.025)		(0.029)	(0.026)	(0.018)	(0.016)
$201 \leq$ size ≤ 600	-0.121***	1.758	0.185***		-0.162***	-0.095***	-0.118***	-0.107***
	(0.023)	(1.532)	(0.027)		(0.036)	(0.034)	(0.022)	(0.020)
size ≥ 601	-0.142***	1.680	0.293***		-0.082*	-0.089*	-0.141***	-0.133***
	(0.024)	(1.343)	(0.030)		(0.048)	(0.036)	(0.023)	(0.021)
Panel B. Individual characteristics								
Age	-0.144**	4.289	-0.073	0.276**	-0.132	-0.131**	-0.134**	0.024**
	(0.059)	(3.696)	(0.070)	(0.025)	(0.090)	(0.001)	(0.056)	(0.011)
Age^2	0.001***	-0.038	0.0005	-0.003***	0.001*	0.001***	0.001***	-0.00009
	(0.0005)	(0.032)	(0.0006)	(0.0002)	(0.0008)	(0.0005)	(0.0005)	(0.00008)
Female	0.010	-1.254	-0.185***	-0.094***	-0.004	0.041**	0.014	0.010
	(0.012)	(0.950)	(0.019)	(0.008)	(0.020)	(0.019)	(0.016)	(0.012)
Female×WOTC							0.034	
							(0.025)	
Education category								
high school	-0.004	-2.205	0.138***	0.056***	0.102***	0.021	0.012	0.003
	(0.024)	(1.981)	(0.026)	(0.012)	(0.034)	(0.036)	(0.023)	(0.019)
some college	0.007	-4.448**	0.269***	0.092***	0.055	0.029	0.020	0.015
	(0.025)	(1.963)	(0.028)	(0.013)	(0.035)	(0.036)	(0.024)	(0.021)
college	0.005	-5.588***	0.408***	0.091***	0.080*	-0.0006	0.014	-0.002
	(0.029)	(2.117)	(0.034)	(0.016)	(0.042)	(0.039)	(0.027)	(0.024)
advanced	0.008	-7.573***	0.539***	0.123***	0.123***	0.061	0.023	0.008
	(0.029)	(1.951)	(0.036)	(0.015)	(0.042)	(0.040)	(0.027)	(0.024)
Sample size	8,541	3,280	8,890	34,141	3,329	3,458	8,541	8,280

Table 16: Effects of the WOTC-Amendment: Other Covariates

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	
Panel C. Health-related characteristics								as a regressor	Interaction with WOTC
# of diagnoses	-0.011	1.186	-0.006	-0.001	-0.019	0.012	-0.006	-0.008	0.003
	(0.010)	(0.751)	(0.012)	(0.005)	(0.016)	(0.016)	(0.009)	(0.009)	(0.014)
Diagnosed disease type									
arthritis	0.020**	-0.942	-0.011	0.010	0.013	0.003	0.010	0.009	0.001
	(0.018)	(1.297)	(0.023)	(0.010)	(0.030)	(0.027)	(0.018)	(0.018)	(0.031)
diabetes	-0.005	-4.205**	-0.025	-0.004	0.034	-0.014	-0.011	-0.008	-0.016
	(0.024)	(1.651)	(0.028)	(0.012)	(0.042)	(0.031)	(0.024)	(0.026)	(0.039)
heart	0.058**	-1.034	-0.006	-0.015	0.099**	0.047	0.057**	0.052**	-0.018
disease	(0.026)	(1.783)	(0.028)	(0.013)	(0.044)	(0.037)	(0.026)	(0.024)	(0.039)
strokes	-0.046	9.168*	0.048	-0.018	-0.088	-0.029	-0.044	-0.004	-0.028
	(0.044)	(5.166)	(0.056)	(0.020)	(0.063)	(0.066)	(0.044)	(0.044)	(0.068)
psychiatric	-0.002	-0.819	0.038	-0.057***	0.018	-0.061	-0.002	0.017	-0.049
problems	(0.025)	(1.557)	(0.029)	(0.013)	(0.039)	(0.032)	(0.025)	(0.031)	(0.044)
high blood	0.014	0.903	0.006	0.010	0.050*	-0.019	0.012	0.019	-0.016
pressure	(0.017)	(1.157)	(0.021)	(0.009)	(0.029)	(0.025)	(0.017)	(0.017)	(0.029)
# of Difficulties with Activities of Daily Living (ADL)									
1	-0.002	3.937	-0.043	-0.024*	0.080	0.0006	0.008	0.004	0.056
	(0.034)	(3.659)	(0.043)	(0.013)	(0.055)	(0.055)	(0.033)	(0.036)	(0.061)
2	0.066	8.944	-0.139***	-0.058***	0.104	0.023	0.051	0.071	0.083
	(0.069)	(9.238)	(0.051)	(0.019)	(0.101)	(0.101)	(0.066)	(0.076)	(0.126)
3	-0.080	20.999	-0.116*	-0.053**	-0.157	0.115	-0.095	-0.243***	0.312
	(0.092)	(15.102)	(0.061)	(0.023)	(0.113)	(0.169)	(0.089)	(0.056)	(0.173)
4	0.009	-5.027	-0.033	-0.086***	-0.027	-0.223	-0.062	0.228	-0.242
	(0.133)	(5.192)	(0.139)	(0.030)	(0.151)	(0.139)	(0.112)	(0.177)	(0.233)
Health evaluation									
2	-0.013	-0.949	-0.055**	0.016	0.048	0.016	-0.00008	-0.001	-0.043
	(0.019)	(1.228)	(0.025)	(0.011)	(0.031)	(0.028)	(0.018)	(0.020)	(0.035)
3	-0.071***	0.842	-0.125***	0.019	-0.028	-0.023	-0.056***	-0.069***	-0.019
	(0.022)	(1.433)	(0.027)	(0.012)	(0.035)	(0.031)	(0.020)	(0.021)	(0.037)
4	-0.191***	-3.804	-0.066	0.429***	-0.216***	-0.140**	-0.161***	-0.126***	-0.130**
	(0.041)	(3.370)	(0.048)	(0.019)	(0.061)	(0.058)	(0.039)	(0.040)	(0.066)
5	-0.288***	2.240	-0.174***	0.345***	-0.259***	-0.203**	-0.250***	-0.204***	-0.100
	(0.056)	(4.967)	(0.061)	(0.022)	(0.095)	(0.081)	(0.054)	(0.055)	(0.095)
BMI	-0.001	-0.022	0.003**	0.001**	-0.001	-0.001	-0.002	-0.001	-0.002
	(0.001)	(0.099)	(0.002)	(0.0007)	(0.002)	(0.002)	(0.001)	(0.001)	(0.002)
(ln) medical	0.003	2.185***	0.019***	-0.003	0.005	-2.07e-6	0.001	0.006	0.004
spending	(0.005)	(0.405)	(0.006)	(0.002)	(0.008)	(186e-6)	(0.005)	(0.005)	(0.007)