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LABOR MARKET SCREENING AND THE DESIGN OF SOCIAL INSURANCE: AN EQUILIBRIUM ANALYSIS OF THE LABOR MARKET FOR THE DISABLED

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ABSTRACT

This paper studies how firms' screening incentives in the labor market affect the optimal design of social insurance programs and quantitatively assesses the U.S. disability policies accounting for firms' screening of the disabled. We develop an equilibrium search model where workers with different productivities have heterogeneous preferences over non-wage benefits and firms cannot offer an employment contract that explicitly depends on worker types. In this environment, firms may use contracts to screen out a certain type of workers, distorting employment rates and contracts in equilibrium. Therefore, the optimal structure of social insurance policies depends on firms' screening incentives. We extend and structurally estimate this framework to quantitatively understand the inefficiencies arising from firms' incentives to screen out disabled workers and examine the optimal joint design of disability insurance (DI) and various forms of firm subsidies. We find that hiring 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

Social insurance and welfare programs account for a significant share of government expenditures in advanced economies.[1] Many of these programs (e.g., disability insurance, DI) are designed to provide protections for households who experience shocks that adversely affect their labor market outcomes. To evaluate these policies, a large number of studies focus on their labor supply side effects, especially whether they reduce work incentives.[2] However, a more complete evaluation also requires knowledge about labor demand side channels. A relevant margin is that firms may screen out (avoid hiring) workers who are targeted in these government programs (e.g., workers experiencing disabilities). These screening incentives arise when firms cannot easily observe worker characteristics, or they face labor market regulations (e.g., anti-discrimination laws such as the Americans with Disabilities Act, ADA) which constrain their abilities to adjust employment contracts. The presence of such labor market screening suggests a potential role for incorporating employer-side policy interventions in designing social insurance programs. Especially, by mitigating firms' screening incentives, employer-side policies may induce workers to take up better jobs, alleviating the work disincentive effects of worker-side policies.

In this paper, we study how firms' screening incentives affect the optimal structure of social insurance programs and quantitatively assess the U.S. disability policies, accounting for firms' screening of the disabled. We consider an equilibrium search model with two key ingredients. First, firms use employment contracts consisting of wage and non-wage benefits (or job amenities) to screen workers. This strategy is operative in our model where workers have heterogeneous preferences on non-wage benefits and firms cannot offer contracts based on a specific worker characteristic. We focus on screening through employment contracts because (i) non-wage benefits (e.g., health insurance, flexibility in work hours) are important components of workers' compensation packages; and (ii) several studies document a significant preference heterogeneity among workers with different health, disability, or skills.[3] Second, workers are risk averse and face (ex-ante) uncertainty about the realization of their types, thereby benefiting from social insurance programs. In this environment, firms could strategically design contracts to attract (or screen out) certain types of workers. Therefore the laissez-faire equilibrium is inefficient not only because of the lack of insurance against worker's realized status but also because of screening distortions.

We theoretically characterize that the optimal social insurance policies, e.g., worker-side insurance provisions and firm-side subsidies, depend not only on insurance and distortionary effects in the labor market but also on the strength of the firm's screening incentives. Moreover, the effectiveness of different ways to subsidize firms also depends on how well the government can execute the policy to help its target groups. If the government is able to (more) accurately identify the policy's

[1] In the United States, expenditure on social insurance programs has reached 19% of GDP in 2019 (OECD, 2020).
[2] See Krueger and Meyer (2002), Moffitt (2002), and Chetty and Finkelstein (2013) for surveys of this literature.
[3] See, e.g., French and Jones (2011) and Aizawa and Fang (2020) for health and health insurance; Aizawa, Mommaerts and Rennane (2023) for firm accommodations for work-related injuries.

target population, hiring subsidies are effective in mitigating screening distortions; however, if it cannot, subsidies that depend on contract characteristics, such as job amenity subsidies, could be more effective because the employment contract is informative about worker types.

We then quantitatively extend this framework to study the labor market for disabled workers and disability policies in the U.S. One in seven people in the working-age population of OECD countries regard themselves as having a disability (OECD, 2010), and as a consequence, the DI program is a significant social insurance policy that has grown substantially in recent years.[4] One of the key labor market policies for disabled workers in the U.S. is the ADA, which prohibits firms from discriminating workers based on their disability statuses. Such regulation in the labor market makes it difficult (if not illegal) for firms to post explicitly disability-dependent contracts and makes it more costly to hire disabled workers.[5] Thus, firms could strategically design contracts, exploiting heterogeneous preferences in non-wage benefits, to screen out workers with disabilities.

In specifying our structural model, we posit that disabled workers prefer having the *option* to reduce working hours as a non-wage benefit more than their non-disabled counterparts. The option to reduce working hours provides a specific form of flexibility and accommodation that could be particularly valuable to the disabled, who occasionally need to stay at home or receive medical care.[6] Therefore, if firms cannot offer disability-dependent employment contracts (due to the ADA), they may strategically choose the provision of the option to reduce working hours, via paid or unpaid leaves, for example, to screen out the disabled. Because firms are not necessarily mandated to provide this option under existing U.S. regulations, they may underprovide it to avoid hiring the disabled without violating regulations.[7] We document various data patterns from the Health and Retirement Study (HRS) that suggest that the option to reduce working hours is relevant for the disabled's labor choice. Importantly, we find that disabled workers tend to work at jobs that provide the option to reduce working hours, implying preference heterogeneity. Further, by exploiting variations in disability policies, we show suggestive evidence that the provision of this job amenity is responsive to the firm's profitability from hiring people with disabilities.

Then, we estimate the model through an indirect inference procedure, using the option to reduce working hours as the data counterpart of the job amenity in the model. 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 the following data variations. First, following an approach

[4]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).

[5]See Acemoglu and Angrist (2001) and Kim and Rhee (2018) for empirical evidence that the ADA may lower the labor demand for people with disabilities.

[6]We do not necessarily interpret that having the option to reduce working hours is equivalent to working part-time, nor that the disabled prefer part-time jobs. We clarify this point in Section 4.2.2.

[7]There are various accommodations (e.g., workplace 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.

used in labor market models with compensating differentials (e.g., Taber and Vejlin, 2020), we utilize the wage differentials between a job with and without amenities of the same individual, which is informative of the amenity cost in our model. Then, we estimate the worker utility from job amenities using two approaches: (i) utilizing cross-sectional variations in amenities; and (ii) exploiting an exogenous policy change on the labor demand side for the disabled, the amendment to the Work Opportunity Tax Credit program in 2004. We implement two different estimations using auxiliary models targeting moments (i) or (ii) and find that our estimation and major findings are robust to specific sets of moments we target. 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 36%, while it is 52% if firms are allowed to offer disability-dependent contracts. As a model validation exercise, we show that the model produces an empirically plausible extensive margin elasticity of labor supply to DI benefits.

We use the estimated model to find the optimal combination of DI and various forms of firm subsidies for hiring disabled individuals. The firm subsidy fits into active labor market policies for the disabled that are now widely adopted in many OECD countries but are still very limited in the U.S.[8] Given the government's ability to partially target these policies for disabled workers, among various firm subsidies, we find that a hiring subsidy provides better consumption insurance among the employed while ameliorating screening distortions in the labor market. Therefore, it increases the ex-ante welfare of workers, highlighting the benefits of expanding 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 hiring subsidies and higher DI benefits. Although more generous DI may distort the labor supply incentives of the disabled, it also reduces firms' screening incentives. Moreover, the hiring subsidy complements DI by mitigating employment distortions generated by DI. Thus, the optimal combination of these policies provides consumption insurance and reduces screening distortions, while balancing the level of employment. Interestingly, we find that the optimal DI benefit tends to be higher in the presence of screening than in its absence, suggesting the importance of incorporating firms' screening incentives in optimal design analyses. Overall, under the optimal policies, the social welfare increases by 2% in terms of consumption, suggesting a potential benefit from systematic reforms of disability policies.

While our empirical contexts are specific to the labor market for the disabled, our approaches and mechanisms are relevant in many other settings. It is plausible that non-wage benefits such as employer-sponsored health insurance, parental leaves, and job stability may be used to screen certain types of workers, resulting in the distortion of the provision of these benefits (See more detailed discussions in Section 2.6). Our results suggest that the policy instruments that mitigate firms' screening incentives should be explicitly incorporated in social insurance design.

[8]Many OECD countries (e.g., Sweden, Norway, and Great Britain) have expanded labor market policies for the disabled to increase their employment (OECD, 2010). In Netherlands, their 2006 DI reform includes partial DI payments with wage subsidies (Koning and Lindeboom, 2015). While the partial DI program may reduce work disincentives, it may not be as effective in addressing the screening problem, which we discuss further in Section 6.4.

Related Literature. First, this paper contributes to the growing literature that assesses the design of social insurance programs incorporating equilibrium labor market effects and labor market frictions. Like this study, many studies use search and matching frameworks that explicitly characterize the role of firms. From a theoretical standpoint, Acemoglu and Shimer (1999), Blanchard and Tirole (2008), and Golosov, Maziero and Menzio (2013), analyze the determinants of optimal social insurance policies that incorporate their distortionary effects in frictional labor markets. Quantitatively, Mitman and Rabinovich (2015), Lise, Meghir and Robin (2016), Chodorow-Reich, Coglianese and Karabarbounis (2019), and Braxton, Herkenhoff and Phillips (2020) study equilibrium labor market implications of unemployment insurance systems. Our contribution is to study the effect of firm's screening on the design of social insurance policies.

Second, this paper also contributes to the literature that analyzes the welfare impacts of disability and health policies. The literature builds on the empirical findings that disability and disability policies have important labor market consequences (see Bound and Burkhauser, 1999 for the survey of this literature, and Maestas, Mullen and Strand 2013, French and Song, 2014, Kostøl and Mogstad, 2014, Deshpande, 2016, and Autor et al., 2019 for recent studies). One of earlier contributions is Golosov and Tsyvinski (2006) that solves a mechanism design problem to characterize the optimal DI and its implementation. Focusing on worker side responses, Kitao (2014), Low and Pistaferri (2015), French and Song (2017), and Michaud and Wiczer (2018) evaluate the welfare impacts of the DI program using rich structural models. In a similar vein, French and Jones (2011), De Nardi, French and Jones (2016), Braun, Kopecky and Koreshkova (2017, 2019), Cole, Kim and Krueger (2019), Aizawa (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 design that incorporates both firm- and worker-side responses in an equilibrium model.

We also relate this paper to previous research on structurally estimating the effect of information frictions in the labor market. An important contribution is Gayle and Golan (2011) that studies the effects of signaling and statistical discrimination on labor market outcomes, especially on gender gaps in earnings and employment. Jarosch and Pilossoph (2018) and Corbae and Glover (2022) examine the impact of statistical discrimination on firms' recruiting incentives and labor market equilibrium. Our study contributes to this literature by quantitatively examining the relevance of labor market screening for policy designs. This departs from the existing literature of labor market screening, which remains highly theoretical (e.g., the rat race model by Akerlof, 1976; the optimal taxation by Stantcheva, 2014; and a few recent studies that integrate search frictions with screening problems that include Guerrieri, Shimer and Wright, 2010; Auster and Gottardi, 2019; Davoodalhosseini, 2019; and Lester et al., 2019).

The rest of the paper is organized as follows. In Section 2, we present a frictional labor market model with screening and establish theoretical results. Then, we discuss the institutional setting in Section 3 and the main data and descriptive patterns in Section 4. We explain our estimation procedures in Section 5, conduct counterfactual analyses in Section 6, and conclude in Section 7.

2 An Equilibrium Labor Market Screening Model

To examine how social insurance policies affect social welfare in a labor market where firms may screen workers, we consider a frictional labor market with adverse selection following Guerrieri, Shimer and Wright (2010). There are two key features in our model. First, workers are risk-averse and heterogeneous in their productivities and preferences on non-wage benefits. Second, ex-ante homogeneous firms decide whether to create a job and if they do, an employment contract to offer which consists of wage and non-wage benefits. Importantly, firms cannot design a job or employment contingent on certain worker characteristics. We characterize an equilibrium in this environment where firm's optimal contract reflects its screening incentive. We then analyze the inefficiencies in the market equilibrium and characterize optimal social insurance policies.

For expositional purpose, in the following section, we first lay out a general model and discuss how we map the model to disability context in Section 2.1.5. As our framework and its many insights can be generalized to other settings, we provide other applications in Section 2.6.

2.1 Model Environment

2.1.1 Workers

The economy is populated by a unit measure of workers, who are characterized by their types, x and h. Firstly, they are ex-ante heterogeneous in their type $x \in \mathscr{X}$, which is observed by all participants in the labor market. We further assume that firms are allowed to offer employment contracts that explicitly depend on x. Secondly, they differ by an additional type $h \in \mathscr{H} \equiv \{1, 2, \cdots, H\}$, which is observed by workers. However, firms cannot offer contracts that depend on h. This may be because the type is unobserved by firms (i.e., asymmetric information), or because of government regulations that prohibit them from doing so. For ease of exposition, we denote this type h as the unobserved type throughout the paper. Although these two types may be correlated, we assume that such correlation is imperfect and the unobserved type cannot be inferred from the observed type alone. Specifically, worker's unobserved type h is a characteristic that is associated with the government's design of social insurance programs: e.g., the government may want to provide benefits to certain types of h. We assume that a worker's type $i \equiv (h, x) \in \mathscr{I}$ is realized before making labor market decisions and denote the probability that a worker is of type i as $\pi_i > 0$.

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 $f_{h,x}$. Workers' preferences are represented by the utility function $u(c) - \left(\chi_{h,x} - \beta_{h,x}\varphi(a)\right)\mathbb{I}(\text{employed})$, where c denotes consumption and $\chi_{h,x} - \beta_{h,x}\varphi(a)$ captures an additional utility cost associated with working given the amount of job amenities a. The utility from consumption satisfies $u' > 0$ and $u'' \leq 0$. The first component of disutility from work $\chi_{h,x}$ is a type-dependent fixed cost of work. The second component $\beta_{h,x}\varphi(a)$ is the utility from job amenity, where $\beta_{h,x}$ is the type-specific preference on job amenity and $\varphi(a)$ satisfies $\varphi' > 0$ and $\varphi'' < 0$ in $a \in \mathbb{R}_+$. If an individual does not work, he produces b_x at home.

Throughout the paper, we make the following assumption on the worker's type h: given x, (i) lower type produces lower net output: $f_{h+1,x} \geq f_{h,x}$; and (ii) lower type has more preference on job amenity: $\beta_{h,x} > \beta_{h+1,x}$. These are the standard monotonicity assumptions imposed in models of adverse selection (e.g., Rothschild and Stiglitz 1976; Guerrieri, Shimer and Wright 2010).[9]

2.1.2 Firms

Ex ante homogeneous and risk-neutral firms produce net 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 type h. A matched 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 $\tilde{C}'' \geq 0$.[10] The firm's payoff from not posting a vacancy is normalized to zero.

2.1.3 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. To make the analysis focused, we consider an environment where workers and firms have a single opportunity to form a match. 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 type h. Similarly, a firm in a y_x-submarket finds its employee with probability $\eta(\theta(y_x))$. Assuming a constant return to scale matching function, we have $\theta\eta(\theta) = \mu(\theta)$.[11] Let $g_h(y_x)$ be the share of type-h applicants in a y_x-submarket. Then the probability of hiring a type-h worker in a y_x-submarket is $\eta(\theta(y_x))\, g_h(y_x)$.

2.1.4 Government Policies

The government can choose three sets of policy instruments: (i) transfers to workers $D_x(I)$ as a function of income I; (ii) subsidies to firms $T_x(w,a)$; and (iii) tax (subsidy) as a function of income

[9] 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, 2018 for their theoretical analyses). Although we choose to model one-dimensional heterogeneity, we control for the potential bias from this modeling assumption in our empirical analysis. See Section 5.2.1 for details.

[10] 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.

[11] We assume that $\mu : [0,\infty] \to [0,1]$ satisfies $\mu' > 0$ and $\mu'' \leq 0$, and $\eta : [0,\infty] \to [0,1]$ satisfies $\eta' < 0$.

$\tau_x(I)$. The transfer function D_x can be government provided insurance or welfare programs for workers. We consider that the government may want to provide policies (i) and (ii) as functions of type h, but it only imperfectly verifies worker's realized type h. Specifically, ψ_h denotes the probability that the government awards a worker with type h the transfer D_x or a firm hiring such a worker the subsidy $T_x(w,a)$. The imperfect verification is relevant for the design of government programs, where one of major issues is that the government cannot perfectly observe individual-level information about the benefit and cost from participating in those programs (e.g., Nichols and Zeckhauser, 1982). Moreover, it allows us to investigate an interesting policy design problem by excluding the obvious solution: if the government perfectly identifies the true type h, it can undo screening distortions in the labor market by providing h-dependent lump-sum transfers.

2.1.5 The Application of the Model: Disabled Workers and Disability Policies

As we later use this model to study labor market for the disabled, we describe the specific mapping of the general model to a disability context. On the worker side, the type x represents worker's skill (e.g., education), while the type h represents the worker's disability status: the least healthy (most severely disabled) type is denoted by $h = 1$, and the healthiest type by $h = H$. Thus, $f_{h+1,x} \geq f_{h,x}$ and $\beta_{h,x} > \beta_{h+1,x}$ imply that workers with more severe disabilities produce less net output (from productivity differences or due to the expected costs of mandated accommodation under the ADA) and have higher utility benefit from working in a job with amenity a.[12] Disabled workers tend to have high disutility from work and therefore may have stronger preferences for certain non-wage benefits that lower their work disutility: in our empirical application, we consider the option to reduce working hours as the relevant amenity. Further, firms are not allowed to offer contracts that are h-dependent, because the ADA prohibits firms from explicitly discriminating against workers based on their disability statuses or because firms may not observe health conditions of workers.[13]

On the policy side, we assume that (i) $D_x(I) = D_x$ if non-employed and 0 otherwise; and (ii) $\psi_{h,x} \geq \psi_{h+1,x}$. We interpret D_x as DI benefit amount, which is only given to non-employed individuals with probability ψ_h.[14] The assumption (ii) implies that this verification probability is increasing in one's severity of disability, making both DI and firm subsidies disability-dependent from the perspectives of workers and firms. This is particularly relevant for disability policies

[12] We can also interpret $f_{h,x}$ as firm's perceived output that may be due to taste as in Becker (1971).

[13] 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 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).

[14] Note that our model abstracts from the take-up (or application) decisions for social insurance benefits. However, as is clear from Section 2.2, the social insurance coverage 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.

(e.g., Low and Pistaferri, 2015; see more discussion in Section 3) where the government engages in screening processes to provide insurance targeted to disabled workers. Overall, given the worker heterogeneity and labor market regulations in the U.S., we believe that our model is appropriate for studying policies for disabled workers.

2.2 Competitive Search Equilibrium (Given Policy Parameters)

We consider the timing of events in which the government first sets the policies, worker's type h is realized, and then workers and firms make labor market decisions as specified above. Let the government policies be denoted by $p \equiv \{D_x, T_x(w,a), \tau_x(w)\}$.[15] Given the policies p, a type-(h,x) individual's expected utility from not working is $U^N_{h,x}(b_x, D_x) = \psi_h u(b_x + D_x) + (1-\psi_h) u(b_x)$ and the utility while employed is $U^E_{h,x}(w,a) = u(w - \tau_x(w)) - \left(\chi_{h,x} - \beta_{h,x}\varphi(a)\right)$. A firm matched with a worker with type-h receives a subsidy with probability ψ_h. As a result, the expected subsidy given to a firm with a type-h worker is $T_{h,x}(w,a) \equiv \psi_{h,x} \cdot T_x(w,a)$. The firm's payoff from hiring a type-(h,x) worker is $v_{h,x}(w,a) = f_{h,x} - C_{h,x}(w,a)$, where $C_{h,x}(w,a) \equiv w + \tilde{C}(a) - T_{h,x}(w,a)$ 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 p. First, in the equilibrium, firms maximize their profits and the free-entry condition $\eta(\Theta_x(y_x)) \sum_h g_h(y_x) v_{h,x}(y_x) \leq \kappa$ holds with equality if $y_x \in Y^p_x$, where Y^p_x is the set of active submarkets for type-x workers and $\Theta_x : Y_x \to [0,\infty]$ 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 his expected utility by searching in the optimal submarket by solving

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

Finally, the market clears; that is, $\forall(h,x)$, $\int_{Y^p_x} \frac{g_h(y_x)}{\Theta_x(y_x)} d\lambda_x(\{y_x\}) \leq \pi_{h,x}$ is satisfied where $\lambda_x(\cdot)$ is the distribution of posted contracts of type x, with equality if $\bar{U}_{h,x} > U^N_{h,x}(b_x, D_x)$.[16]

One can show that a unique, fully separating equilibrium exists, following Guerrieri, Shimer and Wright (2010).[17] In the equilibrium, given the same type x, workers with different type h apply

[15] For simplicity, we assume that the D_x is not taxable income in this theoretical analysis. However, in our counterfactual experiment in the quantitative model, we account for the fact that the DI benefits are taxable income.

[16] In this model, it is also necessary to specify reasonable beliefs about the market tightness off the active submarkets (Y^p) in equilibrium. Note that the market tightness function Θ_x is defined over Y_x, the set of feasible contract space for each type x, instead of 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.

[17] We relegate the formal definition of the equilibrium to Appendix A.1. The proofs of existence and uniqueness follow Guerrieri, Shimer and Wright (2010) and thus are omitted. The key conditions for the proof are (i) the monotonicity of the firm's payoff in h and (ii) the sorting condition, which is similar to the standard single-crossing condition in the literature. The former, i.e., that $v_{h,x}(y_x)$ increases in h for any $y_x \in \bar{Y}_x$, is satisfied under the monotonicity of net output in h: $f_{h+1,x} \geq f_{h,x}$. When we incorporate policies, this constrains the possible range of firm subsidies ($T_x(w,a)$) as they affect firms' profits. We take these constraints into account in our counterfactual analysis that follow. The

to distinct submarkets that are characterized by a unique employment contract. As the contract is separating in the observed type x, the model can give rise to the heterogeneity in observed employment contracts among workers with the same h. This rich heterogeneity in the cross-section makes the model suitable for an empirical application. In our application to the labor market with disabled workers, the researchers observe h (disability status) and x allows us to account for heterogeneity in outcomes within the same disability status. We also show in Section 4 that workers with different disability statuses sort into jobs with distinctive features, 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

In this environment, the equilibrium contract for type-(h,x) solves the following problem:

$$\begin{aligned}
\max \quad & \left\{U^N_{h,x}(b_x,D_x), \max_{w,a,\theta}\left\{\mu(\theta)U^E_{h,x}(w,a)+(1-\mu(\theta))U^N_{h,x}(b_x,D_x)\right\}\right\} \\
\text{s.t.} \quad & \text{(FE)} \quad \mu(\theta)\left(f_{h,x}-C_{h,x}(w,a)\right)=\theta\kappa \\
& \text{(IC)} \quad \mu(\theta)U^E_{h',x}(w,a)+(1-\mu(\theta))U^N_{h',x}(b_x,D_x)\le \bar{U}_{h',x} \text{ for } h'<h \\
& \qquad \theta\in[0,\infty],\ w\in\left[0,f_{h,x}+T_{h,x}(w,a)\right],\ a\in\left[0,\tilde{C}^{-1}\left(f_{h,x}+T_{h,x}(w,a)\right)\right].
\end{aligned} \tag{2}$$

In the remainder of the discussion, we consider equilibrium allocations for a given observed type x and focus on characterizing contracts for different h types for which screening is relevant (because firms cannot offer h-dependent contracts). The worker's utility is maximized subject to a free-entry condition (FE) and the incentive compatibility constraint (IC) that ensures that a lower type worker is better off going to his own submarket that yields utility $\bar{U}_{h',x}$ than entering the submarket of type-h with $h'<h$.[18] We call the solution of this problem a *screening contract* ("*S*") and contrast it with a *no-screening contract* ("*NS*"), which solves the above problem without the (IC) constraint (that is, firms can offer h-dependent contracts).[19] Assume, for an ease of exposition, that the lowest type workers ($h=1$) participate in the labor market. The (IC) constraint is irrelevant for the lowest type ($h=1$) and these workers receive the no-screening contract. The amenity and the employment

sorting condition, i.e., there is a contract that attracts workers with higher h without attracting workers with lower h, is satisfied as the marginal rate of substitution is increasing in h.

[18]In our environment, only the (IC) constraints with $h'<h$ may be binding since those with $h'>h$ are always satisfied.

[19]This terminology is meant to emphasize that when firms are not allowed to write the type (i.e., h)-dependent contracts, firms strategically use contracts to "screen" certain types of workers. In a broader sense, one can say that firms may screen workers at no cost (i.e., without using contracts to screen) using "no-screening" contracts.

levels for the lowest type equalize the marginal benefits to marginal costs,

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

$$\nu_{h,x} \equiv \mu\left(\theta_{h,x}\right) u'\left(c^{E}_{h,x}\right) \frac{\partial \frac{\kappa\theta_{h,x}}{\mu\left(\theta_{h,x}\right)}}{\partial \theta_{h,x}} - \mu'\left(\theta_{h,x}\right)\left(U^{E}_{h,x}\left(w,a\right) - U^{N}_{h,x}\left(b_x, D_x\right)\right), \tag{4}$$

where $c^{E}_{h,x}$ denotes consumption of employed workers. The first term in Equation (3) is the marginal cost of increasing the amenity a, and the second term is the marginal utility gain from increasing the amenity. Similarly, the first term in Equation (4) is the marginal cost of posting an additional vacancy, and the second term is the marginal gain from posting an additional vacancy, determined by the net utility gain from employment with increasing job-finding probability. For $h = 1$, marginal costs and benefits are equated implying $\xi_{h,x} = \nu_{h,x} = 0$.

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

$$\bar{U}_{1,x} \equiv U^{N}_{1,x}\left(b_x, D_x\right) + \mu\left(\theta^{NS}_{1,x}\right)\left[u\left(c^{NS}_{1,x}\right) - \left(\chi_{1,x} - \beta_{1,x}\varphi\left(a^{NS}_{1,x}\right)\right) - U^{N}_{1,x}\left(b_x, D_x\right)\right].$$

Then we can solve this problem sequentially for higher types. Thus, these (IC) constraints generate distortions relative to the *NS* equilibrium in both amenity and employment 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 $\beta_{h,x}$ 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, his job amenity in the screening contract is inefficiently low: $a^{S}_{h,x} < a^{NS}_{h,x}$. This is a standard result in adverse selection models (even without search frictions), and it is designed to keep the lower types from entering the higher type workers' submarkets. 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. 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 lowest type (i.e., $U^{N}_{1,x}\left(b_x, D_x\right) > \bar{U}_{1,x}$), he prefers to stay out of the labor force completely. In this case, the lowest type in the labor market may not coincide with the lowest type in the type space. However, it does not guarantee that the lowest type in the labor market receives the no-screening contract as there is always a possibility that his market contract induces the labor market entry of lower types.

2.4 Efficiency of Equilibrium

2.4.1 Planner's Problem and Allocation

Before we discuss the optimal policy design in the market equilibrium, we characterize the constrained efficient allocation to highlight the inefficiencies in the market equilibrium. For exposition and tractability, we assume that workers are homogeneous in terms of observed type x (i.e., $i = h$) and they all choose to participate in the labor market. Moreover, following Chetty and Saez (2010), we consider that the social planner (and the government) has the utilitarian preference and evaluates social welfare before worker's type is realized.[20] The social planner chooses consumption allocations when employed x_i^E and non-employed x_i^N, amenities a_i, and market tightness θ_i for each type. The planner faces search friction like workers and firms and maximizes social welfare subject to resource constraint. We consider the solution to the planner's problem as the first best allocation. We then characterize the constrained efficient allocation where the planner is also subject to the information friction (i.e., the planner does not directly observe workers' types).[21]

The planner's problem is formally defined as

$$\max_{\left\{\left(\theta_i,a_i,x_i^E,x_i^N\right)\right\}_{i\in\mathscr{I}}} \sum_{i\in\mathscr{I}} \pi_i \left(\mu\left(\theta_i\right)\left(u\left(x_i^E\right)-\left(\chi_i-\beta_i\varphi\left(a_i\right)\right)\right)+\left(1-\mu\left(\theta_i\right)\right)u\left(b_i+x_i^N\right)\right) \tag{5}$$

$$\text{s.t.} \quad (\text{RC}) \quad \sum_{i\in\mathscr{I}} \pi_i\mu\left(\theta_i\right)\left(f_i-C\left(a_i\right)\right) \geq \sum_{i\in\mathscr{I}} \pi_i\left(\theta_i\kappa+\mu\left(\theta_i\right)x_i^E+\left(1-\mu\left(\theta_i\right)\right)x_i^N\right) \tag{6}$$

$$\begin{aligned}(\text{IC}_{i,j}) \quad & \mu\left(\theta_i\right)\left(u\left(x_i^E\right)-\left(\chi_i-\beta_i\varphi\left(a_i\right)\right)\right)+\left(1-\mu\left(\theta_i\right)\right)u\left(b_i+x_i^N\right) \\ & \geq \mu\left(\theta_j\right)\left(u\left(x_j^E\right)-\left(\chi_i-\beta_i\varphi\left(a_j\right)\right)\right)+\left(1-\mu\left(\theta_j\right)\right)u\left(b_i+x_j^N\right) \text{ for } j>i\end{aligned} \tag{7}$$

where (RC) denotes the planner's resource constraint and $(\text{IC}_{i,j})$ denotes the planner's (IC) constraints that ensures that type-i always prefers his own allocation to type-j's allocation with $j > i$. Note that the first best allocation is the solution of Problem (5) subject to (RC) while the constrained efficient allocation is subject to both (RC) and $(\text{IC}_{i,j})$, where we focus on constraints that ensure that a lower type does not want to mimic a higher type to establish a benchmark allocation comparable to equilibrium outcomes.

We summarize a few key properties of the planner's allocation and relegate their derivations to Appendix A.3. The first best allocation provides full consumption insurance ($x_i^E = x_i^N + b_i = x_j^E$) to risk-averse workers across worker types and labor market statuses. Moreover, it assigns higher amenity ($a_{i-1} > a_i$) and lower market tightness ($\theta_{i-1} < \theta_i$) to lower type workers, as they value amenity more and produce less. In the constrained efficient allocation, these properties do not

[20]This allows us to evaluate ex ante welfare of workers facing uncertainty about their types, which creates a motive for government intervention. We can also characterize planner allocations using general welfare weights and results are available upon request.

[21]In the market, this constraint could arise from anti-discrimination laws (ADA). For the planner, this may be due to his inability to verify worker types. We impose these constraints to establish more relevant benchmark allocations to address market inefficiencies. Also note that the government in our environment has better technology, and can, albeit imperfectly, verify worker types. We discuss the relevance of the screening technology in Section 2.5.

hold. Especially, workers are not provided full consumption insurance due to the (IC) constraints. Moreover, for types with binding (IC) constraints, there exists a wedge between the marginal cost and marginal benefit in amenity provision. Lastly, the market tightness is chosen to reflect the societal benefit of the worker.

2.4.2 Comparison with the Market Equilibrium

In Appendix A.3, we show that the laissez-faire equilibrium ($D = T(w,a) = \tau(w) = 0$) allocations are not efficient nor constrained efficient. As Moen (1997) shows, the directed search model leads to the first best allocation when workers are risk neutral and if markets do not suffer from asymmetric information. However, in our environment, the laissez-faire equilibrium is not constrained efficient due to adverse selection (inability of firms to offer h-dependent contracts), risk aversion of workers, and the lack of private insurance markets.

First, firms in the model cannot offer employment contracts specific to worker type and instead design contracts that satisfy (IC) constraints. In equilibrium, such constraints lead to inefficiency as firms do not internalize the effect of the contract terms on (IC) constraints and as the type-specific allocations must be chosen to satisfy the type-specific free entry condition. This results in inefficiencies in contract terms that cannot be addressed by firms directly due to the lack of cross-subsidization across workers with different types, which the planner can attain through the resource constraint. We show in Appendix A.3 that when workers are risk neutral, equilibrium labor market tightness or amount of amenities (or both) are lower than the constrained efficient ones, particularly for types whose (IC) constraints are binding. Importantly, the lack of cross-subsidization arises because we focus on the timing where workers' unobserved types are realized before they search for jobs. If a worker's type is realized after he accepts a job, the firm's provision of a menu of wage-amenity contracts does not lead to any screening distortion because firms can cross-subsidize (See Appendix A.3 for an analytical characterization of this point). Thus, post-employment risk (e.g., work-related disability in our application) is unlikely to cause screening distortions; instead, screening distortions are more relevant at the hiring stage.[22]

In addition, we assume that workers are risk averse, and that there are no private insurance markets (either through employers or insurance companies) against worker's type and unemployment risks. Workers prefer to smooth consumption, similar to Acemoglu and Shimer (1999) and Golosov, Maziero and Menzio (2013). However, in the laissez-faire equilibrium, consumption allocations when employed is w_i and non-employed is b_i, lacking full consumption insurance across employment statuses. Further, with risk aversion, amenity levels are determined by marginal utilities of employed individuals, and consequently, market tightness are not equivalent to the planner allocations.[23] Although the lack of a private insurance market is a strong assumption and its plau-

[22]This does not mean that firms can efficiently insure against any disability risks on the job. Firms may under-provide insurance if workers leave for other jobs: see Aizawa, Mommaerts and Rennane (2023) for an evidence in workers' compensation programs.

[23]If workers are risk-neutral, amenity and market tightness in the laissez-faire equilibrium are equivalent to the

sibility is context-specific, such an assumption is plausible in our application because private DI markets are very thin (See Golosov and Tsyvinski, 2006 and Low and Pistaferri, 2015).

2.5 Optimal Policy Design

2.5.1 Choice of Policy Instruments

How can the government restore efficiency? The above findings suggest that the welfare-improving government intervention involves transfers of resources across workers' realized types and employment statuses. Especially, in order to address inefficiencies arising from adverse selection, one must introduce policies that can relax the (IC) constraint. One possibility is to introduce submarket-specific policies which subsidize a low-type worker's market while taxing a high-type worker's market, thereby easing the (IC) constraints.[24] Albeit theoretically possible, in practice, it may be difficult to implement such submarket-specific policies because the government may not fully observe submarkets in our application (social insurance and labor market). Instead, one may consider tagging firm subsidies based on observed characteristics of workers or employment contracts that favor low-type workers. For example, firm subsidies on job amenity may be effective in inducing cross-subsidization, as low-type workers value job amenities more than high-type workers.[25] The government can also alleviate inefficiencies from the lack of private insurance markets by directly providing insurance. In doing so, the government faces the classic tradeoff between insurance provisions and incentives.

While a theoretical characterization of the optimal policy that implements the constrained efficient allocation may be of interest, given multiple sources of inefficiencies in the model, such an optimal policy may be very complicated. Our focus in this paper is to instead analytically characterize the optimal policy given the restricted set of simple policy instruments. We illustrate how each policy instrument should be designed by balancing its impact on adverse selection, insurance provision, and incentive effects.

2.5.2 Optimal Design of Policies given the Policy Instruments

Following the approach by Saez (2001) and Chetty (2006), we theoretically characterize the optimal conditions for the following three policy tools. First, we consider the optimal social insurance benefit to non-employed workers D. Second, we consider a hiring subsidy to firms, that is $T(w,a) = tr$. Third, as an alternative to hiring subsidy, we consider a proportional job amenity

constrained efficient allocations for the lowest type. This is not true for types with binding ICs: their amenity and market tightness, and consequently, consumption levels are not constrained efficient.

[24] Davoodalhosseini (2019) shows in a directed search model with adverse selection and quasi-linear (thus, risk-neutral) utility, such policy implements the ex-ante constrained-efficient allocation.

[25] Another potential policy instrument could be mandating the level of job amenity. Importantly, mandating a uniform level of job amenity does not solve the inefficiency. As seen from the planner's solution, the efficient amount of amenity should vary depending on worker types. Moreover, firms can adjust the number of job vacancies.

subsidy to firms, that is $T(w,a) = S \cdot \tilde{C}(a)$. These policies are financed by lump-sum taxes on employed workers. We consider that these policies are awarded to a qualified worker (or firm) given the government's verification technology $\{\psi_h\}_{h\in\mathscr{H}}$. 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 study these firm subsidies as potential tools to address screening distortions because they directly affect the firms' relative profits from hiring a worker of a specific type. The main difference between the hiring subsidy and the amenity subsidy is that the latter explicitly depends on the endogenously determined contract in the submarket.

Formally, the government maximizes the social welfare subject to the budget constraint:

$$\begin{aligned}
&\max_{p} \sum_{i\in\mathscr{I}} \pi_i \bar{U}_i \\
\text{s.t.}\ &\sum_{i\in\mathscr{I}} \pi_i \left(\left(1-\mu\left(\theta_i^*(p)\right)\right)\psi_i D + \mu\left(\theta_i^*(p)\right)\psi_i T\left(w_i^*(p), a_i^*(p)\right)\right) = \sum_{i\in\mathscr{I}} \pi_i \mu\left(\theta_i^*(p)\right)\tau\left(w_i^*(p)\right),
\end{aligned}$$

where $\bar{U}_i$ is the indirect utility of worker of type i defined in Equation (1); and wages $w_i^*(p)$, amenities $a_i^*(p)$, and job-finding rates $\mu\left(\theta_i^*(p)\right)$ 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. 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.

For an expositional purpose, we describe the main theoretical result in the following proposition by assuming that there are two types both of whom participate in the labor market. In Appendix A.4, we present the proof of the proposition with multiple types of workers.

Proposition 1.

The optimal social insurance benefit satisfies

$$\overline{E}(\theta) = \left(\widetilde{\varepsilon}_{E,D} + 1\right) + \left(\frac{\pi_2 \cdot \Delta_D}{\bar{U}'\left(c^E\right)\cdot D \cdot \widetilde{E}(\theta)}\right), \tag{8}$$

where $\Delta_D \equiv \mu\left(\theta_2\right) a_2 \varepsilon_{a_2,D}\left(-\xi_2\right) + \theta_2 \varepsilon_{\theta_2,D}\left(-\nu_2\right)$*,* ξ_2 *and* ν_2 *are defined in Equations (3) and (4), and* $\varepsilon_{y,x} = d\log y / d\log x$*; the optimal hiring subsidy satisfies*

$$\overline{\psi}(\theta) = \left(\widetilde{\varepsilon}_{\mu(\theta),tr} + 1\right) + \left(\frac{\pi_2 \cdot \Delta_{tr}}{\bar{U}'\left(c^E\right)\cdot tr \cdot \widetilde{\psi}(\theta)}\right), \tag{9}$$

where $\Delta_{tr} = \mu\left(\theta_2\right) a_2 \varepsilon_{a_2,tr}\left(-\xi_2\right) + \theta_2 \varepsilon_{\theta_2,tr}\left(-\nu_2\right)$*; and the optimal amenity subsidy satisfies*

$$\frac{S}{1-S} = \left(\frac{1-\overline{C}(a,\theta)}{\mathscr{E}_{1-S}}\right) + \left(\frac{\pi_2 \cdot \Delta_{1-S}}{\widetilde{C}(a,\theta)\cdot(1-S)\cdot\mathscr{E}_{1-S}}\right), \tag{10}$$

where $\mathscr{E}_{1-S} \equiv \widetilde{\varepsilon}_{C(a),1-S} + \widetilde{\varepsilon}_{\mu(\theta),1-S}$ *and* $\Delta_{1-S} \equiv \mu(\theta_2)\, a_2 \varepsilon_{a_2,1-S}(-\xi_2) + \theta_2 \varepsilon_{\theta_2,1-S}(-\nu_2)$.

The optimal policies are determined by three factors: (i) insurance effect, (ii) behavioral distortions, and (iii) the degree of screening in the market. First, the insurance effect is captured by the terms $\overline{E}(\theta)$, $\overline{\psi}(\theta)$, and $\overline{C}(a,\theta)$ that represent the concentration of policy expenditures relative to the insurance (consumption smoothing) benefit of these policies measured by the expected marginal utility of consumption.[26] Second, the behavioral distortionary effects of the policies are captured by elasticity terms, $\widetilde{\varepsilon}_{E,D}$, $\widetilde{\varepsilon}_{\mu(\theta),tr}$, and $\mathscr{E}_{1-S}$.[27] In the case of social insurance and hiring subsidies, more generous policies affect equilibrium employment levels. For amenity subsidies, the elasticity captures the effects on amenity costs (contracts of employed workers) and employment rates with respect to the amenity's effective (net-of-subsidy) marginal cost $(1-S)$, captured by their elasticities $\widetilde{\varepsilon}_{C(a),1-S}$ and $\widetilde{\varepsilon}_{\mu(\theta),1-S}$ ($\mathscr{E}_{1-S}$). Lastly, due to the screening incentives of firms, there is an additional channel (the second terms in the right-hand side of optimal policy formulas (8), (9), and (10)). This channel is analogous to the "rat-race" effect in the environment of Stantcheva (2014) driven by screening, summarized by terms Δ_D, Δ_{tr}, and Δ_{1-S}. Unlike in Stantcheva (2014), there are two margins of adjustment: its impacts on amenities and employment rates, magnitudes of which are determined by ξ_2 and ν_2 defined in Equations (3) and (4) and whose values are nonzero only when the (IC) constraints are binding. Intuitively, hiring subsidies or amenity subsidies lessen incentives of firms to screen out the low types. On the worker side, higher social insurance benefit increases the value of the outside option, lowering the net benefit from entering the high type worker's submarket. Subsequently, the (IC) constraint is relaxed and screening distortions decrease. Thus, the presence of screening distortions may generate an additional rationale for more generous social insurance or firm subsidies.

It is important to point out the differential roles of firm subsidies (via hiring or amenity subsidies) and social insurance benefits to workers. First, their insurance effects are distinct from each other. The firm subsidies insure consumption risks of the employed, while social insurance benefit insures consumption risks arising from employment risks. Second, they have different employment effects: while firm subsidies may increase the employment of low-type workers, the social insurance benefits may decrease it.[28] Finally, it should be noted that these economic forces are strengthened if extensive margin choices are endogenized. Higher social insurance benefit makes the low type workers 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

[26] Terms are defined as: $\overline{E}(\theta) = \left(\frac{\sum_i \pi_i (1-\mu(\theta_i)) u'(c_i^U)\psi_i}{\sum_i \pi_i \mu(\theta_i) u'(c_i^E)}\right) / \widetilde{E}(\theta)$; $\overline{\psi}(\theta) = \left(\frac{\sum_i \pi_i u'(c_i^U)\mu(\theta_i)\psi_i}{\sum_i \pi_i u'(c_i^E)\mu(\theta_i)}\right) / \widetilde{\psi}(\theta)$; $\overline{C}(a,\theta) = \left(\frac{\sum_i \pi_i u'(c_i^E)\mu(\theta_i)\psi_i C(a_i)}{\sum_i \pi_i u'(c_i^E)\mu(\theta_i)}\right) / \widetilde{C}(a,\theta)$ where $\widetilde{E}(\theta) = \frac{\sum_j \pi_j (1-\mu(\theta_j))\psi_j}{\sum_j \pi_j \mu(\theta_j)}$; $\widetilde{\psi}(\theta) = \frac{\sum_j \pi_j \mu(\theta_j)\psi_j}{\sum_j \pi_j \mu(\theta_j)}$; and $\widetilde{C}(a,\theta) = \frac{\sum_j \pi_j \mu(\theta_j)\psi_j C(a_j)}{\sum_j \pi_j \mu(\theta_j)}$. Also, $\bar{U}'(c^E) = \sum_i \pi_i \mu(\theta_i) u'(c_i^E)$.

[27] Terms $\tilde{\varepsilon}$ are α_j-weighted sums of elasticities ε where α_j is the contribution of policy expenditures on type j.

[28] In an environment in which the verification probability of unobserved type ψ_i is interior, subsidizing firms can potentially be welfare enhancing compared to social insurance. Since firms are risk-neutral, they can insure the risk of imperfect verification through employment contracts. On the other hand, risk-averse workers face the full risk of verification errors when they are offered the social insurance benefit.

likely to enter the labor market intended for different types.

Above, we characterize two types of firm subsidies: hiring and amenity subsidies. One important distinction between the two is that the latter affects the amount of job amenity directly, as captured by the elasticity $\mathscr{E}_{1-S}$. It implies that the job amenity subsidy may lead to an over-provision of amenities for the lowest type. Moreover, job amenity subsidies are bounded by the amenity cost (i.e., firm's expenditure to provide the amenity): if the amenity cost is relatively small, then it may be difficult to address screening distortion with the amenity subsidy. However, one desirable property relative to hiring subsidy is that it is a more targeted policy in the sense that firms hiring low types receive higher amenity subsidies as amenity levels are higher for low types in equilibrium, which may be more effective in mitigating screening distortions.[29] Thus, if the government's ability to verify workers is imprecise, job amenity subsidies may be more desirable. In general, evaluating the relative advantage of these instruments is a quantitative question.

These considerations highlight that the optimal policy design requires the joint analysis of these policy instruments. One important question is whether firm subsidies may lead to an over-employment of low-type workers. Whether it does (or not) depends on the level of social insurance benefits, as both policies jointly determine the labor supply responses. Thus, in our quantitative policy experiments, we study the optimal joint policies, which incorporate the labor market outcomes in equilibrium—the employment levels, the employment contracts (wages and job amenities), and the values of non-employment—for various types of workers in the economy. Moreover, Proposition 1 underscores the need to recover 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.

2.6 Application of the Model to Other Settings

Although we focus on the quantitative application of this framework to the labor market for individuals with disabilities in the rest of the paper, our framework and insights are applicable to broader settings.

Health Insurance. We can interpret the amenity as employer-based health insurance. Suppose that firms cannot observe the health status of workers (or they cannot offer health-dependent contracts) and the provision of health insurance is more attractive to unhealthy individuals who may be less productive. Then, firms may underprovide health insurance to screen out unhealthy individuals, distorting insurance provision to healthy individuals. Such screening incentives can be mitigated if workers have access to health insurance outside the labor market, such as Medicaid or subsidized private health insurance.

[29] See Nichols and Zeckhauser (1982) for an early illustration of the tradeoff between productive efficiency and targeting efficiency in the context of cash transfers and in-kind benefits.

Welfare Programs. Various welfare programs help support low-income workers, a disproportionately high share of whom are individuals with caring responsibilities (e.g., single parents). If firms perceive that single parents are less productive (e.g., due to higher turnover), but if firms cannot directly set contracts based on those demographic characteristics, then firms may underprovide benefits preferred by the specific type of workers (e.g., flexible work hours).

Unemployment Insurance. This framework also suggests that using progressive employment subsidies can enhance the design of unemployment insurance system. Suppose that firms do not observe worker's skills at hiring stages, and they use non-wage benefits (e.g., job stability) to avoid hiring less skilled workers. Progressive employment subsidies can mitigate screening distortions by lowering the relative cost of hiring low-skilled workers, concurrently reducing moral hazard from unemployment insurance.

Firm's Screening through Job Interviews. One obvious question is what happens if firms screen workers more directly, e.g., through job interviews, in an environment where firms do not face any regulations on screening activities but do not observe worker's productivity (e.g., Jarosch and Pilossoph, 2018). As long as a firm's costly screening does not perfectly eliminate the asymmetric information, social insurance and welfare policies could still be welfare enhancing: for example, targeted subsidies for low-skilled individuals may lower their incentives to apply for a job intended for high-skilled workers. Thus, firms need to spend fewer resources to screen worker's type. Although rigorously confirming the intuition in a different screening model is left as a future work, we conjecture that a similar mechanism is at work in such contexts.

3 Institutional Setting

Before we extend and specify our model in Section 2 to quantitatively assess the labor market for people with disabilities, we now describe policies for the disabled in detail. First is the ADA that we discussed in 2.1.5, a key policy that makes firms' screening incentives relevant. Next are programs that subsidize disabled workers and firms hiring the disabled. After describing these policies, we explain how our model incorporates them and how we use changes in these policies to provide suggestive evidence of screening and to identify structural parameters.

Americans with Disabilities Act (ADA). The ADA is a civil rights law that prohibits discrimination against people with disabilities in all areas of public life, including jobs.[30] Its purpose is to ensure that people with disabilities have the same rights and opportunities as others. The ADA includes five clauses and the most relevant component for the labor market is Title I – Employment.

[30]See `https://www.ada.gov/` for details.

It prohibits employers from discriminating against qualified individuals with disabilities in applying for jobs, hiring, firing, and compensation. Further, it requires employers to provide reasonable accommodations, a change that accommodates employees with disabilities so they can do the job without causing the employer undue hardship. In 2008, the ADA Amendments Act (ADAAA) was passed that broadened the definition of disabilities. This may have affected firms' incentives to screen disabled workers who may be costlier to retain as firms face more regulations on them.

Social Security Disability Insurance (DI). In the U.S., there are two major federal disability transfer programs administered by the Social Security Administration (SSA), Social Security Disability Insurance (DI) and Supplemental Security Income (SSI). As summarized by Bound and Burkhauser (1999), the actual process of being awarded these benefits is complex and involves screening. The law defines disability as the inability to engage in substantial gainful activity by reason of a medically determinable physical impairment expected to result in death or last at least 12 months. The SSA examines the medical condition of an applicant as well as the applicant's ability of work. Once a worker is qualified, the worker receives the benefit based on the applicant's past earnings.[31] While DI is an important social insurance program for those with a work-limiting disability, its outcome is uncertain from the workers' perspective due to the screening process.

Subsidies to Firms Hiring People with Disabilities. There are several policies associated with employer incentives for hiring people with disabilities. The Work Opportunity Tax Credit (WOTC) is a federal tax credit program that was implemented in 1996 in an effort to improve the labor market outcomes of economically disadvantaged individuals (Scott, 2013). Under the WOTC, firms can receive tax credits when they hire workers from certain "target groups." These target groups include workers with disabilities who are hired through state-run vocational rehabilitation agencies and former disabled SSI recipients. For eligible hires with disabilities, employers receive an annual tax credit, which usually amounts to $2,400. Similar subsidy programs exist in a few states. In New York, for example, Workers (with Disabilities) Employment Tax Credit (WETC) was introduced in 1997.[32]

In 2004, the WOTC was amended and broadened the eligibility criteria for people with disabilities, which significantly increased employment certificates for the disabled. As detailed in Appendix C.1, one can calibrate that this policy increases the probability that firms hiring severely disabled workers receive subsidies by 33 percentage points. Similar to the ADAAA, the WOTC Amendment and the introduction of WETC may have impacted firms' screening incentives. Firms are more likely to receive subsidies when hiring disabled workers, lowering their incentives to screen disabled workers.

[31] In addition to SSDI and SSI, these workers can also be eligible for Medicare, which covers medical expenses.

[32] Under WETC, firms hiring workers with disabilities can receive tax credits of $2,100, with essentially the same eligibility criterion as WOTC. Since 1998, firms can receive subsidies through both WOTC and WETC. Detailed description of these policies are in Appendix C.

Use of These Policies in Our Analysis. As we discuss in Section 2.1.5, we consider the anti-discriminatory clause of the ADA as the main reason that firms cannot offer health-dependent employment contracts, and incorporate the status quo DI policy. Furthermore, we exploit changes in disability policies, such as the WOTC Amendment and the ADAAA, to provide suggestive evidence that firms may screen workers with disabilities and to identify parameters in our model. The estimated model is then used to study the optimal design of DI and firm subsidies.

4 Data and Descriptive Evidence

4.1 Data Set and Summary Statistics

Our primary data source is the Health and Retirement Study (HRS). The HRS is a biennial panel survey developed in 1992 focusing on the U.S. population over the age of 50. Although we carry out most analysis using the public version of the HRS, we also obtain its restricted version with additional data to conduct supplementary analysis which we discuss in Appendix C.3. Among readily available data sets, the HRS is appealing for the following two reasons. First, it covers relatively older individuals, who are more likely to be subject to disability risks 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 (male and female) with high school education or less, and 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, we limit our sample to paid workers in private sectors whose weekly earnings are in between 1% and 99% of the earnings distribution. 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, 22% of workers are severely disabled, 23% are moderately disabled, and the rest (55%) 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.

Table 1 documents descriptive statistics for our sample by disability statuses. On average, the labor market performance of more severely disabled workers, as measured by employment, hours worked, and hourly wage, is worse than their healthier counterparts. 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 modify or reduce work schedules. 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 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 Section 4.3, we further show that this relationship becomes stronger after controlling for worker and firm characteristics.

Table 1: Descriptive Statistics by Disability Status

Category	Variable	Disability status: Non-disabled	Moderately disabled	Severely disabled
Fraction of population (%)		55.35	22.84	21.81
Demographics	Age	58.43	58.82	58.73
	Female (%)	57.43	58.10	58.37
Labor market	Employment rate (%)	68.60	45.20	10.88
	Working hours per week	39.81	39.05	36.47
	Hourly wage ($2001)	12.66	11.48	11.00
	Weekly earnings ($2001)	517.55	462.81	416.39
Job amenities	Option to reduce working hours (%)	31.66	32.45	35.38
	Available paid sick leave (days)	13.19	12.82	19.22
	Option to change from full- to part-time (%)	59.69	71.82	72.49
	Employer-sponsored DI coverage (%)	27.98	23.79	22.54

Note: This table reports the summary statistics by disability status, weighted by the individual-level survey weight. Observations are limited to individuals with high school education or less, between ages 51 and 64 from 1996 to 2008, and between 1% and 99% weekly earnings and in the private sector (if employed). The hourly wage rate is written in 2001 U.S. dollars using the CPI. Earnings are constructed using the individual-level information on hourly wage and working hours.

4.2 Empirical Measure of Screening Tools

4.2.1 The Option to Reduce Working Hours

There are potentially many non-wage benefits that firms can exploit to screen out the disabled. Among them, we focus on firms' provision of the option to reduce working hours as a possible screening tool for the following three 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. Such a view is consistent with findings from the literature estimating the effect of health on labor supply (e.g., French, 2005) that the marginal disutility from additional work is higher for unhealthy workers. The data pattern in Table 1 also supports this: disabled workers are more likely to work at jobs that provide the option to reduce working hours. Second, it is easier for firms to adjust this option at the individual worker level, in contrast to firm-level amenities such as employer-based health insurance. Third, crucially for our purposes, this job amenity is not necessarily mandated under the ADA.[33] 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).[34] In recent court cases, providing the option to reduce working hours or extensive sick leaves has not been deemed as a reasonable accommodation.[35] 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.

4.2.2 What *is* the Option to Reduce Working Hours?

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. Although these job characteristics also affect working hours to some extent, we think that these are distinct in important dimensions from the option to reduce working hours.

First, that workers have the *option* to reduce hours does not necessarily imply that they are part-time workers. In the data, workers with high (full-time) hours report having the option to reduce working hours.[36] It is plausible to hypothesize that disabled workers may prefer to work part-time. However, in the U.S., part-time contracts are often associated with wage penalty and fewer fringe benefits. Especially, it is well known that most part-time jobs do not provide health insurance.[37] Under the U.S. health insurance system that is mainly employer-sponsored and lacks universal coverage, workers without access to employer-based health insurance are more likely to be uninsured which could lead to a large welfare loss for the disabled (Aizawa and Fang, 2020). Thus, part-time contracts are not necessarily attractive for the disabled, which leads us to focus on the option to reduce working hours as a plausible job characteristic that may act as a screening tool, distinct from part-time work.

Secondly, having the option to reduce working hours is a specific form of flexibility at the

[33]The HRS also asks employed respondents with a reported work limitation whether they receive any types of accommodations. These include 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.

[34]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, ï¿œ 1, 104 Stat. 331, retrieved from the U.S. House Library in November 2018)

[35]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 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.

[36]Of the workers with more than 40 hours of work per week, 29% of them reported having the option to reduce working hours. If we consider all employed workers without conditioning on hours, the share is 32%.

[37]Among firms that offer health insurance, only 23% of them offered health insurance to part-time workers in 2004 (Kaiser Family Foundation, 2004) and this magnitude has mostly stayed unchanged since then.

job that is different from flexible working hours. Usually, jobs with flexible working hours allow workers to choose when to start and end work, which are particularly valuable for workers with childcare responsibilities or those who constantly provide informal care to their families. However, they do not necessarily provide 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.

The HRS reports several specific amenities related to the worker's ability to reduce his working hours, such as the option to (potentially temporarily) 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. Moreover, it broadly captures various practices that firms can use, as opposed to more specifically defined amenity variables.

It is also important to point out that typical working hour variables are unlikely to capture whether the worker has the option to reduce working hours. The working hours variable usually measures the *regular* work hours per week, which, for example, varies with part-time/full-time employment status. The option to reduce working hours allows workers to adjust their hours given their regular work hours. Due to the lack of granular working hour variations in the data, such benefits cannot be easily measured by the working hours variable. We, therefore, focus on the overall effect of the option to reduce working hours on worker's preference on jobs.

4.2.3 How does the Option to Reduce Working Hours Affect Other Workers?

One natural question is whether the preference for the option to reduce working hours is specific to people with disabilities. For example, workers with young children may also have preferences for this amenity because of their childcare needs. Then, the main question is to what extent firm's provision of the option to reduce working hours is related to their recruiting incentives on the population considered in this paper (i.e., relatively older workers with ages 51-64). As long as the labor market is segmented, a directed search model like ours, the availability of the option to reduce working hours is entirely determined by the specific population in the market. Moreover, in the subsequent empirical analysis, we find that workers with disability are likely to sort into jobs with the option to reduce working hours, even after controlling for a number of other characteristics, and that this amenity tends to be responsive to various disability policies. Therefore, it is reasonable to consider this amenity as one of the relevant recruiting tools in this context.

4.3 Suggestive Evidence of Labor Market Screening

As documented in Table 1, the data suggests the presence of preference heterogeneity on the option to reduce working hours across workers of different disability types. In this section, to show whether the provision of this job amenity is impacted by changes in firms' incentives of hiring certain types of workers, we examine the effect of three policy changes discussed in Section 3: the WOTC amendment, the ADAAA, and the introduction of WETC. Here, we summarize the main findings from the WOTC amendment, and relegate the details of the validity of its empirical design, robustness, and findings from other policy changes to Appendix C.

To begin with, it is useful to think about key implications of the policy changes through the lens of the standard screening models (e.g., Akerlof, 1976; Rothschild and Stiglitz, 1976). The expansion of the WOTC in 2004 increased the chance for firms to receive lump-sum transfers when they hire severely disabled workers.[38] Firms face higher relative profits from hiring severely disabled workers, thereby increasing the equilibrium provision of moderately disabled workers' job amenities as 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.[39] Such a prediction does not arise in the standard competitive equilibrium without screening, where we should not expect any effects for workers who are not directly affected by these policy changes.

Motivated by this theoretical observation, we estimate the following regression:

$$y_{it} = \beta_1 \mathbb{I}_{\text{Post}} + \sum_{h \in \{\text{mod, sev}\}} \beta_{2h} \mathbb{I}_h + \sum_{h \in \{\text{mod, sev}\}} \beta_{3h} \mathbb{I}_{\text{Post}} \mathbb{I}_h + \gamma X_{it} + \nu Z_t + \varepsilon_{it}, \tag{11}$$

where 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 ($y_{it} \in \{0,1\}$), X_{it} includes individual covariates (demographics; objective health measures, e.g., disease prevalence and body mass index; firm characteristics), and Z_t captures other aggregate time-varying controls. 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 WOTC Amendment dummy ($\mathbb{I}_{\text{Post}}$). 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}).

Table 2 shows the key estimates. We find that after the implementation of the WOTC amendment, the amount of job amenities for the moderately disabled increases; at the same time, we find a small and statistically insignificant effect on the job amenity for the severely disabled. We also show in Appendix C that the main response of moderately disabled is from newly hired employees and these results are robust even after accounting for selection.[40]

[38]We view that this interpretation is plausible because the WOTC expansion is available to individuals who were already identified by the government as disabled (refer to Appendix C for further discussions).

[39]These predictions hold because workers cannot privately purchase amenities outside the labor market in the model. Further, if workers are risk-neutral, the lump-sum transfer from WOTC does not affect the equilibrium amenities of the most severely disabled (see Equation (3)). If individuals are risk-averse, the marginal benefit from additional amenities depends on the marginal utility from consumption that may be affected by the WOTC. If this effect is small (i.e., workers are not very risk-averse or consumption increase from the WOTC is small), the prediction holds.

[40]Scott (2013) states that the WOTC favors firms engaging in hiring and firing and its expansion may increase such

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

Coefficients		Option to reduce working hours	
Post-amendment (β_1)		-0.006	(0.082)
Disability status (β_{2h})	Severely Disabled	0.097*	(0.053)
	Moderately Disabled	0.023	(0.028)
Disability status $\times$ Post (β_{3h})	Severely Disabled	0.028	(0.079)
	Moderately Disabled	0.115**	(0.049)

Note: We estimate Equation (11) with the linear probability model using samples between 1996 and 2008. The additional covariates are age, marital status, gender, various health measures (e.g., disease prevalence), firm-size category dummies, and macroeconomic conditions (e.g., employment rates). The sample size is 4,044. Standard errors are clustered at the individual level. $***p < 0.01, **p < 0.05, *p < 0.1$.

These empirical results are consistent with the theoretical predictions of the screening model, and we view them as suggestive evidence that the option to reduce working hours may be an important contractual component for both firms and workers that respond to changes in screening incentives induced by government policies. Further, we use these estimates to identify the parameters determining amenity preference heterogeneity, which we discuss in Section 5.2.1.

5 Estimation

5.1 Quantitative Specification

We now discuss a quantitative extension of our model. To begin with, we use the option to reduce working hours as an amenity that people with more severe disabilities prefer to have at a job.[41] In the data, this option to reduce working hours is represented as a binary variable that we denote as $\tilde{a} \in \{0,1\}$, and there is no perfect sorting between workers' observable characteristics and amenity statuses. To account for these features without changing the main theoretical feature of the model, we depart from our theoretical labor market model in Section 2 in the following ways. First, we allow for the coexistence of jobs with and without amenity in each submarket that are characterized as $(w,\tilde{a}) = \left(w^{E,1},1\right)$ and $(w,\tilde{a}) = \left(w^{E,0},0\right)$ respectively. After a worker enters a submarket, he is matched with a job with (without) amenity with probability a $(1-a)$. This results in worker's utility as

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

incentives. We show in Appendix C that the amendment did not have significant effects on worker tenure.

[41]In modeling the option to reduce working hours, we only specify its utility effect in a reduced form way. If rich data exists, one can micro-found this similar to, e.g., French (2005), where marginal disutility from additional work is higher for workers with poor health. When a disutility shock occurs, workers might want to reduce their hours from *regular* work hours, which is less costly if firms provide the option to reduce hours. Thus, workers with more severe disability statuses who are more prone to these disutility shocks have higher preferences for this job amenity.

where

$$U_{h,x}^{E}(\overrightarrow{w},a) = au\left(w^{E,1}\right) + (1-a)\,u\left(w^{E,0}\right) - \left(\chi_{h,x} - \beta_{h,x}\varphi(a)\right). \tag{12}$$

is worker's expected utility from finding a job.[42] Second, the firm's profit from hiring a worker is

$$v_{h,x}^{\tilde{a}}(w_{\tilde{a}}) = f_{h,x} - w_{\tilde{a}} - c_{h,x}\tilde{a} \tag{13}$$

where $\tilde{a} \in \{0,1\}$ represents whether the job provides the amenity and $c_{h,x}$ is the cost of providing amenity. In Appendix A.5, we characterize the equilibrium, where the key equilibrium object is the market tightness $\theta_{h,x}$, the vector of wage $\overrightarrow{w}_{h,x}$, and the proportion of jobs that provide job amenity, $a_{h,x} \in [0,1]$. We show that the main features of equilibrium remain unchanged and therefore key theoretical properties discussed in the previous sections are preserved in this setting.[43]

5.1.1 Functional Forms

The production function of a worker with health type h and skill type x is represented by $f_{h,x} = f_h \times x$, which assumes complementarity between health and skill. 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. While contracts cannot depend on health status (by regulation or due to private information), health status is *observable* by econometricians. 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.[44]

We assume that workers' preferences over consumption are represented by a log utility function $u(c) = \log c$. Utility from job amenities is specified by $\varphi(a) = \delta_0 - (\delta_0 - a)^{\delta_1}$ with $\delta_1 \geq 2$, which is concave and satisfies $\lim_{a\to 0}\varphi'(a) = \infty$ and $\lim_{a\to\delta_0}\varphi'(a) = 0$.[45] Moreover, to save the number of parameters to be estimated, we assume that $\chi_{h,x} = \chi_h$ and $\beta_{h,x} = \beta_h$. The cost function for amenities is represented by $c_{h,x} = c_0 \cdot f_{3,x}$, which means that the amenity cost is proportional to the skill-specific output of the non-disabled.[46] We assume a matching function $\mu(\theta) = \theta\left(1+\theta^{\gamma}\right)^{-1/\gamma}$, where γ controls its elasticity.

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[42]This specification implies that workers have a concave preference on the proportion of jobs that provide amenities, i.e., the marginal utility from getting jobs with amenities is decreasing in a. This is assumed to generate the interior optimum. One can consider that this is a reduced form approach to capturing the presence of worker's taste in other (non-wage/amenity) components that may allow workers to choose both types of jobs with positive probabilities. One can more rigorously model this by adding preference shock on the job with or without amenities as in the standard discrete choice models. However, such a modeling approach would lead to a different characterization from the model in Section 2 while most economic intuitions should remain similar. Therefore, we make a simplifying assumption to preserve the tractability and consistency of our analysis.

[43]One small difference is that workers face additional risk depending on the type of jobs with and without amenity.

[44]We discretize the distribution into the support with $N_x = 10$, thus there are up to $3 \times N_x$ active submarkets.

[45]Having two parameters (δ_0, δ_1) provides more flexibility in generating the marginal utility benefit from a depending on its level.

[46]Note that we do not allow for the amenity cost to be a function of disability status. However, the net output $f_{h,x}$ itself depends on the disability status (so the share of amenity cost relative to net output differs by disability).

5.1.2 Externally Calibrated Parameters

The individual's probability of becoming a severely, moderately, or non-disabled worker (π_h) is 22%, 23%, and 55%, respectively (corresponds to empirical distribution in the economy). 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.[47]

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.[48] We assume that DI benefit amounts are determined as a constant fraction d of the average productivity among workers of the same skill level, because the amount of DI benefits in the U.S. is determined by the average of the worker's previous earnings. We use $d = 0.3$ as the benchmark replacement rate, which leads to around 40% effective replacement rate of wage in the benchmark economy. 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 a linear utility function as it is impossible to identify each parameter separately. 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., 0.4 in Shimer, 2005 and 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 the non-employed severely disabled is 29% ($b + \psi_h d = 0.1 + 0.62 \times 0.3$) of the average productivity of his skill.

[47]Given our choice of γ, the elasticity of the job-finding rate with respect to market tightness for non-disabled workers is around 0.2, a value within the ranges used in the literature. Menzio and Shi (2011) adopt the same CES function in a directed search environment and calibrate the parameter γ by targeting the empirical elasticity of the unemployment-to-employment transition with respect to the vacancy-to-unemployment ratio (θ). In a model with no search by employed workers (a similar environment to ours), their calibrated γ is 0.25. Alternatively, using the Cobb-Douglas function, Shimer (2005) calibrates the elasticity parameter to the estimated coefficient 0.28.

[48]We assume that the verification probability ψ_h is exogenous and focus on DI and firm subsidies as policy instruments. Low and Pistaferri (2015) structurally estimate these parameters as the DI receipt probability using the Panel Study of Income Dynamics. We use their values for old workers (ages 45–62) who are at most high school graduates. 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 error rates in DI award process merging the HRS with administrative data. The authors find that false rejections occur 55% among applicants, similar in magnitude to our calibrated parameters. Although not perfect, these are the most relevant estimates for the parameter in the literature. While we take these values exogenously, they yield empirically reasonable DI recipient rates; our model predicts that 16% of workers receive DI, similar to empirical DI receipt rates among the old, low-education population.

5.2 Identification and Estimation

5.2.1 Identification

The parameters to be estimated within the model are the net output levels by health statuses $\{f_h\}$; the health-specific preferences for job amenities $\{\beta_h\}$; the curvature of the amenity utility function $\{\delta_0, \delta_1\}$; the health-specific fixed disutility from work $\{\chi_h\}$; the health-dependent variance of the skill (x) distribution $\{\sigma_h^2\}$; the cost of providing job amenity c_0; and the vacancy posting cost κ. We normalize non-disabled workers' fixed disutility from work to zero ($\chi_3 = 0$), leaving 14 parameters to be estimated. Although each parameter influences the entire labor market equilibrium, it is still informative to discuss how we can separately identify the parameters.

The key parameters related to screening are the worker-side preference parameters on job amenities ($\{\beta_h\}$ and $\{\delta_0, \delta_1\}$) and the firm-side job amenity cost parameter c_0. To see how these parameters are separately identified, we first note that the amenity cost parameter can be identified from the compensating wage differential mechanism (Rosen, 1986). As seen from Equation (13), within the same submarket, the free entry condition implies that the profit from jobs with and without the amenity is equalized, and as a result, $w^1_{h,x} + c_{h,x} = w^0_{h,x}$ (see Appendix A.5 for the further detail). Thus, the wage difference of the same type of workers in a job with and without job amenities identifies the cost of job amenities.[49] Once we recover the cost, the health-specific preferences for job amenities $\{\beta_h\}$ can be identified by the proportion of workers with job amenities for each disability type.

To identify the curvature $\{\delta_0, \delta_1\}$, one must exploit variation in job amenities that are independent of disability status. We can identify this parameter in two ways. First, we utilize within disability variation in job amenities. In the model, workers with different skill levels (x), who are in different submarkets, may have different levels of job amenities because of income effects or the slackness of (IC) constraints. Thus, we utilize variation in job amenities across workers with different skill (wage) levels. Second, we exploit exogenous variation in job amenities induced by policy changes. For example, consider an expansion of subsidies given to firms hiring disabled workers (the WOTC amendment discussed in Sections 3 and 4.3). Such subsidies reduce firms' incentives to screen disabled workers ((IC) constraint is relaxed), therefore increase the equilibrium job amenities of less disabled workers, generating an exogenous variation in job amenities. While both variations are informative in identifying the parameters, each has its own limitations. The first approach relies on the assumption that $\{\beta_h\}$ and $\{\delta_0, \delta_1\}$ are common across x. The advantage of the second approach relative to the first is that the variation in amenity is due to a policy change and thus less affected by our modeling assumption on amenity utility. However, it hinges on how precisely we can model the policy changes that are often very complex. As detailed

[49] Many studies utilize compensating wage differentials to identify the utility value from non-wage benefits, after controlling for worker's observed and unobserved heterogeneity (e.g., Taber and Vejlin, 2020). We utilize the same variation to identify the cost of job amenity, which is suitable because in our model, a worker randomly meets a job with and without amenity within a submarket as captured by Equation (12).

below, we model a stylized version of the WOTC amendment as the policy variation for the second identification approach.

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.

It should be emphasized that our equilibrium model and identification approach do not necessarily impose that the screening distortion is operative in the benchmark equilibrium. Depending on model parameters, the model may predict that the equilibrium contracts are equivalent to those without screening; that is, the equilibrium health-dependent contracts can be incentive compatible for all types of workers in the economy. Therefore, our goal is to find the parameters that best fit the data, allowing for screening contracts to arise in equilibrium.

5.2.2 Estimation Strategy

Motivated by our identification strategy, we estimate these parameters via indirect inference by considering the following set of moments in the auxiliary model: (i) average wage, employment, and the option to reduce working hours of non-disabled workers; (ii) coefficients on moderately and severely disabled worker dummies from regressing log wage, employment, and the option to reduce working hours on individual characteristics[50]; (iii) coefficient of variation of wage by disability status; (iv) coefficient on job amenity dummy from a regression of wage on job amenity which controls for an individual fixed effect[51]; (v) the ratios of average option to reduce working hours between high- and low-income non-disabled workers. We then also estimate the model by replacing the moment (v) with (vi) regression coefficients on the effects of WOTC Amendment for the option to reduce working hours in Equation (11) in Section 4.3. We implement two estimations, instead of targeting (v) and (vi) together, because both approaches are subject to different types of weaknesses that we discuss in Section 5.2.1. While we acknowledge the limitations from each approach, we aim to provide the robustness of our substantial quantitative results (especially our welfare analysis from policy counterfactuals) under both identification approaches.

The moments (i)-(iii) account for cross-sectional heterogeneity in wage, employment, and the job amenity. When we construct the moment (iv), we explicitly control for an individual fixed effect to account for potential selection in measuring the wage difference between jobs with and without amenities. In other words, we utilize the within-individual switching of contract character-

[50]Specifically, we target β_{mod} and β_{sev} in $y_{it} = \beta_0 + \sum_{h \in \{\text{mod, sev}\}} \beta_h \mathbb{I}_h + \gamma X_{it} + \varepsilon_{it}$, where y_{it} is the outcome of interest and $\mathbb{I}_h$ is the dummy of individual disability status; and X_{it} includes individual-level control variables (e.g., individual demographic characteristics and health), job characteristics, and year dummies. In the auxiliary model, we run analogous regressions where we control for worker skills (x).

[51]Here, we target β_a in equation $y_{it} = \beta_a \mathbb{I}_a + \gamma_i + \gamma_t + \varepsilon_{it}$,where y_{it} is log wage, γ_i and γ_t are individual and year fixed effects, and $\mathbb{I}_a$ is an indicator variable for whether the individual has the option to reduce working hours on the job. We also estimate this regression by including time-varying individual-level control variables (e.g., age, health) but it does not impact the estimated coefficient β_a.

istics to identify the wage differentials arising from the amenity. As we report later, we see a strong evidence of compensating differential mechanism (the wage is lower in a job with the amenity). The model generates this property because after a worker has chosen a submarket, the amenity provision is determined probabilistically (represented in Equation (12)). Importantly, the moment (v) (or (vi) depending on identification strategy) serves as a variation for separately identifying the amenity's utility benefit from its cost, along with moment (iv). For generating moment (vi), we model a stylized WOTC amendment. In the post WOTC amendment economy, a firm hiring a severely disabled worker receives a lump-sum subsidy which is equal to the 40% of average severely disabled workers' wage with a 33% probability. This choice reflects the average amount of transfers allowed to firms under the policy;[52] and our estimate that the amendment could have increased the probability that a firm receives subsidies by $33pp$.[53]

We form the objective function for our estimation as $\hat{\omega} = \arg\min_{\omega} \left[\hat{\beta}(\omega) - \overline{\beta}\right]' W \left[\hat{\beta}(\omega) - \overline{\beta}\right]$, where W is the weighting matrix, $\overline{\beta}$ is a vector of auxiliary model parameters computed from the data, and $\hat{\beta}(\omega)$ is a vector of the corresponding auxiliary model parameters from simulating data sets from the model (parameterized by a particular structural parameter vector ω).[54] We obtain the standard errors of our estimators based on the asymptotic variance, following Gourieroux, Monfort and Renault (1993).[55]

In Appendix D.3, we provide an additional diagnosis of whether our choice of auxiliary models is really informative in identifying the parameters in practice. We investigate the effects of changing the amenity-related parameters on the moments from the auxiliary models. We find that a change in the amenity cost parameter (c_0) significantly affects the moment (iv); and changes in the amenity utility's parameters (δ_0, δ_1) significantly affect the moments (v) and (vi), with negligible effects on the moment (iv). These findings suggest that our choice of auxiliary models is sensible

[52] The minimum hours worked to qualify for $2,400 tax credit is 400 hours and the average annual hours is 1,780. Given the hourly wage of severely disabled workers in our data, $2,400 is between 12% and 52% of their income.

[53] As discussed in Appendix C.1, the assumption that the WOTC amendment is only associated with hiring of the severely disabled may not reflect the exact implementation of the policy, which is difficult to verify. Within the model, this assumption implies that any post-amendment changes in job amenities of workers who are not severely disabled are driven solely by screening in our model. 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 variations 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 5.2.1. In addition, we do not explicitly model the pre-amendment WOTC tax credit. Such policy impact should be implicitly captured by the productivity of severely disabled.

[54] Our weighting matrix on the estimator W is essentially based on the inverse of the variance-covariance matrix of empirical moments, assigning zero to all the off-diagonal elements. The weights associated with moments (ii), (iv), and (vi) are based on the inverse of standard errors of regression coefficients, and the weights associated with moments (iii) and (v) are set to one. Because of the small sample size concern, we do not use the optimal weighting matrix in our estimation (Altonji and Segal, 1996).

[55] 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 tends to be *locally* smooth for many combinations of parameters and thus decide to obtain the standard errors by calculating the score function of $\hat{\beta}(\omega)$ numerically.

in identifying some of the key parameters.

5.3 Estimation Results

Tables 3 and 4 report the estimated structural parameters and the model fit using the first estimation strategy and in Appendix D.2 are corresponding results under the second strategy that uses the policy variation. Our estimates indicate that disability affects worker productivity and their preferences for job amenities. For example, we find that there is a 42% ($1-\frac{1.924}{3.331}$) 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 has a higher fixed cost of work and a greater preference for job amenities compared to the non-disabled. Thus, in order for severely disabled workers to participate in the labor market, it is essential for them to receive sufficient amounts of job amenities. From the firm's perspective, the cost of providing additional job amenities is reasonably important. Based on our estimates, the amenity costs amount to 5% of the labor productivity of non-disabled.

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	1.924	(0.037)	2.387	(0.102)	3.331	(0.010)
Preference for job amenities: β_h	10.108	(0.044)	6.593	(0.062)	1.0 (normalized)	
Fixed cost of work: χ_h	7.586	(0.019)	5.874	(0.025)	0.0 (normalized)	
Variance of skill distribution: σ_h^2	3.186	(0.170)	0.575	(0.019)	0.638	(0.028)
(b) Base utility from amenity						
Constant: δ_0	0.649	(0.004)				
Curvature: δ_1	2.882	(0.095)				
(c) Firm-side parameters						
Amenity cost: c_0	0.0531	(0.002)				
Vacancy cost: κ	0.0128	(0.001)				

Note: The dollar value in the model is normalized to \$250.

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 4. Importantly, the data suggest that low-income workers are more likely to work at jobs with amenities than high-income workers among the non-disabled. This pattern is the opposite of the standard income effect. The model can generate this pattern through screening distortions: the distortionary effects of screening on amenities are larger among high-income workers.

The parameters estimated from utilizing the effect of WOTC amendment in an auxiliary model are slightly different. For example, the curvature parameter is lower in Table 3 than the one in Table A-14 in Appendix D.2. Accordingly, other parameters are also adjusted, especially the productivity parameters (e.g., non-disabled skill variance). This is due to the fact that the moment used in the first specification is related to the income (skill)-amenity relationship among the non-disabled, governed by productivity heterogeneity. The amenity utility parameters are adjusted to account for the joint relationship between income and amenity. Moreover, as shown in Table A-15 in Appendix D, the model generates little effects of the WOTC amendment on severely disabled's job amenities (coefficient post×severe), but a significant change in the provision of amenities for moderately disabled workers (coefficient post×moderate), consistent with results in Table 2.

Table 4: Model Fit

(a) Employment and wage

Statistics	Data	Model
Employment		
Non-disabled (ND) emp. rate	0.686	0.572
Coeff. of moderately disabled	-0.226	-0.239
Coeff. of severely disabled	-0.530	-0.459
Average wage		
ND wage (level)	2.277	2.247
Coeff. of moderately disabled	-0.182	-0.104
Coeff. of severely disabled	-0.341	-0.133
Coefficient of wage variation		
Non-disabled	0.587	0.546
Moderately disabled	0.618	0.429
Severely disabled	0.653	0.486

(b) Job amenities

Statistics	Data	Model
Job amenities		
ND job amenity (level)	0.317	0.344
Coeff. of moderately disabled	0.071	0.060
Coeff. of severely disabled	0.106	0.136
Fixed effect regression of wage on amenity		
Coeff. on job amenity	-0.082	-0.088
Income-amenity relationship (among ND)		
$\frac{\text{Amenity, 25\%-50\% income}}{\text{Amenity, 50\%-75\% income}}$	1.492	1.212
$\frac{\text{Amenity, } \leq 25\% \text{ income}}{\text{Amenity, 25\%-50\% income}}$	1.443	1.371

Note: This table compares the model-generated statistics to their empirical counterparts. For average wage, we use weekly earnings with the model unit of $250. The form of regression coefficients are explained in footnotes 50 and 51.

While our model matches the targeted moments well, it is important to ensure that the model also generates an empirically plausible response to policy changes. In particular, because our estimation does not rely on the policy variation in DI, we evaluate the extensive margin elasticity of labor supply with respect to DI benefit generosity. In the U.S., empirical studies have found the elasticity to range between 0.2 and 1 (Bound and Burkhauser, 1999; Haveman and Wolfe, 2000).[56] Our model generates an elasticity of 0.24 among moderately and severely disabled workers, which shows the model's ability to generate empirically plausible DI impacts on worker outcomes.

5.4 Equilibrium Effects of Screening

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. The labor market contracts for severely disabled workers are equivalent in the presence and the absence of screening upon participation. As predicted by the model, in the screening economy, job amenities are underprovided to moderately

[56] Gruber (2000) estimates this elasticity to range between 0.28 and 0.36 using quasi-experiments in Canada.

disabled and non-disabled workers. On average, the share of workers with amenities decreases from 52% when there is no screening to 36% when there is screening. While wages of these workers are much less affected by the presence of screening, these workers are compensated with higher employment rates than in the economy without screening, with a more significant effect (2.6pp) on moderately disabled workers.

Table 5: Equilibrium in the Model without Screening (*NS*) and with Screening (*S*)

	Job amenities		Wage		Employment	
	NS	*S*	*NS*	*S*	*NS*	*S*
Severely disabled	0.600	0.600	0.987	0.987	0.099	0.099
Moderately disabled	0.593	0.389	1.984	1.991	0.313	0.339
Non-disabled	0.504	0.340	2.250	2.247	0.568	0.576

6 Quantitative Policy Experiments

Using the estimated structural model, we conduct counterfactual policy experiments. Given the exogenous disability verification technology (ψ_h), we first consider the effects of two policies—the generosity of DI replacement rate (d) and hiring subsidies to firms (tr)[57]—by varying these policy parameters jointly and independently. While there may be various ways of subsidizing firms, we start considering the simplest form of firm subsidy which is easy to implement but is very limited in the current U.S. system. We then compare it with job amenity subsidy, an alternative way to subsidize firms. Due to the imperfect verification technology, workers receive DI benefits with probability ψ_h. Similarly, we assume that firms receive hiring subsidies probabilistically, regardless of the amenity provision, with the effective transfer amounts of $tr_h = \psi_h \cdot tr$. The policy parameters under the benchmark economy are around a 40% replacement rate of average wage (or a 30% DI replacement rate as a function of productivity y) and zero hiring subsidies. 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 income (both labor and DI income) tax (subsidy). This approach better captures the role of policies in providing insurance against (or redistribution across workers of) different disability statuses, rather than providing redistribution across disability statuses *and* skills.[58]

The main quantitative results are based on the estimates reported in Table 3, and the results using the estimates reported in Table A-14 can be found in Appendix E.2. Overall, the quantitative results remain almost the same. Before we present the results from counterfactual analyses, we

[57]Note that the hiring subsidy we experiment with is different from the WOTC amendment we modeled. Under the WOTC amendment, only firms with severely disabled workers received the subsidy, whereas tr is provided to all firms hiring workers with probability ψ_h. Thus, it is a more general policy that affects broader types of workers with differential probabilities, with varying generosity that we experiment with.

[58]We use workers with mid-level skills (the middle six groups out of ten). The qualitative results are consistent with our benchmark findings when we use all workers.

would also like to comment on the range of hiring subsidies we consider. In the current model under the benchmark policy, firms have incentives to screen out disabled workers. If subsidies for disabled workers are very generous, however, it is possible that firms prefer hiring disabled workers over non-disabled workers, which may not be plausible. More importantly, 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, in the following, we restrict firm subsidy parameter space to meet the necessary condition for equilibrium analysis.

As discussed in Section 2.5, 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 the equilibrium effects of policies and then characterize the welfare effects of the policy reforms.

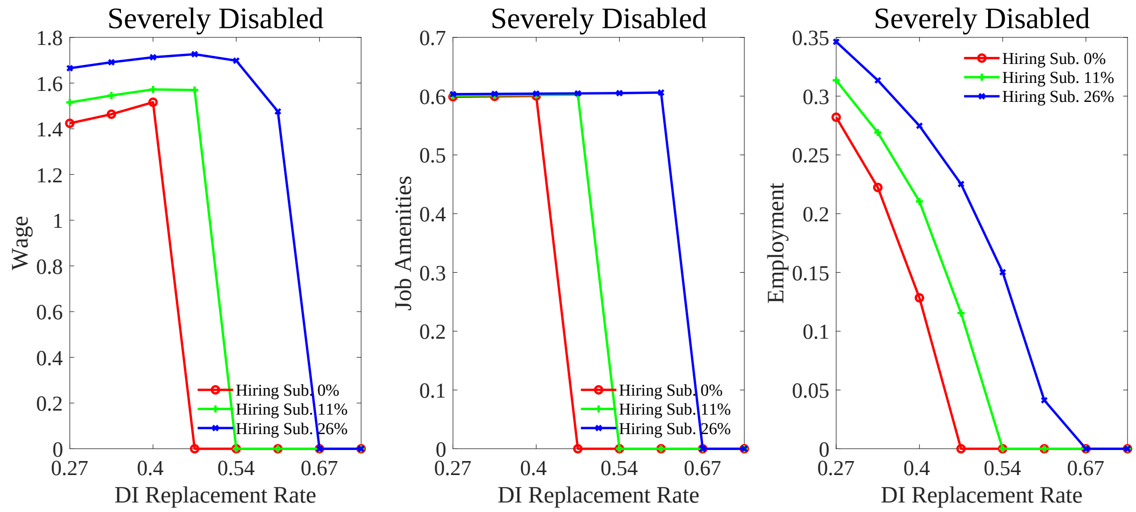
6.1 Equilibrium Effects of Policies

6.1.1 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, and the three lines in each plot correspond to hiring subsidy levels, where we express both policies as percents of average wage in the benchmark economy. In the left panel of Figure 1, we plot the share of workers with job amenities among employed severely disabled workers under joint policy parameters, and in the right panel, we plot the employment rates of severely disabled workers. We observe, first, that as the hiring subsidy increases, severely disabled workers' contracts feature higher wages but with a smaller change in job amenities (due to flatter marginal utility near equilibrium), 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 hiring subsidy is smaller. This employment effect suggests a possible complementarity between these disability policies. Simultaneous expansion of hiring subsidy and DI can undo distortionary employment effects caused by DI.

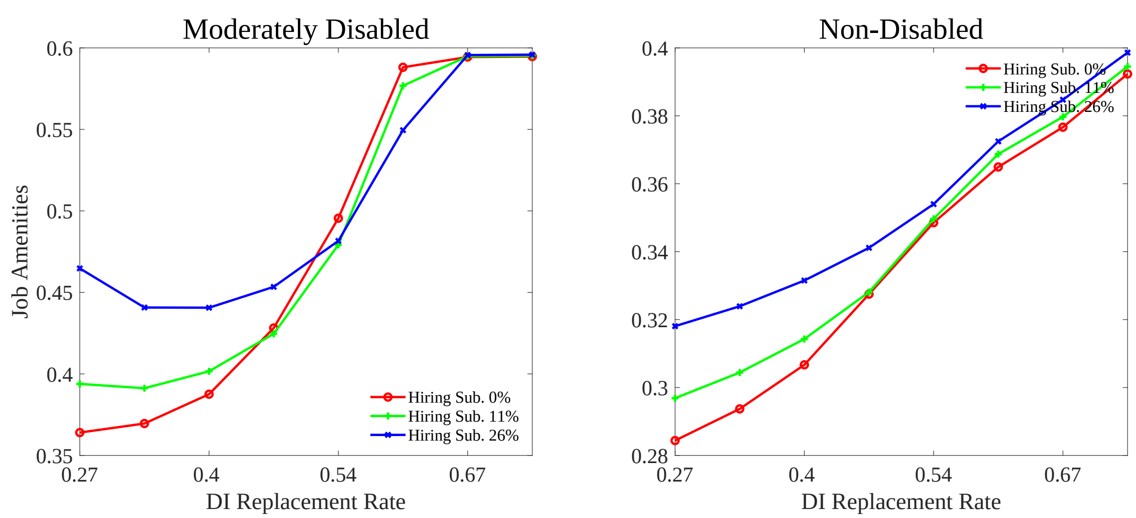
Figure 2 illustrates the equilibrium job amenities for moderately disabled (left panel) and non-disabled (right panel) workers. As the hiring subsidy is provided to all workers, albeit at lower expected rates due to verification probabilities, healthier workers in the labor market are also likely to benefit from higher amenities. Interestingly, for a fixed DI, we observe that the monotonic relationship between amenities and subsidies may not hold for moderately disabled workers: at a higher DI replacement rate (e.g., 60%), moderately disabled workers enjoy higher amenities when there is no hiring subsidies. Several factors are in play for the determination of the equilibrium

Figure 1: Labor Market Equilibrium for Severely Disabled Workers



job amenity, 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). In particular, at lower hiring subsidies (e.g., zero), severely disabled workers quickly drop out of the labor force as DI generosity increases. As seen from Figure 2, because severely disabled workers no longer participate in the labor market (at zero hiring subsidy and 60% DI replacement rate), the amenity of the moderately disabled increases surpassing its level under higher hiring subsidy, highlighting the interaction between the two policies. 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 hiring subsidy) for both moderately and non-disabled workers.

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

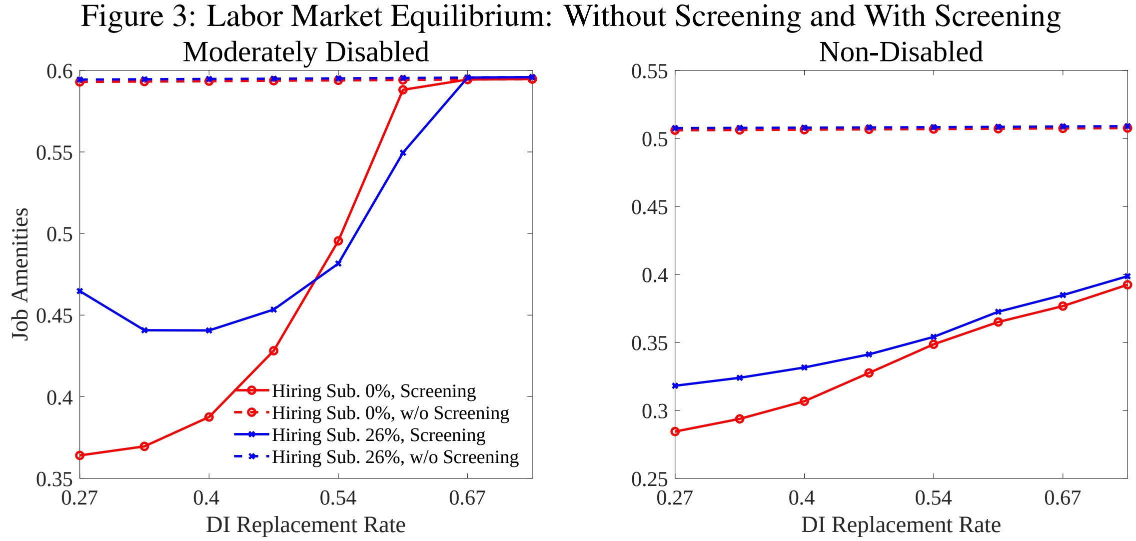


6.1.2 Effects on Screening Distortions

In the presence of screening contracts, the decisions of disabled workers impact the equilibrium outcomes of other types of workers in the labor market too. 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). The amenities without screening are plotted as a dashed line, and with screening, a solid line.[59] 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 with and without screening is substantial. Fixing a hiring subsidy level, 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. 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 hiring subsidies. In this case, the contract distortions on moderately disabled workers are smaller. For a fixed DI replacement rate, the difference between screening and no-screening lines is smaller under 26% subsidies compared to zero subsidies. When hiring subsidies are high, the utility that the severely disabled obtain from working under their

[59]The first-best amenity levels are not constant across DI replacement rates. They are determined by the marginal utilities across jobs with and without amenities.

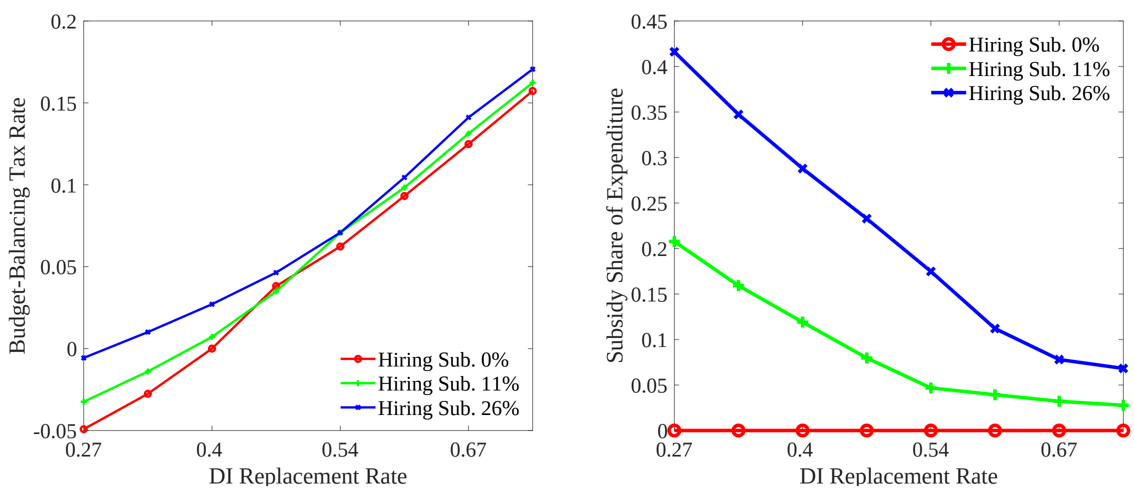
own contract increases, relaxing the (IC) constraint in the moderately disabled worker's problem. From the firm's perspective, a generous hiring subsidy for disabled workers lowers its screening needs, resulting in fewer distortions in other workers' contracts. We observe similar effects on the job amenity 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 present 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 hiring subsidy is high, severely disabled workers' contracts are attractive enough that they have fewer incentives to enter the market for moderately disabled workers (firms' relative profits from hiring disabled workers increase). Both interventions, therefore, affect the degree of screening distortions in equilibrium, but through different mechanisms with heterogeneous equilibrium effects.

6.2 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 realized disability statuses, and the ex-ante welfare implications of the reforms.

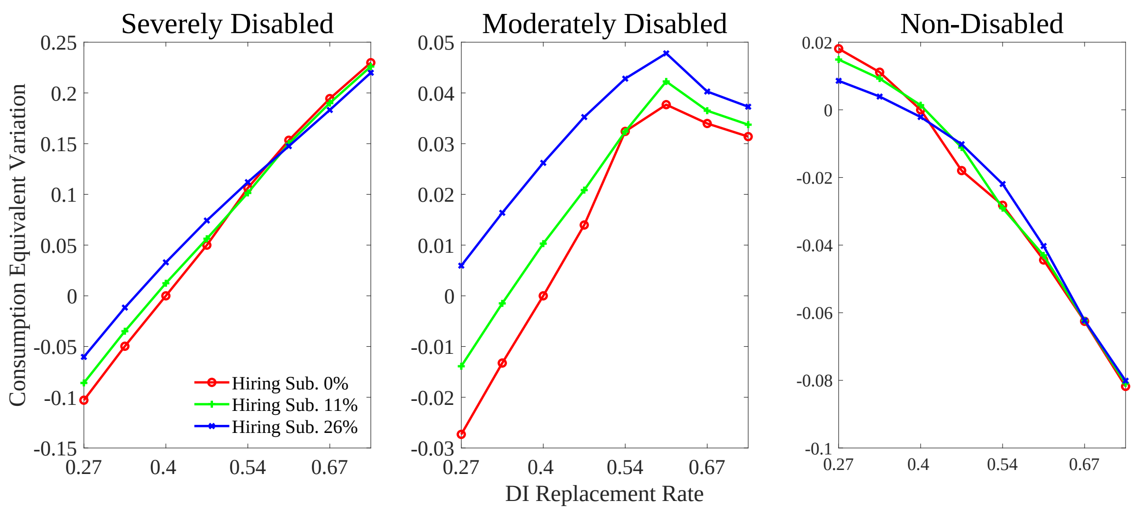
Figure 4: Fiscal Effects of Policy Reforms and Expenditure Composition



In Figure 4, we plot the equilibrium income tax rate and the share of government expenditures spent on firm subsidies. As is evident, the tax rate is increasing in the generosity of DI and the hiring subsidy. However, as DI becomes more generous, the expansion of the hiring subsidy program requires a smaller increase in the tax rate. Under a 40% DI replacement rate, the tax rate needs to increase by $2.7pp$ to introduce a hiring subsidy of amount 26% of the average wage, whereas the tax rate differences are smaller at higher DI replacement rates. The provision of hiring subsidies is costly as the government's expenditures on employed workers increase. At the same time, hiring 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 subsidy in the presence of generous DI has relatively small fiscal consequences, 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 (zero hiring subsidy and 40% DI replacement rate) 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.[60] Figure 5 displays the CEVs by disability statuses, and Figure 6 displays the ex-ante CEVs.

Figure 5: Welfare Effects of Policy Reform by Disability Status

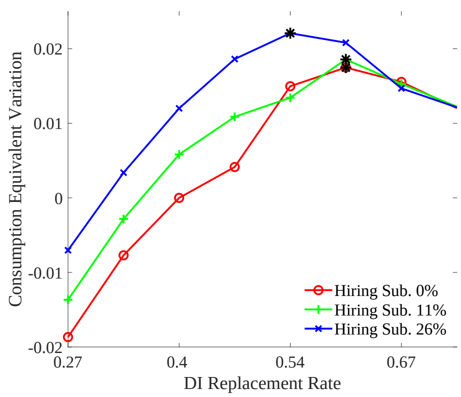


First, we note that there are large differences in preferences for a generous DI policy. While severely disabled workers are willing to give up 20% of their consumption in the benchmark economy for a 67% DI replacement rate, non-disabled workers need to receive around 6% of consumption to be indifferent. The welfare of moderately disabled workers is hump-shaped 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, as the hiring subsidy increases, the welfare change is the most pronounced for moderately disabled workers: at the benchmark DI replacement rate, introducing hiring subsidies leads to a 2.6pp increase in their welfare. This is driven by both a direct effect (from higher amenities and employment) and an indirect effect through the relaxation of screening incentives (as shown in Figure 3), the mechanism highlighted in Proposition 1.

[60]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 $V^{BM}\left(c^{BM}(1+CEV), a^{BM}, \theta^{BM}\right) \equiv V^{CF}\left(c^{CF}, a^{CF}, \theta^{CF}\right)$. Under the log-utility specification of ours, we have $CEV = exp\left[V^{CF}\left(c^{CF}, a^{CF}, \theta^{CF}\right) - V^{BM}\left(c^{BM}, a^{BM}, \theta^{BM}\right)\right] - 1$.

The ex-ante welfare effects of the policy reforms, i.e., the value of the reform before the worker's disability status is realized, are plotted and summarized in Figure 6. The ex-ante CEV's range lies between -2% when DI becomes less generous than the benchmark economy, and around 2% when both DI and hiring subsidies are more generous. In general, we observe that introducing hiring subsidies improves the ex-ante welfare, as is consistent with the disability-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 an interdependence between DI and hiring subsidies. The government finds it optimal to implement generous policies in both DI and firm subsidies. As shown in Figure 1, the hiring subsidy complements DI by mitigating the labor supply disincentive effects of DI. Under the DI replacement rate at 53%, if the hiring subsidy is 26% of the average wage, the aggregate employment rate is 3.6pp higher than under the absence of hiring subsidies. This effect is thanks to the increase in employment of severely disabled workers and moderately disabled workers. Under a 26% hiring subsidies and a 53% DI replacement rate, the ex-ante CEV is 2.2%, indicating a significant welfare gain.

Figure 6: Welfare Effects of Policy Reforms



Policy Parameters	Hiring subsidy	0%	11%	26%
	DI rep. rate	60%	60%	53%
	Tax rate	9.3%	9.8%	7.1%
CEV	Sev. disabled	0.153	0.150	0.112
	Mod. disabled	0.038	0.042	0.043
	Non-disabled	-0.044	-0.043	-0.022
	Ex-Ante	0.018	0.019	0.0221

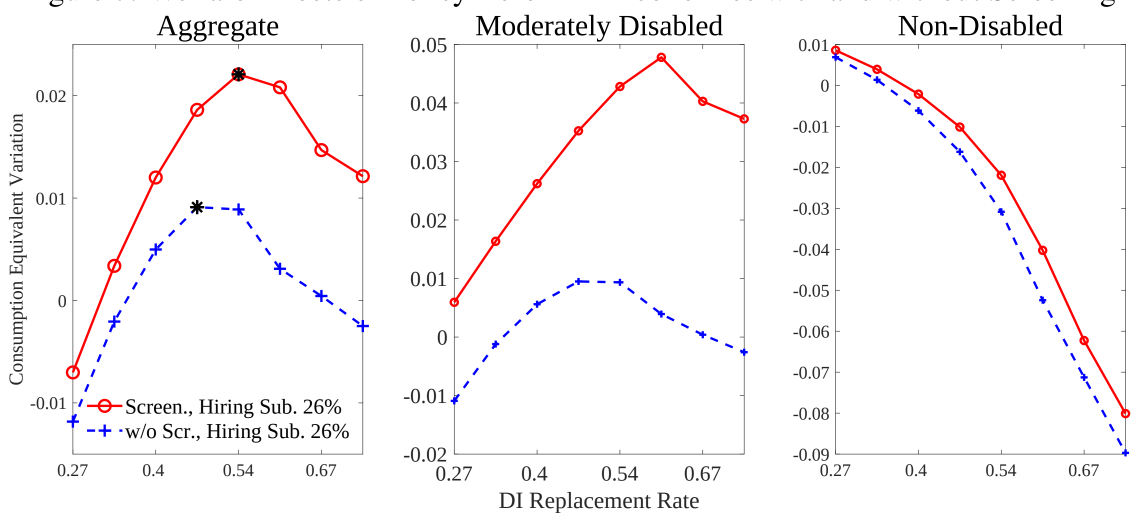
Note: The benchmark policy is 0% firm subsidy and 40% DI replacement rate of average equilibrium wage. The figure on the left plots the ex-ante CEV of policy reforms. The table on the right summarizes the counterfactual policy analyses. For each hiring subsidy amount, we show the corresponding ex-ante-welfare maximizing DI replacement rate, the budget-balancing tax rate, and the resulting disability-specific and ex-ante CEVs under these joint policy combinations.

Overall, our counterfactual results show that the optimal combination of policies features more generous hiring subsidy and DI benefits relative to the benchmark economy. Both policies provide not only consumption insurance but also contribute to reducing contract distortions in equilibrium. Importantly, these policies counteract employment effects of each other. Thus, they can mitigate the possible excessive employment effects generated by 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 2.5.

6.3 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 assume that firms can offer health-dependent contracts, and we compare the welfare effects of 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 hiring subsidy is 26% 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 47%, 6pp lower than the optimal DI replacement rate in the screening economy. 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 a more generous DI optimal in the presence of screening relative to the economy without screening contracts, as shown in the left panel of Figure 7. This 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.

[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, results are qualitatively similar under other subsidy sizes.

6.4 Discussion

So far, we consider the optimal combination of DI and hiring subsidies. One question is whether we can implement a similar outcome using alternative policies. We consider the role of subsidizing firms to provide the amenity, defined as $S \cdot \tilde{C}(a)$ where S is the subsidy policy parameter (still subject to verification probability), the policy tool considered in Section 2.5. The main results are summarized in Appendix E.[62] Similar to hiring subsidies, we find that amenity subsidies are welfare improving, but there are a few differences between the two subsidy regimes. First, the amenity cost subsidy is only given to jobs that provide amenities. While both policies increase the provision of amenities, cost subsidies directly reduce the wage differences across jobs with and without amenities. If, for example, the government fully pays for amenity costs, wages across two jobs are equated and the policy equilibrium yields the highest amenity levels for severely disabled workers. Thus, we observe that the equilibrium amenity responses may be more pronounced than under hiring subsidies, but with limited employment effects as these subsidies cannot benefit those without amenities at their jobs. Further, the cost subsidy is bounded by the amenity cost (otherwise, the equilibrium does not exist in our framework), and given the relatively small estimated amenity cost in our model, the welfare change across different values of S is limited. We still find that at a lower DI replacement rate, there is a positive welfare gain from providing amenity subsidies, but the welfare gain becomes negligible as DI becomes more generous. Overall, these findings further suggest that the actual policy interventions should depend on the size of screening cost and productivity (or wage) differences across workers with different characteristics.

Also, a partial DI program which provides financial benefits to disabled workers who continue to work can be effective in reducing the labor supply disincentive effects of DI. However, it may not be able to mitigate the screening distortions in the labor market described in our framework. To see this point, we can refer back to Equation (2). Suppose that the government provides partial DI benefits to employed disabled workers. Then as long as the job-finding probability is higher in the healthier worker's submarket ($\theta_h > \theta_{h-1}$), the partial DI benefit incentivizes disabled workers to enter the non-disabled submarket. Therefore, if firm's screening activity is relevant, it may be more effective to use firm subsidies.

7 Conclusion

We study the design of social insurance programs by developing an equilibrium labor market search model where firms have an incentive to screen out certain types of workers. We apply our framework to study the labor market for the disabled and examine the optimal design of disability programs. We consider that firms may strategically use the option to reduce working hours

[62] We also conduct counterfactual analysis under higher risk aversion (with CRRA risk preference parameter of 3), after recalibrating parameters to guarantee a reasonable model fit. We find that the results are qualitatively consistent, with the optimal DI replacement rate higher. The results are available upon request.

to screen out disabled workers and structurally estimate the model. The counterfactual policy experiments suggest a potential benefit from providing hiring subsidies, which is effective in reducing the screening distortions 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 paper offers several promising avenues for future work. First, it would be interesting to examine the firm's screening activities and the design of social insurance and welfare programs in other contexts by utilizing our approach. 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

Labor Market Screening and the Design of Social Insurance:
An Equilibrium Analysis of the Labor Market for the Disabled

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A Theoretical Appendix

A.1 Competitive Search Equilibrium

We formally define the equilibrium of the economy below following Guerrieri, Shimer and Wright (2010).

Definition 1. A competitive search equilibrium is a vector $\bar{U} = \{U_{h,x}\} \in \mathbb{R}$, a measure λ_x on Y_x with support Y_x^p, a function $\Theta_x : Y_x \to [0,\infty]$, and a function $G_x : Y_x \to \Delta^H$ 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

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

   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

$$U_{h,x}^E\left(w,a\right) = u\left(w-\tau_x\left(w\right)\right) - \left(\chi_{h,x} - \beta_{h,x}\varphi\left(a\right)\right),$$

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

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

   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),

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

with equality if $\Theta_x(y_x) < \infty$ and $g_h(y_x) > 0$. If $U^E_{h,x}(w,a) < U^N_{h,x}(b_x, D_x)$, either $\Theta_x(y_x) = \infty$ or $g_h(y_x) = 0$.

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

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

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

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

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

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

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

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

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

$$\left(f_2 - C\left(a_2^{NS}\right) + \beta_2\varphi\left(a_2^{NS}\right) - \chi_2 - \tilde{D}_2\right) = \frac{\kappa}{\mu'\left(\theta_2^{NS}\right)}. \tag{14}$$

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

$$\frac{\kappa}{\mu'\left(\theta_2^S\right)} = f_2-C\left(a_2^S\right)+\frac{C'\left(a_2^S\right)}{\beta_2\varphi'\left(a_2^S\right)}\left(\beta_2\varphi\left(a_2^S\right)-\beta_2\frac{\Delta\tilde{D}}{\Delta\beta}\right)-\tilde{d}_2\left(1-\frac{\beta_2}{\tilde{D}_2}\frac{\Delta\tilde{D}}{\Delta\beta}\right), \quad (15)$$

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 (15) 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 (Constrained) Efficient Allocations

A.3.1 First-Best Allocation

We first consider the first-best allocation where the social planner maximizes social welfare subject to the resource constraint.

$$(P-FB) \qquad \max_{\left\{\left(\theta_i,a_i,x_i^E,x_i^N\right)\right\}_{i\in\{1,2,\cdots,I\}}} \sum_i \pi_i \left(\mu\left(\theta_i\right)\left(u\left(x_i^E\right)-\left(\chi_i-\beta_i\varphi\left(a_i\right)\right)\right)+\left(1-\mu\left(\theta_i\right)\right)u\left(b_i+x_i^N\right)\right)$$

$$\text{s.t.} \qquad \sum_{i=1}^{I}\pi_i\mu\left(\theta_i\right)\left(f_i-C\left(a_i\right)\right)\geq\sum_{i=1}^{I}\pi_i\left(\theta_i\kappa+\mu\left(\theta_i\right)x_i^E+\left(1-\mu\left(\theta_i\right)\right)x_i^N\right)$$

The FOC with respect to consumption x_i^E and x_i^N boil down to $u'\left(x_i^E\right)=u'\left(b_i+x_i^N\right)=\lambda$, where λ is the multiplier on resource constraint, implying perfect consumption insurance across employment status (E and N) and type i. Thus, from the resource constraint, the first-best consumption level is given by $x^{FB}=\sum_{i=1}^{I}\pi_i\left[\mu\left(\theta_i\right)\left(f_i-C\left(a_i\right)\right)-\theta_i\kappa\right]$. Combining the above result with the FOC with respect to amenity, we obtain

$$u'\left(x^{FB}\right) \quad = \quad \beta_i\frac{\varphi'\left(a_i\right)}{C'\left(a_i\right)}, \tag{16}$$

which implies that $a_i>a_{i+1}$. Further, the FOC with respect to θ_i can be written as

$$\kappa \quad = \quad \mu'\left(\theta_i\right)\left(f_i-C\left(a_i\right)+\frac{\beta_i\varphi\left(a_i\right)-\chi_i}{u'\left(x^{FB}\right)}\right), \tag{17}$$

The optimal vacancy-unemployment ratio is determined such that the marginal costs of creating a vacancy is equal to the marginal benefit from extra matches in each submarket, which consists of the net productivity $\left(f_i-C\left(a_i\right)\right)$ and the value of amenity net of the disutility of work $\left(\beta_i\varphi\left(a_i\right)-\chi_i\right)$. The net productivity is increasing in i, and the the relative value of amenity is decreasing in i. If the former effect dominates the latter, then the marginal benefit from a match is increasing for healthier workers, resulting $\theta_i<\theta_{i+1}$.

A.3.2 Constrained Efficient Allocation

Now we characterize the constrained efficient allocation where the social planner solves for welfare-maximizing allocations subject to the resource constraint and information friction. We illustrate the economic insights using a model with two types. We illustrate a case in which the low type (lower productivity workers) has an incentive to mimic the high type, a more relevant assumption for our application to social insurance programs.

The constrained efficient allocation is a solution of the following problem:

$$(P-CE) \qquad \max_{\left\{\left(\theta_i,a_i,x_i^E,x_i^N\right)\right\}_{i\in\{1,2\}}} \sum_i \pi_i \left(\mu\left(\theta_i\right)\left(u\left(x_i^E\right)-\left(\chi_i-\beta_i\varphi\left(a_i\right)\right)\right)+\left(1-\mu\left(\theta_i\right)\right)u\left(b_i+x_i^N\right)\right).$$

$$\text{s.t.} \qquad \sum_{i=1}^{2}\pi_i\mu\left(\theta_i\right)\left(f_i-C\left(a_i\right)\right)\geq\sum_{i=1}^{2}\pi_i\left(\theta_i k+\mu\left(\theta_i\right)x_i^E+\left(1-\mu\left(\theta_i\right)\right)x_i^N\right) \tag{18}$$

$$\mu\left(\theta_1\right)\left(u\left(x_1^E\right)-\left(\chi_1-\beta_1\varphi\left(a_1\right)\right)\right)+\left(1-\mu\left(\theta_1\right)\right)u\left(b_1+x_1^N\right) \tag{19}$$

$$\geq \mu\left(\theta_2\right)\left(u\left(x_2^E\right)-\left(\chi_1-\beta_1\varphi\left(a_2\right)\right)\right)+\left(1-\mu\left(\theta_2\right)\right)u\left(b_1+x_2^N\right)$$

Denote the associated Lagrangian multipliers for Equations (18) and (19) as λ_R and λ^{IC}. Taking the FOC with respect to consumption x_i^E and x_i^N, $u'\left(x_i^E\right)=u'\left(b_i+x_i^N\right)$ for both types. Thus, perfect consumption insurance across employment status is still optimal (i.e, $x_i^E=b_i+x_i^N\equiv x_i$). Comparing the FOCs for consumption across types, $\frac{\pi_1+\lambda^{IC}}{\pi_1}u'\left(x_1\right)=\frac{\pi_2-\lambda^{IC}}{\pi_2}u'\left(x_2\right).$

Due to information friction, consumption differs by disability status. The FOC with respect to a_1 implies $u'\left(x_1\right)=\beta_1\frac{\varphi'\left(a_1\right)}{C'\left(a_1\right)}$, identical to Equation (16). For type 2, however, the corresponding optimality condition becomes

$$u'\left(x_2\right) \quad = \quad \beta_2\left(\frac{\pi_2-\lambda^{IC}\frac{\beta_1}{\beta_2}}{\pi_2-\lambda^{IC}}\right)\frac{\varphi'\left(a_2\right)}{C'\left(a_2\right)}, \tag{20}$$

and the provision of amenity for type 2 declines as the planner treats type 2 value amenity less by $\frac{\pi_2-\lambda^{IC}\frac{\beta_1}{\beta_2}}{\pi_2-\lambda^{IC}}$, internalizing its effects on the (IC) constraint. Let's denote the type-2 workers' effective preference on job amenity as $\tilde{\beta}_2\equiv\beta_2\left(\frac{\pi_2-\lambda^{IC}\frac{\beta_1}{\beta_2}}{\pi_2-\lambda^{IC}}\right)<\beta_2$ as well as the effective disutility of work as $\tilde{\chi}_2=\chi_2-\lambda^{IC}\chi_1$. Finally, the FOCs with respect to θ_i imply that

$$k \quad = \quad \mu'\left(\theta_1\right)\left(f_1-C\left(a_1\right)+\frac{\beta_1\varphi\left(a_1\right)-\chi_1}{u'\left(x_1\right)}\right) \; = \; \mu'\left(\theta_2\right)\left(f_2-C\left(a_2\right)+\frac{\tilde{\beta}_2\varphi\left(a_2\right)-\tilde{\chi}_2}{u'\left(x_2\right)}\right).$$

Identical to the first-best allocation, the market tightness for type 1 is determined such that the marginal benefit from additional match is equal to its marginal costs (Equation (17)). For type 2, similar to the optimal condition for a_2 in Equation (20), the marginal benefit from job amenity is evaluated with $\tilde{\beta}_2<\beta_2$.

If we further assume risk-neutrality, we have the following properties across the screening equilibrium allocations (EQ) and constrained-efficient allocations (CE). For type 1, $a_i^{EQ}=a_i^{CE}$ and $\theta_i^{EQ}=\theta_i^{CE}$, but consumption may not be equivalent, since there may be cross-subsidy across types in CE. Moreover, for type 2, we have $a_2^{EQ}<a_2^{CE}$ or $\theta_2^{EQ}<\theta_2^{CE}$ or both. To see this, it is important to first note that the welfare is strictly higher in CE than one in EQ because in the CE, the social planner can always reallocate resources between types. Consider the EQ where the

IC constraint binds. Consider w_1 and w_2 would be the equilibrium wage in EQ. Note that these wages must satisfy the type-specific free entry condition. Now, consider that the social planner considers an allocation where they transfer such that $x_2^E = w_2 - \varepsilon$ and $x_1^E = w_1 + \varepsilon$, holding others fixed. Then, the type 1 does not have incentive to mimic type 2, and the IC constraint no longer binds. By noting that, the government can slightly increase a_2 or θ_2 (or both) so that the resource constraint is still satisfied while increasing welfare.

Note that when workers are risk neutral, equilibrium is constrained efficient if worker's type is realized after a worker is hired and firms can offer a state-contingent employment contract subject to the information friction. Consider an ex-ante homogeneous worker who applies to a submarket. Once a worker accepts a job offer, a worker's type i is realized. Firms can offer a state-contingent employment contract (a_i, w_i) for each state i. With this setting, we can formulate firm's optimal contracting problem as (assuming homogeneous home production b for simplicity)

$$\begin{aligned} &\max_{\theta,\{(a_i,w_i)\}_{i\in\{1,2\}}} \mu(\theta)\sum_i \pi_i\left(u(w_i) - (\chi_i - \beta_i\varphi(a_i))\right) + (1-\mu(\theta))\,u(b) \\ \text{s.t.}\quad & \mu(\theta)\sum_{i=1}^{2}\pi_i\left(f_i - C(a_i) - w_i\right) \geq \theta k \\ & \mu(\theta)\left(u(w_1) - (\chi_1 - \beta_1\varphi(a_1))\right) + (1-\mu(\theta))\,u(b) \\ & \quad \geq \mu(\theta)\left(u(w_2) - (\chi_1 - \beta_1\varphi(a_2))\right) + (1-\mu(\theta))\,u(b). \end{aligned}$$

When the worker is risk neutral, the solution to this problem is identical to that of constrained efficient problem where the planner also faces the situation in which the worker's type is realized after the worker matches with a job and is subject to the information friction. The main reason is that in this setting, firm's free entry condition becomes identical to the planner's resource constraint. As one can see from the free entry condition, firms can cross-subsidize resources across states. This differs from our setting where worker's type is already realized at the time of job application.

A.4 Proof of Proposition

In this appendix, we provide a proof of the Proposition 1 for I types of workers.

A.4.1 Proof of Optimal Disability Insurance

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

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

Substituting these constraints into the objective function, we obtain:

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

We can apply the FOC 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: (i) mechanical revenue effect; (ii) a welfare effect; and (iii) a behavioral effect.

First, the mechanical effect is

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

where $\bar{U}'(c_e) = \sum_i \pi_i \mu(\theta_i) u'(c_{e,i})$ is the welfare-weighted marginal utility of consumption of employed workers ($c_{e,i}$), $\widetilde{E}(\theta) = \frac{\sum_j \pi_j(1-\mu(\theta_j))\psi_j}{\sum_j \pi_j \mu(\theta_j)}$ is the ratio of DI enrollees over the employed. 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 denominator would be one.

Second, the welfare effect is

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

where $\overline{E}(\theta) = \frac{\frac{\sum_i \pi_i (1-\mu(\theta_i)) u'(c_{u,i})\psi_i}{\sum_i \pi_i \mu(\theta_i) u'(c_{e,i})}}{\frac{\sum_j \pi_j(1-\mu(\theta_j))\psi_j}{\sum_j \pi_j \mu(\theta_j)}}$ is the concentration of DI spending relative to its welfare benefit measured by the marginal utility from consumption.

Finally, the behavioral effect is

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

where $\widetilde{\varepsilon}_{E,D}$ 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:

$$\bar{U}'(c_e)\widetilde{E}(\theta)\Delta D\left(-1+\overline{E}(\theta)-\widetilde{\varepsilon}_{E,D}\right)=0,$$

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

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.

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

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

where u_i^E and u_i^N are utility of employed and unemployed workers, and $\mathbb{I}_i^{IC}$ is one if IC constraint is binding for type i.

Thus, the optimal DI policy is determined by

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

where

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

By rearranging terms, we have

$$\overline{E}(\theta)+\sum_i \pi_i \mathbb{I}_i^{IC}\left(\frac{\mu(\theta_i)\frac{a_i}{D}\varepsilon_{a_i,D}\xi_{a,i}+\frac{\theta_i}{D}\varepsilon_{\theta_i,D}\nu_{\theta,i}}{\bar{U}'(c_e)\widetilde{E}(\theta)}\right)=\widetilde{\varepsilon}_{E,D}+1,$$

with $\varepsilon_{a_i,D} = d\log a_i / d\log D$ and $\varepsilon_{\theta_i,D} = d\log\theta_i / d\log D$, 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 types of workers. □

A.4.2 Proof of Optimal Hiring Subsidy

Without Labor Market Screening. The government's problem is written as:

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

$$\text{s.t.} \qquad \frac{\mu(\theta_i)}{\theta_i}\left(f_i - w_i - C(a_i) + \psi_i tr\right) = \kappa \text{ and } T = \frac{\sum_i \pi_i \mu(\theta_i)\psi_i tr}{\sum_i \pi_i \mu(\theta_i)}.$$

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

$$\sum_i \pi_i \left((1-\mu(\theta_i)) U_i^N(b,D) + \mu(\theta_i)\left(u\left(f_i - C(a_i) + \psi_i tr - \frac{\kappa\theta_i}{\mu(\theta_i)} - \frac{\sum_i \pi_i \mu(\theta_i)\psi_i tr}{\sum_i \pi_i \mu(\theta_i)}\right) - (\chi_i - \beta_i \varphi(a_i))\right)\right).$$

First, the mechanical revenue effect from a Δtr change in hiring subsidy is determined as

$$\Delta M = -\sum_i \pi_i \mu(\theta_i) u'(c_{e,i}) \frac{\sum_j \pi_j \mu(\theta_j)\psi_j}{\sum_j \pi_j \mu(\theta_j)} \Delta tr \equiv -\bar{U}'(c_e)\widetilde{\psi}(\theta)\Delta tr,$$

where $\widetilde{\psi}(\theta)$ is the average expected probability that a job is awarded the hiring subsidy: $\widetilde{\psi}(\theta) = \frac{\sum_j \pi_j \mu(\theta_j)\psi_j}{\sum_j \pi_j \mu(\theta_j)}$.

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

$$\Delta W = \sum_i \pi_i \mu(\theta_i) u'(c_{e,i})\psi_i \Delta tr = \bar{U}'(c_e)\widetilde{\psi}(\theta)\overline{\psi}(\theta)\Delta tr,$$

where $\overline{\psi}(\theta)$ is the concentration of the subsidy-eligible type population relative to the insurance benefit, captured by the marginal utility of consumption: $\overline{\psi}(\theta) = \frac{\frac{\sum_i \pi_i u'(c_{e,i})\mu(\theta_i)\psi_i}{\sum_i \pi_i u'(c_{e,i})\mu(\theta_i)}}{\frac{\sum_i \pi_i \mu(\theta_i)\psi_i}{\sum_i \pi_i \mu(\theta_i)}}$. Note that if $u'(c_{e,i}) = 1$ (risk-neutral workers), $\overline{\psi}(\theta) = 1$.

Finally, we have the behavioral effect:

$$\begin{aligned}
\Delta B &= -\sum_i \pi_i \mu(\theta_i) u'(c_{e,i}) \sum_j \psi_j tr \frac{\partial \frac{\pi_j \mu(\theta_j)}{\sum_k \pi_k \mu(\theta_k)}}{\partial tr} \Delta tr = -\bar{U}'(c_e) \sum_j \psi_j \frac{\pi_j \mu(\theta_j)}{\sum_k \pi_k \mu(\theta_k)} \frac{\frac{\partial \frac{\pi_j \mu(\theta_j)}{\sum_k \pi_k \mu(\theta_k)}}{\partial tr}}{\frac{\frac{\pi_j \mu(\theta_j)}{\sum_k \pi_k \mu(\theta_k)}}{tr}} \Delta tr \\
&= -\bar{U}'(c_e) \sum_j \frac{\pi_j \mu(\theta_j) \psi_j}{\sum_k \pi_k \mu(\theta_k)} \varepsilon_{\mu(\theta_j),tr} \Delta tr = -\bar{U}'(c_e) \widetilde{\psi}(\theta) \sum_j \frac{\frac{\pi_j \mu(\theta_j) \psi_j}{\sum_k \pi_k \mu(\theta_k)}}{\widetilde{\psi}(\theta)} \varepsilon_{\mu(\theta_j),tr} \Delta tr \\
&= -\bar{U}'(c_e) \widetilde{\psi}(\theta) \sum_j \alpha_j \varepsilon_{\mu(\theta_j),tr} \Delta tr = -\bar{U}'(c_e) \widetilde{\psi}(\theta) \widetilde{\varepsilon}_{\mu(\theta),tr} \Delta tr
\end{aligned}$$

where α_j is the contribution of hiring subsidy costs by type j: $\alpha_j = \frac{\frac{\pi_j \mu(\theta_j)\psi_j}{\sum_k \pi_k \mu(\theta_k)}}{\widetilde{\psi}(\theta)}$; and $\varepsilon_{\mu(\theta_j),1-S} = \frac{d \log\left(\frac{\pi_j \mu(\theta_j)}{\sum_k \pi_k \mu(\theta_k)}\right)}{d \log(tr)}$ are elasticities of employment with respect to the subsidy; and $\left(\widetilde{\varepsilon}_{\mu(\theta),tr}\right)$ is the α_j-weighted elasticity. Note that this channel clarifies the key behavioral margin the hiring subsidy can affect the equilibrium outcomes is employment response if there is no screening.

The optimal hiring subsidy 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 is

$$\bar{U}'(c_e) \widetilde{\psi}(\theta) \Delta tr \left(-1 + \overline{\psi}(\theta) - \widetilde{\varepsilon}_{\mu(\theta),tr}\right) = 0,$$

or $1 + \widetilde{\varepsilon}_{\mu(\theta),tr} = \overline{\psi}(\theta)$.

With Labor Market Screening. 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 inability to apply the envelope condition leads to a different form of welfare effect similar to the case of DI:

$$\Delta W = \Delta tr \left[\bar{U}'(c_e) \widetilde{\psi}(\theta) \overline{\psi}(\theta) + \sum_i \pi_i \mathbb{I}_i^{IC} \left(\mu(\theta_i) \frac{\partial a_i}{\partial tr} (-\xi_{a,i}) + \frac{\partial \theta_i}{\partial tr} (-\nu_{\theta,i}) \right) \right]$$

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

$$\overline{\psi}(\theta) + \sum_i \pi_i \mathbb{I}_i^{IC} \left(\frac{\mu(\theta_i) a_i \varepsilon_{a_i,tr} \xi_{a,i} + \theta_i \varepsilon_{\theta_i,tr} \nu_{\theta,i}}{\bar{U}'(c_e) \widetilde{\psi}(\theta) \cdot tr} \right) = \widetilde{\varepsilon}_{\mu(\theta),tr} + 1,$$

where $\varepsilon_{a_i,tr} = d \log a_i / d \log(tr)$ and $\varepsilon_{\theta_i,tr} = d \log \theta_i / d \log(tr)$. We can obtain the results in Proposition 1 when we assume that there are two types of workers. □

A.4.3 Proof of Optimal Job Amenity Subsidies

Without Labor Market Screening. The solution approach is very similar to hiring subsidy and DI, and therefore we only provide a concise proof.

First, the mechanical revenue effect from a ΔS change in the subsidy rate is

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

where $\widetilde{C}(a,\theta)$ 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): $\widetilde{C}(a,\theta) = \frac{\sum_j \pi_j \mu(\theta_j) \psi_j C(a_j)}{\sum_j \pi_j \mu(\theta_j)}$. Second, the welfare effect is given as

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

where $\overline{C}(a,\theta)$ 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: $\overline{C}(a,\theta) = \frac{\frac{\sum_i \pi_i u'(c_{e,i}) \mu(\theta_i) \psi_i C(a_i)}{\sum_i \pi_i u'(c_{e,i}) \mu(\theta_i)}}{\frac{\sum_i \pi_i \mu(\theta_i) \psi_i C(a_i)}{\sum_i \pi_i \mu(\theta_i)}}$. Finally, we have the behavioral effect:

$$\begin{aligned}
\Delta B &= -\sum_i \pi_i \mu(\theta_i) u'(c_{e,i}) \sum \pi_j \psi_j S \frac{\partial \frac{C(a_j)\mu(\theta_j)}{\sum_k \pi_k \mu(\theta_k)}}{\partial S} \Delta S \\
&= \bar{U}'(c_e) \sum_j \mathbf{1}_{(\psi_\mathbf{j}=\mathbf{1})} \left(\frac{\frac{SC(a_j)\pi_j \mu(\theta_j)}{\sum_k \pi_k \mu(\theta_k)}}{1-S} \frac{\frac{\partial C(a_j)}{\partial (1-S)}}{\frac{C(a_j)}{1-S}} + \frac{\frac{SC(a_j)\pi_j \mu(\theta_j)}{\sum_k \pi_k \mu(\theta_k)}}{1-S} \frac{\frac{\partial \frac{\pi_j \mu(\theta_j)}{\sum_k \pi_k \mu(\theta_k)}}{\partial (1-S)}}{\frac{\frac{\pi_j \mu(\theta_j)}{\sum_k \pi_k \mu(\theta_k)}}{1-S}} \right) \Delta S \\
&= \bar{U}'(c_e) \sum_j 1_{(\psi_j=1)} \frac{\frac{SC(a_j)\pi_j \mu(\theta_j)}{\sum_k \pi_k \mu(\theta_k)}}{1-S} \left(\varepsilon_{C(a_j),1-S} + \varepsilon_{\mu(\theta_j),1-S} \right) \Delta S \\
&= \frac{S}{1-S} \bar{U}'(c_e) \widetilde{C}(a,\theta) \sum_j \frac{1_{(\psi_j=1)} \frac{C(a_j)\pi_j \mu(\theta_j)}{\sum_k \pi_k \mu(\theta_k)}}{\widetilde{C}(a,\theta)} \left(\varepsilon_{C(a_j),1-S} + \varepsilon_{\mu(\theta_j),1-S} \right) \Delta s \\
&= \frac{S}{1-S} \bar{U}'(c_e) \widetilde{C}(a,\theta) \sum_j \alpha_j \left(\varepsilon_{C(a_j),1-S} + \varepsilon_{\mu(\theta_j),1-S} \right) \Delta S \\
&= \frac{S}{1-S} \bar{U}'(c_e) \widetilde{C}(a,\theta) \left(\widetilde{\varepsilon}_{C(a),1-S} + \widetilde{\varepsilon}_{\mu(\theta),1-S} \right) \Delta S,
\end{aligned}$$

where α_j is the contribution of amenities costs by type j: $\alpha_j = \frac{1_{\left(\psi_j=1\right)} \frac{C(a_j)\pi_j\mu\left(\theta_j\right)}{\sum_k \pi_k\mu(\theta_k)}}{\widetilde{C}(a,\theta)} = \frac{\pi_j\mu\left(\theta_j\right)\psi_j C(a_j)}{\sum_k \pi_k\mu(\theta_k)\psi_k C(a_k)}$; $\varepsilon_{C\left(a_j\right),1-S} = \frac{d\log C(a_j)}{d\log(1-S)}$ and $\varepsilon_{\mu\left(\theta_j\right),1-S} = \frac{d\log\left(\frac{\pi_j\mu\left(\theta_j\right)}{\sum_k \pi_k\mu(\theta_k)}\right)}{d\log(1-S)}$ are elasticities of total cost of amenities and employment with respect to the net-of-subsidy marginal cost of amenities, $(1-S)$; and $\left(\widetilde{\varepsilon}_{C(a),1-S}, \widetilde{\varepsilon}_{\mu\left(\theta_j\right),1-S}\right)$ 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 summing these three effects and setting it as zero:

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

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. As before, the only change from the case without labor market screening is the welfare effect:

$$\Delta W = \Delta S\left\{\bar{U}'(c_e)\,\overline{C}(a,\theta)\,\widetilde{C}(a,\theta)+\sum_i \pi_i \mathbb{I}_i^{IC}\left(\mu(\theta_i)\frac{\partial a_i}{\partial S}(-\xi_{a,i})+\frac{\partial \theta_i}{\partial S}(-\nu_{\theta,i})\right)\right\}$$

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

$$\frac{S}{1-S} = \frac{1-\overline{C}(a,\theta)}{\widetilde{\varepsilon}_{C(a),1-S}+\widetilde{\varepsilon}_{\mu(\theta),1-S}} + \sum_i \pi_i \mathbb{I}_i^{IC}\left[\frac{\mu(\theta_i)\frac{a_i\varepsilon_{a_i,1-S}}{1-S}(-\xi_{a,i})+\frac{\theta_i\varepsilon_{\theta_i,1-S}}{1-S}(-\nu_{\theta,i})}{\widetilde{C}(a,\theta)\bar{U}'(c_e)\left(\widetilde{\varepsilon}_{C(a),1-S}+\widetilde{\varepsilon}_{\mu(\theta),1-S}\right)}\right],$$

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

A.5 Quantitative Model Analysis

For a quantitative mapping of the model, we modified our benchmark model to allow for a binary realization of amenity and consider $a_{h,x}$ as the proportion of jobs with the amenity. For an expositional purpose, assume that workers decide to participate in the labor market and the interior solution is optimal: in the quantitative analysis, we explicitly account for an endogenous labor force participation margin. In solving the screening problem numerically, we consider the problem where only the local (IC) constraint is relevant, a feature common in many screening models.

Then, the problem solves:

$$\max_{\theta_{h,x},a_{h,x},w_{h,x,0}w_{h,x,1}} \mu\left(\theta_{h,x}\right)\left[a_{h,x}u\left(w_{h,x,1}\right)+\left(1-a_{h,x}\right)u\left(w_{h,x,0}\right)-\left(\chi_{h,x}-\beta_{h,x}\varphi\left(a_{h,x}\right)\right)\right]+\left(1-\mu\left(\theta_{h,x}\right)\right)u\left(b_{h,x}\right)$$

$$\begin{aligned}
\text{s.t.}&\mu\left(\theta_{h,x}\right)\left[f_{h,x}-w_{h,x,0}\right]\geq\theta_{h,x}\kappa\\
&\mu\left(\theta_{h,x}\right)\left[f_{h,x}-w_{h,x,1}-c_{h,x}\right]\geq\theta_{h,x}\kappa\\
&\bar{U}_{h-1,x}\geq\mu\left(\theta_{h,x}\right)\left[a_{h,x}u\left(w_{h,x,1}\right)+\left(1-a_{h,x}\right)u\left(w_{h,x,0}\right)-\left(\chi_{h-1,x}-\beta_{h-1,x}\varphi\left(a_{h,x}\right)\right)\right]+\left(1-\mu\left(\theta_{h,x}\right)\right)u\left(b_{h-1,x}\right)
\end{aligned}$$

If the interior solution is optimal, the following set of FOCs must be satisfied:

$$\begin{aligned}
&w_{h,x,0}=f_{h,x}-\frac{\theta_{h,x}\kappa}{\mu\left(\theta_{h,x}\right)}\\
&w_{h,x,1}=f_{h,x}-c_{h,x}-\frac{\theta_{h,x}\kappa}{\mu\left(\theta_{h,x}\right)}\\
&\partial a_{h,x}:\mu\left(\theta_{h,x}\right)\left\{\left[u\left(w_{h,x,1}\right)-u\left(w_{h,x,0}\right)\right]+\beta_{h,x}\varphi'\left(a_{h,x}\right)\right\}=\lambda^{IC}\mu\left(\theta_{h,x}\right)\left[u\left(w_{h,x,1}\right)-u\left(w_{h,x,0}\right)+\beta_{h,x-1}\varphi'\left(a_i\right)\right]\\
&\partial\theta_{h,x}:\left(1-\lambda_{h,x}^{IC}\right)\mu'\left(\theta_{h,x}\right)\left[a_{h,x}u\left(w_{h,x,1}\right)+\left(1-a_{h,x}\right)u\left(w_{h,x,0}\right)\right]\\
&\qquad-\mu'\left(\theta_{h,x}\right)\left[\chi_{h,x}-\beta_{h,x}\varphi\left(a_{h,x}\right)+u\left(b_{h,x}\right)-\lambda^{IC}\left(\chi_{h-1,x}-\beta_{h-1,x}\varphi\left(a_{h,x}\right)+u\left(b_{h-1,x}\right)\right)\right]\\
&\qquad=\left(1-\lambda_{h,x}^{IC}\right)\left[k\left(a_{h,x}u'\left(w_{h,x,1}\right)+\left(1-a_{h,x}\right)u'\left(w_{h,x,0}\right)\right)\frac{\mu\left(\theta_{h,x}\right)-\theta_{h,x}\mu'\left(\theta_{h,x}\right)}{\mu\left(\theta_{h,x}\right)}\right]
\end{aligned}$$

where $\lambda_{h,x}^{IC}$ is Lagrangian multiplier associated with the IC constraint. An important implication is that $w_{h,x,0}=w_{h,x,1}+c_{h,x}$, a property that we exploit in our empirical implementation.

B Data: Health and Retirement Study

Table A-1 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 A-1: Work Limitation and Self-reported Health Evaluation

		Work limitation		Total
		No	Yes	
Self-reported health	1 (excellent)	2,220	150	2,370
	2 (very good)	5,544	665	6,209
	3 (good)	5,779	1,883	7,662
	4 (fair)	2,526	3,107	5,633
	5 (poor)	394	2,400	2,794
Total		16,463	8,205	24,668

Note: This table reports the number of observations by the work limitation and health evaluation variables. Observations are limited to individuals with high school education or less, between ages 51 and 64 from 1996 to 2008, and between 1% and 99% weekly earnings and in the private sector (if employed), which leaves us 24,668 observations overall.

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 health conditions of respondents. 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 A-2. We confirm that our disability measure is indeed positively correlated with the severity of health conditions in various types of health outcomes.

Table A-2: Descriptive Statistics of Other Health Measures in the HRS

Health measures	Non-disabled	Moderately disabled	Severely disabled
Body Mass Index	27.87	29.58	30.32
Missed work due to health issues (days)	4.09	8.89	21.35
Out-of-pocket medical spending ($2001)	1579.15	2772.79	3676.56
Doctor's diagnoses (%)			
Experiencing back problems	24.25	48.69	67.35
Arthritis or rheumatism	41.64	65.56	77.14
High blood pressure or hypertension	39.56	57.03	66.50
Emotional, nervous, or psychiatric problems	9.65	22.80	43.66
Diabetes or high blood sugar	9.47	22.72	32.91
Heart attack, congestive heart failure, or other heart problems	8.78	19.99	36.68
Cancer or a malignant tumor of any kind (except skin cancer)	5.83	9.90	12.33
Chronic lung disease (except asthma)	4.27	11.59	25.40
Stroke or transient ischemic attack (TIA)	1.40	4.68	12.34

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 2001 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 $2,500 ($\approx$ ($481 $-$ $431) $\times$ 50), given the weekly earnings 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, nongovernment 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,[1] 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 32% after 2004.[2] To gauge the relative magnitude of this amendment, we combine statistics from the March Current Population Survey (CPS) and the American Community Survey (ACS) with the WOTC data. Given that the WOTC is given to newly hired workers, we calculate that there was approximately a $33pp$ increase in the number of WOTC certificates among newly hired workers with severe disabilities, which we use in the quantitative WOTC modeling for estimation.[3]

We acknowledge that this calculation has a few limitations. First, we are not able to obtain the share given to the age group in our sample. Second, we are not able to count the number of new WOTC certificates awarded to severely or moderately disabled workers. However, we view that the WOTC certificates are the most relevant for severely disabled. By using our HRS data, we show in Table A-3 that severely disabled individuals are more likely to have recently received DI benefits, and thus also more likely to qualify for WOTC. Furthermore, as we discuss in Appendix C.1.5, through the lens of economic models, our estimates are consistent if we interpret that subsidies are mainly given to severely disabled. While this policy calibration may be an upper bound on the amendment's effect on severely disabled workers, we think this choice may help discipline the size of screening effects in the estimated model, as we discuss in Section 5.2. Therefore, although we cannot precisely observe the actual take-up of the WOTC amendment from our data, we believe that our modeling of WOTC may be reasonable.

[1] 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 participation 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.

[2] 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).

[3] The ACS reports individuals who have disability in prime age (21-64) of 17 millions in 2005 (ACS, 2005), and among them, about 19 percent of workers is severely disabled given our definition. Additionally, as the transition rate from non-employment to employment among severely disabled workers is 1.3% from the March CPS (sample consists of workers reporting the same disability status over two consecutive periods), the number of newly hired, severely disabled workers is about 41,990 (17mil$\times$0.19$\times$0.013). Combining this with 14,200 (58,400-44,200) increase in certificates is around one third.

Table A-3: Disability Insurance Receipt by Disability Status

	Mean	Std. dev.
Non-disabled	0.005	0.073
Moderately disabled	0.111	0.315
Severely disabled	0.325	0.468

Note: This table documents the proportion of individuals who have recently received the DI benefits by disability status.

C.1.1 The Effect of WOTC Amendment: Main Results

We run the following regression (same as Equation (11) in Section 4.3):

$$y_{it} = \beta_1 \mathbb{I}_{\text{Post}} + \sum_{h \in \{\text{mod, sev}\}} \beta_{2h} \mathbb{I}_h + \sum_{h \in \{\text{mod, sev}\}} \beta_{3h} \mathbb{I}_{\text{Post}} \mathbb{I}_h + \gamma X_{it} + \nu Z_t + \varepsilon_{it} \qquad (21)$$

where 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 ($y_{it} \in \{0,1\}$); X_{it} include individual-specific characteristics (demographics; objective health measures, e.g., disease prevalence and body mass index; firm size);[4] and Z_t captures macroeconomic conditions.[5]

Table A-4: Effects of the WOTC Amendment on the Option to Reduce Working Hours

		Option to reduce working hours					
Coefficients		(1) All employed		(2) New hires (tenure$\leq$ 3)		(3) New hires (tenure=0)	
Post-amendment (β_1)		-0.006	(0.082)	-0.029	(0.092)	-0.184	(0.181)
Disability status (β_{2h})	Severe	0.097*	(0.053)	0.132	(0.083)	-0.185	(0.138)
	Moderate	0.023	(0.028)	-0.051	(0.041)	-0.192**	(0.078)
Disability status	Severe	0.028	(0.079)	-0.106	(0.116)	-0.031	(0.185)
$\times$ Post (β_{3h})	Moderate	0.115**	(0.049)	0.153**	(0.077)	0.232*	(0.123)
Sample size		4,044		1,802		490	

Note: We estimate Equation (21) with the linear probability model using samples between 1996 and 2008. The additional covariates used in the regression are age, marital status, gender, various health measures (e.g., disease prevalence shown in Table A-2), firm-size category dummies, and macroeconomic conditions (e.g., employment rates). Standard errors are clustered at the individual level. *** p<0.01, ** p<0.05, * p<0.1.

Table A-4 summarizes our regression results on the option to reduce working hours for the WOTC amendment. Moreover, Appendix C.1.5 provides graphical evidence that workers with

[4]Although we include many individual characteristics as possible, 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 individual is highly persistent with limited variations. If the individual fixed effect is included, the identification requires changes in disability statuses of the same individual for both pre- and post-policy change era. Such data variation for a sufficient number of samples is not attainable in our data. This issue does not apply for our individual fixed effect regression described in footnote 51, which does not need changes in disability status.

[5]We use GDP growth rate and employment rates constructed from aggregate data from the Bureau of Economic Analysis, Bureau of Labor Statistics, and the U.S. Census Bureau. We also experimented to just include the year dummy and find that the main estimates (β_{2h} and β_{3h}) are identical to those reported in this paper. Such a result is available on request.

different disability statuses experienced similar trends on their amenities before the WOTC amendment.[6] Column (1) reports the main estimates based on all employed workers. After controlling for the post-amendment and disability dummies, 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. Columns (2) and (3) report 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 amendment is much larger among these newly hired workers. As in most quasi-experimental studies, one must be careful in interpreting our regression coefficients whether they are purely due to the policy impacts or due to other factors. In the next section, we discuss that these estimates are unlikely to be driven by selection effects and provide a number of robustness checks. Although it is not possible to control for all possible confounding factors, the regression coefficient provides meaningful variation in job amenities in response to the policy change, which motivate us to utilize it to identify a parameter in our model. Moreover, in the main specification, we cannot statistically distinguish between $\beta_{3,mod}$ and $\beta_{3,sev}$ despite the large differences in the point estimates. As we show below, our finding that the large and significant estimate of $\beta_{3,mod}$ and the small and insignificant estimate of $\beta_{3,sev}$ will remain regardless of additional controls. Indeed, we find that these estimates will be statistically distinguishable when we add more controls, as described below.

C.1.2 Robustness Analyses

We check the robustness of our results by controlling for industry; restricting sample years; controlling for gender-specific effects and health composition; and using an alternative health measure. In all following specifications, benchmark control variables (X_{it}, Z_t) are included (unless otherwise noted) and standard errors are clustered at the individual level. In Table A-5, we present results with industry controls; all results in the benchmark specification (without industry controls) are also robust.

Industry. We report results for all workers (column (1)) and new workers (with tenure less than three years, column (2)) and results from various robustness analyses that we explain below with industry controls. We first note that the coefficient estimate $\beta_{3,mod}$ that measures the effect of WOTC on moderately disabled workers remain positive and significant, whereas $\beta_{3,sev}$ is not statistically significant, under various specifications with industry controls. Note that in Column (1), our estimates of $\beta_{3,mod}$ is statistically distinguishable from $\beta_{3,sev}$.

[6] Note that unlike the standard differences-in-differences, both treated (severely disabled) and untreated (e.g., moderately disabled) may be affected by the policy change. However, having the parallel pre-trend helps us interpret the policy impacts easier.

Table A-5: Results of Robustness Analyses

		(1) All	(2) New (ten.≤3)	(3) Sample 96-06	(4) Gender ×post	(5) Health ×post	(6) Alt. measure
Post (β_1)		0.012	-0.028	0.020	0.016	0.023	0.0207
		(0.082)	(0.094)	(0.085)	(0.087)	(0.089)	(0.081)
Dis. (β_{2h})	Severe	0.083	0.133*	0.045	0.083	0.059	0.148
		(0.059)	(0.080)	(0.062)	(0.059)	(0.059)	(0.128)
	Moderate	-0.023	-0.042	-0.045	-0.023	-0.033	0.036
		(0.032)	(0.042)	(0.033)	(0.031)	(0.033)	(0.043)
Dis.	Severe	0.010	-0.120	0.003	0.010	0.038	-0.205
×Post (β_{3h})		(0.083)	(0.113)	(0.111)	(0.083)	(0.088)	(0.187)
	Moderate	0.156***	0.145*	0.238***	0.156***	0.180***	0.170**
		(0.051)	(0.076)	(0.080)	(0.050)	(0.052)	(0.070)
# of obs.		2,980	1,692	2,224	2,980	2,980	2,980

Note: See text for details. *** p<0.01, ** p<0.05, * p<0.1.

Sample Periods. Despite controlling for macroeconomic conditions, results might be confounded by early effect of the Great Recession on disabled workers. Using sample years up to 2006 (column (3)) does not impact our main results.

Gender-Specific Effects. The increase in amenities among the moderately disabled after the 2004 WOTC amendment could be driven by certain characteristics of workers that are independent from their disability status. In particular, it has been often argued that female workers may have a different preference for work schedule compared to their male counterparts. If the changes in the option to reduce working hours were mainly driven by the compositional change of female workers among the moderately disabled, our result would not be relevant to firms' response in screening the disabled. To address this concern, we introduce a gender-specific post dummy as an additional regressor, and find that there are no significant differences on the effects of the WOTC amendment (column (4)).

Worker Composition. We check whether the results are 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 (column (5)). 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, 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, our result is robust 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 A-6).

Table A-6: Work Limitation and Diagnoses

Share (%)		Number of diagnoses									Total
		0	1	2	3	4	5	6	7	8+	
Work limitation	no limitation	15.71	21.29	16.45	8.86	3.44	1.02	0.32	0.03	0.00	67.13
	limitation	1.05	4.17	7.46	7.87	6.06	3.80	1.67	0.65	0.11	32.87

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, 6% are severely disabled, 27% are moderately disabled, and 67% are non-disabled. Thus, we are applying tighter criteria for being severely disabled compared to the benchmark case. Table A-5 documents the results. Results (column (6)) suggest that the estimation outcomes are robust to the choice of disability measures.

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 above, 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 2.5. 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 A-8, 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.1.3 Effects on Labor Market Outcomes

Tables A-7 and A-8 document the effects of WOTC amendment on employment (with various specifications) and other labor market outcomes.

Table A-7: Effects of the WOTC-Amendment on Employment

Coeff.		Dependent variable: Employment				
		Benchmark	Sample 1996-2006	Gender×post	Health×post	Alt. measure
Post (β_1)		0.067***	0.072***	0.050***	0.067***	0.065***
		(0.019)	(0.019)	(0.021)	(0.019)	(0.017)
Dis. (β_{2h})	Sev.	-0.530***	-0.528***	-0.529***	-0.530***	-0.501***
		(0.014)	(0.014)	(0.014)	(0.014)	(0.022)
	Mod.	-0.238***	-0.237***	-0.238***	-0.238***	-0.468***
		(0.014)	(0.014)	(0.014)	(0.014)	(0.012)
Dis.	Sev.	-0.002	-0.014	-0.002	-0.002	-0.007
×Post (β_{3h})		(0.017)	(0.018)	(0.017)	(0.017)	(0.023)
	Mod.	0.025	0.014	0.025	0.025	-0.010
		(0.021)	(0.022)	(0.021)	(0.021)	(0.017)
# of obs.		22,604	20,679	22,604	22,604	22,604

Note: We run linear probability model under various specifications. *** p<0.01, ** p<0.05, * p<0.1.

We do not observe any significant effects of the policy on employment under various specifications, alleviating concerns that changes in employment led to the observed changes in the option to reduce working hours. We also find that the effect on wage and income tend to be small on average especially for moderately disabled workers. However, if we look at newly hired severely disabled workers (tenure less than three years), we find positive point estimates on wage and income. Although the estimates are still noisy, this finding is consistent with the view that the WOTC amendment increases wages offered to severely disabled workers. Finally, we find that the WOTC Amendment has virtually no effect on tenure of workers. The lack of significant effects on tenure suggests that firms did not respond to the amendment by engaging in more frequent hiring and firing of disabled workers, a concern raised by policymakers (Scott, 2013).

Table A-8: Effects of the WOTC-Amendment on Labor Market Outcomes

		Dependent variable				
		(log) Hourly wage (all)	(log) Hourly wage (tenure$\leq$ 3)	(log) Income (all)	(log) Income (tenure$\leq$ 3)	Tenure
Post (β_1)		0.111	-0.109	0.114	-0.217*	10.99***
		(0.084)	(0.090)	(0.122)	(0.125)	(1.18)
Dis. (β_{2h})	Sev.	-0.217***	-0.289***	-0.371***	-0.565***	-4.154***
		(0.063)	(0.078)	(0.082)	(0.121)	(1.041)
	Mod.	-0.108***	-0.092**	-0.169**	-0.157**	-2.080***
		(0.030)	(0.045)	(0.038)	(0.065)	(0.651)
Dis.	Sev.	0.000	0.118	0.038	0.282*	0.878
$\times$Post (β_{3h})		(0.079)	(0.107)	(0.112)	(0.164)	(1.931)
	Mod.	-0.026	0.039	-0.032	0.046	0.449
		(0.048)	(0.074)	(0.063)	(0.103)	(1.062)
# of observations		3,768	1,678	3,768	1,678	3,768

Note: This table reports the coefficient estimates of regressions on labor market outcomes. *** p<0.01, ** p<0.05, * p<0.1.

C.1.4 Effects on Other Measures of Job Amenities

We estimate Equation (21) 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 long-term DI (LTDI) coverage. Results are reported in Table A-9. The results show that the WOTC amendment had limited effects on these amenity provision. This may be due to the small sample sizes for the availability of part-time work and the availability of sick days, which may be among various policies firms use to provide the option to reduce working hours. Importantly, it may be difficult for firms to exploit these amenities to screen out disabled workers. For example, LTDI is determined at the firm level (thus may not be applicable to our modeling) and *paid* sick leave days, in addition to being determined at the firm level, may be subject to state-level regulations. Thus, we view the option to reduce working hours as the most relevant measure of amenity for empirical and quantitative analyses.

Table A-9: Effects of the WOTC Amendment on Other Job Amenities

		Dependent variable			
		Available part-time	Paid sick leave (day)	Vacation (week)	LTDI coverage
Post-amendment (β_1)		0.048	0.256	0.634	-0.034
		(0.146)	(0.198)	(0.687)	(0.072)
Disability status (β_{2h})	Severe	0.136	-0.090	-1.014**	-0.131***
		(0.112)	(0.182)	(0.511)	(0.047)
	Moderate	0.146***	-0.066	-0.096	-0.080***
		(0.054)	(0.067)	(0.365)	(0.027)
Disability status	Severe	-0.042	0.227	0.083	0.045
$\times$ Post-amendment (β_{3h})		(0.149)	(0.239)	(0.536)	(0.078)
	Moderate	-0.066	-0.143	-0.143	0.111**
		(0.086)	(0.104)	(0.436)	(0.046)
# of observations		1,039	1,482	4,005	4,080

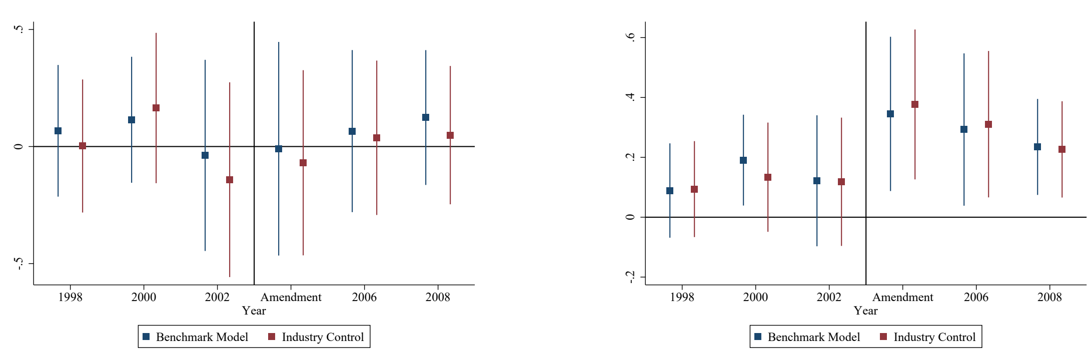
Note: *** p<0.01, ** p<0.05, * p<0.1.

C.1.5 Additional Diagnosis and Discussion

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 (21)) by replacing the terms associated with the coefficients β_{3h} and ν with the year-disability status interaction terms and the year dummy. Specifically, we are interested in whether the year-specific dummies for each disability status before the implementation of the WOTC exhibit the same trend. Figure A-1 plots the coefficients on year-disability

Figure A-1: 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.

status dummies (with 1996, our initial year of observation, as the base year) and their 95% confidence intervals for severely disabled (Panel (a)) and moderately disabled (Panel (b)) workers under our benchmark model and the model with industry control. As seen from Panel (a), we find that the year coefficients for severely disabled workers do not exhibit any patterns before or after the amendment and tend to be very small. However, in Panel (b), we see that moderately disabled workers experienced a significant and positive change in their amenities in post-amendment years. That is, pre-amendment, severely and moderately disabled workers experienced similar patterns in their amenity provision, which changed after the WOTC amendment.

Our estimates suggest that it is plausible to interpret this policy change as giving subsidies to firms hiring severely disabled. For this purpose, assume instead that the WOTC expansion increased the probability of getting tax credit from hiring moderately disabled (but not severely disabled). In equilibrium without screening contracts, their amenities should not increase under risk-neutrality; if workers are risk averse, the amenity may change only if wage changes. However, we do not see much response in moderately disabled's wage (Table A-8). The similar prediction arises in equilibrium with screening contracts. If the subsidy does not impact severely disabled, then it does not impact the IC constraints that firms may face to screen out severely disabled. As a result, we should only expect that the amenity goes up if workers are risk averse and wage changes. Therefore, if we want to interpret these evidences in reasonable models where amenity is endogenous, it is more plausible to assume that subsidies are mainly for hiring severely disabled workers.

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:

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

The dependent variable y_{it} indicates whether an individual i at time t has an option to reduce working hours or not. The definition of the other regressors remains the same as those described in Equation (21). 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 A-10 summarizes the regression results.

Table A-10: Effects of the ADA Amendment on the Option to Reduce Working Hours

		Benchmark model		Industry control	
		(1) All employed	(2) New hires	(3) All employed	(4) New hires
Post-amendment (β_1)		-0.128**	-0.023	-0.105**	-0.022
		(0.055)	(0.067)	(0.052)	(0.065)
Disability status (β_{2h})	Severe	0.065	0.042	0.053	0.057
		(0.113)	(0.119)	(0.102)	(0.100)
	Moderate	0.208***	0.228***	0.239***	0.256***
		(0.079)	(0.085)	(0.075)	(0.079)
Disability× Post (β_{3h})	Severe	0.191	0.182	0.203	0.143
		(0.132)	(0.156)	(0.125)	(0.139)
	Moderate	-0.120	-0.293***	-0.152*	-0.310***
		(0.087)	(0.100)	(0.082)	(0.096)
# of observations		1,503	833	1,499	831

Note: We use those with tenure less than or equal to three years as new hires. *** p<0.01, ** p<0.05, * p<0.1.

For moderately disabled workers, the expansion of the ADA-eligible workers led to a *decrease* in the provision of the option to reduce working hours. This effect was especially more prominent among newly hired workers as shown in columns (2) and (4). However, we find that there was no statistically significant change among the severely disabled workers' amenity levels after 2008. These observations are consistent with a view that firms may use the option to reduce working hours to screen workers. 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 moderately disabled workers would decline after 2008.

C.3 State-Level Analyses

So far, we exploit policy changes occurred at the national level. In this section, we also examine a state policy change that affects firm's incentive to hire people with disabilities. Several states in the U.S. provide additional subsidies for firms hiring people with disabilities. Although we do not observe much large policy changes in the last 20 years, one potentially meaningful variation is the introduction of state-wide subsidies in New York (NY) in 1998 called Workers (with Disabilities) Employment Tax Credit (WETC). Through the WETC, firms hiring workers with disabilities can receive tax credits, which amounts to $2,100.[7] The eligibility is essentially the same as the WOTC.

[7] See https://dol.ny.gov/hiring-incentives-tax-credits-and-funding-opportunities.

From 1998, firms can receive subsidies through both WOTC and WETC. We estimate the following regression model:

$$y_{it} = \beta_1 \mathbb{I}_{\{t>1998\}} + \sum_{h \in \{\text{mod, sev}\}} \beta_{2h} \mathbb{I}_h + \sum_{h \in \{\text{mod, sev}\}} \beta_{3h} \mathbb{I}_{\{t>1998\}} \mathbb{I}_h + \gamma \mathbf{X_{it}} + \nu Z_t + \varepsilon_{it}.$$

In order to implement this analysis, we use the restricted version of the HRS which contains state identifiers of each individual. The estimation is done using only observations who live in NY between 1994 and 2004. Although it is plausible to add other population in other states (e.g, those living neighboring states), we refrain from doing so because their sample sizes are also small and it is less likely to expect that the labor market shocks in NY is parallel to those in neighboring states.

Table A-11: Effects of the WETC on the Option to Reduce Working Hours: NY

Coefficients		Option to reduce working hours			
		(1) demo control		(2) health control	
Post-amendment (β_1)		-0.171	(0.10)	-0.151	(0.12)
Disability status (β_{2h})	Severe	-0.082	(0.10)	-0.089	(0.22)
	Moderate	-0.084	(0.08)	-0.178	(0.12)
Disability status	Severe	-0.048	(0.16)	-0.087	(0.23)
$\times$ Post-WETC (β_{3h})	Moderate	0.128	(0.12)	0.196	(0.13)
Sample size		675		493	

Note: We estimate Equation (21) with the linear probability model using samples between 1994 and 2004. The additional covariates used in the regression are age, age-squared, annual employment rates in NY, firm-size category dummies, and health outcomes. Standard errors are clustered at the individual level. *** p<0.01, ** p<0.05, * p<0.1.

The estimates are reported in Table A-11. Despite a small sample size, we see a positive effects on moderately disabled workers' amenities post-WETC. Given the statistically power, it is very difficult to draw a robust conclusion from this analysis. However, at least, it provides suggestive evidence which is qualitatively consistent with estimated effects from other policies.

D Additional Estimation Results

D.1 Auxiliary Model

We report the empirical moment used as targets in our estimation in Section 5.3.

Table A-12: Cross-Sectional job amenity, wage, and employment regression results

		Dependent variable		
		Option to Reduce working hours	log weekly income	employment
Disability status (β_{2h})	Severe	0.106**	-0.341***	-0.530***
		(0.047)	(0.065)	(0.014)
	Moderate	0.071***	-0.182***	-0.226***
		(0.024)	(0.034)	(0.013)

Note: The table reports the estimated coefficients of the disability dummies we use as a part of auxiliary models discussed in footnote 50. The additional covariates used in the regression are age, year dummies, firm-size category dummies, and health outcomes. Standard errors are clustered at the individual level. *** p<0.01, ** p<0.05, * p<0.1.

Table A-13: The regression of log wage on amenity

	Dependent variable: log weekly income
Amenity dummy	-0.082***
	(0.017)
Individual FE	Yes

Note: The table reports the estimated coefficients of the regression of log wage (weekly earning) on the amenity dummy we use as a part of auxiliary models discussed in footnote 51. We control individual fixed effect and year dummy. We also find that including additional controls, such as age, health outcomes, and other covariates we use in other regressions does not impact the estimated coefficient of the amenity dummy Standard errors are clustered at the individual level. *** p<0.01, ** p<0.05, * p<0.1.

D.2 Estimation Results using Policy Variation

Table A-14 and A-15 present parameter estimates and model fit from estimating the model using the WOTC amendment variation.

Table A-14: Parameters and Model Fit, Alternative Identification

	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	1.920	(0.073)	2.386	(0.034)	3.333	(0.022)
Preference for job amenities: β_h	10.125	(0.047)	6.583	(0.039)	1.0 (normalized)	
Fixed cost of work: χ_h	7.584	(0.013)	5.865	(0.025)	0.0 (normalized)	
Variance of skill distribution: σ_h^2	3.186	(0.245)	0.566	(0.029)	0.786	(0.078)
(b) Base utility from amenity						
constant	0.648	(0.010)				
curvature	2.982	(0.163)				
(c) Firm-side parameters						
fixed amenity cost: c_0	0.042	(0.003)				
Vacancy cost: κ	0.014	(0.001)				

Note: The dollar value in the model is normalized to $250.

Table A-15: Model Fit, Alternative Identification

(a) Employment and wage		
Statistics	Data	Model
Employment		
ND emp. rate	0.686	0.556
Coeff of moderately disabled	-0.226	-0.245
Coeff of severely disabled	-0.530	-0.447
Average wage		
ND wage (level)	2.277	2.130
Coeff of moderately disabled	-0.182	-0.091
Coeff of severely disabled	-0.341	-0.115
Coefficient of wage variation		
Non-disabled	0.587	0.595
Moderately disabled	0.618	0.421
Severely disabled	0.653	0.475

(b) Job amenities		
Statistics	Data	Model
Job amenities		
ND job amenity (level)	0.317	0.356
Coeff of moderately disabled	0.071	0.051
Coeff of severely disabled	0.106	0.132
Fixed effect regression of wage on amenity		
Coeff on job amenity	-0.082	-0.072
WOTC coefficients on job amenities		
Post × Severe	0.028	-0.013
Post × Moderate	0.115	0.074

Note: This table compares the model-generated statistics to their empirical counterparts. The regression coefficients are based on the regression equations described in footnotes 50 and 51 and Equation (11).

D.3 Additional Diagnosis of Model Estimation

In this section, we provide an additional diagnosis to evaluate which moments are sensitive to a small change in parameters. We conduct the comparative statics of the model parameters to see their impacts on the model's predicted outcomes on the targets we use in the estimation. Given our focus on the screening incentives, we report the effects of changing parameters related to amenities: the amenity cost parameter c_0 and parameters governing the utility from amenities (δ_0, δ_1). The main findings are reported in Table A-16.[8] There are several notable patterns. First, although every moment is affected by the change in each of these parameters, we find that changing these parameters has negligible impacts on wage and employment. Second, we find that increasing the cost c_0 substantially affects the coefficient on job amenity in the fixed effect regression of wage on amenity. Third, changes in utility parameters (δ_0, δ_1) affect various moments related to job amenities except for the coefficient on job amenity in the fixed effect regression of wage on amenity. These findings suggest that worker-side parameters and firm-side parameters for the job amenities have differential implications on the predicted outcomes, suggesting that our choice of auxiliary models is informative in identifying these parameters in practice.

[8] We also tried to calculate the sensitivity moment (Andrews, Gentzkow and Shapiro, 2017). However, we found that different numerical approximations of the derivatives led to quite different results due to possible non-smoothness in the model. Therefore, we report an informal diagnosis based on simple comparative statics where the numerical results are much more stable.

Table A-16: Diagnosis of Sensitivity of Model's Moments with Respect to Parameters

	benchmark	higher c_0	higher δ_0	higher δ_1
Job amenities				
ND job amenity (level)	0.344	0.341	0.326	0.305
Coeff. of moderately disabled	0.060	0.063	0.070	0.061
Coeff. of severely disabled	0.136	0.140	0.194	0.168
Income-amenity relationship (among ND)				
$\frac{\text{Amenity, 25\%-50\% income}}{\text{Amenity, 50\%-75\% income}}$	1.212	1.212	1.197	1.245
$\frac{\text{Amenity, } \leq 25\% \text{ income}}{\text{Amenity, 25\%-50\% income}}$	1.371	1.349	1.243	1.411
WOTC coefficients on job amenities				
Post × Severe	-0.013	-0.006	-0.024	-0.031
Post × Moderate	0.074	0.073	0.067	0.083
Fixed effect regression of wage on amenity				
Coeff. on job amenity	-0.088	-0.096	-0.089	-0.088
Employment				
Non-disabled (ND) emp. rate	0.572	0.572	0.573	0.572
Coeff. of moderately disabled	-0.239	-0.240	-0.239	-0.238
Coeff. of severely disabled	-0.459	-0.468	–0.391	-0.456
Average wage				
ND wage (level)	2.247	2.243	2.238	2.252
Coeff. of moderately disabled	-0.104	-0.105	-0.099	-0.104
Coeff. of severely disabled	-0.133	-0.133	-0.140	-0.136

Note: This table reports the comparative statics results of the effects of changing model parameters on the model-generated statistics. Column (1) reports the outcomes under the benchmark case where the model parameters are from those reported in Table 3; Column (2) reports the outcomes under the case where the amenity cost parameter c_0 increases by 10 %; Column (2) reports the outcomes under the case where the constant term in the utility from amenity δ_0 increases by 1 %; Column (3) reports the outcomes under the case where the curvature in the utility from amenity δ_1 increases by 10 %. Note that we choose a smaller change in Column (2) because this parameter changes outcomes much larger than others. Furthermore, outcomes reported in WOTC coefficients on job amenities are based on parameters in Table A-14 which are estimated to target these moments.

E Additional Counterfactual Experiment Results

E.1 Amenity Subsidy

Here, we consider amenity subsidy as a way to subsidize firms. It is important to note that the amenity subsidy is also subject to government's verification technology ψ_h. Thus, even at the subsidy rate of 100%, firms with severely disabled workers are effectively getting a 62% subsidy to amenity costs. As seen in Figure A-2, higher subsidy rates increase amenity provision for severely disabled workers, but with limited employment effects, as these only benefit those with amenities and have smaller impacts on wages (unlike hiring subsidies). In Figure A-3, we observe that given the relatively small size of the policy benefits from the firm's perspective, the amenity subsidy has negligible effects on amenity provision of healthier workers. The resulting welfare effects are plotted in Figure A-4. Due to the size of the amenity cost and its limited effects on contract and employment outcomes, the incremental effects of changes in subsidy rates are small.

Figure A-2: Sev. Disabled Workers Outcomes

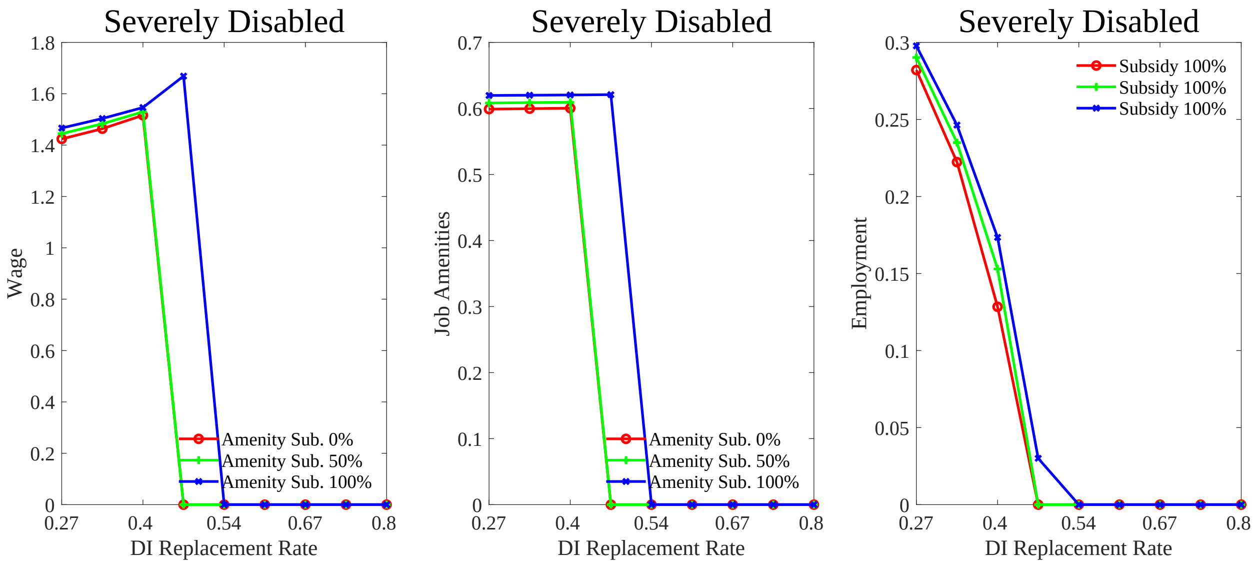
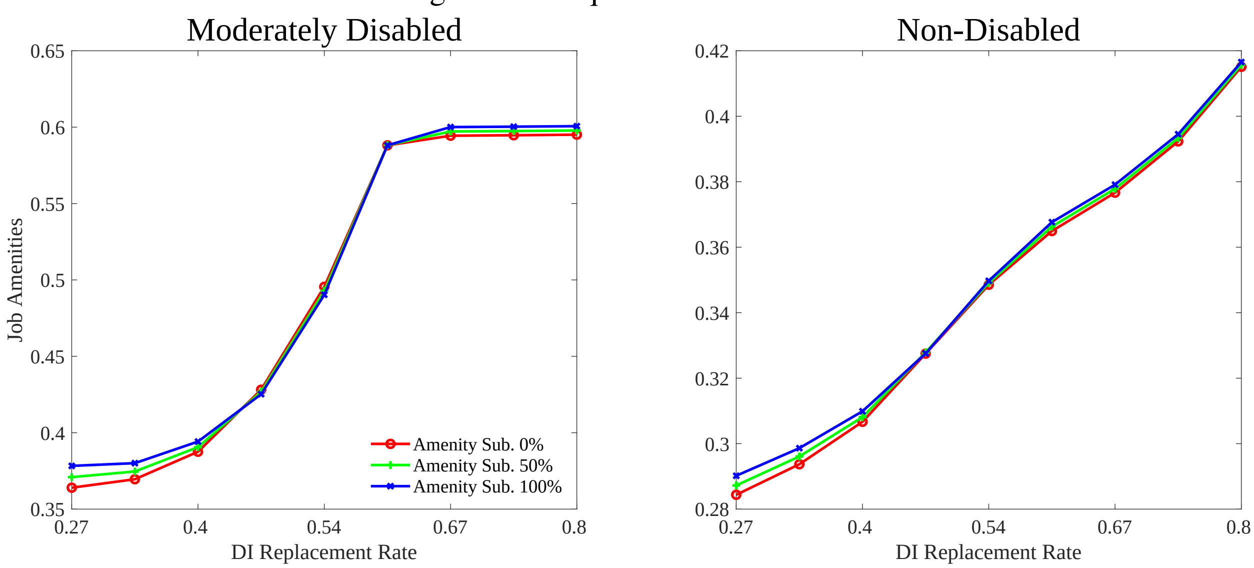


Figure A-3: Equilibrium Amenities



E.2 Results Based on Estimates Using an Alternative Identification Strategy

In Figure A-5 are welfare results based on estimates reported in Table A-14, where we estimate using the WOTC amendment policy variations. As seen from these figures, the main findings quantitatively remain the same.

Figure A-4: Welfare Effects of Amenity Subsidies

(a) by Disability Status   (b) Ex Ante Welfare

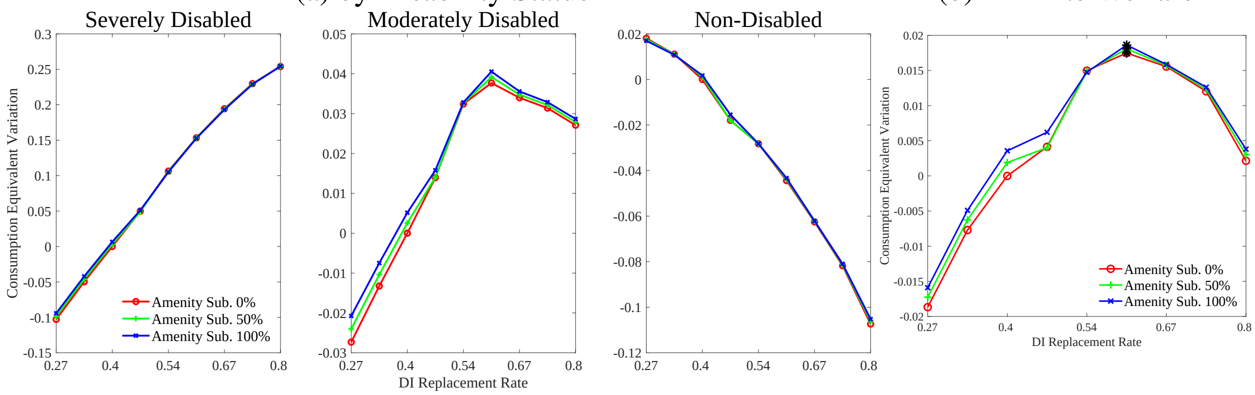
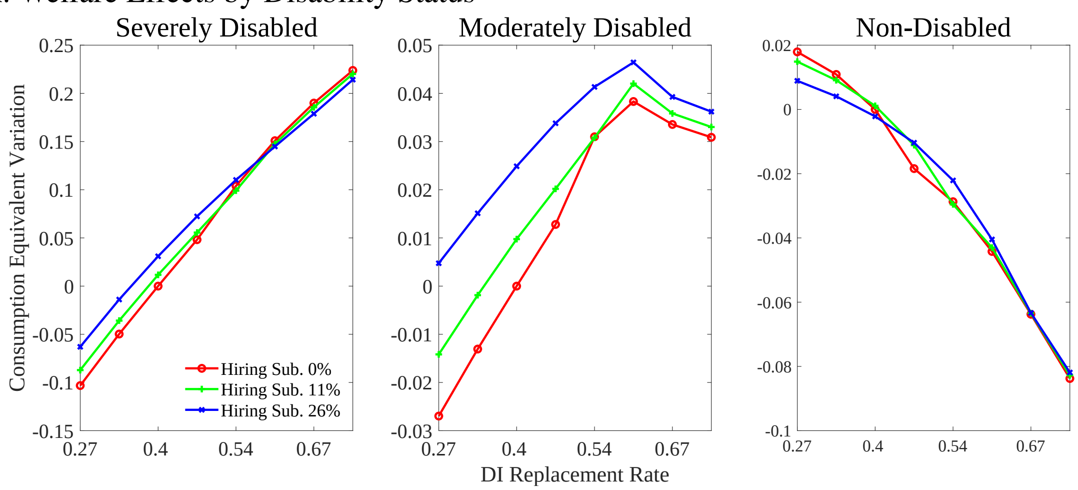
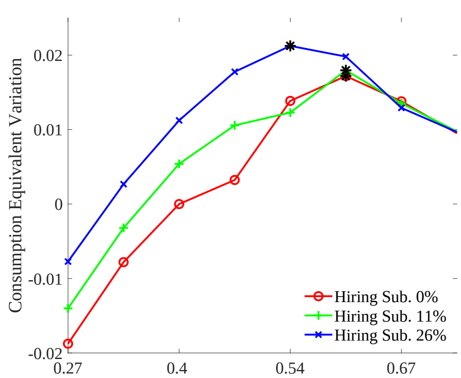


Figure A-5: Welfare Effects of Policy Reforms by Disability Status under Alternative Estimates

A. Welfare Effects by Disability Status



B. Ex-Ante Welfare Effects and Welfare-Maximizing Policy



Policy Parameters	Hiring subsidy	0%	11%	26%
	DI rep. rate	60%	60%	53%
	Tax rate	9.6%	10.2%	7.3%
CEV	Sev. disabled	0.151	0.148	0.1102
	Mod. disabled	0.038	0.042	0.043
	Non-disabled	-0.044	-0.043	-0.022
	Ex-Ante	0.017	0.018	0.021

Note: The benchmark policy is 0% firm subsidy and 40% DI replacement rate of average equilibrium wage. The figure on the left plots the average CEV of policy reforms. The table on the right summarizes the counterfactual policy analyses. For each hiring subsidy amounts, we show the corresponding ex-ante-welfare maximizing DI replacement rate, the budget-balancing tax rate, and the resulting CEVs under these joint policy combination by health status and on average.