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ABSTRACT

This paper studies the optimal design of social insurance programs for disabled workers by developing and estimating an equilibrium labor search model with screening contracts. In the model, firms may strategically use employment contracts, consisting of wage and job amenities, to screen out the disabled. The optimal structure of disability policies depends on firms' screening incentives, which may distort employment rates and contracts. By exploiting policy changes on the labor demand side for the disabled in the United States, we identify and estimate our equilibrium model to explore the optimal joint design of disability policies, including disability insurance (DI) and subsidies to firms accommodating disabled workers. We find that firm subsidies mitigate screening distortions; at the same time, they interact with DI by reducing the labor supply disincentives it generates. The optimal policy structure leads to a considerable welfare gain by simultaneously making firm subsidies and DI benefits more generous.

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1 Introduction

Today, one in seven people in the working-age population of OECD countries regard themselves as having a disability (OECD, 2010). Various social insurance policies have been implemented to support individuals with disabilities. First, public disability insurance (DI) programs provide income support to disabled individuals who are unable to work. 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 mandating the provision of reasonable accommodations. Recently, there has been growing interest in reforming social insurance programs for disabled workers, especially due to concerns about the financial sustainability of the DI program, which has become 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. 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 understand how these policies affect both labor supply and labor demand of 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. Several studies argue that the introduction of the ADA substantially raised the cost of hiring disabled workers, thereby lowering the labor demand for these workers.[2] These findings indicate 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 disability status. Consequently, there are no existing studies that examine the design of disability policies by accounting for both labor-supply and labor-demand responses.

This paper studies the optimal design of social insurance programs for the disabled in an equilibrium labor search model with screening employment contracts. We posit that firms strategically choose the provision of the option to reduce working hours, via paid or unpaid leave for example, to screen out the disabled. This job amenity (or non-

[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]See, for example, DeLeire (2000), Acemoglu and Angrist (2001), and Kim and Rhee (2018). Also, Koning and Lindeboom (2015) discusses that the Dutch reform, which increased the financial responsibility of employers with disabled workers, could strengthen employers' screening incentives.

pecuniary benefit) provides a specific form of flexibility and accommodation that could be particularly valuable to the disabled, who occasionally needs to stay at home or receive medical care. Because firms are not necessarily mandated to provide this amenity under existing U.S. regulation (e.g., the ADA), they may under-provide it to avoid hiring the disabled without violating regulations.[3,4] We develop an equilibrium search model with this screening mechanism and show analytically how labor market policies and DI should be designed to address screening distortions. Then, by exploiting disability policy changes in the United States, we estimate our model and find that the screening distortion is quantitatively substantial. Our counterfactual policy experiments show that providing subsidies to firms accommodating the disabled mitigates their screening incentives; at the same time, these subsidies interact with DI by reducing DI's work disincentive effects. Thus, the optimal policy structure prescribes a simultaneous increase in the generosity of firm subsidies and DI benefits, resulting in a considerable welfare gain.

We first theoretically characterize the optimal disability policies. Our model extends labor market screening models (e.g., Akerlof, 1976; Guerrieri et al., 2010; and Stantcheva, 2014) by incorporating worker heterogeneity in disability and skill. A worker's disability status affects his disutility from work, net output, and preference for job amenities. In a frictional labor market, workers optimally choose whether to search for a job and what type of job to search for (i.e., the search process is directed). Firms choose wages and job amenities to maximize their profits, but their contracts cannot explicitly depend on a worker's disability status. Thus, firms design contract terms to screen out a specific type of worker, exploiting preference heterogeneity in job amenities. We show that the optimal structure of disability policies, such as DI and subsidies to firms to accommodate the disabled (as one of labor market policies), depend not only on redistributive and distortionary effects in the labor market, but also on the strength of firm's screening incentives. Both policies mitigate firm's screening incentives but in different mechanisms: the subsidy to firms directly reduces the differences in the ex-post profit between a job matched with a disabled worker and one with a non-disabled worker, while DI lessens the distortion by reducing disabled job applicants.

Next, we estimate our equilibrium model using the Health and Retirement Study (HRS). In our data, disabled workers tend to work at jobs that provide the option to reduce working hours.[5] We also provide suggestive evidence that firms may use the option to reduce working hours as a tool for screening out the disabled. Then, we estimate

[3]There are various accommodations (e.g., work place modifications or special equipment) that the ADA mandates firms to provide to meet the needs of disabled workers, but the option to reduce working hours is not one of them.

[4]We do not necessarily interpret that having the option to reduce working hours is equivalent to working part time, nor that the disabled prefers part-time jobs. We clarify this point in Section 3.

[5]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.

the model through an indirect inference procedure. The main identification challenge in estimation is that the degree of labor market screening is endogenously determined in equilibrium, affected by parameters governing both the labor supply side (the worker utility from job amenities) and the labor demand side (the cost of providing job amenities). To separately identify these parameters, we utilize variation in the data induced by the policy change on the labor demand side for the disabled, the amendment to the Work Opportunity Tax Credit program in 2004. Based on our estimates, the inefficiencies in job amenities arising from firms' screening contracts can be sizable: in the estimated screening model, the share of employees with the option to reduce working hours is 13% (between 5.5% and 21%) lower on average than the share if firms are allowed to offer disability-dependent contracts (i.e., in the economy without screening contracts). As a model validation exercise, we also show that the model produces an empirically plausible employment effect of DI, similar to those in the literature exploiting quasi-experiments (e.g., Maestas et al., 2013 and French and Song, 2014).

Then, we use the estimated model to find the optimal combination of DI and firm subsidies to provide the option to reduce working hours. This job amenity subsidy, which accommodates working disabled individuals, fits into active labor market policies for the disabled that are now widely adopted in many OECD countries.[6] First, we find that this job amenity subsidy provides better consumption insurance among the employed while ameliorating screening distortions in the labor market. Therefore, it increases the welfare of all workers, highlighting the benefits of adopting such a labor market policy in the U.S. Second, compared to the benchmark economy, we find that the optimal policy structure features both generous amenity subsidies and higher DI benefits. Although more generous DI may distort the labor supply incentives of the disabled, it also reduces firm's screening incentives. Moreover, the amenity subsidy complements DI by mitigating employment distortion generated by DI. Thus, the optimal combination of these policies provides consumption insurance and reduces screening distortions, while balancing the level of employment. Overall, it increases the social welfare by 1.6% in terms of consumption, suggesting a potential benefit from systematic reforms of disability policies.

Related Literature. First, this paper contributes to the growing literature that studies, both theoretically and quantitatively, the welfare impacts of disability and health policies.[7] A seminal contribution is Golosov and Tsyvinski (2006) which solves a mechanism

[6] According to OECD (2010), many OECD countries (e.g., Sweden, Norway, and Great Britain) have gradually expanded labor market policies for the disabled to increase their employment rates. As an example, the Netherlands' DI reform of 2006 included partial DI payments with wage subsidies (Koning and Lindeboom, 2015). The partial DI program helps reduce labor supply distortions by smoothing disability benefits across employment statuses. However, it may not be as effective in addressing the screening problem, which is the focus of our paper (we discuss this issue further in Section 2).

[7] There is also an extensive empirical literature studying disability and DI. Please refer to Bound and Burkhauser (1999) for the survey of this literature.

design problem, where the government cannot observe the worker's disability status. The authors theoretically and numerically characterize the optimal DI system and its implementation. More recently, Kitao (2014), Low and Pistaferri (2015), French and Song (2017), and Michaud and Wiczer (2018) evaluate the welfare impacts of the U.S. DI program by developing rich structural models, mainly focusing on the worker side responses. In a similar vein, De Nardi et al. (2016), Braun et al. (2017), Braun et al. (2019), Cole et al. (2019), and Aizawa and Fang (2020) use structural models to evaluate various health policies. Our main contribution is to provide an analysis of disability policy designs that incorporate both firm- and worker-side responses in a rich equilibrium labor market model. We show that accounting for firms' screening incentives is crucial in determining the optimal structure of policies for the disabled.

Moreover, this paper contributes to the large macro public finance and macro labor literature analyzing social insurance programs using equilibrium labor search models. From a theoretical standpoint, Acemoglu and Shimer (1999) and Blanchard and Tirole (2008), and more recently Golosov et al. (2013), analyze the determinants of optimal social insurance policies that incorporate their distortionary effects in frictional labor markets. From a quantitative standpoint, Mitman and Rabinovich (2015), Lise et al. (2016), Chodorow-Reich et al. (2019), and Braxton et al. (2020) study equilibrium labor market implications of unemployment insurance systems. Our contribution is to develop a quantitative framework to assess the optimal joint design of worker- and firm-side policies in the labor market with both search and screening frictions.[8]

There is a large theoretical literature concerning screening problems in the labor market. A pioneering work is the rat-race model developed by Akerlof (1976). Stantcheva (2014) theoretically shows that a screening channel has an important qualitative effect on optimal income taxation. More recently, Guerrieri et al. (2010), Auster and Gottardi (2019), and Lester et al. (2019) develop various models that integrate search frictions with screening problems.[9] Importantly, the literature on labor market screening remains highly theoretical. We contribute to the literature by quantitatively examining the relevance of labor market screening for policy designs.

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

[8]A related contribution is Corbae and Glover (2020), who study the impact of restricting pre-employment credit screening in a search and bargaining model of the labor market with adverse selection.

[9]See also Davoodalhosseini (2019) that theoretically studies the efficiency property of the directed search equilibrium with adverse selection.

2 An Equilibrium Labor Market Screening Model

2.1 Model Environment

Workers. The economy is populated by a unit measure of workers, who are heterogeneous in their disability status $h \in \mathcal{H} \equiv \{1, 2, \cdots, H\}$ and skill type $x \in \mathcal{X}$. The share of each type $i \equiv (h, x) \in \mathcal{I}$ is $\pi_i > 0$. The least healthy (most severely disabled) type is denoted by $h = 1$, and the healthiest type by $h = H$. Workers value consumption and leisure, and decide whether to look for a job (extensive margin) and which job to apply for (intensive margin) given the menu of employment contracts. When employed, a worker produces *net* output $f_{h,x}$ with $f_{h+1,x} \geq f_{h,x}$. The heterogeneity in net output by health status may be from productivity differences driven by health or due to the expected costs of mandated accommodation under the ADA.[10]

Workers' preferences are represented by the utility function

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

where c denotes consumption and $\chi_h - \beta_h \varphi(a)$ captures the disutility from work given the amount of job amenities a. The utility from consumption 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 amenity $\beta_h \varphi(a)$. The job amenity a lowers the disutility from work through function $\varphi(a)$, where $\varphi' > 0$ and $\varphi'' < 0$ for $a \in \mathbb{R}_+$. Furthermore, preference on amenity β_h differs by health type, where we assume $\beta_h > \beta_{h+1}$ so that unhealthy workers value a more than healthier types.[11] If an individual does not work, he produces b_x at home.

Firms. Ex ante homogeneous and risk-neutral firms produce output $f_{h,x}$ when matched with a type-(h, x) worker. To hire a worker, a firm pays κ and posts a contract, which consists of wage w and job amenity a. Firms can observe the worker's skill x and are allowed to post x-dependent contracts. However, the contract cannot be contingent on a worker's disability type h, either because they are prohibited from doing so under the ADA regulation or because of information frictions (h is unobservable).[12] A matched

[10]We can also interpret output as firm's perceived output and firms may discriminate against less healthy workers for taste reasons as in Becker (1971).

[11]If there is multi-dimensional heterogeneity in individuals that are unobserved or not conditioned by firms, and that leads to a violation of monotonicity assumption in firm's payoff (discussed in Section 2.2), then it creates a number of complications in equilibrium analysis (see Azevedo and Gottlieb, 2017 and Chang, 2017 for their theoretical analyses). While we choose to model one-dimensional heterogeneity, we control for the potential bias from this modeling assumption in our empirical analysis. See footnote 48 in Section 4.1 for details.

[12]We consider the ADA as given and take $f_{h,x}$ as a primitive of the model, but $f_{h,x}$ itself could be endogenous to the ADA depending on its interpretation. Strictly speaking, the ADA does not force firms to explicitly offer the same contract to workers with different disability statuses if their *true* productivities

firm's payoff is the residual of net output after paying wage w and the costs of providing job amenities $\tilde{C}(a)$, which satisfies $\tilde{C}' > 0$ and $\tilde{C}'' \geq 0$.[13] Firms' payoff of not posting a vacancy is normalized to zero.

Labor Market. The labor market is frictional and search is directed. We specify the order of decisions in the labor market as follows: first, firms decide to post contracts; then workers decide whether to enter the labor market and which contracts to apply to. Each submarket is defined by a contract $y_x \equiv (w, a) \in Y_x$, where Y_x is the set of feasible contracts. The market tightness (vacancy-to-applicants ratio) in each submarket is denoted by $\theta(y_x)$. A worker in a y_x-submarket finds a job with probability $\mu(\theta(y_x))$ *regardless of* his disability type. Similarly, a firm in a y_x-submarket finds its employee with probability $\eta(\theta(y_x))$. Assuming a constant returns to scale matching function, we have $\theta\eta(\theta) = \mu(\theta)$.[14] Let $g_h(y_x)$ be the share of type-h workers among the applicants in a y_x-submarket. Then the probability of hiring a type-h worker in a y_x-submarket is $\eta(\theta(y_x))\, g_h(y_x)$.

Government Policies. The government can choose three sets of policy instruments: (i) DI benefit amounts D_x, (ii) subsidies to firms $T(w, a)$ for accommodating the disabled, and (iii) wage tax (subsidy) $\tau(w)$. We assume that the government imperfectly verifies the true type of workers (similar to Low and Pistaferri, 2015) when providing DI benefits and firm subsidies. The probability of identifying 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. Therefore, both DI and firm subsidies are effectively disability-dependent from the perspective of workers and firms. The effective subsidy amount $\psi_h T(w, a)$ is higher for disabled workers, and therefore it is intended to incentivize firms to create a more accommodating work environment for disabled workers. This imperfect verification assumption is empirically plausible and has been widely accepted in the disability literature.[15] It also allows us to investigate an interesting policy design problem by excluding

differ after the provision of mandated accommodations. In this case, one may consider such a productivity difference as skill heterogeneity, and thus firms are allowed to offer differential contracts based on the health status even under the ADA. However, empirical evidence suggests that firms' ability to offer differential contracts in health became more limited after the ADA: more workers filed lawsuits claiming discrimination based on the ADA, and the ADA is strictly enforced if differential treatments are purely due to firms' misperception or discrimination (Acemoglu and Angrist, 2001).

[13] There might be ex ante heterogeneity among firms in terms of the efficiency in providing job amenity. While this might lead to heterogeneity in the degree of screening incentives across firms, it does not eliminate all screening incentives and the main qualitative findings from the simple model hold.

[14] We assume standard properties on $\mu(\theta)$ and $\eta(\theta)$ hold: $\mu : [0, \infty] \to [0, 1]$ satisfies $\mu' > 0$ and $\mu'' \leq 0$, and $\eta : [0, \infty] \to [0, 1]$ satisfies $\eta' < 0$.

[15] We assume that the verification probability ψ_h is exogenous and focus on DI and firm subsidies as policy instruments. However, ψ_h can be considered as another policy instrument, for example, in a model with costly verification in which the government decides how much resources to expend to correctly verify

the obvious solution: if the government perfectly identifies the true disability type, it can undo all labor market distortions by providing h-dependent lump-sum transfers.

2.2 Competitive Search Equilibrium (Given Policy Parameters)

Let the government policies be denoted by $\boldsymbol{p} \equiv \{D_x, T(w,a), \tau(w)\}$. Given the policies $\boldsymbol{p}$, 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 the DI application decision, the DI status is still endogenously determined by the (extensive margin) labor supply decision and the probability of finding a job, the latter of which depends on firms' labor demand.[16] Similarly, the utility while employed is

$$U^E_{h,x}(w,a) = u(w - \tau(w)) - (\chi_h - \beta_h \varphi(a)).$$

A firm matched with a worker with disability status h receive a subsidy with probability ψ_h. As a result, the expected subsidy given to a firm with a type-h worker is $T_h(w,a) = \psi_h T(w,a)$. The firm's payoff from hiring a type-(h,x) worker is

$$v_{h,x}(w,a) = f_{h,x} - C_h(w,a)$$

where $C_h(w,a) \equiv w + \tilde{C}(a) - T_h(w,a)$ is the net cost of hiring a worker.

We now define the competitive equilibrium in our search model. For brevity, we omit the dependence of equilibrium objects on policy parameters $\boldsymbol{p}$. First, in the equilibrium, firms maximize their profits and the free-entry condition holds,

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

with equality if $y_x \in Y^p_x$, where Y^p_x is the set of active submarkets for type-x workers and $\Theta : Y_x \to [0,\infty]$ represents a function of the market tightness over the set of feasible contracts Y_x. Second, conditional on the contracts posted and the search behaviors of others, each type-(h,x) worker maximizes expected utility by searching in the optimal submarket by solving

workers' true disability statuses.

[16] In Section 4.1, 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.

$$\bar{U}_{h,x} \equiv \max\left\{ U^N_{h,x}\left(b_x, D_x\right), \max_{(w,a)\in Y^p_x} \left\{ \mu\left(\Theta\left(y_x\right)\right) U^E_{h,x}\left(w,a\right) + \left(1-\mu\left(\Theta\left(y_x\right)\right)\right) U^N_{h,x}\left(b_x, D_x\right) \right\} \right\}. \quad (1)$$

Finally, the market clears; that is, $\forall(h,x)$, $\int_{Y^p_x} \frac{g_h(y_x)}{\Theta(y_x)} d\lambda\left(\{y_x\}\right) \leq \pi_{h,x}$ is satisfied, with equality if $\bar{U}_{h,x} > U^N_{h,x}\left(b_x, D_x\right)$.[17]

One can show that a unique, fully separating equilibrium exists, following Guerrieri et al. (2010).[18] In the equilibrium, given the same skill x, workers with different disability statuses apply to distinct submarkets that are characterized by a unique employment contract. As the contract is separating in skill x, the model can give rise to the heterogeneity in observed employment contracts between workers of the same disability status. This possibility of generating rich predictions make the model suitable for an empirical application. Moreover, as shown in Section 3, 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. These empirical observations suggest that the separating equilibrium is a plausible feature in our context.

2.3 Characterizing Equilibrium Allocations

The equilibrium contract of type-(h,x) solves the following problem:

$$\begin{aligned}
(P1) \quad & \max \quad \left\{ U^N_{h,x}\left(b_x, D_x\right), \max_{w,a,\theta} \left\{ \mu\left(\theta\right) U^E_{h,x}\left(w,a\right) + \left(1-\mu\left(\theta\right)\right) U^N_{h,x}\left(b_x, D_x\right) \right\} \right\} \\
& \text{s.t.} \quad (\text{FE}) \quad \mu\left(\theta\right)\left\{f_{h,x} - C_h\left(w,a\right)\right\} = \theta\kappa \\
& \qquad\quad (\text{IC}) \quad \mu\left(\theta\right) U^E_{h-1,x}\left(w,a\right) + \left(1-\mu\left(\theta\right)\right) U^N_{h-1,x}\left(b_x, D_x\right) \leq \bar{U}_{h-1,x} \qquad (2) \\
& \qquad\qquad\qquad \theta \in [0,\infty], \; w \in \left[0, f_{h,x} + T_h\left(w,a\right)\right], \; a \in \left[0, \tilde{C}^{-1}\left(f_{h,x} + T_h\left(w,a\right)\right)\right].
\end{aligned}$$

The worker's utility is maximized subject to a free-entry condition (FE) and the incentive compatibility constraint (IC). Note that the (IC) constraint is irrelevant for the least

[17] 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^p_x. 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.

[18] We relegate the formal definition of the equilibrium of the economy to Appendix A.1. One can prove the uniqueness and existence by following Guerrieri et al. (2010) and thus is omitted. The key conditions for the proof are (i) the monotonicity of the firm's payoff in worker's disability status and (ii) the single-crossing condition on workers' preferences. The former, i.e., that $v_{h,x}\left(y_x\right)$ increases in h for any $y_x \in \bar{Y}_x$, is satisfied under our assumption on monotonicity of net output in health: $f_{h+1,x} \geq f_{h,x}$. When we incorporate policies, this constrains the possible range of firm subsidies ($T\left(w,a\right)$) as they directly affect the firm's profit from hiring a disabled worker. We take these constraints into account in our counterfactual analysis that follow. The single-crossing condition is satisfied, as the marginal rate of substitution is increasing in health.

healthy workers ($h = 1$).[19] Thus, these workers receive the same contract as what they would have received if firms were allowed to write health-dependent (no-screening, "NS") contracts.[20] The amenity and the employment levels for the least healthy equalize the marginal benefit and marginal cost,

$$\xi_{h,x} \equiv u'\left(c^E_{h,x}\right) \cdot \left\{\partial C_h(w,a)/\partial a\right\} - \beta_h \varphi'(a), \tag{3}$$

$$\nu_{h,x} \equiv -\mu'(\theta_{h,x})\left\{u(c^E_{h,x}) - u(c^N_{h,x})\right\} - \mu(\theta_{h,x})\, u'(c^E_{h,x}) \frac{\partial \frac{\kappa\theta_{h,x}}{\mu(\theta_{h,x})}}{\partial \theta_{h,x}}, \tag{4}$$

setting both $\xi_{h,x} = \nu_{h,x} = 0$, in which $c^E_{h,x}$ and $c^N_{h,x}$ denote consumption for the employed and non-employed workers, respectively.

However, contracts for healthier types ($h \geq 2$) need to ensure that less-healthy workers have no incentive to mimic a healthier type: the (IC) constraint states that the utility of a type-$(h-1,x)$ worker entering the submarket for type-(h,x) should be less than or equal to the utility he receives from entering his own submarket. The indirect utility of the least healthy type entering a submarket with contract $\left(w^{NS}_{1,x}, a^{NS}_{1,x}\right)$ is

$$\bar{U}_{1,x} \equiv U^N_{1,x}(b_x, D_x) + \mu\left(\theta^{NS}_{1,x}\right)\left\{u\left(c^{NS}_{1,x}\right) - \left(\chi_1 - \beta_1 \varphi\left(a^{NS}_{1,x}\right)\right) - U^N_{1,x}(b_x, D_x)\right\}.$$

Then we can solve this problem sequentially for higher types. These (IC) constraints therefore generate distortions (relative to the equilibrium health-dependent contracts) in both the amenity and employment rates of workers for whom the (IC) constraint is binding, and thus $\xi_{h,x}$ and $\nu_{h,x}$ are no longer zero.

One can establish various theoretical properties in the environment with risk-neutral workers. By assumption on the preference parameter β_h and concavity of φ, we have $a^{NS}_{h+1,x} < a^{NS}_{h,x}$. 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: $a^S_{h,x} < a^{NS}_{h,x}$.[21] 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.

[19] Assume, for ease of exposition, that the least healthy workers ($h = 1$) participate in the labor market. Depending on the value of the outside option and the labor market opportunities, the least healthy workers in the labor market might not coincide with the least healthy worker type in the economy.

[20] 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.

[21] In practice, firms can, without violating the ADA, offer lower wages if individuals take leaves of absence due to 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 out disabled workers, yielding the same economic intuition as offering lower a.

A useful feature of a search-frictional labor market is the equilibrium determination of the market tightness, and thus the employment rate. 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 for the least healthy type (i.e., $U^{N}_{1,x}(b_x, D_x) > \bar{U}_{1,x}$), he prefers to stay out of the labor force completely. 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

Given welfare weights $\{\omega_i\}_{i\in\mathcal{I}}$ for type $i \equiv (h, x)$ and the government's verification technology $\{\psi_h\}_{h\in\mathcal{H}}$, the government maximizes the social welfare subject to the budget constraint:

$$\max_{\boldsymbol{p}} \sum_{i\in\mathcal{I}} \omega_i \bar{U}_i$$
$$\text{s.t.} \sum_{i\in\mathcal{I}} \pi_i \left[(1-\mu(\theta^*_i(\boldsymbol{p})))\,\psi_h D_x + \mu(\theta^*_i(\boldsymbol{p}))\,\psi_h T(w^*_i(\boldsymbol{p}), a^*_i(\boldsymbol{p}))\right] = \sum_{i\in\mathcal{I}} \pi_i \mu(\theta^*_i(\boldsymbol{p}))\,\tau(w^*_i(\boldsymbol{p})),$$

where $\bar{U}_i$ is the indirect utility of worker of type i defined in Equation (1); and wages $w^*_i(\boldsymbol{p})$, amenities $a^*_i(\boldsymbol{p})$, and job finding rates $\mu^*_i(\theta^*_i(\boldsymbol{p}))$ 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.[22] Note that firms' profits do not directly enter into our welfare criteria because firms earn zero profit in equilibrium. However, firms still affect welfare through their choices of wages and job amenities that determine their profitabilities.

To understand the determinants of optimal policies, we theoretically characterize them following the approach by Saez (2001) and Chetty (2006). First, we consider a proportional job amenity subsidy to firms, that is $T(w, a) = S \cdot C(a)$, where S denotes the subsidy rate. Second, we consider the optimal DI benefit amounts of D_x, and assume that both policies are financed by lump-sum taxes on employed workers.

In this environment, the policies affect not only the equilibrium employment rates, but also the levels of wages and job amenities, all of which are subject to firms' screening incentives. We consider the amenity subsidy as a potential tool to address screening distortions because it directly affects the firm's relative profits from hiring a worker of

[22] 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 is similar to the intuition in the dynamic public finance literature.

specific type. It is possible to incorporate other policy instruments, especially partial disability insurance, which provides financial benefits to disabled workers even when they are employed. However, its effect on screening distortions is quite limited.[23] We therefore consider a firm-side disability policy intervention, which is a more direct policy instrument in our context that explicitly incorporates the demand-side responses.

For an expositional purpose, we describe the main theoretical result in the following proposition by assuming that workers are risk neutral and there are two health types and one skill type (so that $D_x = D$). Although it implies that there is no insurance benefit of these policies, these policies still serve as a redistribution tool. In Appendix A.3, we present the proof of the proposition which allows risk-aversion and many worker types.

Proposition 1.

Optimal Policies.
The optimal amenity subsidy rate satisfies

$$\frac{S}{1-S} = \frac{1-\overline{C}(\boldsymbol{a},\boldsymbol{\theta})}{\mathcal{E}_{1-S}} + \frac{\omega_2 \cdot \Delta_{1-S}}{\widetilde{C}(\boldsymbol{a},\boldsymbol{\theta}) \cdot (1-S) \cdot \mathcal{E}_{1-S}},$$

where $\mathcal{E}_{1-S} \equiv \widetilde{\epsilon}_{C(\boldsymbol{a}),1-S} + \widetilde{\epsilon}_{\mu(\boldsymbol{\theta}),1-S}$ *and* $\Delta_{1-S} \equiv \mu(\theta_2)\, a_2 \epsilon_{a_2,1-S}(-\xi_2) + \theta_2 \epsilon_{\theta_2,1-S}(-\nu_2)$ *(*ξ_2 *and* ν_2 *are defined in Equations (3) and (4));*

and the optimal DI benefit satisfies

$$\overline{E}(\boldsymbol{\theta}) = \left(\widetilde{\epsilon}_{\tilde{E}(\boldsymbol{\theta}),D} + 1\right) + \frac{\omega_2 \cdot \Delta_D}{\widetilde{E}(\boldsymbol{\theta}) \cdot D \cdot \widetilde{\epsilon}_{\tilde{E}(\boldsymbol{\theta}),D}},$$

where $\Delta_D \equiv \mu(\theta_2)\, a_2 \epsilon_{a_2,D}(-\xi_2) + \theta_2 \epsilon_{\theta_2,D}(-\nu_2)$.

The optimal amenity subsidy is determined by three factors.[24] First, it depends on the redistributive motive (insurance role) of the government, captured by $\overline{C}(\boldsymbol{a},\boldsymbol{\theta})$, the concentration of amenity spending per employed worker relative to the redistributive preference. Second, the optimal subsidy depends on the magnitudes of its distortionary ("behavioral") effects on amenities costs (contracts of employed workers) and employment rates with respect to the amenity's effective (net-of-subsidy) marginal cost $(1-S)$,

[23] To see this point, we can refer back to Equation (2). Suppose that the government provides the partial DI benefits to employed disabled workers. Then as long as the job-finding probability is higher in healthier worker's submarket ($\theta_h > \theta_{h-1}$), the partial DI benefit incentivizes disabled workers to enter the non-disabled's submarket. Overall, introducing the partial DI Program is effective in mitigating the labor supply disincentive effects of DI, but may not be able to mitigate the screening distortions in the labor market.

[24] The terms are defined as: $\widetilde{C}(\boldsymbol{a},\boldsymbol{\theta}) = \frac{\sum_j \pi_j \mu(\theta_j) \psi_j C(a_j)}{\sum_j \pi_j \mu(\theta_j)}$; $\overline{C}(\boldsymbol{a},\boldsymbol{\theta}) = \left[\frac{\sum_i \omega_i \mu(\theta_i) \psi_i C(a_i)}{\sum_i \omega_i \mu(\theta_i)}\right] / \widetilde{C}(\boldsymbol{a},\boldsymbol{\theta})$; all elasticities $\epsilon_{y,x} = \frac{d \log y}{d \log x}$; $\widetilde{\epsilon}_{\cdot,1-S} \equiv \sum_i \alpha_i \epsilon_{\cdot,1-S}$ with $\bar{\mu}(\theta_i) \equiv \left(\frac{\pi_i \mu(\theta_i)}{\sum_k \pi_k \mu(\theta_k)}\right)$; and $\alpha_i = \frac{\pi_i \mu(\theta_i) \psi_i C(a_i)}{\sum_k \pi_k \mu(\theta_k) \psi_k C(a_k)}$.

captured by their elasticities $\widetilde{\epsilon}_{C(\boldsymbol{a}),1-S}$ and $\widetilde{\epsilon}_{\mu(\boldsymbol{\theta}),1-S}$ ($\mathcal{E}_{1-S}$). Due to the screening incentives of firms, there is an additional channel (the second term) to be considered, analogous to the "rat-race" effect in the environment of Stantcheva (2014) driven by screening. Unlike in Stantcheva (2014), there are two margins of adjustment: its impact on amenities and employment, magnitudes of which are captured in Equations (3) and (4). Intuitively, higher subsidies make it more profitable for firms to hire disabled workers who value job amenities more and thus receive larger job amenities, relaxing the (IC) constraint. Thus, the presence of screening distortions may generate an additional rationale for increasing subsidies. Under the utilitarian welfare function, the optimal subsidy rate is zero without screening.

Similar effects are present in the optimal determination of DI.[25] The optimal DI is set in order to balance the redistributional (insurance) channel $\overline{E}(\boldsymbol{\theta})$ with the distortionary behavioral effect $\widetilde{\epsilon}_{\tilde{E}(\boldsymbol{\theta}),D}$. The additional screening channel captures the DI's effect on contract distortions. Higher DI increases the value of the outside option for the disabled, lowering the net benefit from entering the non-disabled worker's submarket. Subsequently, the (IC) constraint is relaxed and screening distortions decrease. Finally, it should be noted 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.

It is important to point out the differential roles of job amenity subsidies and DI. First, their redistributive effects are distinct from each other. The job amenity subsidies induce redistribution from employed workers to the "employed" disabled. On the other hand, the DI benefit redistributes resources from employed workers to the "non-employed" disabled. Second, they have different employment effects: while job amenity subsidies may increase the employment of disabled workers, the DI benefits may decrease it.[26] These considerations highlight the fact that optimal policy design requires the joint analysis of these two policy instruments.

Moreover, Proposition 1 underscores 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 a quantitative optimal policy analysis.

[25]The terms are defined as $\widetilde{E}(\boldsymbol{\theta}) = \frac{\sum_j \pi_j (1-\mu(\theta_j))\psi_j}{\sum_j \pi_j \mu(\theta_j)}$ and $\overline{E}(\boldsymbol{\theta}) = \left[\frac{\sum_i \omega_i (1-\mu(\theta_i))\psi_i}{\sum_i \omega_i \mu(\theta_i)}\right] / \widetilde{E}(\boldsymbol{\theta})$.

[26]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. Since 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 DI benefit.

3 Data and Descriptive Evidence

3.1 Data Set

3.1.1 The Health and Retirement Study (HRS)

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. Our main empirical analysis considers 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 categorize the degree of disability based on two variables: the self-reported work limitation and the self-reported health evaluation. 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 B, we provide the disability categories in detail and show that our disability measures are highly positively correlated with a variety of objective health variables in the HRS.

3.1.2 Screening Tools in the Data

Although there are potentially many screening tools that firms can exploit to screen out the disabled, we focus on firms' provision of the option to reduce working hours as a possible screening tool for the following reasons. First, disabled workers may prefer to have such an option, via paid or unpaid leave, as they face the *occasional* needs of staying at home or taking medical care. Moreover, it is easier for firms to adjust this option at each individual worker-job level to screen out certain workers, in contrast to most standard non-wage benefits such as employer-based health insurance, which is determined at the firm level. Crucially for our purposes, 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).[27] In recent court cases, providing the option to reduce working hours or extensive sick leaves has not been deemed as a reasonable accommodation.[28] Thus, compared with other mandated accommodations (such as special equipment), it is likely that there are fewer legal restrictions that prevent firms from using the option to reduce working hours to screen out disabled workers.

One may wonder what precisely the option to reduce working hours captures in our analysis, as there are other similar job characteristics, such as part-time work and flexible working hours. We think that these are distinct in important dimensions from the option to reduce working hours. First, it is plausible to hypothesize that longer working hours yields greater disutility on the disabled, and that part-time work can be interpreted as the amenity in our framework. However, that workers have the "option" to reduce hours does not necessarily imply that they are part-time workers, whose contracts are often associated with wage penalty and fewer fringe benefits. Indeed, in the data, workers with high (full-time) hours report having the option to reduce working hours.[29] Conceptually, therefore, we interpret the option to reduce working hours as being more consistent with the notion of job amenity (or non-pecuniary benefit), rather than the actual number of hours worked. Secondly, having the option to reduce working hours is a specific form of flexibility at the job that is different from flexible working hours. Usually, jobs with flexible working hours allow workers to choose when to start and end work, but not necessarily the option to reduce hours through, for example, more generous leave policies. Thus, we consider the option to reduce working hours as a job amenity that can better accommodate disabled workers at their jobs. Of course, certain non-disabled workers may also prefer to receive this job amenity to some degree. Ultimately, whether it works as a screening tool depends on preference heterogeneity between disabled and non-disabled, which is an empirical question.[30]

[27] 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." (The Americans with Disabilities Act of 1990, Pub. L. No. 101-336, § 1, 104 Stat. 331, retrieved from the U.S. House Library in November 2018)

[28] 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, medical leaves, flexible starting or ending times for medical reasons, or telecommunication were not considered as reasonable accommodations under the ADA.

[29] Among workers reporting more than 40 hours of work per week, about 29% of them report having the option to reduce working hours. If we do not condition on hours and consider all employed workers, the share with the amenity is 32%.

[30] For example, workers with childcare responsibilities may also have a preference for the option to reduce working hours. We address this issue by showing that disabled workers prefer the option to reduce working hours even after controlling for individual-level characteristics. Moreover, we exploit the variation in the data induced by policy changes that affected firm's profitability of hiring disabled workers to

The HRS reports several specific amenities related to the workers' ability to reduce their working hours, such as the option to change from full- to part-time and the availability of paid sick leaves. Among them, we use the variable "option to reduce working hours" partly because we suffer from statistical issues if we use other job attributes available due to a significant missing variable problem.[31]. Moreover, it broadly captures various practices that firms can use, as opposed to more specifically defined amenity variables.

3.1.3 Summary Statistics

Table 1 documents descriptive statistics for our sample by disability statuses. On average, while the ages are similar across disability statuses, those with severe disabilities are less educated. Their labor market performance, as measured by employment, hours worked, and hourly wage, is worse than their healthier counterparts.

Table 1: Descriptive Statistics by Disability Status

Category	Variable	Disability status		
		Non-disabled	Moderately disabled	Severely disabled
Fraction of population		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 paid sick leave (days)	14.2	14.0	18.85
	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, which leaves us 42,352 observations overall. 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. Disabled workers tend to work at jobs that provide the option to

discipline firm's screening incentives specific to disabled workers.

[31]We focus on job amenities that could be related to the work preferences of the disabled but are not mandated under the ADA. The HRS also 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 whether they receive these accommodations.

modify or reduce work schedule. 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 offer 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. In the next section, we also show that this relationship becomes stronger after we control for worker and firm characteristics.

3.2 Descriptive Evidence

Before implementing the structural estimation of our model, we provide suggestive evidence that the option to reduce working hours may be used as a screening tool. The basic idea is to exploit plausibly exogenous policy variations that affect firms' relative profits from hiring a disabled worker compared with a non-disabled worker. Then, we derive testable predictions of the policy effects from screening models that are distinct from those from models without screening contracts. As such policies influence firms' screening incentives, the provision of the screening amenity would change in response.

We specifically consider two labor-demand-side policy changes in the U.S. Our first policy variation is the 2004 amendment to the Work Opportunity Tax Credit (WOTC) program. This policy provides a lump-sum tax credit to firms hiring workers from target groups, which include disabled workers. Employers receive an annual tax credit, which usually amounts to \$2,400, approximately the annual wage difference between the severely disabled and moderately disabled.[32] We exploit changes in eligibility for disabled workers, which were implemented in 2004 and subsequently increased employment certificates for the disabled by 35%. As detailed in Appendix C.1, this policy can have a meaningful impact on firms' profitabilities from hiring disabled workers, especially among old-age new hires. Our second policy variation is the ADA Amendments Act of 2008 (ADAAA), which broadens the definition of disabilities that are subject to the ADA. After 2008, individuals with health conditions such as mental illness, cancer, diabetes, and HIV/AIDS became eligible to claim protection under the ADA.[33] Although these policy changes may not provide perfect experimental settings, as discussed in Appendix C.2, they are exogenous variations that affected firms' relative profits from hiring disabled workers so as to potentially change their behaviors.

Now, we discuss the main testable predictions from the standard screening models (e.g., Akerlof, 1976, Rothschild and Stiglitz, 1976, and ours) that are distinct from models

[32]Given the the statistics reported in Table 1, their annual wage difference is approximately \$2,900 ($\approx$ (\$582.8 $-$ \$524.7) $\times$ 50) if we assume that both work full-time.

[33]Our sample years for the ADAAA analysis are from 2004 to 2014.

without screening contracts. The expansion of the WOTC in 2004 increased the chance for firms to receive lump-sum transfers when they hire severely disabled workers.[34] Firms then face higher relative profits from hiring severely disabled workers, thereby increasing the equilibrium provision of moderately disabled workers' job amenities because there is less incentive to screen out severely disabled workers (i.e., the (IC) constraint for moderately disabled worker's contract is relaxed). The impact on the job amenity level of the most severely disabled can be negligible because lump-sum transfers do not affect the marginal benefit or cost of amenities, and the (IC) is unaffected.[35,36] On the other hand, the expansion of eligibility for the ADA in the ADAAA can adversely affect firms' profits from hiring workers with disabilities, thereby increasing firms' incentives to screen out the disabled. In this case, one would expect that job amenities for healthier workers after 2008 would decline in order to screen out disabled workers in response to the policy change. Importantly, both predictions are specific to screening models. In the standard competitive equilibrium without screening contracts, we should not expect any effects for those workers who are not directly affected by these policy changes.

Building on these predictions, our main empirical specification for testing whether firms use the option to reduce working hours to screen out the disabled is given by

$$y_{it} = \beta_1 \mathbb{I}_{\text{Post}} + \sum_{h \in \{\text{mod, sev}\}} \beta_{2h} \mathbb{I}_h + \sum_{h \in \{\text{mod, sev}\}} \beta_{3h} \mathbb{I}_{\text{Post}} \mathbb{I}_h + \boldsymbol{\gamma} \boldsymbol{X}_{it} + \boldsymbol{\nu} \boldsymbol{Z}_t + \varepsilon_{it}. \quad (5)$$

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 individual-level control variables in $\boldsymbol{X}_{it}$ include employees' demographics, objective health measures (e.g., disease prevalence and body mass index), and firm and occupation characteristics. The vector $\boldsymbol{Z}_t$ is the set of control variables for macroeconomic conditions. 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 health-related measures, we are able to control for the heterogeneities within each disability group. Although we include many individual characteristics as possible (see Appendix C.3), we do not include the individual fixed effect despite the panel structure of the HRS. We refrain from using a fixed effect because the disability status of an indi-

[34]We view that this interpretation is plausible because the WOTC expansion is available to individuals who were already identified by the government as disabled.

[35]In particular, if workers are risk-neutral, the lump-sum transfer from the WOTC does not affect the magnitude of equilibrium job amenities of the most severely disabled type (see Equation (3)). 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 (i.e., if individuals are not too risk averse or if the consumption increase from the WOTC is small), the prediction still holds.

[36]This implication is true based on our assumption that workers cannot privately purchase these job amenities outside the labor market.

vidual is highly persistent with limited variations.

Our parameter of interest is β_{3h}, which is the coefficient on the interaction term between the disability status dummy ($\mathbb{I}_h$) and the post-policy-change dummy ($\mathbb{I}_{Post}$). The coefficient captures the disability-specific impact of the policy relative to non-disabled workers, after controlling for the post-amendment effect (β_1) and disability effect (β_{2h}). Importantly, in the presence of screening, all workers in the labor market may be impacted by the policy change.

Table 2 summarizes our regression results on the option to reduce working hours for the WOTC amendment.[37]We use the observations between the years 1996 and 2008 to avoid the confounding effects of ADAAA which became effective in 2009.[38] Column (1) reports the main estimates from the linear probability model of Equation (5) based on all employed workers. First, there are significant differences in the provision of 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 correlation without controlling for any other characteristics. Second, we find that the coefficient of the moderately disabled interacted with post-amendment (coefficient β_{3h}) is positive and statistically significant, while it is small and insignificant for severely disabled workers. [39] 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 arising from the WOTC is much larger among these newly hired workers.[40]

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 (5) with the linear probability model using samples between 1996 and 2008. 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. Standard errors are clustered at the individual level. *** p<0.01, ** p<0.05, * p<0.1.

[37]See Appendix C.1.4 for evidence that workers with different disability statuses experienced similar trends on their amenities before the WOTC amendment.

[38]Our empirical results are robust when we use sample years of up to 2006 (to avoid the early effects of the Great Recession) as shown in Appendix C.

[39]Note that our estimated coefficients for severely disabled tend to have a large standard error due to the small observations of those who are severely disabled and employed in our data. However, the magnitudes of the point estimates are robust with respect to many different specifications, as reported in Appendix C.1.

[40]We define a subsample of newly hired workers as workers with less than two years of employment tenure for the same employer.

In Appendix C.1, we further document the impact of policies on other labor market outcomes and other job amenities. We find that there are no statistically significant impacts on employment for both severely and moderately disabled, mitigating a concern for selection effects. The wage of the severely disabled marginally increases, consistent with predictions of the screening model.[41] We conduct a number of robustness analyses to examine whether these results are driven by additional compositional changes (selection effects) in disabled workers; the particular categorization of disability; the gender-based preference heterogeneity; and the trends in DI enrollment. In Appendix C.1, we show that our results are robust with respect to these concerns.

In the case of the ADAAA, we find that the provision of the option to reduce working hours decreases for the moderately disabled after the policy implementation, as the screening incentives of firms increased. We describe these details in Appendix C.2. Overall, these findings suggest that firms might be strategically using the option to reduce working hours as a screening tool.

4 Estimation

4.1 Identification and Estimation

We now discuss the identification and estimation of our equilibrium screening model. Given the suggestive evidence in the previous section, we use the option to reduce working hours in the data as the measure of job amenity in the model. The key challenge in our estimation lies in separately identifying the cost of providing the job amenity ($C(a)$) and its utility value to workers ($\psi(a)$). We address this challenge by exploiting the variation in data induced by the demand-side policy change introduced in Section 3.2. We then estimate the model through an indirect inference procedure.

It should be emphasized that our structural estimation does not necessarily impose the presence of screening in the labor market. Depending on model parameters, the model may predict that the equilibrium contracts are equivalent to those in the absence of screening; that is, the equilibrium health-dependent contracts can be incentive compatible for all types of workers in the economy. Our goal is, therefore, to find the parameters that best fit the data, allowing for screening contracts to arise in equilibrium.

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

[41] While the studies of the WOTC are very limited, Hamersma (2008) reports similar impacts on employment and wages as ours, using Wisconsin data on a subset of the WOTC-eligible target groups (welfare recipients).

and skill. 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.[42]

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 respondents' 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 $\tilde{C}(a) = c_0 + c_1 a \left(1/(1-a) - 1\right)^{c_2}$, in which the parameter c_0 represents the fixed cost of providing the job amenities,[43] c_1, the scale, and c_2, the convexity of the cost function. Under this parametric assumption, the marginal cost of amenities satisfy $\lim_{a\to 0} \tilde{C}'(a) = 0$ and $\lim_{a\to 1} \tilde{C}'(a) = \infty$. 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 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.[44]

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.[45] We assume that DI benefit amounts are determined as

[42]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.

[43]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 47.

[44]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. Menzio and Shi (2011) adopts the same CES function in a directed search environment and calibrates 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.

[45]Low and Pistaferri (2015) structurally estimates these parameters as the DI receipt probability using the Panel Study of Income Dynamics. We use their values estimated for old workers (ages 45–62). They categorize disabled workers using the work limitation and the degree of limitation, among which the latter is missing in the HRS. More recently, Low and Pistaferri (2019) estimate the error rates in DI award process

a constant fraction d of the average productivity among workers of the same skill level, as they depend on the average of the worker's previous earnings in the U.S. We use $d = 0.6$ as the benchmark replacement rate.[46] There are also two parameters that affect the value of not working: the value of home production (b_x) and the health-dependent fixed costs of work (χ_h). The existing literature usually does not estimate them separately, especially in models with linear utility function as it is impossible to do so. Instead, following the literature, we externally set b_x to be 10% ($b = 0.1$) of the average productivity of the worker's skill level. We choose the value lower than those typically used in search and matching literature (e.g., $b = 0.4$ in Shimer, 2005 and $b = 0.7$ in Lise and Robin, 2017), as we also model other components affecting the value of non-employment, such as the DI benefit and the disutility of work. 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.

Identification. The parameters to be estimated within the model are the net output levels by health statuses 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 ($\chi_3 = 0$) and their preference for amenities to one ($\beta_3 = 1$), leaving 15 parameters to be estimated.

The key parameters related with screening are the worker-side preference parameters on job amenities ($\{\beta_h\}$ and δ) and the firm-side job amenity cost parameters ($\{c_0, c_1, c_2\}$). 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 (3)). To separately identify worker-side and firm-side parameters, we exploit the variation in data induced by the policy change of the 2004 WOTC amendment, as discussed in Section 3.2. Importantly, the lump-sum tax credit given to firms only affects the firm's profitability of hiring disabled workers.

by merging the HRS with administrative data. The authors find that false rejections occur 55% among the DI applicants, which is similar in magnitude of our calibrated parameters. Although not perfect, these are the most relevant estimates for the parameter in the literature. Further, while we take these values exogenously, they yield empirically reasonable DI recipient rates; in 2016, DI recipients in the U.S. ranged between 6.4% and 14.5% among workers aged 50–64 (Social Security Advisory Board), and our model predicts that 11% of workers receive DI.

[46]We do not explicitly model the DI benefit as a function of equilibrium wages because it requires solving a fixed point problem, as the DI benefits are determined endogenously as equilibrium objects, and would be computationally demanding. Khan et al. (2017) use the HRS to 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%. Using a lower replacement rate d does not affect our overall qualitative and quantitative results.

Thus, it induces changes in job amenities driven by the labor demand side through a screening mechanism.[47,48] The remaining parameters are identified in a straightforward manner. The cross-sectional variations in wages and employment rates across workers identify parameters $\{f_h, \chi_h, \sigma_h^2\}$. 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.

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 3.2 (i.e., the coefficients reported in Column 1 of Table 2). These moments are chosen to reflect our identification discussion. We form the objective function for our estimation as

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

where W is the weighting matrix, $\overline{\beta}$ is a vector of auxiliary model parameters computed from the data, and $\hat{\beta}\left(\omega\right)$ is a vector of the corresponding auxiliary model parameters obtained from simulating datasets from the model (parameterized by a particular structural parameter vector ω).[49] To simulate model-based moments, we need to model the WOTC amendment. 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.[50] This implies that any post-amendment changes in the job amenities of

[47]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.

[48]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.

[49]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. Because of the small sample size concern, we do not use the optimal weighting matrix in our estimation (Altonji and Segal, 1996).

[50]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

workers who are not severely disabled are driven solely by screening in our model.[51] We obtain the standard errors of our estimators based on the asymptotic variance, following Gourieroux et al. (1993).[52]

4.2 Estimation Results

Table 3: Parameters Estimated within the Model

	Estimate	(Std. Err.)	Estimate	(Std. Err.)	Estimate	(Std. Err.)
(a) Health-dependent worker-side parameters						
	Severely Disabled		Moderately Disabled		Non-Disabled	
Net 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)
(b) Other worker-side parameters						
Curvature in utility from job amenities: δ	0.762	(0.134)				
(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 estimated 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% ($1 - \frac{2.343}{3.107}$) net 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,

data, $2,400 is between 10% and 40% of their income.

[51] Although this may be a stronger assumption on the policy than the one in Section 3.2, 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 4.1.

[52] 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 $\hat{\beta}(\omega)$ numerically.

it is essential for them to receive sufficient amounts of job amenities. From the firm's perspective, the cost of providing additional job amenity is reasonably important. Based on our estimates, the difference in amenity costs between firms hiring an average-skill severely disabled worker and firms hiring an average-skill moderately disabled amounts to 16% of the average wage among employed.

The model is able to fit the most salient qualitative features in both the cross-sectional heterogeneity of wage and employment and 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.

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 $\times$ Severe	0.014	-0.010
Post $\times$ 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.

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 size of labor supply disincentive effects of DI using exogenous variations in the DI application processes. Among them, Maestas et al. (2013) finds that marginal applicants are 28 percentage point (pp) more likely to work in the absence of the DI program. Further, these effects are heterogeneous across DI applicants and range from no effect to $50pp$. 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).

In our simulated model, the removal of DI leads the overall employment rate to increase by $1.36pp$. In Appendix D, we conduct a back-of-the-envelope calculation to estimate the overall 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 $2.68pp$ higher. Furthermore, depending on the skill and health statuses, the employment effects in our model also similarly range between $0.3pp$ and $47pp$. This result thus shows the model's ability to generate empirically plausible DI impacts on the employment rate.

4.3 Mechanisms

Without screening, contracts are independently determined for each skill and health type in equilibrium. However, labor market composition affects type-specific contracts when firms screen. In Table 5, we illustrate this by comparing the equilibrium outcomes in the economy with and without screening contracts under the estimated parameters. As predicted by the model, in the screening economy, job amenities are under-provided to moderately disabled and non-disabled workers. Instead, 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 sufficiently high. For these skill groups (labeled Average worker and Highest-skilled worker in Table 6), firms' incentives to screen disabled workers are higher, and the equilibrium contract distortions are larger; moderately disabled workers receive between $3pp$ (7%) and $4pp$ (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 $1.6pp$ (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 $7.5pp$ (21%) and $8.6pp$ (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.[53]

5 Quantitative Policy Experiments

Using the estimated structural model, we conduct counterfactual policy experiments. Given the exogenous disability verification technology (ψ_h), we consider the effects of two policies—the generosity of DI replacement rate (d) and the (proportional) subsidy to firms for the costs of providing amenities (S)—by varying these policy parameters jointly and independently. 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 pro-

[53] This may have differential implications on policy design across skill types. Since high-skilled, severely disabled workers are more likely to work regardless of DI benefits, firm subsidies may be more effective in addressing screening distortions among high-skilled workers. On the other hand, for low-skilled individuals, the joint choice of DI and firm subsidies matter because their extensive labor supply margins may be more responsive to DI, which affects the extent of screening distortions. In our optimal joint policy design analysis, we therefore focus on low-skilled workers.

viding redistribution across disability statuses *and* skills.[54] As discussed in Section 2.4, some of the key determinants of optimal policy structure are the policy impacts on the employment rate and the level of amenity, as well as the screening incentives. In the following, we first discuss equilibrium effects of policies and then characterize the welfare effects of the policy reforms.

5.1 Equilibrium Effects of Policies

Allocative Effects. In Figure 1, we plot labor market equilibrium allocations for severely disabled workers under different policy combinations. The x-axis represents the DI replacement rate (d), and the three lines in each plot correspond to subsidy rates (S) of 0%, 5%, and 15%.[55] 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 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. This employment effect suggests a possible complementarity between these disability policies. Simultaneous expansion of amenity subsidy and DI can undo distortionary employment effects by the other.

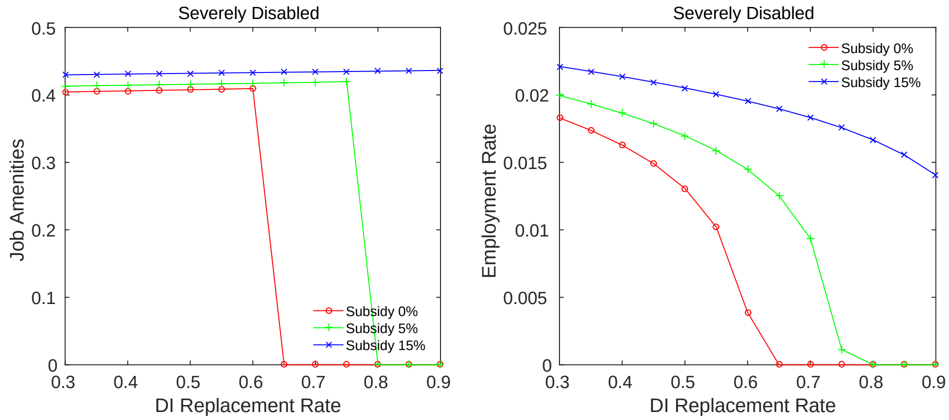
Figure 2 illustrates the equilibrium job amenities for moderately disabled (left panel) and non-disabled (right panel) workers. As the amenity subsidy directly lowers the marginal cost of amenities (albeit at lower expected rates due to verification probabilities), healthier workers in the labor market are also likely to benefit from higher amenities.[56]

[54]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.

[55]In the current model under the benchmark policy, firms have the 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, which may not be plausible. Also, in such a case, the monotonicity assumption discussed in Section 2.2 is violated, and the existence and uniqueness of the equilibrium cannot be guaranteed. Therefore, we restrict the amenity subsidy parameter in the counterfactual analyses to meet necessary conditions for equilibrium analysis, so that firms' incentives (to screen out disabled workers) are similarly aligned with those in the benchmark economy.

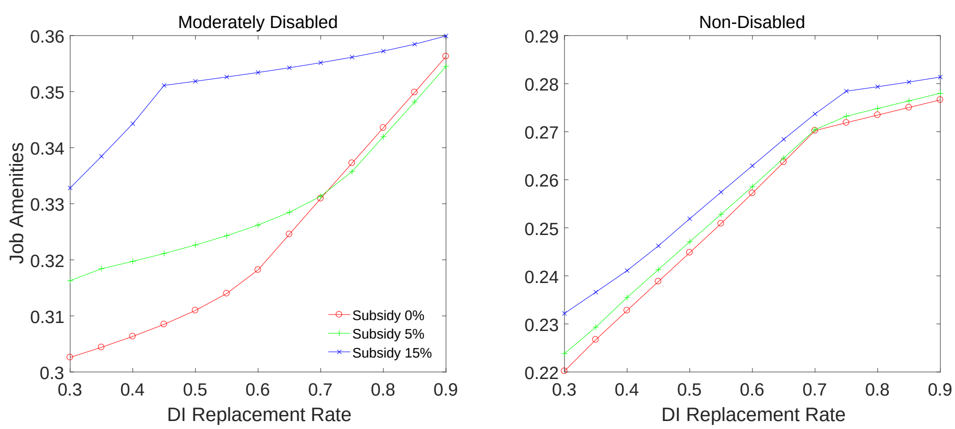
[56]Note that the monotonic relationship between amenities and subsidy rates (for a fixed DI) may not

Figure 1: Labor Market Equilibrium for Severely Disabled Workers



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.

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



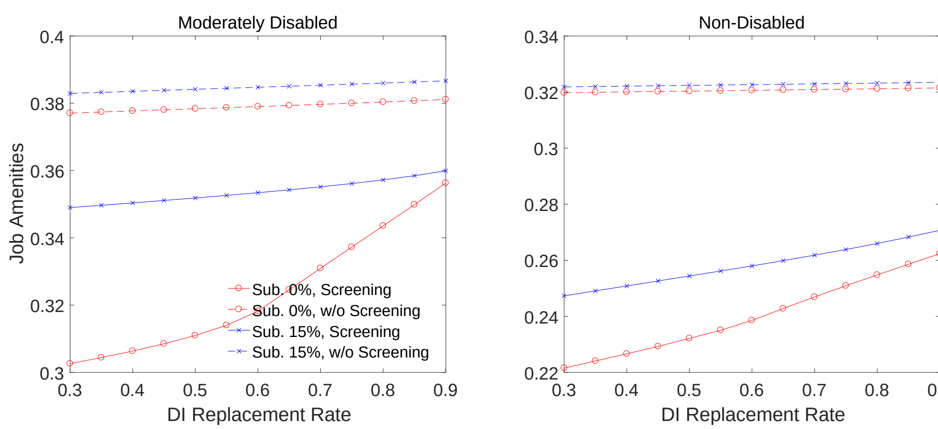
Effects on Screening Distortions. In the presence of screening contracts, the decisions of disabled workers impact the equilibrium outcomes of other workers in the labor mar-

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.

ket. 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.[57] 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 substantial. Fixing the subsidy rate, the distortionary effects on amenities decrease as DI becomes more generous. 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 with more generous 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.[58] 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 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

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

[58]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.

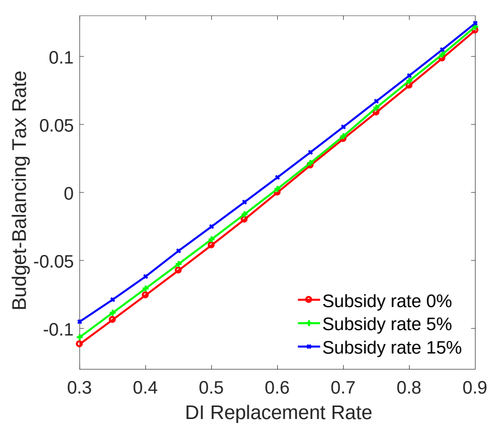
rate. When the amenity subsidy rate is high, the utility that the severely disabled obtain from working under their own contract increases, relaxing the (IC) constraint in the moderately disabled worker's problem. From the firm's perspective, a generous amenity subsidy for disabled workers lowers its 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 (○-line to ×-line).

Overall, we observe two ways in which the screening distortions are affected by policies. First, if DI becomes more generous, severely disabled workers' outside option increases, lowering their labor force participation and 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 the average welfare implications of the reforms. We use the utilitarian social welfare as a welfare criteria.

Figure 4: Fiscal Effects of Policy Reforms

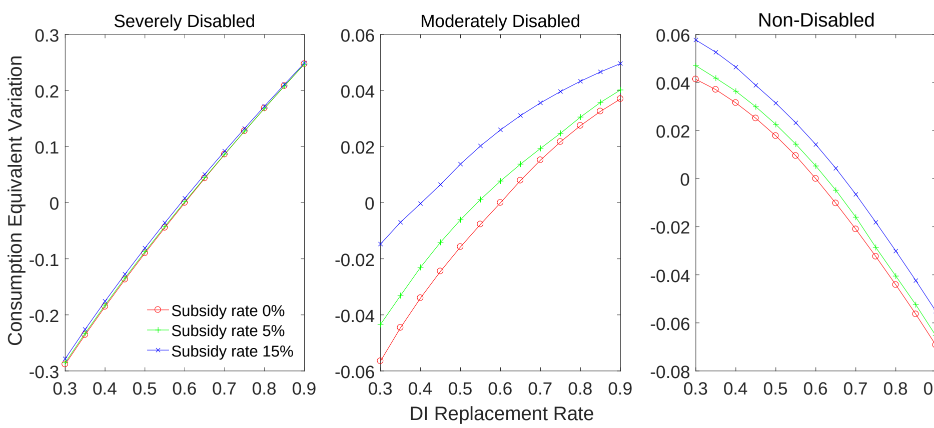


In Figure 4, we plot the equilibrium wage tax rate. As is evident, the tax rate is increasing in the generosity of DI and the amenity subsidy. However, as DI becomes more generous, the expansion of the amenity subsidy requires a smaller increase in the tax rate. Under a 30% DI replacement rate, the tax rate needs to increase by $2pp$ to introduce a

15% amenity subsidy, whereas an increase of $0.5pp$ 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 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.

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.[59] Figure 5 displays the CEVs by health statuses, and Figure 6 displays the average CEVs.

Figure 5: Welfare Effects of Policy Reform by Health Status



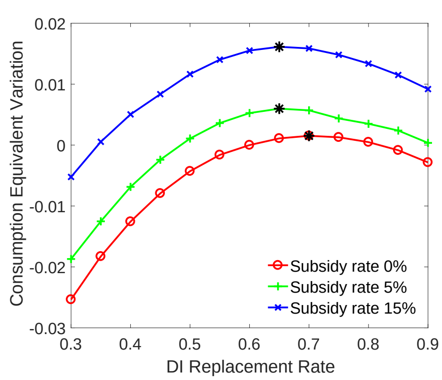
First, we note that there are large differences in preferences for a generous DI policy. While severely disabled workers are willing to give up 24% of their consumption in the benchmark economy for a 90% DI replacement rate, non-disabled workers need to receive around 7% of consumption to be indifferent. 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 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

[59]Specifically, let $V^{BM}\left(c^{BM}, a^{BM}, \theta^{BM}\right)$ and $V^{CF}\left(c^{CF}, a^{CF}, \theta^{CF}\right)$ denote the values in the benchmark and counterfactual economy that depend on equilibrium outcomes $\{c, a, \theta\}$. Then, we define CEV such that $V^{BM}\left(c^{BM}\left(1+CEV\right), a^{BM}, \theta^{BM}\right) \equiv V^{CF}\left(c^{CF}, a^{CF}, \theta^{CF}\right)$. Under the log-utility specification of ours, we have $CEV = exp\left[V^{CF}\left(c^{CF}, a^{CF}, \theta^{CF}\right) - V^{BM}\left(c^{BM}, a^{BM}, \theta^{BM}\right)\right] - 1$.

workers receive 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 mechanism highlighted in Proposition 1.

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 both 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%.[60] The government finds it optimal to implement generous policies in both DI and amenity subsidies. As shown in Figure 1, the amenity subsidy complements DI by mitigating the labor supply disincentive effects of DI. Moreover, as 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.

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	0.086	0.045	0.051
Mod. disabled	0.015	0.014	0.031
Non-disabled	-0.021	-0.005	0.004
Average	0.002	0.006	0.016

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.

Overall, our counterfactual results show that the optimal combination of policies features generous amenity subsidy and higher generosity of the DI benefit relative to the benchmark economy. Both policies provide not only consumption insurance but also contribute to reducing the contract distortions. Importantly, these two policies counteract employment effects of each other. Thus, they can mitigate the possible excessive employ-

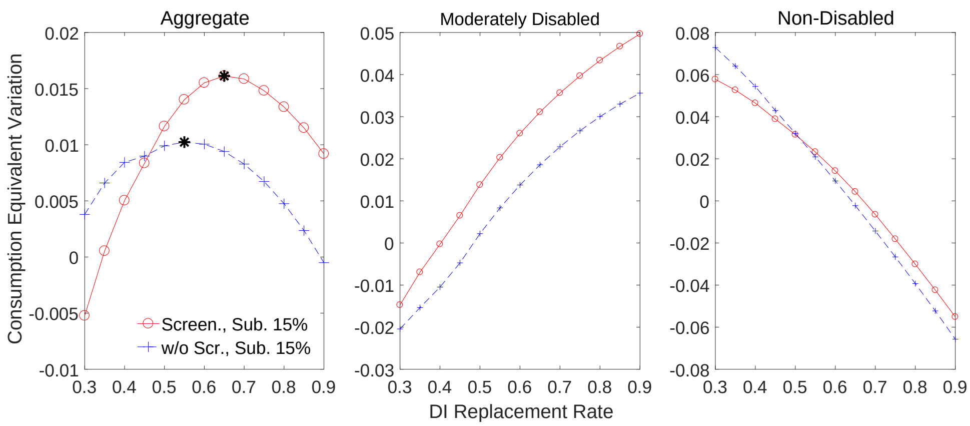
[60]When we conduct policy reforms with workers of all skill levels, the optimal DI replacement rate is higher, as the government uses DI as a means of redistributing resources across workers of heterogeneous skills as well as health statuses. Further, we find that the optimal DI is higher when the subsidy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

ment effects generated by amenity subsidies as well as excessive non-employment effects generated by DI. As a result, the optimal combination of the policies is set to balance insurance and redistributional benefits, screening distortions, and employment effects, which are the key factors determining the optimal policy as highlighted in Section 2.4.

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).[61] The optimal DI replacement in the no-screening economy is 55%, 10pp lower than the optimal DI replacement rate in the screening economy.[62] 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, and reduces screening incentives, giving more benefits to healthier workers. These factors make "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.

[61] 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.

[62] 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.

This quantitative result is consistent with the intuition from our theoretical analysis of optimal policy discussed in Proposition 1. As policies not only impact the equity-efficiency trade-off but also the screening incentives of firms, the optimal policies are to incorporate the latter factor if screening is present in equilibrium. Within our framework, the screening (or the rat race) effect is quantitatively operative, suggesting the importance of taking into account the firms' screening incentives in the labor market for optimal policy analyses.

6 Conclusion

In this paper, we study the design of social insurance programs for disabled workers. We develop an equilibrium labor search model where firms may strategically use the option to reduce working hours to screen out disabled workers. We estimate our equilibrium model by exploiting labor-demand-side policy changes for the disabled. The counterfactual policy experiments suggest a potential benefit from providing job amenity subsidies, which is effective in reducing the screening distortion in the labor market and increasing welfare. Moreover, we find that the optimal policy structure achieves a considerable welfare gain by simultaneously making firm subsidies and DI benefits more generous. Our joint policy design analysis suggests the benefit of systematic reforms of disability policies.

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

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

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

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

2. Workers' Optimal Job Search: Let

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

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

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

   and $U_{h,x}^N(b_x, D_x)$ 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 $Y_x^p = \emptyset$, $\bar{U}_{h,x} = U_{h,x}^N(b_x, D_x)$. 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 $\Theta(y_x) < \infty$ and $g_h(y_x) > 0$. If $U_{h,x}^E(w, a) < U_{h,x}^N(b_x, D_x)$, either $\Theta(y_x) = \infty$ or $g_h(y_x) = 0$.

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

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

   with equality if $\bar{U}_{h,x} > U_{h,x}^N(b_x, D_x)$.

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

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

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

$$\left\{f_2 - C\left(a_2^{NS}\right) + \beta_2\varphi\left(a_2^{NS}\right) - \chi_2 - \tilde{D}_2\right\} = \frac{\kappa}{\mu'\left(\theta_2^{NS}\right)}. \tag{6}$$

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

$$\frac{\kappa}{\mu'\left(\theta_2^S\right)} = f_2 - C\left(a_2^S\right) + \frac{C'\left(a_2^S\right)}{\beta_2\varphi'\left(a_2^S\right)}\left(\beta_2\varphi\left(a_2^S\right) - \beta_2\frac{\Delta\tilde{D}}{\Delta\beta}\right) - \tilde{d}_2\left(1 - \frac{\beta_2}{\tilde{D}_2}\frac{\Delta\tilde{D}}{\Delta\beta}\right), \tag{7}$$

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 (7) 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

In this appendix, we provide a general proof of the Proposition 1. Compared to the restricted environment in Proposition 1, we relax the following assumptions. First, we allow that workers may be risk averse. Second, we analyze the case with I types of workers, as opposed to two types.

A.3.1 Proof of Optimal Job Amenity Subsidies

Without Labor Market Screening. We first discuss the optimal policy in the absence of labor market screening (when firms can offer health-dependent contracts). The government's problem is written as:

$$
\begin{aligned}
&\max_{S} \sum_i \omega_i \left(\left(1-\mu\left(\theta_i\right)\right) U_i^N\left(b, D\right) + \mu\left(\theta_i\right)\left(u(w_i - T) - \left(\chi_i - \beta_i \varphi\left(a_i\right)\right)\right)\right) \\
\text{s.t.} \quad &\frac{\mu\left(\theta_i\right)}{\theta_i}\left(f_i - w_i - (1 - S\psi_i)C(a_i)\right) = \kappa \text{ and } T = \frac{\sum_i \pi_i \mu\left(\theta_i\right) S\psi_i C(a_i)}{\sum_i \pi_i \mu\left(\theta_i\right)}.
\end{aligned}
$$

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) and decompose the effects of 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, $\bar{U}'\left(\boldsymbol{c}_e\right) = \sum_i \omega_i \mu\left(\theta_i\right) u'(c_{e,i})$ 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): $\widetilde{C}(\boldsymbol{a}, \boldsymbol{\theta}) = \frac{\sum_j \pi_j \mu\left(\theta_j\right) \psi_j C(a_j)}{\sum_j \pi_j \mu\left(\theta_j\right)}$.
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 one.

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

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

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:

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

where α_j is the contribution of amenities costs by type j: $\alpha_j = \frac{1_{\left(\psi_j=1\right)}\frac{C(a_j)\pi_j\mu\left(\theta_j\right)}{\sum_k \pi_k\mu(\theta_k)}}{\widetilde{C}(\boldsymbol{a},\boldsymbol{\theta})} = \frac{\pi_j\mu\left(\theta_j\right)\psi_j C(a_j)}{\sum_k \pi_k\mu(\theta_k)\psi_k C(a_k)}$; $\epsilon_{C\left(a_j\right),1-S} = \frac{d\log C(a_j)}{d\log(1-S)}$ and $\epsilon_{\mu\left(\theta_j\right),1-S} = \frac{d\log\left(\frac{\pi_j\mu\left(\theta_j\right)}{\sum_k \pi_k\mu(\theta_k)}\right)}{d\log(1-S)}$ are elasticities of total cost of amenities and employment with respect to the net-of-subsidy marginal cost of amenities, $(1-S)$; and $\left(\widetilde{\epsilon}_{C(a),1-S}, \widetilde{\epsilon}_{\mu\left(\theta_j\right),1-S}\right)$ 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 subsidy rate 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 because of the envelope condition (Saez, 2001). Then, the optimal subsidy rate 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

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

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

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 discussed above. The mechanical revenue effect is denoted by $\Delta M = -\bar{U}'(\boldsymbol{c}_e)\,\widetilde{C}(a,\theta)\Delta S$, and the behavioral effect is denoted by

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

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

$$\begin{aligned}\xi_{a,i} &= -\left(-u'(c_{e,i})(1-S\psi_i)\frac{\partial C(a_i)}{\partial a_i}+\frac{\partial\beta_i\varphi(a_i)}{\partial a_i}\right); \\ \nu_{\theta,i} &= -\frac{\partial\mu(\theta_i)}{\partial\theta_i}\left(u(c_{e,i})-u(c_{u,i})\right)-\mu(\theta_i)\,u'(c_{e,i})\frac{\partial\frac{\kappa\theta_i}{\mu(\theta_i)}}{\partial\theta_i},\end{aligned}$$

both of which are zero in an equilibrium without screening. They are non-zero when firms' incentive compatibility constraint is binding, that is, when $\mu(\theta_i)\,U_{i-1}^E(w_i,a_i)+(1-\mu(\theta_i))\,U_{i-1,x}^N(b,D)=\bar{U}_{i-1}$.

The optimal subsidy rate 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 $\epsilon_{\theta_i,1-S}=d\log\theta_i/d\log(1-S)$. We can obtain the results in Proposition 1 when we assume that workers are risk neutral and that there are two type of workers. □

A.3.2 Proof of Optimal Disability Insurance

Without Labor Market Screening. The government's optimal disability insurance (DI) benefit problem reads (assume $S = 0$ for simplicity):

$$\max_{d} \sum_{i} \omega_i \left((1-\mu(\theta_i)) \left(\psi_i u(D+b) + (1-\psi_i) u(b) \right) + \mu(\theta_i) \left(u(w_i - T) - (\chi_i - \beta_i \varphi(a_i)) \right) \right)$$

$$\text{s.t.} \qquad \frac{\mu(\theta_i)}{\theta_i} (y_i - w_i - C(a_i)) = \kappa \text{ and } T = \frac{\sum_i \pi_i (1-\mu(\theta_i)) \psi_i D}{\sum_i \pi_i \mu(\theta_i)}.$$

Substituting these constraints into the objective function, we obtain:

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

Similar to the case for amenity subsidies, we can characterize the optimal DI benefit by introducing (i) a mechanical revenue effect, (ii) a welfare effect, and (iii) a behavioral effect. First, the mechanical effect is

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

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

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

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 redistributional preference of the government. Finally, the behavioral effect is

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

where $\widetilde{\epsilon}_{E,D}$ is the elasticity of the fraction of DI recipients over the employed with respect to DI benefits. The optimal DI benefit is such that the sum of these three effects equals zero:

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

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

With Labor Market Screening. With labor market screening, the mechanical revenue effect and the behavioral effect are identical to those in the absence of screening; however, the welfare effect now includes a screening effect. The welfare effect is expressed as

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

where $\mathbb{I}_i^{IC}$ is defined as in A.3.1. Thus, the optimal DI policy is determined by

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

where $(\xi_{a,i}, \nu_{\theta,i})$ are defined as in the case of amenity subsidies, and $\widetilde{E}\left(\boldsymbol{\theta}\right) = \frac{\sum_j \pi_j\left(1-\mu\left(\theta_j\right)\right)\psi_j}{\sum_j \pi_j \mu\left(\theta_j\right)}$. 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. We can obtain the results in Proposition 1 when we assume that workers are risk neutral and that there are two type of workers.□

B Data: 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.

Table 8: Descriptive Statistics of Other Health Measures in the HRS

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
# of observations	27,483	8,135	6,734

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.

C Suggestive Evidence from the U.S. Policy Changes

C.1 The 2004 WOTC Amendment

The Work Opportunity Tax Credit 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. This amount is comparable to 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.

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. The 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,[63] but also because of an indirect effect that increased the visibility of the program. As a result, the average number of the WOTC certificates for the disabled increased by 35% after 2004.[64] Our preliminary analysis suggests that the existence of the WOTC is relevant for firms hiring relatively older and severely disabled workers. We combine the data from the Bureau of Labor Statistics, the Social Security Administration, and the HRS to conduct a back-of-the envelope calculation. The number of certificates issued to disabled workers (both vocational rehabilitation referrals and SSI recipients) amounts to between 10% and 40% of severely disabled, newly hired workers, when we consider the number of workers with tenure less than a year and tenure between 1 and 2 years, respectively.

C.1.1 Robustness Analyses

Controlling for Worker Composition 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.

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).

[63] 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. The participant rate in the TtW program 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, the expansion of the eligibility of the WOTC seemed to have made it more accessible for firms to receive subsidies by hiring disabled workers.

[64] The average number of the WOTC certificates for the disabled remained stable in 2002 and 2003 (Levine, 2005). After the 2004 amendment, the issued certificates for disabled groups increased by 32% (from 44,200 to 58,400 annually). These post-amendment averages were calculated 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 (data source: the Employment and Training Administration, WOTC Certifications by Target Group).

Table 9: Results of Robustness Analyses

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: Dependent variable is the option to reduce working hours. 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.

Table 10: Summary Statistics: The Number of Diagnoses

Share (%)		Number of diagnoses 0	1	2	3	4	5	6	7	8	Total
Work limitation	no limitation	19.0	23.9	17.6	9.2	3.3	1.0	0.2	0.0	0.0	74.2
	limitation	0.9	3.4	5.9	6.3	4.6	2.8	1.3	0.5	0.1	25.8

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.[65]

Controlling for Gender-Specific Effects 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

[65]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.

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 (5). We find that there are no significant differences on the effects of the WOTC amendment by gender group (Table 9).

Trend Increase in DI Enrollment As extensively documented in the literature (e.g., see Liebman, 2015), 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 C.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 out 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.

C.1.2 Effects 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*
× 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.

C.1.3 Effects on Other Measures of Job Amenities

We estimate Equation (5) in Section 3.2 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 out a particular worker.

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

Coefficients		Dependent variable			
		Available part-time	Available paid sick leave (day)	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

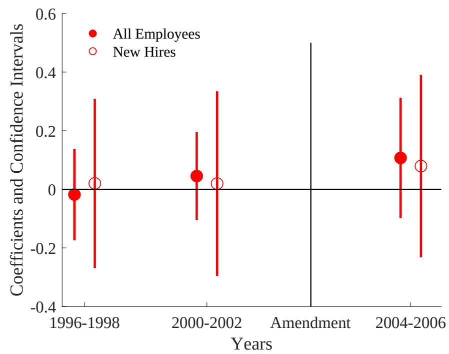
Note: The additional covariates used in the regression include age, age-squared, years of education, annual growth rate of GDP, annual employment rates, firm-size categories, and health outcomes. Standard errors are clustered at the individual level. *** p<0.01, ** p<0.05, * p<0.1.

C.1.4 Additional Diagnosis

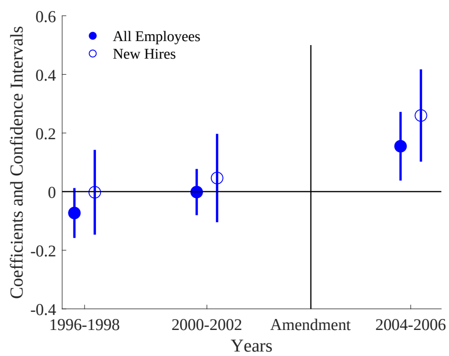
We also examine whether the option to reduce working hours evolves similarly across workers with different disability status before the 2004 WOTC (pre-trend conditions). To do so, we modify our main empirical regression (Equation (5)) by introducing time-specific dummies for disability status. Specifically, we are interested in whether time-specific dummies for each disability status before the implementation of the WOTC exhibit the same trend. Due to sample size issues, especially among severely disabled workers who are employed, we pool years into three periods: 1996 and 1998 survey years; 2000 and 2002 survey years; and 2004 and 2006 survey years. Thus, the base year in this specific analysis is 2008, which allow us to consistently pool years by two survey years before and after the amendment. Figure 8 summarizes the estimated coefficients and the 95% confidence intervals for all employed and newly hired workers for severely disabled (Panel (a)) and moderately disabled (Panel (b)) workers. As seen from Panel (a), we find that the year coefficients for severely disabled workers are small and roughly constant, although the confidence intervals are much larger due to the small observations of those who are severely dis-

Figure 8: Year-Specific Effects on the Option to Reduce Working Hours

(a) Severely Disabled Workers



(b) Moderately Disabled Workers



Note: We plot the coefficients on disability- and year-specific dummies and their 95% confidence intervals. 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. Standard errors are clustered at the individual level.

abled and employed in our data. Moreover, as shown from Panel (b), the coefficients on 1996-2002 year dummies of moderately disabled workers remain roughly similar, but the coefficient on years 2004-2006 is positive and statistically significant. This pattern is much more distinctive for new hires, which is more relevant for screening channels. Note that the level of amenity for moderately disabled in 2008 (base year) is roughly the same as that in pre-WOTC periods. This may be due to an early effect of the Great Recession on disabled workers. All the results of the impact of the 2004 WOTC amendment are robust even if we restrict our sample years to include up to 2006, as seen in Table 13.

Table 13: Effects of the WOTC Amendment on the Option to Reduce Working Hours: Sample Period 1996-2006.

Coefficients		(1) All employed		(2) New hires	
Post-amendment (β_1)		0.007	(0.060)	0.014	(0.070)
Disability status (β_{2h})	Severe	0.156***	(0.060)	0.204**	(0.083)
	Moderate	0.051	(0.033)	0.044	(0.048)
Disability status	Severe	0.030	(0.102)	0.010	(0.119)
$\times$ Post-amendment (β_{3h})	Moderate	0.129**	(0.058)	0.209***	(0.067)
# of observations		6,599		2,913	

Note: We estimate Equation (5) 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. Standard errors are clustered at the individual level. *** p<0.01, ** p<0.05, * p<0.1.

C.2 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.

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

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

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 (5). 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. The sample period for the ADAAA analysis is between 2004 and 2014. We consider the post-ADAAA period as years after 2008, because the ADAAA went into effect in the beginning of 2009. Table 14 summarizes the regression results.

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. This effect was especially more prominent among newly hired workers as shown in Column (2). However, we find that there was no statistically significant change among the severely disabled workers' amenity levels after 2008. Again, these findings are consistent with the standard screening model's predictions, as described in Section 3.2. 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.

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

Coefficients		Sample period: 2004 to 2014	
		(1) All employed	(2) New hires
Post-amendment (β_1)		-0.075**	0.001
		(0.0350)	(0.045)
Disability status (β_{2h})	Severe	0.214**	0.172
		(0.108)	(0.132)
	Moderate	0.205***	0.222***
		(0.061)	(0.074)
Disability status	Severe	0.062	0.136
× Post-amendment (β_{3h})		(0.107)	(0.135)
	Moderate	-0.105*	-0.212***
		(0.062)	(0.074)
# of observations		3,728	1,917

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, gender dummy, 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.

C.3 List of Control Variables

We present the list of the regressors 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.[66] 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.

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

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).[67] The summary statistics associated with these objective health measures are reported in Table 8 of Section B.

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 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.

D Employment Effects of DI Removal

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.[68]

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%.[69]

[67]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.

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

[69]The number is calculated as the 10-year average of employment rates for workers of ages 50-64 from

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 $2.6pp$ increase in the employment rate of this group.

2008 to 2010. Data source: BLS statistics, the number of employed for ages 50-54 (LNU02024937Q) and 55-64 (LNU02000095Q).