Online Appendix

A Theoretical Framework

A.1 Static Model

Derivation Welfare Effect Strictness of DI Eligibility Rules. Starting from (2) the welfare effect of changing θ^* is given by

$$\begin{aligned}\frac{\partial W}{\partial \theta^*} &= \int_{\theta^A}^{\infty} \frac{\partial p(\theta;\theta^*)}{\partial \theta^*}(v(c^b) - \max\{v(c^z), u(c^w) - \theta\})dF(\theta) + \lambda \frac{\partial G}{\partial \theta^*} \\ &\quad + \frac{\partial \theta^A}{\partial \theta^*} p(\theta^A) f(\theta^A) \underbrace{\left(u(c^w) - v(c^b) + \frac{\psi}{p(\theta^A)} - \theta^A\right)}_{=0 \text{ by definition of } \theta^A \text{ in eq. (1)}}\end{aligned} \tag{A.1}$$

where

$$\frac{\partial G}{\partial \theta^*} = (b+\tau)\frac{\partial \theta^A}{\partial \theta^*} p(\theta^A) f(\theta^A) + (b+\tau)\int_{\theta^A}^{\theta^R} -\frac{\partial p(\theta;\theta^*)}{\partial \theta^*} dF(\theta) + (b-z)\int_{\theta^R}^{\infty} -\frac{\partial p(\theta;\theta^*)}{\partial \theta^*} dF(\theta) \tag{A.2}$$

following from the government's budget constraint. Defining $B(\theta^*) \equiv (b+\tau)\left(\partial \theta^A/\partial \theta^*\right) p(\theta^A) f(\theta^A)$, $M_W \equiv -\int_{\theta^A}^{\theta^R} (\partial p(\theta;\theta^*)/\partial \theta^*)\, dF(\theta)$, $M_Z \equiv -\int_{\theta^R}^{\infty} (\partial p(\theta;\theta^*)/\partial \theta^*)\, dF(\theta)$ and $M(\theta^*) \equiv M_W(b+\tau) + M_Z(b-z)$, we can rewrite $\frac{\partial G}{\partial \theta^*} = B(\theta^*) + M(\theta^*)$. Plugging these terms into the above equation for $\partial W/\partial \theta^*$ yields condition (5) in the main text.

Derivation Welfare Effect DI Benefit Level. Starting from equation (2) we get

$$\begin{aligned}\frac{\partial W}{\partial (-b)} &= -\int_{\theta^A}^{\infty} p(\theta;\theta^*) v'(c^b) dF(\theta) + \lambda \frac{\partial G}{\partial (-b)} \\ &\quad + \frac{\partial \theta^A}{\partial (-b)} p(\theta^A) f(\theta^A) \underbrace{\left(u(c^w) - v(c^b) + \frac{\psi}{p(\theta^A)} - \theta^A\right)}_{=0 \text{ by definition of } \theta^A}\end{aligned} \tag{A.3}$$

where

$$\frac{\partial G}{\partial (-b)} = (b+\tau)\frac{\partial \theta^A}{\partial (-b)} p(\theta^A) f(\theta^A) + \int_{\theta^A}^{\infty} p(\theta;\theta^*) dF(\theta). \tag{A.4}$$

The behavioral fiscal effect is $B(b) \equiv -\left(\partial \theta^A/\partial b\right) p(\theta^A) f(\theta^A)(b+\tau)$ and the mechanical fiscal effects is $M(b) \equiv \int_{\theta^A}^{\infty} p(\theta) dF(\theta)$. Equation (7) then immediatly follows.

Derivation Stricter Eligibility Rules vs. Lower Benefits: $\frac{W_{\theta^*}}{T_{\theta^*}} > \frac{W_b}{T_b}$. In the main text we claim that increasing θ^* instead of reducing b to save 1 dollar is preferable if and only if

$$\frac{W_{\theta^*}}{T_{\theta^*}} > \frac{W_b}{T_b}. \tag{A.5}$$

This statement is true irrespective of the sign of the total welfare effect of stricter screening and reduced benefit generosity. To see this we define

$$\begin{aligned}
W_{\theta^*} &\equiv \lambda\left[M(\theta^*)+B(\theta^*)\right] - \int_{\theta^A}^{\infty} \frac{-\partial p(\theta;\theta^*)}{\partial\theta^*}\Big(v(c^b) - \max\{v(c^z), u(c^w)-\theta\}\Big)\, dF(\theta) \\
T_{\theta^*} &\equiv M(\theta^*)+B(\theta^*) > 0 \\
W_b &\equiv \lambda\left[M(b)+B(b)\right] - \int_{\theta^A}^{\infty} p(\theta;\theta^*) v'(c^b) dF(\theta) \\
T_b &\equiv M(b)+B(b) > 0.
\end{aligned}$$

We then need to check condition (A.5) for the following four cases (all combinations of signs of the welfare effects $W_{\theta^*} \gtreqless 0$ and $W_b \gtreqless 0$):

1. $W_{\theta^*} > 0$ and $W_b > 0$: Both stricter screening and reduced benefits are welfare improving, then the planner wants to choose instrument with the higher ratio.

2. $W_{\theta^*} < 0$ and $W_b < 0$: Both welfare reducing, then choose instrument with smaller welfare loss i.e. higher ratio as $T_x > 0$.

3. $W_{\theta^*} > 0$ and $W_b \leq 0$: only stricter screening welfare improving, want to chose screening and (A.5) holds trivially.

4. $W_{\theta^*} \leq 0$ and $W_b > 0$: only benefits welfare improving, want to chose benefits. In this case (A.5) does not hold.

Approximation Error for Relative Insurance Losses. For the upper bound of $\frac{V_{\theta^*}}{V_b}$, we use the following Taylor approximation

$$\frac{1}{\lambda M(\theta^*)}\int_{\theta^A}^{\infty} \frac{-\partial p(\theta;\theta^*)}{\partial\theta^*}(v(c^b) - v(c^z)) dF(\theta) \approx \frac{1}{\lambda M(\theta^*)}\int_{\theta^A}^{\infty} \frac{-\partial p(\theta;\theta^*)}{\partial\theta^*} v'(c^b)(c^b - c^z) dF(\theta). \tag{A.6}$$

By the mean value theorem there exists $\bar{c} \in [c^z, c^b]$ such that

$$v(c^b) - v(c^z) = v'(c^b)(c^b - c^z) - \frac{1}{2}v''(\bar{c})(c^b - c^z)^2. \tag{A.7}$$

The approximation error in (A.6) is therefore given by

$$R = \frac{1}{\lambda M(\theta^*)}\int_{\theta^A}^{\infty} \frac{-\partial p(\theta;\theta^*)}{\partial\theta^*}\left[-\frac{1}{2}v''(\bar{c})(c^b - c^z)^2\right] dF(\theta). \tag{A.8}$$

We now also derive an upper bound on this approximation error

$$R \leq \frac{1}{\lambda M(\theta^*)} \int_{\theta^A}^{\infty} \frac{-\partial p(\theta;\theta^*)}{\partial \theta^*} \left[-\frac{1}{2} v''(\bar{c})(b-z)^2\right] dF(\theta) \tag{A.9}$$

$$\leq \frac{1}{\lambda} \int_{\theta^A}^{\infty} \left[-\frac{1}{2} v''(\bar{c})(b-z) \frac{\Delta DI(b-z)}{M(\theta^*)}\right] dF(\theta) \tag{A.10}$$

The first inequality (A.9) uses that the consumption drop is smaller than the income drop due to self-insurance mechanisms. In (A.10), ΔDI is an indicator function for individuals who no longer make it into DI because of the stricter rules which expands the integral as in (14). The approximation error for $\frac{V_{\theta^*}}{V_b}$ is therefore bounded by

$$R\left(\frac{V_{\theta^*}}{V_b}\right) \leq -\frac{1}{2} \frac{\int_{\theta^A}^{\infty} v''(\bar{c})(b-z) \frac{\Delta DI(b-z)}{M(\theta^*)} dF(\theta)}{E\left[v'(c^b)|\text{on DI}\right]}. \tag{A.11}$$

If $v'''(\cdot) \approx 0$ is small, then $v''(\bar{c}) = v''(c^b)$ for any $\bar{c} \in [c^z, c^b]$ and we can implement (A.11) by

$$-\frac{1}{2} \frac{\int_{\theta^A}^{\infty} v''(\bar{c})(b-z) \frac{\Delta DI(b-z)}{M(\theta^*)} dF(\theta)}{E\left[v'(c^b)|\text{on DI}\right]} \approx -\frac{1}{2} \int_{\theta^A}^{\infty} \frac{v''(c^b)}{v'(c^b)} (b-z) \frac{\Delta DI(b-z)}{M(\theta^*)} dF(\theta) \tag{A.12}$$

$$= \frac{1}{2} \int_{\theta^A}^{\infty} -\frac{v''(c^b)}{v'(c^b)} c^b \frac{(b-z)}{c^b} \frac{\Delta DI(b-z)}{M(\theta^*)} dF(\theta) \tag{A.13}$$

$$= \frac{1}{2} \gamma \int_{\theta^A}^{\infty} \frac{(b-z)}{c^b} \frac{\Delta DI(b-z)}{M(\theta^*)} dF(\theta) \tag{A.14}$$

$$\leq \frac{1}{2} \gamma \int_{\theta^A}^{\infty} \frac{(b-z)}{b} \frac{\Delta DI(b-z)}{M(\theta^*)} dF(\theta) \tag{A.15}$$

where γ denotes the coefficient of relative risk aversion and (A.13) assumes that DI recipients are in the worst case hand-to-mouth, i.e. $c^b \geq b$.

Empirically, we can directly implement the integral in (A.13) with our DiD approach. We find $\int_{\theta^A}^{\infty} \frac{(b-z)}{b} \frac{\Delta DI(b-z)}{M(\theta^*)} dF(\theta) = 0.25$ for the RSA-58 change and $\int_{\theta^A}^{\infty} \frac{(b-z)}{b} \frac{\Delta DI(b-z)}{M(\theta^*)} dF(\theta) = 0.27$ for the RSA-59 change.

Therefore the approximation error for reasonable values of risk aversion is small. Chetty (2006b) argues that labor supply estimates from the literature imply $\gamma \approx 1$. In this case our approximation error is at most $\frac{1}{2} \cdot 0.25 \cdot \gamma = 0.125$. Hence, in Table 4 the upper bound would become 0.48 and 0.63 for the RSA-58 and RSA-59 change respectively.

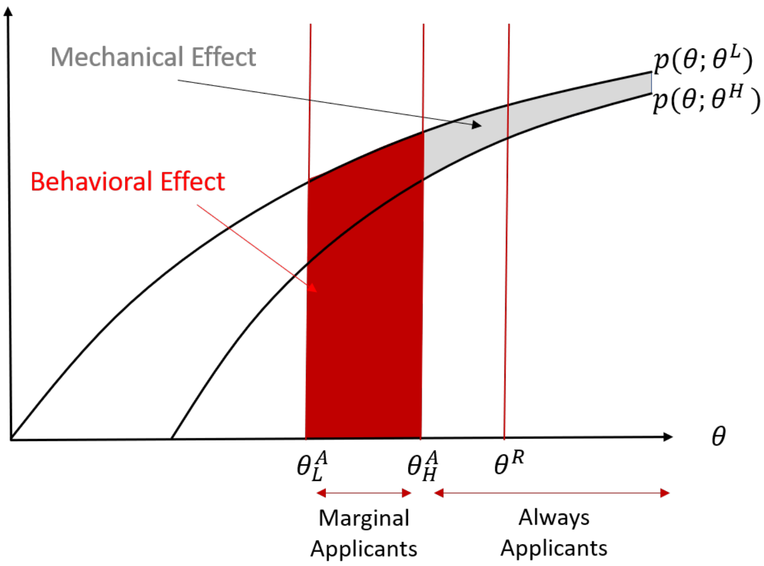
Given our fiscal multiplier estimates we would need extremely high values of risk aversion of $\gamma > 11$ to make our insurance value bounds inconclusive.[40]

[40]Our bounds become inconclusive if the upper bound of the insurance loss exceeds the relative mul-

Non-marginal Change of Strictness of DI Eligibility Rules. Condition (5) in the main text holds for a marginal change in θ^*. Here we consider the welfare effect of a discrete change. Suppose strictness of eligibility rules increase from θ^L to $\theta^H > \theta^L$. This implies that the award probability falls, $p(\theta;\theta^H) < p(\theta;\theta^L)$, and fewer individuals apply, $\theta_H^A > \theta_L^A$ where θ_L^A denotes the marginal applicant with the lenient criteria θ^L and θ_H^A denotes the marginal applicant with the high standard θ^H. Note that θ^R is still independent of the eligibility rules.

Figure A.1 illustrates the effects of a non-marginal change in strictness of eligibility rules. If rules become stricter, the award probability curve shifts down from $p(\theta;\theta^L)$ to $p(\theta;\theta^H)$. As a response fewer individuals apply. Individuals with $\theta < \theta_H^A$ no longer apply under the stricter rules. Individuals with $\theta \in \left[\theta_L^A, \theta_H^A\right]$ are therefore "marginal applicants" as they only apply under the lenient rules. The share of these marginal applicants is $\pi^{MA} = F(\theta_H^A) - F(\theta_L^A)$. The behavioral effect is the area under the old award curve of these marginal applicants. Individuals with a disability level above θ_H^A continue to apply. These are always applicants and their share is $\pi^{AA} = 1 - F(\theta_H^A)$. The difference between the old and new award curve for these always applicants corresponds to the mechanical effect. Some of these mechanically screened out individuals return to work (θ to the left of θ^R) and some substitute to welfare benefits (θ to the right of θ^R). Hence, we have the same effects as in the marginal case, but these effects are slightly differently defined.

Figure A.1: Illustration Non-Marginal Change



Note: This figure illustrates the effects of a non-marginal change in strictness of DI eligibility rules. The mechanical effect is driven by always applicants, while the behavioral fiscal effect is driven by marginal applicants.

Let W_H and W_L denote welfare in the two regimes. Welfare in the two regimes $S \in \{H, L\}$ is

$$\begin{aligned} W_S = \; & \int_0^{\theta_S^A} (u(c^w) - \theta) dF(\theta) + \int_{\theta_S^A}^{\theta^R} (1 - p(\theta;\theta^S))(u(c^w) - \theta) dF(\theta) + \\ & + \int_{\theta_S^A}^{\infty} p(\theta;\theta^S) v(c^b) dF(\theta) + \int_{\theta^R}^{\infty} (1 - p(\theta;\theta^S)) v(c^z) dF(\theta) - \int_{\theta_S^A}^{\infty} \psi dF(\theta). \\ & + \lambda \left(G(\theta^S, b) - \bar{G} \right) \end{aligned} \tag{A.16}$$

Assuming λ and $\bar{G}$ are the same in both regimes $S \in \{H, L\}$ the welfare effect of the discrete change in

tipliers, that is $0.36 + \frac{1}{8}\gamma \geq 1.77 = \frac{1+B(\theta^*)/M(\theta^*)}{1+B(b)/M(b)}$ and would require $\gamma > 11$.

eligibility rules $\Delta W \equiv W_H - W_L$ is given by

$$\begin{aligned}
\Delta W \quad = \quad & -\int_{\theta_H^A}^{\infty} \left[p(\theta;\theta^L) - p(\theta;\theta^H)\right]\left[v(c^b) - \max\{u(c^w) - \theta; v(c^z)\}\right] dF(\theta) \\
& -\int_{\theta_L^A}^{\theta_H^A} p(\theta;\theta^L)\left[v(c^b) - (u(c^w) - \theta)\right] - \psi dF(\theta) \\
& +\lambda\left[G(\theta^H, b) - G(\theta^L, b)\right].
\end{aligned} \tag{A.17}$$

The first line of (A.17) measure the loss in insurance value for the always applicants (mechanically screened out), the second line is the insurance loss that marginal applicants experience – the key difference to the marginal case, where there is no first-order welfare impact of changes in application behavior. The third line captures the gain for the taxpayer (the fiscal cost reduction). The Envelope theorem does not apply for a non-marginal change in θ^* and behavioral responses have a first order welfare effect. Note that for the limiting case of a marginal change $\theta^H \to \theta^L$ we have $\theta_H^A \to \theta_L^A$ and $\int_{\theta_L^A}^{\theta_H^A} p(\theta;\theta^L)\left[v(c^b) - (u(c^w) - \theta)\right] - \psi dF(\theta) \to p(\theta_L^A;\theta^L)\left[v(c^b) - (u(c^w) - \theta_L^A)\right] - \psi = 0$ by the definition of the marginal applicant θ_L^A.

We can write the fiscal effect again as the behavioral fiscal effect B_Δ plus the mechanical fiscal effect M_Δ, $G(\theta^H, b) - G(\theta^L, b) = B_\Delta + M_\Delta$, where

$$B_\Delta \equiv (b+\tau) \cdot \int_{\theta_L^A}^{\theta_H^A} p(\theta;\theta^L) dF(\theta), \tag{A.18}$$

$$M_\Delta \equiv (b+\tau)\int_{\theta_H^A}^{\theta^R} \left[p(\theta;\theta^L) - p(\theta;\theta^H)\right] dF(\theta) - (b-z)\int_{\theta^R}^{\infty} \left[p(\theta;\theta^L) - p(\theta;\theta^H)\right] dF(\theta). \tag{A.19}$$

We can then rearrange (A.17) to $\Delta W \gtreqless 0 \Leftrightarrow$

$$1 + \frac{B_\Delta}{M_\Delta} \gtreqless \frac{L_{AA}}{\lambda M_\Delta} + \frac{L_{MA}}{\lambda M_\Delta}, \tag{A.20}$$

where

$$L_{AA} \equiv \int_{\theta_H^A}^{\infty} \left[p(\theta;\theta^L) - p(\theta;\theta^H)\right]\left[v(c^b) - \max\{u(c^w) - \theta; v(c^z)\}\right] dF(\theta) \tag{A.21}$$

are the insurance losses of the always applicants and

$$L_{MA} \equiv \int_{\theta_L^A}^{\theta_H^A} p(\theta;\theta^L)\left[v(c^b) - (u(c^w) - \theta)\right] - \psi dF(\theta) \tag{A.22}$$

measure the insurance losses of the marginal applicants.

Relative Insurance Value Bounds with Non-marginal Change of DI Eligibility Rules. The bounds on the relative insurance values derived in Section 2 also hold for non-marginal changes in eligibility rules. The insurance loss of non-marginally stricter eligibility rules is given by $V_{\Delta\theta^*} = \frac{1}{\lambda M_\Delta}(L_{AA} + L_{MA})$, where L_{AA} and L_{MA} are defined in (A.21) and (A.22) respectively. First note that $L_{MA} \leq \int_{\theta_L^A}^{\theta_H^A} p(\theta;\theta^L)\left[v(c^b) - v(c^z)\right] dF(\theta)$ and that $L_{AA} \leq \int_{\theta_H^A}^{\infty}\left[p(\theta;\theta^L) - p(\theta;\theta^H)\right]\left[v(c^b) - v(c^z)\right] dF(\theta)$. Therefore,

$$
\begin{aligned}
V_{\Delta\theta^*} &= \frac{1}{\lambda M_\Delta}(L_{AA} + L_{MA}) && \text{(A.23)}\\
&\leq \frac{1}{\lambda M_\Delta}\int_{\theta_L^A}^{\theta_H^A} p(\theta;\theta^L)\left[v(c^b) - v(c^z)\right] dF(\theta) && \text{(A.24)}\\
&\quad + \frac{1}{\lambda M_\Delta}\int_{\theta_H^A}^{\infty}\left[p(\theta;\theta^L) - p(\theta;\theta^H)\right]\left[v(c^b) - v(c^z)\right] dF(\theta)\\
&= \frac{1}{\lambda M_\Delta}\int_{\theta_L^A}^{\infty} \Delta DI\left[v(c^b) - v(c^z)\right] dF(\theta) && \text{(A.25)}\\
&\approx \frac{1}{\lambda M_\Delta}\int_{\theta_L^A}^{\infty} \Delta DI\left[v'(c^b)(c^b - c^z)\right] dF(\theta) && \text{(A.26)}\\
&\leq \frac{1}{\lambda}\int_{\theta_L^A}^{\infty} v'(c^b)\frac{\Delta DI(b-z)}{M_\Delta} dF(\theta) && \text{(A.27)}
\end{aligned}
$$

where ΔDI is the probability that individuals does not enter DI under the stricter rules. That is, $\Delta DI = p(\theta;\theta^L)$ for marginal applicants with $\theta \in \left[\theta_L^A, \theta_H^A\right]$ and $\Delta DI = p(\theta;\theta^L) - p(\theta;\theta^H)$ for always applicants with $\theta > \theta_H^A$. The upper bound (A.27) is identical to the upper bound (14) in the main text. Therefore, our upper bound on the relative insurance values is robust to non-marginal changes in eligibility rules.

The lower bound in (16) also still holds for non-marginal changes in eligibility rules. This is easy to see as $V_{\Delta\theta^*} > \frac{1}{\lambda M_\Delta}(L_{AA}) > \frac{1}{\lambda M_\Delta}\int_{\theta^R}^{\infty}\left[p(\theta;\theta^L) - p(\theta;\theta^H)\right]\left[v(c^b) - v(c^z)\right] dF(\theta)$.

A.2 General Model

Setup. The setup mirrors the static model but extends it in two important dimensions. First, we extend the model to T periods, so agents need to make inter-temporal decisions. Second, we allow for richer heterogeneity beyond θ. θ as well as other state variables evolve stochastically over the agent's relevant time horizon. Let $X_{i,t} = \{\theta_{i,t}, A_{i,t}, \chi_{i,t}\}$ denote the vector of state variables where $\theta_{i,t}$ denotes agent i's disability level in period t, $A_{i,t}$ denotes the asset level and $\chi_{i,t}$ is a vector of other state variables (which allows for heterogeneity across agents such as differences in wages etc.). The state vector $X_{i,t}$ summarizes all the information relevant for agent i's choices in period t. The laws of motion of assets in the disability, employment and welfare benefit state are

$$A_{i,t+1} = (1+r_t)A_{i,t} + b_{i,t}(X_{i,t}) - c^b_{i,t}(X_{i,t}) \quad (A.28)$$

$$A_{i,t+1} = (1+r_t)A_{i,t} + w_{i,t}(X_{i,t}) - \tau_{i,t}(X_{i,t}) - c^w_{i,t}(X_{i,t}) \quad (A.29)$$

$$A_{i,t+1} = (1+r_t)A_{i,t} + z_{i,t}(X_{i,t}) - c^z_{i,t}(X_{i,t}). \quad (A.30)$$

$b_{i,t}(X_{i,t})$ denotes DI benefits of individual i in period t and can depend on the agent's state $X_{i,t}$. Analogously, $w_{i,t}(X_{i,t})$ denotes labor income, $\tau_{i,t}(X_{i,t})$ are taxes and $z_{i,t}(X_{i,t})$ denotes social welfare benefits. Agents make state contingent plans on how much to consume in each labor market state $\left\{c^b_{i,t}(X_{i,t}), c^w_{i,t}(X_{i,t}), c^z_{i,t}(X_{i,t})\right\}$, whether they apply to DI benefits $\alpha_{i,t}(X_{i,t}) \in \{0,1\}$ and, if not, on DI whether they work or claim social welfare benefits $\omega_{i,t}(X_{i,t}) \in \{0,1\}$.

The within-period sequence of events and choices is identical to the static model in Section 2. At the beginning of the period, the shocks $\theta_{i,t}$ and $\chi_{i,t}$ are revealed. Having learned $X_{i,t}$, she decides whether to file a DI application and, if accepted, becomes a DI beneficiary for the rest of her life.[41] If her application is rejected, she either resumes work or claims social welfare benefits, whatever yields higher utility. Note that the general model here also admits the possibility that $\theta^A \geq \theta^R$. This might occur for agents with low wage realization and low DI acceptance probabilities.

Denote by $D_{i,t}, W_{i,t}$ and $Z_{i,t}$, respectively, the probability that, in period t, agent i is a DI benefit recipient, an employed worker, or a social welfare recipient. These probabilities are given by

$$D_{i,t} = 1 - \left[\prod_{k=0}^{t} \left(1 - \alpha_{i,k}(X_{i,k}) \cdot p\left(\theta_{i,k}, \theta^*_k\right)\right)\right] \quad (A.31)$$

$$W_{i,t} = \omega_{i,t}(X_{i,t}) \left[\prod_{k=0}^{t} \left(1 - \alpha_{i,k}(X_{i,k}) \cdot p\left(\theta_{i,k}, \theta^*_k\right)\right)\right] \quad (A.32)$$

$$Z_{i,t} = \left(1 - \omega_{i,t}(X_{i,t})\right) \left[\prod_{k=0}^{t} \left(1 - \alpha_{i,k}(X_{i,k}) \cdot p\left(\theta_{i,k}, \theta^*_k\right)\right)\right]. \quad (A.33)$$

The probability agent i transitions to DI in period k is $\alpha_{i,k}(X_{i,k}) \cdot p\left(\theta_{i,k}, \theta^*_k\right)$. Hence, the probability that an agent is not yet on DI in period t is $\left[\prod_{k=0}^{t}\left(1 - \alpha_{i,k}(X_{i,k}) \cdot p\left(\theta_{i,k}, \theta^*_k\right)\right)\right]$. From this pool, $\omega_{i,t}(X_{i,t})$ of the non DI individuals work and $1 - \omega_{i,t}(X_{i,t})$ are on social welfare benefits.[42] We assume that the first application bears a fix cost ψ and follow-up applications are costless. $\Lambda_{i,t} = \alpha_{i,t}(X_{i,t}) \prod_{k=0}^{t-1}\left(1 - \alpha_{i,k}(X_{i,k})\right) \in 0,1$ indicates whether agent i applies for the first time in period t. The other state variables, disutility of work $\theta_{i,t}$ and $\chi_{i,t}$, follow stochastic processes that can, in principle, depend on agents' choices. The expectation operator $\mathbb{E}[\cdot]$ below captures the evolution of the state variables and encompasses aggregation across individuals and time.[43] The agent's problem is then given

[41] The assumption that DI is an absorbing state, is supported by the empirically observed negligibly low outflow rates, particularly among older workers.

[42] We assume that social welfare, unlike DI, is not an absorbing state. This implies that an agent who has not yet entered DI is "at risk" of being employed or being on social welfare in period k.

[43] The operator $\mathbb{E}[Y]$ aggregates the variable Y over states of nature and across individuals, i.e. $\mathbb{E}[Y] = \int\int Y(X_{i,t}) dF(X_{i,t}) di$ where $F(\cdot)$ is the distribution of state variables $X(i,t)$. Notice that this is a flexible formulation: the only restriction we impose on this distribution of state variables is that it does not directly depend on the planner's policy instruments $P = \{\theta^*_t, b_t\}_{t=0}^{T-1}$. The evolution of $X(i,t)$, however,

by

$$
\begin{aligned}
V_i(P) \quad = \quad & \max E\left[\sum_{t=0}^{T-1}\beta^t\left(v(c_{i,t}^b)\cdot D_{i,t}+v(c_{i,t}^z)\cdot Z_{i,t}+\left(u(c_{i,t}^w)-\theta_{i,t}\right)\cdot W_{i,t}-\Lambda_{i,t}\cdot\psi\right)\right] \\
& +E\left[\sum_{t=0}^{T-1}\beta^t\mu_{i,t}^D\left((1+r_t)A_{i,t}+b_{i,t}-c_{i,t}^b-A_{i,t+1}\right)D_{i,t}\right] \\
& +E\left[\sum_{t=0}^{T-1}\beta^t\mu_{i,t}^W\left((1+r_t)A_{i,t}+w_{i,t}-\tau_{i,t}-c_{i,t}^w-A_{i,t+1}\right)W_{i,t}\right] \\
& +E\left[\sum_{t=0}^{T-1}\beta^t\mu_{i,t}^Z\left((1+r_t)A_{i,t}+z_{i,t}-c_{i,t}^z-A_{i,t+1}\right)Z_{i,t}\right].
\end{aligned}
\tag{A.34}
$$

The social planner maximizes social welfare by choosing the strictness of DI eligibility θ_s^* and DI benefit function b_s in each period s. We denote this disability policy by $P=\{\theta_s^*,b_s\}_{s=0}^{T-1}$. The planner therefore solves

$$\max_P W(P)=\int_i V_i(P)di+\lambda\left(G(P)-\bar{G}\right) \tag{A.35}$$

where

$$G(P)=\int_i E\left[\sum_{t=0}^{T-1}(1+r_t)^{-t}\left(W_{i,t}\cdot\tau_{i,t}-D_{i,t}\cdot b_{i,t}-Z_{i,t}\cdot z_{i,t}\right)\right]di \tag{A.36}$$

is the planners net revenue, $\bar{G}$ is an exogenous revenue constraint and λ denotes the Lagrange multiplier on the planner's budget constraint.

Welfare Effects of DI Eligibility Rules and DI Benefits. The following propositions characterize the optimal DI policy $P=\{\theta_s^*,b_s\}_{s=0}^{T-1}$.

Proposition 1. *Assume the planner's budget constraint is differentiable in θ_s^*. Optimal strictness of DI eligibility rules in period s, θ_s^*, then fulfills*

$$1+\frac{\mathbb{E}\left[B(\theta_s^*)\right]}{\mathbb{E}\left[M(\theta_s^*)\right]}=\frac{\mathbb{E}\left[L_W\right]+\mathbb{E}\left[L_Z\right]}{\lambda\mathbb{E}\left[M(\theta_s^*)\right]} \tag{A.37}$$

where

$$\mathbb{E}\left[M(\theta_s^*)\right]\equiv\mathbb{E}\left[\sum_{t=s}^{T-1}(1+r_t)^{-t}\left(M_{W_{i,t}}\left(b_{i,t}+\tau_{i,t}\right)+M_{Z_{i,t}}\left(b_{i,t}-z_{i,t}\right)\right)\right] \tag{A.38}$$

is the mechanical fiscal effect and $\mathbb{E}\left[B(\theta_s^*)\right]\equiv\partial G(P)/\partial\theta_s^*-\mathbb{E}\left[M(\theta_s^*)\right]$ is the behavioral fiscal effect.

can depend on agent i's choices which themselves depend on the policy instruments P. We use the operator $E\left[Y_{i,t}\right]=\int Y(X_{i,t})dF(X_{i,t})$ to denote the expectation w.r.t. state variables for a given individual and the operator $\mathbb{E}\left[Y\right]$ to aggregate these expectations across individuals.

$M_{W_{i,t}}$ is the mechanical employment effect

$$M_{W_{i,t}} \equiv -\omega_{i,t}\left(\alpha_{i,s}\cdot\frac{\partial p(\theta_{i,s},\theta_s^*)}{\partial\theta_s^*}\prod_{k=0,k\neq s}^{t}\left(1-\alpha_{i,k}p_{i,k}\right)\right) \tag{A.39}$$

and $M_{Z_{i,t}}$ is the mechanical benefit substitution effect

$$M_{Z_{i,t}} \equiv -\left(1-\omega_{i,t}\right)\left(\alpha_{i,s}\cdot\frac{\partial p(\theta_{i,s},\theta_s^*)}{\partial\theta_s^*}\prod_{k=0,k\neq s}^{t}\left(1-\alpha_{i,k}p_{i,k}\right)\right). \tag{A.40}$$

$\mathbb{E}[L_W]$ and $\mathbb{E}[L_Z]$ denote the insurance losses for individuals who return to work and substitute to welfare benefits respectively and are defined by

$$\mathbb{E}[L_W] \equiv \mathbb{E}\left[\sum_{t=s}^{T-1}\beta^t\left(M_{W_{i,t}}\left(v(c_{i,t}^b)-\left(u(c_{i,t}^w)-\theta_{i,t}\right)\right)\right)\right] \tag{A.41}$$

$$\mathbb{E}[L_Z] \equiv \mathbb{E}\left[\sum_{t=s}^{T-1}\beta^t\left(M_{Z_{i,t}}\left(v(c_{i,t}^b)-v(c_{i,t}^z)\right)\right)\right]. \tag{A.42}$$

Proof. See Supplementary Material S.3. □

Proposition 2. *Assume the planner's budget constraint is differentiable in b_s for all periods s. The optimal DI benefit level in period s fulfills*

$$1+\frac{\mathbb{E}[B(b_s)]}{\mathbb{E}[M(b_s)]} = \frac{\mathbb{E}\left[v'(c_s^b)\right]}{\lambda\cdot\mathbb{E}[M(b_s)]} \tag{A.43}$$

where $\mathbb{E}[M(b_s)] \equiv \mathbb{E}\left[(1+r_s)^{-s}\left(D_{i,s}\right)\right]$ is the mechanical fiscal effect of adjusting DI benefits, $\mathbb{E}[B(b_s)] \equiv -\partial G(P)/\partial b_s - \mathbb{E}[M(b_s)]$ denotes the behavioral fiscal effect and $\mathbb{E}\left[v'(c_s^b)\right] \equiv \mathbb{E}\left[\beta^s D_{i,s}v'(c^b)\right]$.

Proof. See Supplementary Material S.3. □

Welfare Effect Stricter Eligibility Rules: Non-marginal Change. Analogous to the discussion in the static model, consider a discrete change in eligibility rules in period s from θ_s^L to $\theta_s^H > \theta_s^L$. To resemble our empirical setup, assume that strictness of DI eligibility is high, $\theta^* = \theta^H$, until age s and lenient afterwards. This is denoted by policy $P^L = (\theta_0^H,\ldots,\theta_{s-1}^H,\theta_s^L,\theta_{s+1}^L,\theta_{T-1}^*;b_0,\ldots,b_{T-1})$. The reform we study empirically increased the age of relaxed screening from s to $s+1$. This corresponds to policy $P^H = (\theta_0^H,\ldots,\theta_{s-1}^H,\theta_s^H,\theta_{s+1}^L,\theta_{T-1}^*;b_0,\ldots,b_{T-1})$. Let $a_{i,t}^H$ denote the application decision of individual i in period t if the policy is P^H and $a_{i,t}^L$ denote the application decision under policy P^L. The discrete welfare effect is

$$\begin{aligned}\Delta W &= W(P^H) - W(P^L) \\ &= \int_i V_i(P^H) - V_i(P^L) di + \lambda \left(G(P^H) - G(P^L) \right)\end{aligned} \tag{A.44}$$

assuming that λ is the same under both policies. We can again decompose the fiscal effect $G(P^H) - G(P^L)$ into the mechanical and behavioral fiscal effect. The mechanical fiscal effect is given by

$$\mathbb{E}\left[M_\Delta(\theta_s^*)\right] \equiv \mathbb{E}\left[\sum_{t=s}^{T-1} (1+r_t)^{-t} \left(M_{\Delta W_{i,t}} \left(b_{i,t} + \tau_{i,t}\right) + M_{\Delta Z_{i,t}} \left(b_{i,t} - z_{i,t}\right)\right)\right] \tag{A.45}$$

where $M_{\Delta W_{i,t}}$ is the mechanical employment effect

$$M_{\Delta W_{i,t}} \equiv \omega_{i,t} \left(\alpha_{i,s}^H \cdot \left[p_{i,s}^L - p_{i,s}^H\right] \prod_{k=0, k \neq s}^{t} \left(1 - \alpha_{i,k}^H p_{i,k}\right) \right) \tag{A.46}$$

and $M_{\Delta Z_{i,t}}$ is the mechanical benefit substitution effect

$$M_{\Delta Z_{i,t}} \equiv \left(1 - \omega_{i,t}\right) \left(\alpha_{i,s}^H \cdot \left[p_{i,s}^L - p_{i,s}^H\right] \prod_{k=0, k \neq s}^{t} \left(1 - \alpha_{i,k}^H p_{i,k}\right) \right). \tag{A.47}$$

The mechanical fiscal effect is, as in the static model, driven by always applicants, $\alpha_{i,s}^H = 1$ (those who apply under the strict rules at age s), and the change in their award probability $\left[p_{i,s}^L - p_{i,s}^H\right]$. The share of always applicants at age s is given by $\pi^{AA} = \mathbb{E}\left[\alpha_{i,s}^H \cdot \prod_{k=0}^{s-1}\left(1 - \alpha_{i,k}^H p_{i,k}\right)\right]$.[44] We define the behavioral fiscal effect as the residual $\mathbb{E}\left[B_\Delta(\theta_s^*)\right] \equiv \left(G(P^H) - G(P^L)\right) - \mathbb{E}\left[M_\Delta(\theta_s^*)\right]$. The behavioral fiscal effect is driven by changes in the application behavior and potential other changes in behavior (which might affect the whole state distribution $F(X_{i,t})$). Writing out the behavioral fiscal effect is cumbersome because many margins can change. Empirically, we follow the same strategy by estimating the total fiscal effect and the mechanical fiscal effect and then calculate the behavioral fiscal effect as the residual.

Similarly, we can write the insurance loss as

$$\int_i V_i(P^H) - V_i(P^L) di = \mathbb{E}\left[L_{\Delta W}\right] + \mathbb{E}\left[L_{\Delta Z}\right] + \mathbb{E}\left[L_{MA}\right] \tag{A.48}$$

where

$$\mathbb{E}\left[L_{\Delta W}\right] \equiv \mathbb{E}\left[\sum_{t=s}^{T-1} \beta^t \left(M_{\Delta W_{i,t}} \left(v_i(c_{i,t}^b) - \left(u_i(c_{i,t}^w) - \theta_{i,t}\right)\right)\right)\right] \tag{A.49}$$

$$\mathbb{E}\left[L_{\Delta Z}\right] \equiv \mathbb{E}\left[\sum_{t=s}^{T-1} \beta^t \left(M_{\Delta Z_{i,t}} \left(v_i(c_{i,t}^b) - v_i(c_{i,t}^z)\right)\right)\right] \tag{A.50}$$

[44] The share of marginal applicants is $\pi^{MA} = \mathbb{E}\left[\left[\alpha_{i,s}^L - \alpha_{i,s}^H\right] \cdot \prod_{k=0}^{s-1}\left(1 - \alpha_{i,k}^H p_{i,k}\right)\right]$.

and $\mathbb{E}\left[L_{MA}\right] \equiv \int_i V_i(P^H) - V_i(P^L)di - \mathbb{E}\left[L_{\Delta W}\right] - \mathbb{E}\left[L_{\Delta Z}\right] > 0$ is the utility loss associated with behavioral changes. The welfare effect of a discrete change is therefore $\Delta W \gtreqless 0 \Leftrightarrow$ if

$$1 + \frac{\mathbb{E}\left[B_\Delta(\theta_s^*)\right]}{\mathbb{E}\left[M_\Delta(\theta_s^*)\right]} \gtreqless \frac{\mathbb{E}\left[L_{\Delta W}\right] + \mathbb{E}\left[L_{\Delta Z}\right]}{\lambda \mathbb{E}\left[M_\Delta(\theta_s^*)\right]} + \frac{\mathbb{E}\left[L_{MA}\right]}{\lambda \mathbb{E}\left[M_\Delta(\theta_s^*)\right]}. \tag{A.51}$$

Relative Insurance Value Bounds with Non-marginal Change of DI Eligibility Rules. The idea of the upper bound from (14) also applies in the dynamic model for non-marginal changes in eligibility criteria. To see this, note that

$$\int_i V_i(P^H) - V_i(P^L)di \leq \mathbb{E}\left[\sum_{t=s}^{T-1} \beta^t \Delta DI_{i,t}\left(v_i(c_{i,t}^b) - v_i(c_{i,t}^z)\right)\right] \tag{A.52}$$

holds because of individual optimization. $\Delta DI_{i,t}$ is an indicator for individuals who are on DI under the lenient policy but no longer under the stricter policy because they are either mechanically screened out (always applicants) or decide to no longer apply (marginal applicants). $c_{i,t}^b$ and $c_{i,t}^z$ denote the consumption levels pre-reform under the lenient policy. The RHS of (A.52) therefore sums up the potential maximal utility loss, $v_i(c_{i,t}^b) - v_i(c_{i,t}^z)$, from period s onwards for individuals who are no longer on DI benefits because of the policy change, $\Delta DI_{i,t} = 1$. The idea of (A.52) is to bound the insurance loss by the loss of a lazy decision maker, who would not re-optimization despite the new policies in place. This lazy decision maker must be worse off than a decision maker who adapts to the new rules and reoptimizes. To see this more clearly we make the argument separately for always applicants and marginal applicants.

For the always-applicants there are two potential effects of the stricter rules. First, they might no longer qualify for DI. The maximal loss for them in this case is $v_i(c_{i,t}^b) - v_i(c_{i,t}^z)$ each period they are not on DI benefits, where consumption is measured at the pre-reform level. Second, they might change their behavior already before period s in anticipation of the stricter rules. For instance, they might save more (consume less or work more) to self-insure against the future loss in insurance. Such a change in behavior changes consumption levels before and after period s, and this change in behavior is costly and has direct welfare effects. However, the loss due to changes in behavior must be smaller than the loss $E\left[\sum_{t=s}^{T-1} \beta^t \Delta DI_{i,t}\left(v_i(c_{i,t}^b) - v_i(c_{i,t}^z)\right)\right]$. If it was not, the change in behavior could not have been optimal in the first place.

The same argument applies to the marginal applicants. They change their application behavior and potentially other behavior too in response to the policy and incur an insurance loss. However, their insurance loss must be smaller than $E\left[\sum_{t=s}^{T-1} \beta^t \Delta DI_{i,t}\left(v_i(c_{i,t}^b) - v_i(c_{i,t}^z)\right)\right]$. Again if it was not, the change in behavior could not have been optimal in the first place.

From (A.52) the dynamic version of bound (14) directly follows

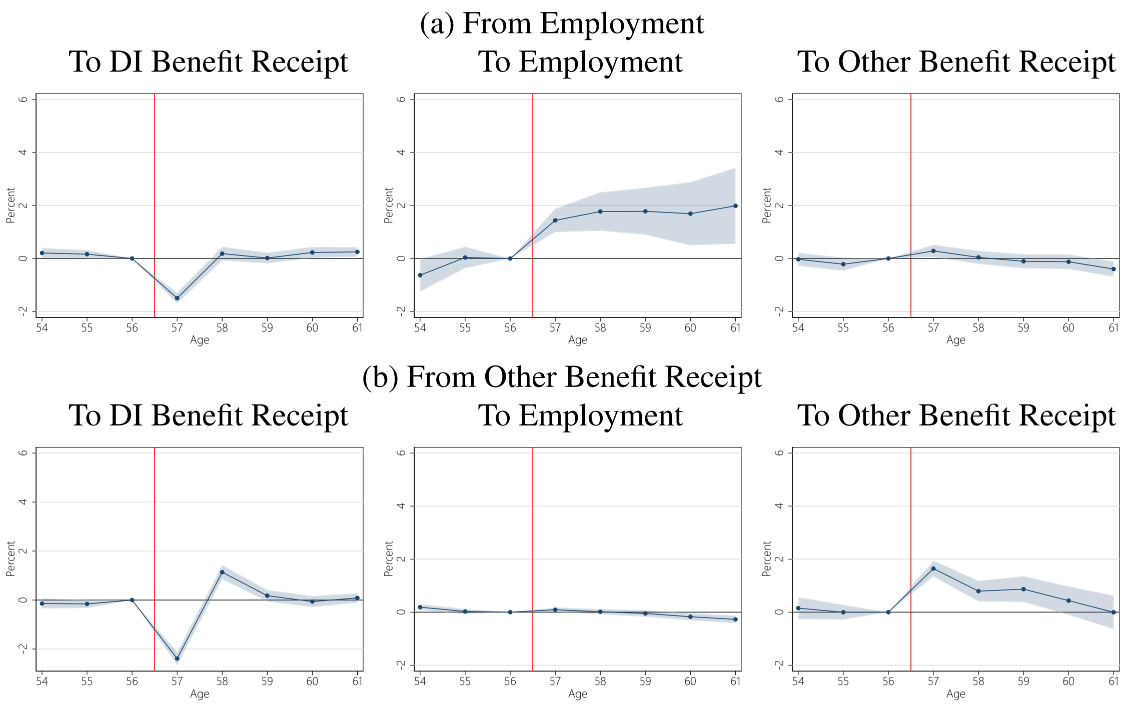
$$V_{\theta^*} \leq \frac{1}{\lambda}\mathbb{E}\left[\sum_{t=s}^{T-1} \beta^t v_i'(c_{i,t}^b) \frac{\Delta DI_{i,t}\left(b_{i,t} - z_{i,t}\right)}{\mathbb{E}\left[M_\Delta(\theta_s^*)\right]}\right]. \tag{A.53}$$

B Additional Results for Stricter DI Eligibility

B.1 Labor Market Transitions

Our estimates show that stricter DI eligibility rules increases employment and other benefit receipt. The increases can result either from changes in the inflow into employment or other benefit receipt, or from changes in the persistence in employment or other benefit receipt. To shed light on the importance of these two effects, we estimate the impact of the RSA increases on transitions from and persistence in employment and ohter benefit receipt. Figure B.2 plots the corresponding β_k-coefficients from equation (17) for the RSA-58 increase. The first column of panel (a) shows a drop in transitions from employment to DI receipt at age 57, where DI eligibility becomes stricter. However, we do not see more transitions from employment to DI when eligibility is relaxed again, suggesting fewer employed individuals enter the DI program overall. The middle column suggests that most of these individuals stay employed longer as we see a sharp increase in employment persistence from age 57 to 61. In contrast, the last column of panel a shows that transitions from employment to other benefits change little.

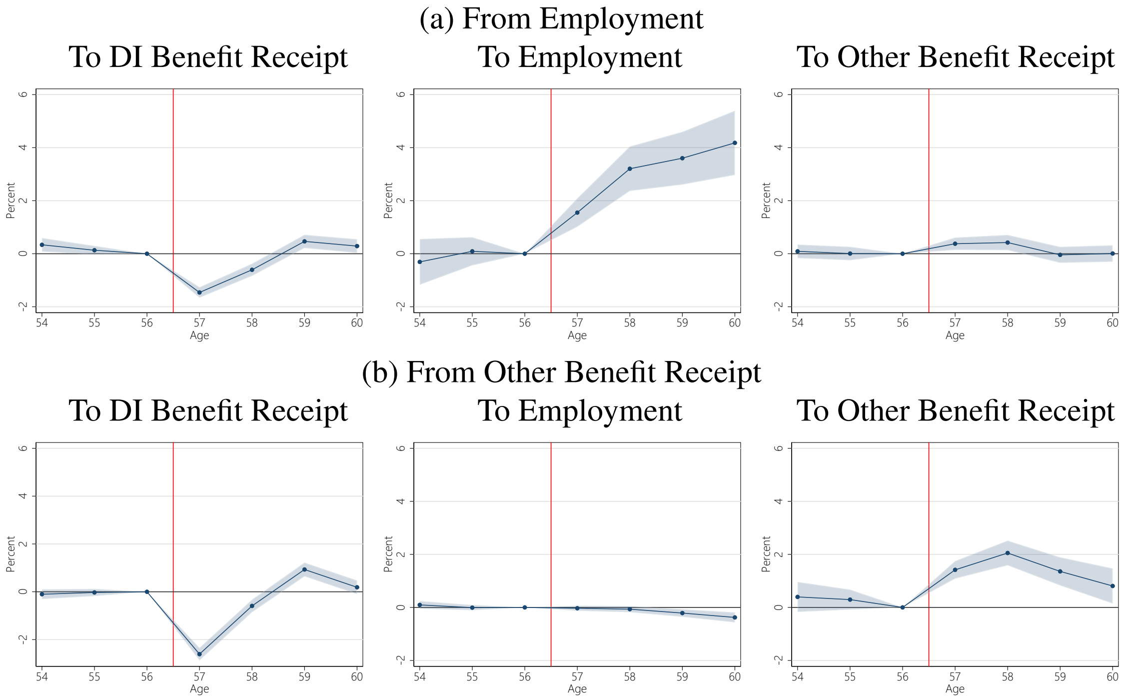
Figure B.2: RSA Effects on Transitions, RSA 58



Notes: The figure shows the estimated β_k-coefficients from the econometric specification in (17) for the RSA-58 increases using the sample of eligible men. The shaded area denotes the 95 percent confidence interval.

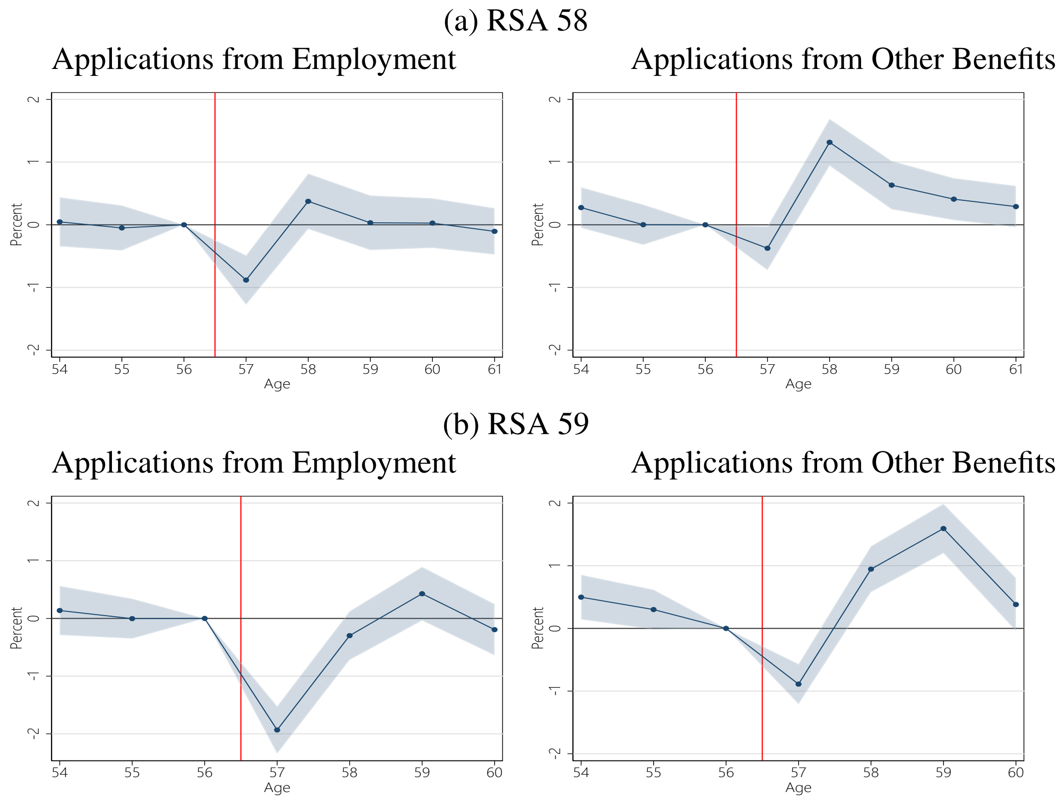
Panel (b) shows comparable figures for transitions out and persistence in other benefit receipt. As for employment, the first column shows a sharp drop in transitions from other benefits to DI at age 57 but also an increase in transitions to DI at age 58, suggesting that many individuals on other benefits postpone applying for DI by one year. Consistent with this idea, the middle column of panel b shows no effect on transitions from other benefits to employment. Instead, we see an increase in the persistence of other benefit receipt, particularly at age 57 (last column). The results are qualitatively identical for the RSA-59 increase but larger in magnitude because we consider a two-year increase in the RSA (Figure B.3). Overall, this analysis suggests that employment persistence is entirely driven by people who are already employed and now stay employed longer.

Figure B.3: RSA Effects on Transitions, RSA 59



Notes: The figure shows the estimated β_k-coefficients from the econometric specification in equation (17) for the RSA-58 increases using the sample of eligible men. The shaded area denotes the 95 percent confidence interval.

Figure B.4: Effects of RSA on Labor Market States and DI Application by Age



Notes: The figure shows the estimated β_k-coefficients from the econometric specification in equation (17) for the RSA-58 increases using the sample of eligible men. The shaded area denotes the 95 percent confidence interval.

We also shed light on which individuals are driving the permanent drop in applications. To this end, we construct two additional outcome variables: a dummy for applying at time t and being employed at time $t-1$ and a dummy for applying at time t and being on other benefits at time $t-1$. Since employment persistence is driven by those already employed, we would expect that this group also causes the drop in application rates. Consistent with this idea, panel (a) of Figure B.4 shows that, among the employed, the RSA-58 increase induces a significant drop in applications at age 57 but no increase in applications at later ages; they do not apply anymore when the RSA is relaxed again. Conversely, among those on other benefits, we see almost no drop in application rates at age 57 and a significant increase at age 58 and beyond. Yet, application rates for the full sample are still lower at age 58 (as Figure 2 in the paper shows) because the share of people on other benefits is much smaller than the share of people in employment. As panel (b) shows, patterns look qualitatively similar for the RSA-59 increase, but the magnitudes are larger.

Figure B.5: Effects of RSA 59 on Labor Market States and DI Application by Age

Notes: The figure shows the estimated β_k-coefficients from the econometric specification in equation (17) for the RSA-59 increases using the sample of eligible men. The shaded area denotes the 95 percent confidence interval.

B.2 Main Empirical Estimates for RSA-59

This section presents the main empirical estimates of the RSA-59 increase. We run the same DID specification as for the RSA-58 increase (equation 17), but use the RSA-59 cohort as the treated cohort instead of the RSA-58 cohort. Figure B.5 shows the estimated β_k-coefficients for the key labor market outcomes (shaded areas denote the 95 percent confidence interval). We estimate the effects up to age 60, the last age we can observe the RSA-59 cohort in our data.

Overall, the patterns are qualitatively similar to those of the RSA-58 increase but the effect magnitude is larger. The estimates before the pre-reform RSA of 57 are always close to zero and statistically insignificant, but then start to diverge from age 57 onwards. We see large and permanent drops in DI benefit receipt and DI applications and permanent increases in employment and other benefit receipt. Table B.1 reports the average effects for the outcomes from Figure B.5 between ages 57 and 60 as well as the corresponding fiscal impacts. The estimated effects are almost twice as large as the estimates for the RSA-58 increase.

Table B.1: Average Effect of Stricter DI Eligibility Rules RSA-59

Labor market effects (%-points)			Fiscal effects (Euro)		
	Estimate	Mean		Estimate	Mean
DI benefit receipt	-4.94***	17.3	DI benefits	-1793***	6245
	(0.43)		(A)	(159)	
Application ever	-2.86***	20.29	Tax revenue	428***	11625
	(0.36)		(B)	(64)	
Employment	3.19***	71.59	Other benefits	450***	1182
	(0.43)		(C)	(64)	
Other benefit receipt	2.19***	7.3	Total fiscal effect	-1770***	-4199
	(0.31)		(A-B+C)	(186)	
No. Observations	2,176,311			2,176,311	

Notes: The table reports the average effect of the RSA for the ages above age 56. The estimates are constructed by taking the average of the β_k-coefficients from equation (17) for $k \geq 57$. *Mean* denotes the mean above the RSA for the RSA-57 cohort. Fiscal effects are reported in 2018 Euro. Standard errors are reported in parentheses and are clustered within birth year, birth month, and state of residence. Levels of significance: *10%, **5%, and ***1%.

B.3 Spousal Responses to Stricter DI Eligiblity

A growing literature studies the role of the family in sharing risks and smoothing consumption to adverse income shocks (see, e.g., Blundell et al., 2016). In this section, we examine whether the spouses respond to the changes in DI eligibility rules. We focus on spouses for whom we can match a men from the main sample (56.5% of men in our sample). We then follow those spouses when the husband is between 54 to 61 years old—the age window we consider in the main analysis. To estimate the impact of stricter eligiblity rules, we estimate the same regression as for the main sample (equation 17) using the same outcome variables but this time for the spouse (e.g., employment of the spouse). Since the RSA increases may affect some spouses directly, we also run a specification that includes interaction terms of the spouses' age in years times the spouses' birth-year month.

Figure B.6 plots the estimated β_k-coefficients for different outcomes, separately for the RSA-58 increase (left column) and the RSA-59 increase (right column). The shaded area denotes the 95 percent confidence interval. The point estimates are always quantitatively small and statistically insignificant. Table B.2 shows the average effect on spouses when the husband is between 57 to 61 years old (57 to 60 years old for the RSA-59 change). Consistent with graphical evidence, the average effects are small and statistically insignificant. The only exception is a statisticaly significant increase in DI benefits for RSA-58, but the estimate is roughly 15 times smaller than for the main sample. We also find that the fiscal multiplier does not change in a meaningful way when accounting for spousal fiscal impact. For RSA-58 it is 2.5 without and 2.7 with spousal responses; for RSA-59 it is 2.03 without and 2.09 with spousal responses.[45]

Moreover, Figure B.7 shows that RSA increases have the same labor market and financial impacts for all men, married men (men for whom we can merge a spouse), and the household (married men and their spouses), implying that the fiscal effects of all men are representative for married men. This finding

[45]The RSA-58 fiscal multiplier with spousal responses is 1+(976+80-391)/391 where 976 is the total fiscal effect for men, 80 is the total spouscal fiscal effect, and 391 is the mechanical fiscal effect. The RSA-59 fiscal multiplier with spousal responses is calculated in the same way.

Table B.2: Average Effect of Men's Stricter DI Eligibility Rules on Spouses

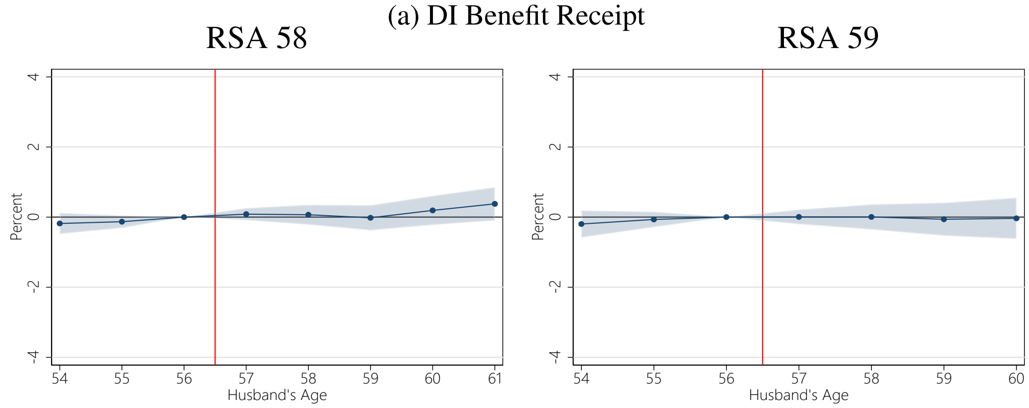
	RSA 58			RSA 59		
	Main controls	Augmented controls	Mean	Main controls	Augmented controls	Mean
A. Spousal labor market effects (%-points)						
DI benefit receipt	0.23	0.14	5.82	0.07	-0.02	5.67
	(0.14)	(0.15)		(0.18)	(0.20)	
DI application ever	0.14	0.09	8.35	-0.10	-0.09	7.98
	(0.18)	(0.18)		(0.19)	(0.22)	
Employment	0.17	0.28	54.19	-0.34	-0.07	56.84
	(0.38)	(0.38)		(0.51)	(0.45)	
Other benefit receipt	0.20	0.27	4.07	0.03	0.16	4.11
	(0.19)	(0.20)		(0.24)	(0.26)	
B. Spousal fiscal effects (Euro)						
DI benefits	68⋆⋆	59⋆	920	34	23	886
(A)	(29)	(30)		(37)	(42)	
Tax revenue	11	10	3,202	-18	7	3,346
(B)	(26)	(26)		(35)	(33)	
Other benefits	23	31	349	22	26	352
(C)	(20)	(21)		(26)	(29)	
Total fiscal effect	80⋆	80⋆	-1,932	75	43	-2,109
(A-B+C)	(45)	(47)		(63)	(67)	
No. Observations		1,380,530			1,232,600	

Notes: The table reports the average effect of the RSA for the ages above age 56. The estimates are constructed by taking the average of the β_k-coefficients from equation (17) for $k \geq 57$. The specification with base controls is the same as in equation (17). The specification with augmented also includes year-month of birth times age in year interaction terms for the spouse to control for the possibility that some spouses are directly treated by the RSA reforms. *Mean* denotes the mean above the RSA for the RSA-57 cohort. Fiscal effects are reported in 2018 Euro. Standard errors are reported in parentheses and are clustered within birth year, birth month, and state of residence. Levels of significance: ⋆10%, ⋆⋆5%, and ⋆⋆⋆1%.

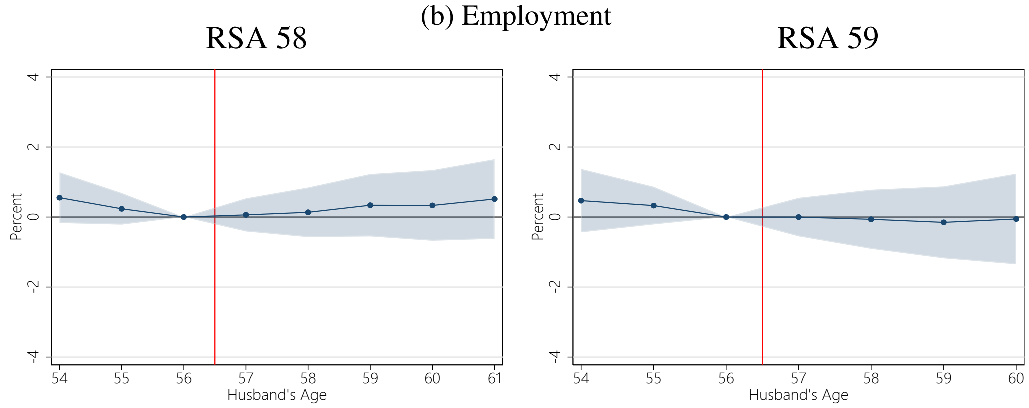
is important because we use spousal labor supply responses to estimate the insurance value of stricter disability eligibility criteria relative to lower benefits. This strategy identifies the insurance losses of married men.

Figure B.6: Effects of RSA by Age, Spouses

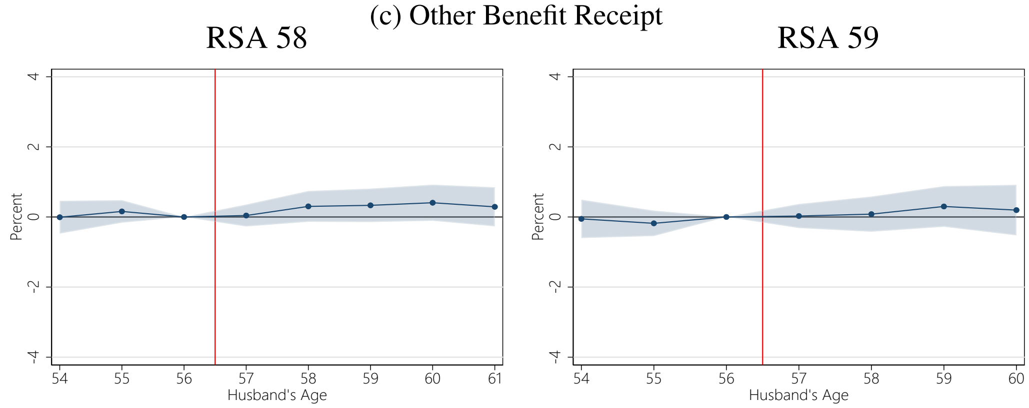
(a) DI Benefit Receipt



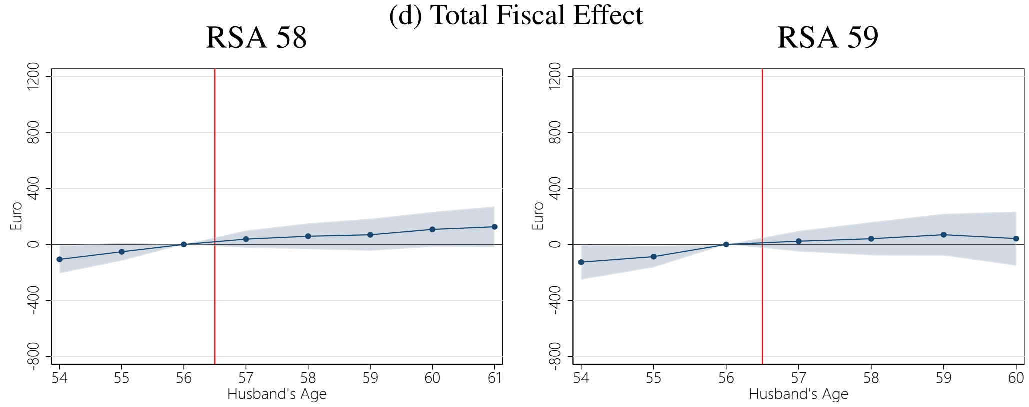
(b) Employment



(c) Other Benefit Receipt



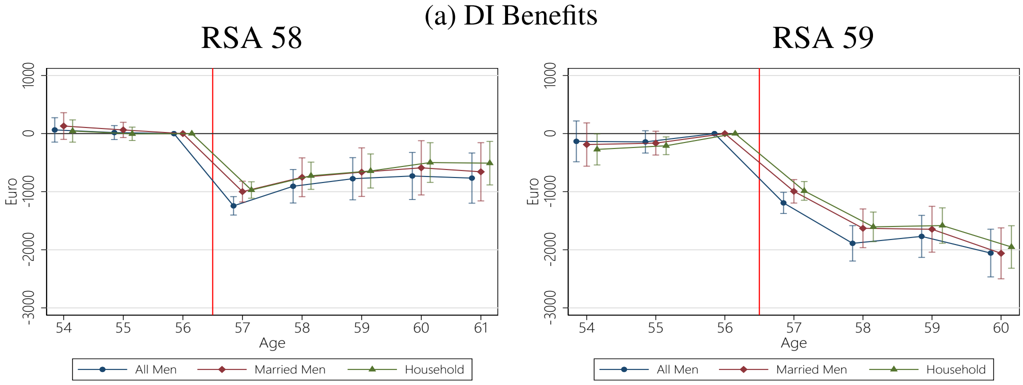
(d) Total Fiscal Effect



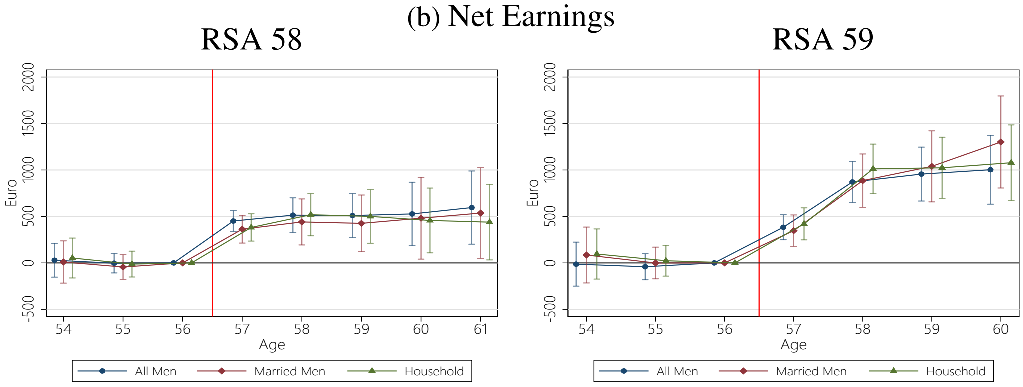
Notes: The figure shows the estimated β_k-coefficients from the econometric specification in equation (17) for the RSA 58 and RSA 59 increases using the sample of spouses. The shaded area denotes the 95 percent confidence interval.

Figure B.7: Fiscal Effects of RSA for All Men, Married Men, and the Household

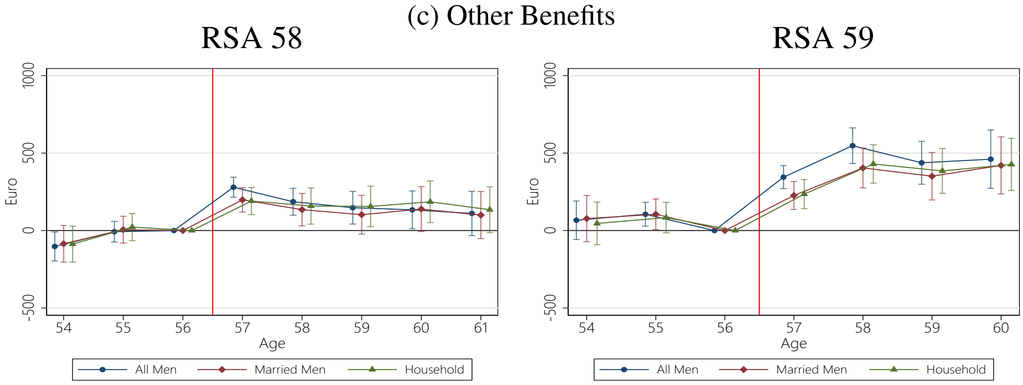
(a) DI Benefits



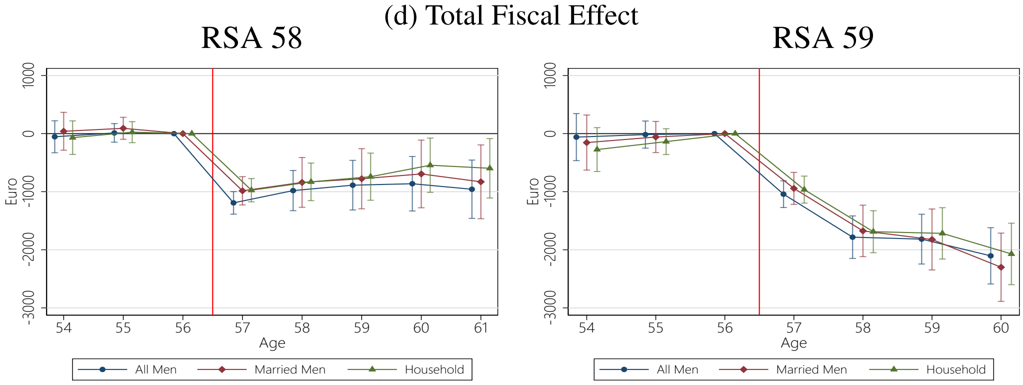
(b) Net Earnings



(c) Other Benefits



(d) Total Fiscal Effect



Notes: The figure shows the estimated β_k-coefficients from the econometric specification in equation (17) for the RSA-58 increases using the sample of eligible men, married men (=men for whom we can match a spouse), and the household (=married men and spouses). The shaded area denotes the 95 percent confidence interval.

C Additional Results for Lower DI Benefits

C.1 Empirical Estimates for 30-56 Year Old Individuals

Table C.3 reports the labor market and fiscal impacts of lower DI benefits for 30-56-year-old individuals from estimating equation (19). The qualitative patterns are similar to those for 57-60-year-old individuals (Table 2) but the magnitude of the effects is about 10-15 times smaller.

Table C.3: Average Effect of Benefit Generosity for 30-56 Year Old Individuals

Labor market effects (%-points)			Fiscal effects (Euro)		
	Estimate	Mean		Estimate	Mean
DI application ever	0.014***	2.75	DI benefits	2.26***	324
	(0.003)		(A)	(0.26)	
DI inflow	0.003***	1.76	Payroll taxes	-0.19***	10,322
	(0.001)		(B)	(0.07)	
Employment outflow	<0.001	88.33	Other benefits	-1.27***	1,630
	(0.001)		(C)	(0.24)	
Other benefit outflow	0.003***	9.91	Behavioral fiscal effect	1.18***	-8,368
	(0.001)		(D=A-B+C)	(0.18)	
Observations	15,968,003			15,968,003	

Notes: The table reports estimates for γ from the econometric specification in (19). Fiscal effects are reported in annual 2018 Euros. *Mean* denotes the mean in levels for the year 2004. Standard errors are reported in parentheses and are clustered within birth year and birth month. Levels of significance: *10%, **5%, and ***1%.

C.2 Spousal Responses to Lower DI Benefits

We construct an analogous spousal sample to examine the impact of lower DI benefits on spousal (see Supplementary Material Table T.9 for summary statistics). We then estimate the main regression for benefit generosity using as spousal labor market and fiscal outcomes as outcome variables. Table C.4 shows the corresponding estimates. Similar to changes in eligibility criteria, we find that changes in benefit generosity have no impact on spousal labor market or fiscal outcomes. Since the sample is smaller than the screening sample, the estimates are somewhat less precise. Still, they are quantitatively small and do not change the fiscal multipliers in a meaningful way: the fiscal multiplier for benefit generosity is 1.41 without and 1.46 with spousal responses. [46]

D Estimating the Fiscal Multiplier of DI Reforms

D.1 Complier Analysis Stricter Eligibility Rules

In this section, we describe the complier analysis for difference-in-differences settings, as outlined in De Chaisemartin and D'Haultfoeuille (2018); Jäger et al. (2019), to study the characteristics of marginal, always, and never applicants. We follow the same steps to study the characteristics of marginal, always,

[46] The benefit generosity fiscal multiplier with spouses is calculated as 1+(18.69+2.07)/45.16, where 18.69 is the behavioral fiscal effect of men, 2.07 is the behavioral fiscal effect of spouses, and 45.16 is the mechanical fiscal effect.

Table C.4: Average Effect of Benefit Generosity for Spouses of 57-60 Year Old Men

Labor market effects (%-points)			Fiscal effects (Euro)		
	Estimate	Mean		Estimate	Mean
DI application ever	0.008	9.88	DI benefits	0.32	776
	(0.030)		(A)	(2.37)	
DI inflow	-0.031*	7.98	Payroll taxes	-0.80	5,669
	(0.019)		(B)	(0.83)	
Employment outflow	-0.014	74.29	Other benefits	1.58	675
	(0.012)		(C)	(2.02)	
Other benefit outflow	-0.017	5.72	Behavioral fiscal effect	2.07	-4,219
	(0.013)		(D=A-B+C)	(2.15)	
Observations	532,487			532,487	

Notes: The table reports estimates for γ from the econometric specification in equation (19). The sample consists of spouses whose husband is between 57-60 years old. The time period is 2004-2017. Fiscal effects are reported in annual 2018 Euros. *Mean* denotes the mean in levels for the year 2004. Standard errors are reported in parentheses and are clustered within birth year and birth month. Levels of significance: *10%, **5%, and ***1%.

and never enrollees. We focus here on the complier characteristics of the RSA-58 increase. Supplementary Material W.1 provides the formal framework and the results for the RSA-59 increase.

Table D.5 shows the population shares and average characteristics of marginal applicants and , always applicants and enrollees, and never applicants and enrollees for the RSA-58 change. We estimate a share always applicants $\pi^{AA} = 0.070$ (among individuals aged 57). The shares of marginal and never applicants are $\pi^{MA} = 0.014$ and $\pi^{NA} = 0.916$. Marginal applicants are less likely to be on sick leave at age 56 than always applicants. This is important in the present context because being on sick leave is a good proxy for underlying health problems. Marginal and always applicants have similar average earnings in the best 15 years, though at age 56 the labor market attachment of marginal applicants is stronger than the one of always applicants: 73 % of marginal applicants are employed at age 56, compared to 60 % of always applicants and 87 % of never applicants. Marginal applicants are more likely to be blue-collar workers and are more likely to apply with a musculoskeletal impairment, consistent with low-skilled/manual workers experiencing the largest relaxation in disability eligibility when reaching the RSA. [47]

D.2 Pre-57 Applicants: Representative for Always Applicants?

Here, we provide further evidence that pre-57 applicants are representative for always applicants. First, if pre-57 applicants are representative for always applicants, stricter DI eligibility rules should *not* change their application behavior. Indeed, Panel (a) of Figure D.8 shows that pre-57 applicants in the RSA-58 cohort who face strict eligiblity rules at age 57 are equally likely to apply for DI at age 57 than those in the RSA-57 cohort, but they are less likely to be awarded benefits. After age 57, we see significant increases in DI applications (and DI inflow) in the RSA-58 cohort, which aligns with the dynamics in the theoretical model: If more applicants are mechanically screened out today, more will reapply tomorrow. Panel (b) shows similar patterns for the RSA-59 cohort.

Second, we focus on the RSA-58 cohort and compare key characteristics of age-57 applicants with pre-57 applicants who re-apply age 57. Age-57 applicants are always applicants, since eligibility is strict at age 57. Hence, this comparison reveals whether age-57 always applicants among pre-57 applicants

[47] The analogous results for the RSA-59 change resemble qualitatively the results for the RSA-58 change. This is shown in Supplementary Material Table W.11.

Table D.5: Applicant characteristics, RSA 58

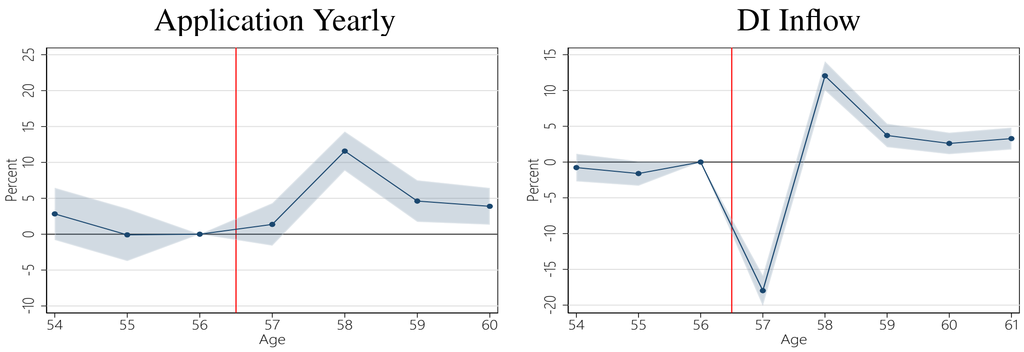
	Marginal M	Always A	Difference M-A	Never N	Difference M-N
Share in population	1.44⋆⋆⋆	7.00⋆⋆⋆	-5.56⋆⋆⋆	91.56⋆⋆⋆	-90.13⋆⋆⋆
(in %)	(0.13)	(0.11)	(0.22)	(0.06)	(0.17)
Applied before Age 57	16.43⋆⋆⋆	35.60⋆⋆⋆	-19.17⋆⋆⋆	10.59⋆⋆⋆	5.83
(in %)	(3.84)	(0.58)	(4.27)	(0.07)	(3.84)
Sick Leave at age 56	0.93	9.64⋆⋆⋆	-8.71⋆⋆⋆	1.03⋆⋆⋆	-0.10
(in %)	(1.87)	(0.30)	(2.11)	(0.02)	(1.87)
Unemployed at age 56	21.09⋆⋆⋆	26.02⋆⋆⋆	-4.93	4.92⋆⋆⋆	16.17⋆⋆⋆
(in %)	(3.38)	(0.59)	(3.89)	(0.04)	(3.38)
Employed at age 56	72.99⋆⋆⋆	60.28⋆⋆⋆	12.71⋆⋆⋆	86.57***	-13.58⋆⋆⋆
(in %)	(3.85)	(0.65)	(4.40)	(0.07)	(3.86)
Avg. annual earnings	41,183⋆⋆⋆	40,894⋆⋆⋆	289	46,074⋆⋆⋆	-4,891⋆⋆⋆
(Euro)	(791)	(146)	(918)	(27)	(792)
Potential DI benefits	2,413⋆⋆⋆	2,392⋆⋆⋆	20	2,677⋆⋆⋆	-264⋆⋆⋆
(per month)	(49)	(9)	(56)	(2)	(49)
Potential UI benefits	1,214⋆⋆⋆	1,478⋆⋆⋆	-264⋆⋆⋆	1,785⋆⋆⋆	-571⋆⋆⋆
(per month)	(65)	(10)	(73)	(2)	(65)
Blue-collar	93.26⋆⋆⋆	81.35⋆⋆⋆	11.91⋆⋆⋆	55.29⋆⋆⋆	37.98⋆⋆⋆
(in %)	(3.59)	(0.63)	(4.12)	(0.12)	(3.60)
Married	53.01⋆⋆⋆	47.21⋆⋆⋆	5.80	57.08⋆⋆⋆	-4.07
(in %)	(4.34)	(0.76)	(5.00)	(0.12)	(4.35)
Musculoskeletal	59.52⋆⋆⋆	43.89⋆⋆⋆	15.63⋆⋆⋆		
(in %)	(4.57)	(0.77)	(5.23)		
Mental	15.27⋆⋆⋆	14.28⋆⋆⋆	0.99		
(in %)	(3.44)	(0.64)	(4.02)		
Other	25.21⋆⋆⋆	41.83⋆⋆⋆	-16.62⋆⋆⋆		
(in %)	(4.66)	(0.77)	(5.33)		

Notes: The table reports the population shares and average characteristics of marginal applicants, always applicants, and never applicants for the RSA-58 increase. We derive these estimates using the complier analysis for difference-in-differences settings described in Supplementary Material W.1. Earnings are reported in 2018 Euros. Avg. annual earnings measures the average earnings of the best 15 years. Bootstrapped standard errors are reported in parentheses. Levels of significance: ⋆10%, ⋆⋆5%, and ⋆⋆⋆1%.

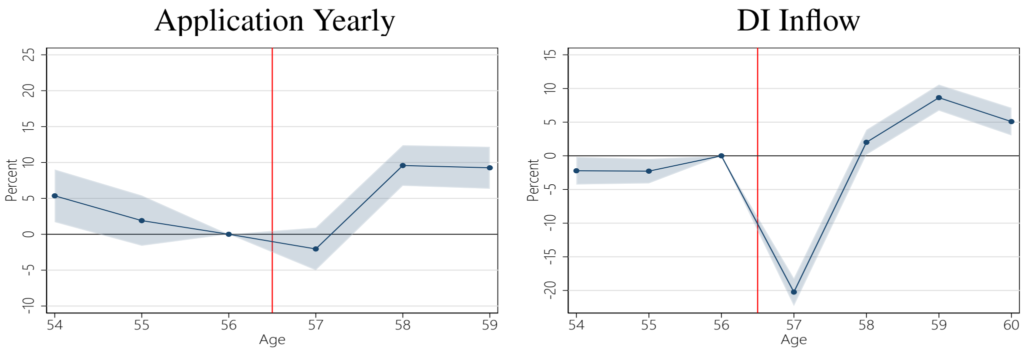
are comparable to all age-57 always applicants. Panel (a) of Figure D.9 shows that trends in DI benefit receipt and the total fiscal effect are almost the same for the two groups in the 15 quarters after the DI application at age 57. Panel (b) shows that pre-57 applicants are also representative for always applicants in the RSA-59 cohort.

Figure D.8: Effect of RSA on DI Application Yearly and DI Inflow by Age for Pre-57 Applicants

(a) RSA-58 Increase



(b) RSA-59 Increase



Notes: The figure shows the estimated β_k-coefficients from the econometric specification in (17) for the RSA-58 increase (panel a) and the RSA-59 increase (panels b) using the sample of pre-57 applicants. Pre-57 applicants comprise individuals who have applied for DI between age 50 and age 56. The shaded area denotes the 95 percent confidence interval.

D.3 Robustness of the Mechanical Effect and the Fiscal Multiplier

Table D.6 reports estimates of the mechanical effect and the fiscal multiplier for alternative specifications and samples. Overall, the analysis suggests that the mechanical and fiscal effects are robust. If at all, our main specification overestimates the mechanical effect and underestimates the fiscal multiplier.

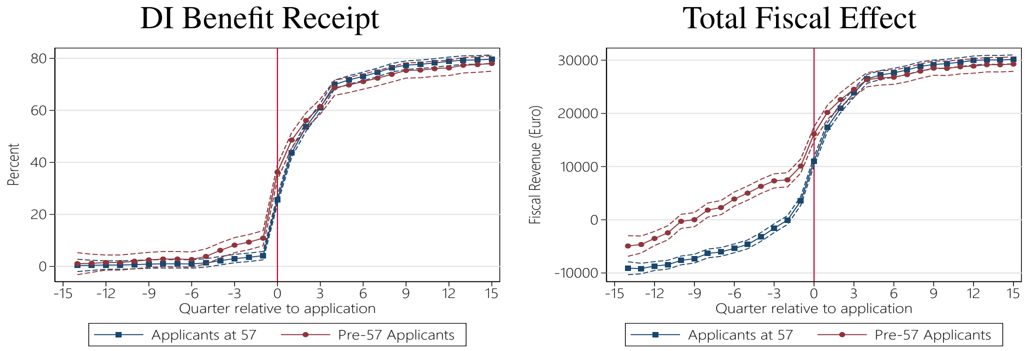
The main specification, reprinted in the first row of Table D.6, controls for some individual and region-specific characteristics (average earnings over the best 15 years at age 54, number of insurance years at age 54, number of years employed by age 54, number of years unemployed by age 54, and indicators for region, industry, and having ever been on sick leave by age 54). We exclude these additional controls in the specification "base controls" and obtain almost identical estimates. In contrast, the specification "augmented controls" does the opposite and adds an even richer set of controls for health and employment histories[48] We again get estimates that are similar to those in the main specification.

We also explore the robustness for different samples. First, instead of using Pre-57 applicants as the main specification, we focus on individuals with a sick leave spell at age 56. As previous studies on

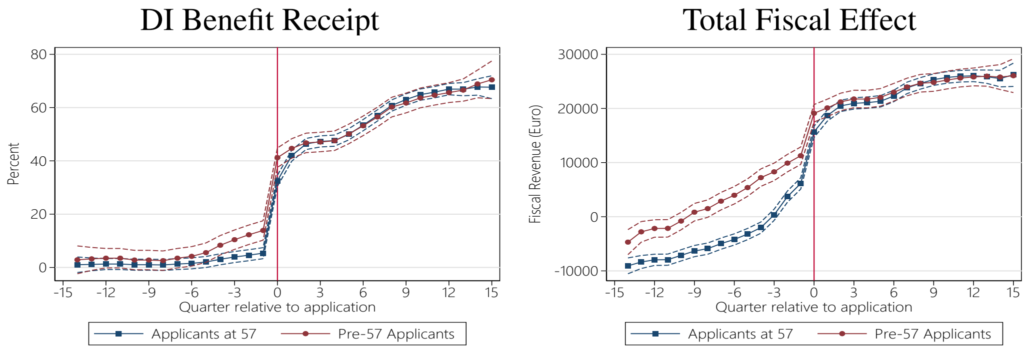
[48]Baseline controls as in the main specification plus a fourth-order polynomial in average earnings over the best 15 years at age 54, a fourth-order polynomial in insurance years at age 54, earnings at age 56, the number of contribution years in the last 15 years at age 56, separate indicators for whether an individual has applied for disability benefits at age 56 with a mental impairment or a musculoskeletal impairment, and separate indicators for whether an individual is employed or on sick leave at age 56.

Figure D.9: Comparison of Applicants at 57 and Pre-57 Applicants in RS-58 Cohort

(a) RSA-58 Cohort



(b) RSA-59 Cohort



Notes: Panel (a) focuses on the RSA-58 cohort and compares trends in DI benefit receipt and the total fiscal effect for applicants at age 57 (always applicants) and pre-57 applicants who reapply at age 57. Panel (b) shows analogous figures for the RSA-59 cohort. The comparison shows that the two groups are very similar in outcomes after their application at age 57.

Austria show, the onset of a sick leave spell is a good proxy for a health shock and is highly predictive of future DI benefit receipt (e.g., Staubli 2011; Manoli and Weber 2016). Moreover, the complier analysis shows that the share of people on sick leave at age 56 is significantly higher among always applicants than marginal applicants: 1 percent for marginal applicants (statistically insignificant) and around 10 percent for always applicants. Consequently, individuals with a sick leave spell at age 56 are mainly always applicants. As the specification "sick leave at age 56" shows, we find smaller mechanical effects and larger fiscal multipliers for this sample. Yet, we cannot reject the null hypothesis that they are statistically the same as the main estimates.

As a final robustness test, we implement an exact matching approach. Specifically, we start by limiting the sample to individuals who apply for DI benefits at age 57 for the RSA-58 increase and ages 57 or 58 for the RSA-59 increase. In the treatment group, these applicants correspond to always applicants because they face strict eligibility rules at age 57 for the RSA-58 increase and ages 57 and 58 for the RSA-59 increase. In the control group, these applicants consist of both always and marginal applicants because they face lenient eligibility rules at these ages. To make the two groups comparable, we use exact matching. We select for each treated applicant an applicant in the control group that looks observationally equivalent based on a set of background characteristics.[49] The last row shows that the exact matching yields similar estimates as the main specification: The mechanical effect is slightly larger for RSA 58 (401 Euros) and somewhat smaller for RSA 59 (733 Euros).

[49]The decile of average earnings over the best 15 years at age 56, the decile of insurance years at age 56, the decile of the number of employment years at age 56, blue-collar status, having an employment spell at age 56, having applied with a musculoskeletal impairment at age 57, and having applied with an impairment at age 57 other than musculoskeletal or mental.

Table D.6: Fiscal Multiplier for Eligibility Rules, Robustness Tests

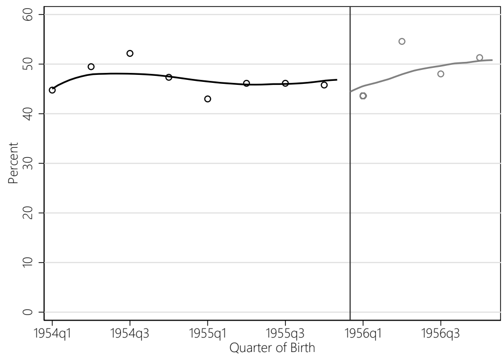
	RSA 58		RSA 59	
	Mechanical Effect (M)	Multiplier (1+B/M)	Mechanical Effect (M)	Multiplier (1+B/M)
Main specification	−391⋆⋆	2.50	−871⋆⋆⋆	2.03
	(153)		(192)	
Base controls	−396⋆⋆	2.46	−871⋆⋆⋆	2.03
	(155)		(191)	
Augmented controls	−374⋆⋆	2.61	−856⋆⋆⋆	2.07
	(152)		(194)	
Sick leave at age 56	−306⋆⋆	3.19	−734⋆⋆	2.41
	(152)		(226)	
Age-57 applicants, matching	−401⋆⋆⋆	2.43	−733⋆⋆⋆	2.41
	(67)		(84)	

Notes: Table presents estimates of the mechancial effect and the fiscal multiplier of stricter eligibility rules for different specifications. "Main sample" estimates the mechancial effect using the pre-57 applicants and conrolling for the baseline covariates described in the main text. "Base controls" uses pre-57 applicants but only includes age-in-years, year-month of birth, and year fixed effects. "Additional controls" uses pre-57 applicants and baseline controls but also controls more flexibly for labor market history before age 57 (see text for details). "Sick leave at age 56" only uses individuals who are on sick leave at age 56. "Age-57 applicants, matching" uses applicants at age 57 and an exact matching approach to make the treatment and control groups comparable (see text for details). We always re-scaled the mechanical effect by the population share of always applicants. The behavioral fiscal effect is the total fiscal effect minus the mechanical fiscal effect.

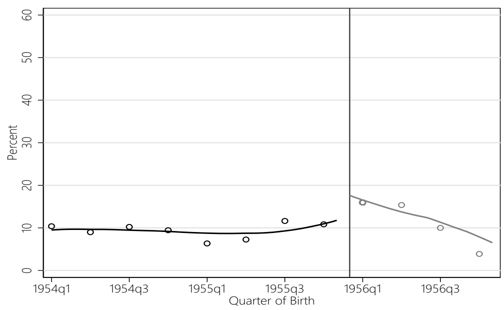
E Estimating the Relative Insurance Values

Figure E.10: Spousal Labor Supply Patterns

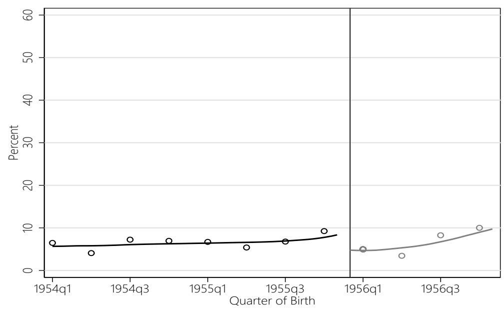
(a) Spousal Labor Force Participation



(b) Spousal DI Take-up



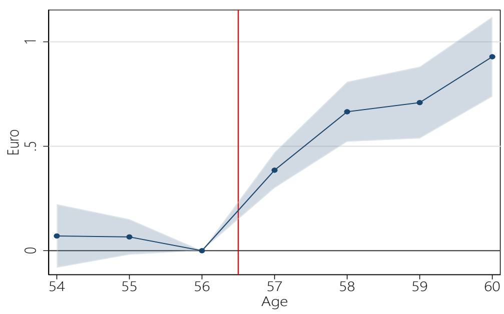
(c) Spousal Other Benefits Take-up



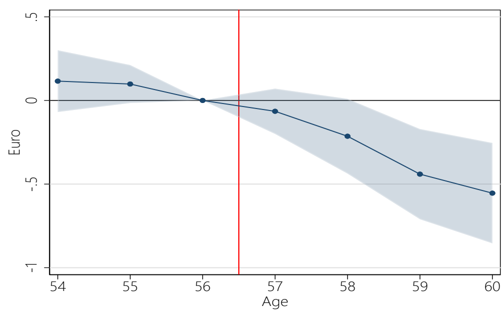
Notes: The figure plots average spousal labor market outcomes at husbands age 57-61 for husband who enters DI at age 57 by quarter of birth (the lines represent local linear regressions with a bandwith of 12 months). Panel (a) shows that there is no clear discontinuity for spousal labor force participation. Panel (b) and (c) plot spousal DI and other welfare benefit take-up.

Figure E.11: Insurance Value Bounds Estimation for RSA-59 Change

(a) Estimate IP1



(b) Estimate IP2



Notes: The figure shows the estimated β_k-coefficients from the econometric specification in (17) for IP 1 and IP 2 defined in equation (20). The shaded area denotes the 95 percent confidence interval.