Optimal Design of Asset-Tested Transfer Programs*

Andreas Peichl, Dominik Sachs & Daniel Weishaar

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Abstract

Asset means testing regulations are a recurring but controversial feature of transfer programs in modern welfare states. In this project, we derive conditions for the optimal design of asset-tested transfer programs which are based on reduced-form elasticities. The optimal level of asset testing trades-off the benefits from targeting redistribution to individuals in need against the tax revenue changes implied by labor supply and savings reactions. As an empirical application, we plan to provide a quantification of the German basic income support system and seek to outline avenues for welfare-improving reforms. In contrast to previous work, our study will discuss the potential of non-standard asset testing rules which depend on age, the employment history, the duration of unemployment and the asset type.

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* **Peichl**: ifo Munich and University of Munich (peichl@econ.lmu.de); **Sachs**: University of Munich (dominik.sachs@econ.lmu.de **Weishaar**: University of Munich (daniel.weishaar@econ.lmu.de).

1 Introduction

Asset means testing regulations represent a standard tool of targeting welfare programs to individuals in need. In the European Union alone, 22 out of 27 countries make the provision of transfers explicitly contingent on wealth.[1] These asset testing regulations channel scarce public funds in line with the needs-based principle of social justice, but introduce distortions to labor supply and capital accumulation (Hubbard et al. 1995; Wellschmied 2021). The standard optimal taxation literature disregards these particularities, because it is usually assumed that the government provides a demogrant to all individuals (Diamond 1998; Mirrlees 1971; Saez 2001). This project seeks to take the real-world feature of asset testing seriously and study its consequences through the lens of an optimal taxation problem with unobserved heterogeneity.

In a first step, we derive sufficient statistics for the optimal design of asset tested welfare benefits in a stylized two period model with extensive labor supply and savings decisions of agents. Agents have different ability levels and face heterogeneous fixed cost of labor supply. In this model, the optimal level of asset testing trades off welfare gains from redistribution to individuals in need against labor supply and savings distortions. A higher asset limit increases welfare of benefit recipients who would like to save more to smooth consumption. However, a higher asset limit also reduces the work incentive of these individuals. In addition to those standard distortions, a higher asset limit incentivizes marginal agents to reduce their savings to become eligible for welfare support in case of adverse circumstances.

Based on the insights from this stylized model, we analyze in a second step the conditions for welfare-improving reforms of asset testing in German basic income support for job seekers (*Grundsicherung für Arbeitssuchende*). As a key pillar of the German social security system[2], this tax-funded transfer has the objective to ensure a basic subsistence level for two particular groups. First, it targets individuals who are searching for a job and are not eligible for superordinate public insurance benefits like unemployment benefit I. Second, individuals can also claim the benefit as an income supplement if they do not earn enough to make ends meet. The benefit receipt is based on the needs at the household level and is subject to strict eligibility criteria.

[1] Contingency on wealth can take different forms, ranging from strict asset limit thresholds to applying a fictional rate of return to certain assets. For a comprehensive overview of asset testing in European countries and the different forms asset testing can take, see Marchal et al. (2020).

[2] In contrast to the terminology in the United States, social security does not exclusively refer to the pension system, but to the entire safety net which is provided by the German welfare state.

Among others, households do not qualify for the benefit if their wealth lies above a certain asset limit, which depends on the household structure and the age of household members. For instance, a single household without children of age 25 (60) receives the yearly benefit of around €10000 only if its wealth is below €23000 (€55000). Based on the status quo, we will analyze the potential for welfare improving reforms of the German basic income support system. Thereby, we explicitly account for the interactions between taxes, transfers and asset limits and explore the usefulness of non-standard characteristics of asset testing rules such as dependencies on the employment history and variations across asset types.

The remainder of this document is structured as follows. Section 2 relates the project to the existing literature. Section 3 derives the implicit trade-offs of asset testing regulations in a two-period framework. Section 4 informs about the institutional background of the German welfare system in general and the asset testing regulations in German basic income support in particular.

2 Literature

Starting with Sherraden (1991), who criticized the "self-defeating nature" of asset testing regulations in the United States, economists have been thinking about the distortions of asset testing in welfare programs. Hubbard et al. (1994, 1995) were the first to analyze asset tests through the lens of a structural life cycle model with stochastic earnings, out-of-pocket medical expenditures and lifespan uncertainty. Based on their model, the authors show that public transfers, which decrease one-by-one in earnings and assets, reduce the savings incentives for individuals with low permanent income. The reduction of savings goes beyond the standard crowding-out of private precautionary savings since the asset test works effectively like a tax on wealth holdings once the asset limit is reached. While Hubbard et al. (1994, 1995) provided a very stylized model of U.S. welfare policies at that time, later life cycle models replicated real-world regulations in more detail. Recently, for instance, Wellschmied (2021) modeled the diverse set of income support programs during the 1990s separately instead of combining them into one transfer. Further, by including exogenous job loss, an employment decision at the extensive margin and by differentiating between durable and non-durable consumption goods, the author showed that asset testing does not only reduce the savings of households, but also decreases employment rates at prime age. In addition, households are incentivized to shift wealth towards durable consumption goods, which are not asset-tested and serve as an imperfect substitute for financial wealth. Based on counterfactual simulations, Wellschmied (2021) indicated that the actual asset limit during the analyzed time frame had been too low compared to a welfare maximizing asset limit of around $150,000. Ortigueira and Siassi (2016) developed a similar framework for policy analysis, which abstracts from unemployment, but includes intensive labor supply decisions and a more sophisticated household structure. Although not focusing exclusively on asset testing, the authors revealed that current asset limits in the Temporary Assistance for Needy Families (TANF) program primarily depress savings of single mothers with low labor productivity.

Apart from structural life cycle models, the previous literature also used other frameworks to study the nature and usefulness of asset testing regulations. For instance, Koehne and Kuhn (2015) analyzed asset means testing in unemployment insurance in a model with endogenous job loss and search effort during unemployment. Their model implies that a stronger dependence of unemployment benefits on asset holdings increases job finding probabilities because agents enter unemployment with lower assets and thus have to search with higher effort for a new job. While Koehne and Kuhn (2015) studied asset tests within a restricted class of policies, Golosov and Tsyvinski (2006) revealed that asset tests can be a useful instrument to implement optimal allocations in a dynamic optimal taxation problem. In particular, the authors showed that the government can design an incentive-compatible disability insurance by making eligibility subject to an (age-dependent) asset test. Intuitively, an asset test can implement the optimum, since it prevents false claimants from applying for the policy.

The empirical literature is not fully conclusive on whether the distortionary nature of asset testing regulations influences the behavior of individuals. Support for the reactions to asset testing regulations come from Feldstein (1995) who showed that asset testing in scholarship rules in the United States effectively act as a capital levy and decrease financial assets of households. Further, more closely related to basic income support policies, Powers (1998) analyzed changes in the Aid to Families with Dependent Children (AFDC) program across the United States in 1981. The study showed that single female-headed households with children—the primary target group of the policy—increased savings by 25 cents for every one-dollar increase of the asset limit. Similar responses to asset-based means tests are found for the Supplemental Security Income (SSI) for the elderly and Medicaid (Neumark and Powers 1998; Gruber and Yelowitz 1999).

In contrast to these results, two studies do not find any significant effect of asset testing regulations. Using different data sources, Sullivan (2006) and Hurst and Ziliak (2006) exploited asset limit changes across U.S. states during the transformation of the AFDC program into the TANF program during the 1990s. Both studies showed that neither changes in liquid asset limits nor vehicle allowance regulations resulted in lower savings or higher home and checking account ownership. However, Nam (2008) suggested that the missing effect might be related to fact that both Sullivan (2006) and Hurst and Ziliak (2006) analyzed the effect of *loosened* asset testing regulations whereas Powers (1998) studied *tightened* asset limits. Running down savings as a response to a decrease in asset limits takes few time and is thus observed more directly. In contrast, building up savings takes more time, which renders short-run identification difficult.

Our project seeks to bridge the gap between these three strands of the literature. In contrast to the structural life cycle model approach, we seek to derive conditions for the optimal design of asset testing which are general enough to be applied in different contexts. Our project goes beyond the work of Golosov and Tsyvinski (2006), because we focus on *non-permanent* and *heterogeneous* shocks to agents of different ability. By deriving general conditions for welfare-improving reforms of the asset limit in terms of reduced-form elasticities, we can also show, how different assumptions about the behavior of individuals—informed by the inconclusive empirical literature—influences the optimality of asset testing rules.

3 Simple Model

This section presents a stylized two-period model which is a useful instrument to understand the trade-offs implied by asset-tested transfer programs.

Environment Consider a two-period model and a continuum of agents of mass one. In the first period, agents draw productivity θ from a distribution with pdf $f(\theta)$ and cdf $F(\theta)$ where $\theta \in [\theta_{min}, \theta_{max}]$. Agents do not have any wealth at the beginning of the first period, i.e. $A_0 = 0$ for all agents. In the first period, agents work a fixed amount of hours $l_1 = \bar{l}$ and earn gross income $y^g = \theta l_1$. In the second period, agents draw a participation cost δ which is distributed with pdf $g(\delta|\theta)$ and cdf $G(\delta|\theta)$.

Choices By maximizing the discounted live-time utility, agents decide in the first period on how much to save. Thereby, future utility is discounted by the factor β and savings are rewarded with interest rate r. In the second period, based on the participation cost draw, agents decide on whether to work ($l_2 = \bar{l}$) or not ($l_2 = 0$).

Government The government introduces a tax and benefit system which depends on gross income y^g and the asset stock A. If end-of-period assets are below the asset limit L specified by the government, agents receive a welfare benefit (refundable tax credit) B. Otherwise, agents have access to a tax allowance which equals $\frac{B}{\tau}$. Consequently, net income y^n is given by

$$y^n = \begin{cases} y^g - \tau \max\{y^g - \frac{B}{\tau}, 0\}, & \text{if } A > L \\ y^g - \tau y^g + B, & \text{if } A \leq L \end{cases}. \tag{1}$$

Note that the welfare benefit and the tax allowance are constructed such that they yield the same net income if $y^g - \frac{B}{\tau} > 0$. The government thereby provides a social safety net which differentiates between low and high wealth individuals. For agents with assets below the asset limit and no income, the government provides a benefit B which is phased out at the regular tax rate τ. Agents with wealth above the asset limit do not receive the benefit, but don't have to pay taxes up to the income level $\frac{B}{\tau}$.

Maximization Problem The first period maximization problem of the agent reads

$$\max_{A_1} \frac{c_1^{1-\gamma}}{1-\gamma} + \beta \left[\int_{\delta_{min}}^{\bar{\delta}(\theta, A_1)} \left(\frac{c_{2,E}^{1-\gamma}}{1-\gamma} - \delta \right) g(\delta|\theta) d\delta + \int_{\bar{\delta}(\theta, A_1)}^{\delta_{max}} \left(\frac{c_{2,U}^{1-\gamma}}{1-\gamma} \right) g(\delta|\theta) d\delta \right] \tag{2}$$

$$\text{s.t. } c_1 + A_1 = \left(\theta \bar{l} - \tau \theta \bar{l} + B \right) \tag{3}$$

$$\text{s.t. } c_{2,E} = \begin{cases} (1+r)A_1 + \theta \bar{l} - \tau \max\{\theta \bar{l} - \frac{B}{\tau}, 0\}, & \text{if } (1+r)A_1 > L \\ (1+r)A_1 + \theta \bar{l} - \tau \theta \bar{l} + B, & \text{if } (1+r)A_1 \leq L \end{cases} \tag{4}$$

$$\text{s.t. } c_{2,U} = \begin{cases} (1+r)A_1, & \text{if } (1+r)A_1 > L \\ (1+r)A_1 + B, & \text{if } (1+r)A_1 \leq L \end{cases} \tag{5}$$

$$\text{s.t. } \theta \sim F(\theta), \ \delta \sim D(\delta|\theta). \tag{6}$$

3.1 Household Optimization

Given the finite time horizon, the model can be solved via backwards induction. In short, labor supply in the second period is determined by the cost draw, savings from the first period, and the skill level. The savings choice in the first period depends on the skill level and the expectations regarding second period consumption outcomes and participation costs.

Second Period The labor supply choice in the second period depends on the comparison between the utility in the case of (non)employment. In particular

$$l_2 = \begin{cases} \bar{l}, & \text{if } \frac{c_{2,E}^{1-\gamma}}{1-\gamma} - \frac{c_{2,U}^{1-\gamma}}{1-\gamma} \geq \delta \\ 0, & \text{otherwise} \end{cases} \tag{7}$$

Differentiating between wealth states above and below the asset limit, it must hold that

$$l_2\big[(1+r)A_1 > L\big] = \begin{cases} \bar{l}, & \text{if } \frac{\big((1+r)A_1+\theta\bar{l}-\tau\max\{\theta\bar{l}-\frac{B}{\tau},0\}\big)^{1-\gamma}}{1-\gamma} - \frac{\big((1+r)A_1\big)^{1-\gamma}}{1-\gamma} \geq \delta \\ 0, & \text{otherwise} \end{cases} \tag{8}$$

$$l_2\big[(1+r)A_1 \leq L\big] = \begin{cases} \bar{l}, & \text{if } \frac{\big((1+r)A_1+\theta\bar{l}-\tau\theta\bar{l}+B\big)^{1-\gamma}}{1-\gamma} - \frac{\big((1+r)A_1+B\big)^{1-\gamma}}{1-\gamma} \geq \delta \\ 0, & \text{otherwise} \end{cases} \tag{9}$$

Holding the tax rate and benefit level constant, equation 8 (9) defines the threshold $\bar{\delta}(A_1, \theta)$ for which the agent is indifferent between working and not working. Two remarks are worth noting. First, the threshold increases in θ, because a higher skill level increases the return of working, i.e. agents are willing to bear more labor costs. Second, the dependency of the thresholds on assets is less clear. On the one hand, higher assets A_1 imply that the marginal utility from working decreases. On the other hand, higher savings might push agents above the asset limit which makes them loose the benefit, i.e. the marginal utility from working increases.

First Period The savings decision in the first period depends on the expectations about the second period labor supply choice. The optimal savings choice balances the cost of consuming less in the first period and the expected benefit from consuming more in the second period.

$$u'(c_1) = \beta \left[\int_{\delta_{min}}^{\overline{\delta}(\theta,A_1)} u'(c_{2,E})(1+r)g(\delta|\theta)d\delta + \int_{\overline{\delta}(\theta,A_1)}^{\delta_{max}} u'(c_{2,U})(1+r)g(\delta|\theta)d\delta \right] \tag{10}$$

It is important to note that the threshold $\overline{\delta}$ is endogenous to the savings decision. However, we can show that the optimal savings are increasing in θ if the direct effect of the skill level and savings on the marginal utility outweighs their effect on the threshold level $\overline{\delta}$ (see Appendix A.1).

The asset limit The asset limit introduces a non-continuity into the savings decision of agents. At a certain skill level, it pays off to stop saving more, because the advantage of receiving the benefit in the second period outweighs the utility loss from violating the intertemporal first order condition in Equation 10. We denote this lower skill threshold by $\underline{\theta}$. It is defined as the point, where the interior savings decision coincides with the asset limit. Agents keep their savings at $\frac{L}{1+r}$ until the violation of the intertemporal first order condition becomes too large to sustain it. We denote this upper skill threshold by $\overline{\theta}$.

3.2 Welfare Effects

In the following, we express total welfare as a Lagrangian. We assume that for all individuals with $\theta > 0$, it must hold that $y^g - \frac{B}{\tau} \geq 0$, i.e. the asset test becomes only relevant for agents in the second period which do not work. We denote choice variables of the lower (upper) interior solution by an additional subscript $\underline{I}(\overline{I})$ and the intermediate corner solution by an additional subscript C. Table 1 displays consumption possibilities depending on the savings area, in which the agent encounters herself. Accounting for the respective consumption possibilities, total welfare reads

Table 1: Consumption

Savings Area	C_1	$C_{2,E}$	$C_{2,U}$
$\underline{I}$	$\theta\bar{l} - \tau\max\{\theta\bar{l} - \frac{B}{\tau}, 0\} - A_{1,\underline{I}}$	$(1+r)A_{1,\underline{I}} + (1-\tau)\theta\bar{l} + B$	$(1+r)A_{1,\underline{I}} + B$
C	$\theta\bar{l} - \tau\max\{\theta\bar{l} - \frac{B}{\tau}, 0\} - \frac{L}{1+r}$	$L + (1-\tau)\theta\bar{l} + B$	$L + B$
$\overline{I}$	$\theta\bar{l} - \tau\max\{\theta\bar{l} - \frac{B}{\tau}, 0\} - A_{1,\overline{I}}$	$(1+r)A_{1,\overline{I}} + \theta\bar{l} - \tau\max\{\theta\bar{l} - \frac{B}{\tau}, 0\}$	$(1+r)A_{1,\overline{I}}$

$$\mathcal{L} = \underbrace{\int_{\theta_{min}}^{\underline{\theta}} \left[\frac{c_{1,\underline{I}}^{1-\gamma}}{1-\gamma} + \beta \Big[\int_{\delta_{min}}^{\overline{\delta}(\theta, A_{1,\underline{I}})} \left(\frac{c_{2,E,\underline{I}}^{1-\gamma}}{1-\gamma} - \delta \right) g(\delta|\theta) d\delta + \int_{\overline{\delta}(\theta, A_{1,\underline{I}})}^{\delta_{max}} \left(\frac{c_{2,U,\underline{I}}^{1-\gamma}}{1-\gamma} \right) g(\delta|\theta) d\delta \Big] \right] f(\theta) d\theta}_{\text{Lifetime utility of agents with savings below the asset limit}}$$

$$+ \underbrace{\int_{\underline{\theta}}^{\overline{\theta}} \left[\frac{c_{1,C}^{1-\gamma}}{1-\gamma} + \beta \Big[\int_{\delta_{min}}^{\overline{\delta}(\theta, A_{1,C})} \left(\frac{c_{2,E,C}^{1-\gamma}}{1-\gamma} - \delta \right) g(\delta|\theta) d\delta + \int_{\overline{\delta}(\theta, A_{1,C})}^{\delta_{max}} \left(\frac{c_{2,U,C}^{1-\gamma}}{1-\gamma} \right) g(\delta|\theta) d\delta \Big] \right] f(\theta) d\theta}_{\text{Lifetime utility of agents who save exactly at the asset limit}}$$

$$+ \underbrace{\int_{\overline{\theta}}^{\theta_{max}} \left[\frac{c_{1,\overline{I}}^{1-\gamma}}{1-\gamma} + \beta \Big[\int_{\delta_{min}}^{\overline{\delta}(\theta, A_{1,\overline{I}})} \left(\frac{c_{2,E,\overline{I}}^{1-\gamma}}{1-\gamma} - \delta \right) g(\delta|\theta) d\delta + \int_{\overline{\delta}(\theta, A_{1,\overline{I}})}^{\delta_{max}} \left(\frac{c_{2,U,\overline{I}}^{1-\gamma}}{1-\gamma} \right) g(\delta|\theta) d\delta \Big] \right] f(\theta) d\theta}_{\text{Lifetime utility of agents with savings above the asset limit}}$$

$$+ \lambda \Bigg(\underbrace{\tau \int_{\theta_{min}}^{\underline{\theta}} \left[(1+r)(\theta \bar{l} - \frac{B}{\tau}) + \int_{\delta_{min}}^{\overline{\delta}(\theta, A_{1,\underline{I}})} \left(\theta \bar{l} - \frac{B}{\tau} \right) g(\delta|\theta) d\delta \right] f(\theta) d\theta}_{\text{Net tax payments of agents with savings below the asset limit}}$$

$$+ \underbrace{\tau \int_{\underline{\theta}}^{\overline{\theta}} \left[(1+r)(\theta \bar{l} - \frac{B}{\tau}) + \int_{\delta_{min}}^{\overline{\delta}(\theta, A_{1,C})} \left(\theta \bar{l} - \frac{B}{\tau} \right) g(\delta|\theta) d\delta \right] f(\theta) d\theta}_{\text{Net tax payments of agents who save exactly at the asset limit}}$$

$$+ \underbrace{\tau \int_{\overline{\theta}}^{\theta_{max}} \left[(1+r)(\theta \bar{l} - \frac{B}{\tau}) + \int_{\delta_{min}}^{\overline{\delta}(\theta, A_{1,\overline{I}})} \left(\theta \bar{l} - \frac{B}{\tau} \right) g(\delta|\theta) d\delta \right] f(\theta) d\theta}_{\text{Net tax payments of agents with savings above the asset limit}}$$

$$- \underbrace{\int_{\theta_{min}}^{\underline{\theta}} \left[\int_{\overline{\delta}(\theta, A_{1,\underline{I}})}^{\delta_{max}} \left(B \right) g(\delta|\theta) d\delta \right] f(\theta) d\theta}_{\text{Benefit receipt of non-employed agents with savings below the asset limit}}$$

$$- \underbrace{\int_{\underline{\theta}}^{\overline{\theta}} \left[\int_{\overline{\delta}(\theta, A_{1,C})}^{\delta_{max}} \left(B \right) g(\delta|\theta) d\delta \right] f(\theta) d\theta}_{\text{Benefit receipt of non-employed agents who save exactly at the asset limit}} \Bigg)$$

3.2.1 Welfare effects of a change in the asset limit

In the following, we assess the welfare implications of an increase in the asset limit. We assume that the government sets both tax rate τ and benefit level B optimal, i.e.

$$\frac{\partial \mathcal{L}}{\partial B} = 0, \ \frac{\partial \mathcal{L}}{\partial \tau} = 0$$

The change of welfare as a response to an increase in the asset limit can be described as

$$\frac{\partial \mathcal{L}}{\partial L} = \underbrace{\int_{\underline{\theta}}^{\overline{\theta}} u'\Big(C_{1,C}\Big)\left[-\frac{1}{(1+r)} + \beta + \beta\gamma\left(1 - \frac{E(C_{2,C})}{C_{1,C}}\right)\right] f(\theta) d\theta}_{\text{1. Utility gain from higher } L \text{ for constrained agents in } C\ (>0)}$$

$$+ \underbrace{\lambda \int_{\underline{\theta}}^{\overline{\theta}} \left[\eta(\theta)\ G(\overline{\delta}|\theta)\ \tau\theta\overline{l}\right] f(\theta) d\theta}_{\text{2. Change in net tax revenue from agents in } C \text{ due to lower employment probability } (<0)}$$

$$+ \underbrace{\lambda\xi(\overline{\theta})\ F(\overline{\theta})\ \eta(\overline{\theta})\ G\big(\overline{\delta}(\overline{\theta}, A_{1,\overline{I}})\big)\ [L + B - (1+r)A_{1,\overline{I}}]\ \tau\overline{\theta}\ \overline{l}}_{\text{3. Change in tax revenue due to second period labor supply change of agents switching from } \bar{I} \text{ to C } (<0)}$$

$$- \underbrace{\lambda\ \xi(\overline{\theta})\ F(\overline{\theta})\ \Big[1 - G\big(\overline{\delta}(\overline{\theta}, A_{1,C})\big)\Big]\ B}_{\text{4. Mechanical change in benefit payments to agents switching from } \bar{I} \text{ to C } (<0)}$$

In the following, we briefly outline the intuition behind the different components of the welfare effect. Detailed derivation can be found in Appendix A.4.

Direct Utility Effect (>0) A higher asset limit has a direct utility effect on agents, for which the savings constraint binds and who chose to stick at the asset limit. The direct utility effect is positive, because a higher asset limit closes the intertemporal marginal utility gap implied by the asset limit constraint. The strength of the direct utility effect increases in the interest rate, the discount factor, the coefficient of relative risk aversion, and decreases in the ratio between expected future and todays consumption of constrained agents.

Tax Revenue of Constrained Agents (< 0) Since a higher asset limit allows agents in the corner solution to save more, this decreases their endogenous probability to chose to work in the second period, i.e. it decreases the cost threshold up to which agents are willing to work in the second period. Thus, net tax payments from second period decrease. The strength of this effect is larger if the participation tax $\tau\theta\bar{l}$ is higher and if the strength of the employment reaction to changes in wealth is larger. The latter is expressed as the semi-elasticity of employment with respect to an exogeneous increase in resources ($\eta(\theta)$).

$$\eta(\theta) = \frac{dG(\bar{\delta}|\theta)}{dL}\frac{1}{G(\bar{\delta}|\theta)} = g(\bar{\delta}|\theta)\frac{d\bar{\delta}(\theta, A_{1,C})}{dL}\frac{1}{G(\bar{\delta}|\theta)}$$

Tax Revenue of Switchers (< 0) An increase in L induces some agents to switch from the upper interior solution to the corner solution and reduce their savings to the asset limit. There are two counteracting forces. On the one hand, lower savings increase the marginal benefit from working. On the other hand, agents now receive the benefit under non-employment which reduces the benefit from working in the second period. The compound welfare effect is shown to be negative since $L+B \geq (1+r)A_{1,\bar{I}}$. The strength of the savings reaction is expressed in terms of the semi-elasticity $\xi(\theta)$ which indicates, how a change in the asset limit changes the share of agents below the asset limit.

$$\xi(\bar{\theta}) = \frac{\partial F(\bar{\theta})}{\partial L}\frac{1}{F(\bar{\theta})} = \frac{\partial\bar{\theta}}{\partial L}\frac{f(\bar{\theta})}{F(\bar{\theta})}$$

Benefit Payment Effect of Switchers (< 0) A higher asset limit expands the benefit receipt, because it increases the share of agents with savings below the asset limit. This has a negative effect on net tax revenue, because these additional agents have access to welfare benefits in case of unemployment. The strength of this effect increases in the number of additional agents saving below the asset limit, the unemployment probability of these additional agents, and the benefit level itself.

Note that the effects on welfare operate only via a direct utility effect on agents which are constrained in their savings choice and via net tax revenue changes in the second period. The asset limit does not have a tax revenue effect on the first period, because all agents are employed and work fixed hours (given that labor market costs exist only in the second period).

3.2.2 Welfare effects of a change in the benefit level

In the following, we assess the welfare implications of an increase in the benefit level. We assume that the government sets both tax rate τ and asset limit L optimal, i.e.

$$\frac{\partial \mathcal{L}}{\partial \tau} = 0, \; \frac{\partial \mathcal{L}}{\partial L} = 0$$

The change of welfare as a response to an increase in the benefit level is

$$\frac{\partial \mathcal{L}}{\partial B} = \underbrace{\int_{\theta_{min}}^{\overline{\theta}} \left[u'\Big(C_1\Big) + \beta E\Big[u'\Big(C_2\Big)\Big]\right] f(\theta)d\theta + \int_{\overline{\theta}}^{\theta_{max}} \left[u'\Big(C_{1,\overline{I}}\Big) + \beta G(\overline{\delta}|\theta) u'\Big(C_{2,\overline{I},E}\Big)\right] f(\theta)d\theta}_{\text{Direct utility effect from higher } B\ (>0)}$$

$$- \underbrace{\lambda \left[(1+r) + \int_{\theta_{min}}^{\theta_{max}} G(\overline{\delta}|\theta) f(\theta)d\theta + \int_{\theta_{min}}^{\overline{\theta}} \big(1 - G(\overline{\delta}|\theta)\big) f(\theta)d\theta \right]}_{\text{Mechanical effect on tax revenue } (<0)}$$

$$+ \underbrace{\lambda \left[\int_{\theta_{min}}^{\overline{\theta}} \kappa(\theta)\ G(\overline{\delta}|\theta)\ \tau\theta\overline{l}\ f(\theta)d\theta + \int_{\overline{\theta}}^{\theta_{max}} \kappa(\theta)\ G(\overline{\delta}|\theta)\ \big(\tau\theta\overline{l} - B\big)\ f(\theta)d\theta \right]}_{\text{Effect on net tax revenue via change in labor supply of Non-Switchers } (<0)}$$

$$+ \quad \underbrace{\lambda \left[\psi(\overline{\theta})\ F(\overline{\theta})\ \eta(\overline{\theta})\ G(\overline{\delta}(\overline{\theta}, A_{1,\overline{I}}))\ [L + B - (1+r)A_{1,\overline{I}}]\ \big(\tau\overline{\theta}\overline{l}\big) \right]}_{\text{Change in tax revenue due to labor supply change of agents switching from } \overline{I} \text{ to } C\ (<0)}$$

$$- \qquad \underbrace{\lambda \left[\psi(\overline{\theta})\ F(\overline{\theta})\ (1 - G(\overline{\delta}(\overline{\theta}, A_{1,\overline{I}})))B \right]}_{\text{Change in tax revenue due to benefit payments to agents switching from } \overline{I} \text{ to } C\ (<0)}$$

Direct Utility Effect (>0) A higher benefit level increases welfare through the direct effect on utility for all agents who work (due to the implicit lower tax payment) and to agents who do not work and have savings below the asset limit. A higher benefit level does, however, not affect the utility of unemployed agents above the asset limit.

Mechanical Effect on Tax Revenue (< 0) A larger benefit mechanically reduces net tax revenue from employed agents and unemployed agents below the asset limit.

Behavioral Effect of Non-switchers (< 0) Third, since a higher benefit level changes resources available in the first and second period, agents endogeneous employment probability and tax revenue changes. The direction of the effect depends on the semi-elasticity of employment with respect to the benefit level $\kappa(\theta)$.

$$\kappa(\theta) = \frac{\partial G(\bar{\delta}|\theta)}{\partial \bar{\delta}} \frac{\partial \bar{\delta}}{\partial B} \frac{1}{G(\delta|\theta)} = \frac{g(\bar{\delta}|\theta)}{G(\bar{\delta}|\theta)} \frac{\partial \bar{\delta}}{\partial B}$$

Behavioral Effect of Switchers on Tax Revenue (< 0) A higher benefit level induces some individuals to switch to the corner solution and restrict savings to the asset limit (see Appendix A.2) This increases resources available and therefore reduces employment probability. This magnitude of the effect depends on the semi-elasticity of the share of agents below the asset limit with respect to the benefit level ($\psi(\bar{\theta})$) and the semi-elasticity of employment with respect to an exogeneous increase in resources ($\eta(\bar{\theta})$).

Behavioral Effect of Switchers on Benefit Payments (< 0) A higher benefit level induces some individuals to switch to the corner solution which manifests in additional benefit payments to unemployed agents.

3.2.3 Welfare effects of a change in the tax rate

In the following, we assess the welfare implications of an increase in the tax rate. We assume that the government sets both benefit level B and asset limit L optimal, i.e.

$$\frac{\partial \mathcal{L}}{\partial B} = 0, \; \frac{\partial \mathcal{L}}{\partial L} = 0$$

The change of welfare as a response to an increase in the tax rate can be described as

$$\frac{\partial \mathcal{L}}{\partial \tau} = \underbrace{\int_{\theta_{min}}^{\theta_{max}} \left[-u'\Big(C_1\Big)\theta\bar{l} - \beta G(\bar{\delta}|\theta)u'\Big(C_{2,E}\Big)\theta\bar{l}\right] f(\theta)d\theta}_{\text{Direct utility effect from higher } \tau \text{ for agents } (<0)}$$

$$+ \underbrace{\lambda\left[(1+r)\theta\bar{l} + \int_{\theta_{min}}^{\theta_{max}} G(\bar{\delta}|\theta)\theta\bar{l}f(\theta)d\theta\right]}_{\text{Mechanical effect on tax revenue } (>0)}$$

$$+ \underbrace{\lambda\left[\int_{\theta_{min}}^{\bar{\theta}} \sigma(\theta)\ G(\bar{\delta}|\theta)\ \tau\theta\bar{l}\ f(\theta)d\theta + \int_{\bar{\theta}}^{\theta_{max}} \sigma(\theta)\ G(\bar{\delta}|\theta)\ \big(\tau\theta\bar{l} - B\big)\ f(\theta)d\theta\right]}_{\text{Effect on net tax revenue via change in labor supply of Non-Switchers } (<0)}$$

$$+ \quad \underbrace{\lambda\ \iota(\bar{\theta})\ F(\bar{\theta})\left[\eta(\bar{\theta})G(\bar{\delta}(\bar{\theta}, A_{1,\bar{I}}))[L + B - (1+r)A_{1,\bar{I}}]\big(\tau\overline{\theta l}\big)\right]}_{\text{Change in tax revenue due to labor supply change of agents switching from } \bar{I} \text{ to } C\ (<0)}$$

$$+ \qquad \underbrace{\lambda\ \iota(\bar{\theta})\ F(\bar{\theta})\left[\Big(1 - G(\bar{\delta}(\bar{\theta}, A_{1,\bar{I}}))\Big)B\right]}_{\text{Change in tax revenue due to labor supply change of agents switching from } \bar{I} \text{ to } C\ (<0)}$$

Direct Utility Effect (>0**)** A higher tax rate decreases welfare for all employed agents in both periods.

Mechanical Effect on Tax Revenue (<0**)** A larger tax rate mechanically increases tax revenue from employed agents.

Behavioral Effect of Non-switchers (<0**)** Third, since a higher tax rate changes the resources available in the first and second period, agents endogeneous employment probability and tax revenue changes. The direction of the effect depends on the semi-elasticity of employment with respect to the tax rate $\sigma(\theta)$.

$$\sigma(\theta) = \frac{\partial G(\bar{\delta}|\theta)}{\partial \bar{\delta}}\frac{\partial \bar{\delta}}{\tau}\frac{1}{G(\delta|\theta)} = \frac{g(\bar{\delta}|\theta)}{G(\bar{\delta}|\theta)}\frac{\partial \bar{\delta}}{\partial \tau}$$

Behavioral Effect of Switchers on Tax Revenue (< 0) A higher tax rate decreases expected lifetime utility for all ability levels both for the interior and the corner solution. At the margin, given that the optimal savings respond negatively to an increase in the tax rate, agents switch to the corner solution (see Appendix A.3). The switch to the corner solution reduces tax revenue, because the employment probability decreases.

Behavioral Effect of Switchers on Benefit Payments (< 0) The switch to the corner solution also increases benefit payments to unemployed agents.

4 Institutional Background

Basic income support for job seekers is part of the multi-tier social security system of Germany, which supports individuals during unemployment or in case of low earnings. The major components of this system are unemployment benefit 1 (UB 1), basic income support for job seekers (unemployment benefit 2 , UB 2) and social assistance.[3] Although this project focuses on UB 2 only, we shortly describe, how this benefit relates to the other two components.

Unemployment Benefit 1 The first layer, UB 1 , is based on a mandatory unemployment insurance system and is financed through insurance contributions deducted from the monthly payroll. Unemployed individuals can claim UB 1 if they had been employed subject to insurance contributions for at least 12 months during the last two years prior to unemployment. The benefit replaces 60 (67) percent of previous net assessed earnings for individuals without (with) dependent children.[4] Depending on the individual's age and on the duration of insurance contributions, UB 1 is only received for the first 6 to 24 months of unemployment. However, as an insurance-based benefit, UB 1 is not subject to an asset test.

Unemployment Benefit 2 Basic income support for job seekers can be claimed by individuals between age 15 and the statutory retirement age if they are unemployed, not eligible for UB 1 and able to work at least three hours per day. Further, individuals can also apply for UB 2 as an

[3] We abstract from other services like housing benefit (*Wohngeld*), child supplement (*Kinderzuschlag*) and social compensation (*Soziale Entschädigung*). For details, see Federal Ministry of Labour and Social Affairs (2019).

[4] Due to the cap on social security contributions (*Beitragsbemessungsgrenze*), the monthly level of UB 1 is bounded above by around €2000 (2019).

income supplement if they are employed and their earnings are not sufficient to cover elementary living expenses. As a tax-funded transfer, which has the objective to ensure a basic subsistence level and to foster the labor market integration of the benefit recipient, UB 2 provides less generous support than UB 1. The benefit size is determined at the household level and consists of a standard benefit rate of €424 (€382) per month for an adult in a single (couple) household and age-dependent benefit rates for children ranging from €245 to €339 per month for each child in the household.[5] In addition to standard benefit rates, households obtain housing and heating allowances, which are meant to cover expenses for reasonable accommodation. The local authorities have the discretionary power to decide on the exact amount of these allowances taking into account local conditions of the housing market and the specific household composition. In total, a single household without children receives €10128 per year, while a couple household without (with two) children receives €15828 (€21180).[6]

The receipt of basic income support is subject to strict eligibility requirements. Most importantly, individuals need to search actively for jobs and are required to strive for a re-integration into the labor market. In case of misconduct, for instance when refusing a job offer by the job center, the local employment agency can suspend benefit payments temporarily. Apart from that, individuals do not receive access to basic income support, if they can use other household resources, i.e. other forms of income or wealth, to pay for the cost of living.

In terms of income earned by benefit recipients, only the first €100 do not reduce the obtained benefit amount. In the range between €100 and €1000, only 20 percent of the income is exempt, while benefit recipients can only keep 10 cents for each euro earned between €1000 and €1200.[7] While the effect of the income test is not the primary focus of this analysis, the interactions between earned income and benefit receipt are taken into account because they lead to high effective marginal tax rates for welfare recipients (Peichl et al. 2017).

In addition to the information on earned income, the employment agency also requires claimants to disclose their wealth holdings. According to the Social Code 2 , basic income support is granted only if realizable assets are below certain thresholds.[8] These thresholds consist of constant and

[5]These figures refer to the regulations as of January 2019. Note that claiming UB 2 for children does limit the receipt of regular child benefits. Consequently, the net benefit rate for children is actually lower.

[6]Beyond regular benefit components, households can declare special needs, for instance for educational and non-recurring expenditures or during pregnancy.

[7]For benefit recipients with dependent children, 10 percent of the income between €1000 and €1500 is exempt.

[8]Realizable assets are all financial and non-financial assets, which must be used up before income support is

age-dependent components and are differentiated by the purpose of saving. Independent of a specific purpose, every adult household member receives a basic allowance of €150 per year of age. For every minor child in the household, the asset limit increases by a constant amount of €3100. For retirement provisions, every household member above age 15 obtains an allowance of €750 per year of age.[9] Finally, every household member receives a fixed allowance of €750 to finance necessary household purchases. These regulations are supplemented by minimum and maximum allowances, which depend on the birth year of the claimant. Aggregating different asset allowances, a single household without children of age 25 faces a total asset limit of €23250, which increases over the life by €900 per year of age, but is bounded above by around €60000. A couple of age 40 with two children (age 6 to 13) faces a total asset limit of €81200. While accounting for heterogeneous household structures and life cycle stages, these asset testing regulations ensure that only those in need receive public support.

Social Assistance The third layer of the social security system is social assistance, which is the last safety net for individuals who are not eligible for super-ordinate public support and who cannot finance a basic living for themselves. It is mainly targeted to individuals above the statutory retirement age (basic income support in old age) and individuals who are permanently unfit for work (support in the event of reduced earning capacity). Eligibility is also based on the needs of households and the benefit components are equivalent to UB 2 . However, income and asset testing regulations are stricter than under basic income support for job seekers.

Basic income support for job seekers (UB 2) and the asset testing regulations therein affect a relatively large share of both employed and unemployed individuals. In 2018, around 715000 individuals received UB 1 , whereas 1.1 million individuals received social assistance (Bundesagentur für Arbeit 2019a; Statistisches Bundesamt 2019). In the same year, more than six million individuals (3.1 million households) received benefits within the scope of UB 2 . These figures include both full recipients, claimants of an income supplement and other members of the household indirectly affected by UB 2 receipt (Bundesagentur für Arbeit 2019b). The predominant household type among UB 2 beneficiaries were single households without children (1.7 million).

granted. In contrast, protected assets, which include among others government-subsidized pension plans, reasonable motor vehicles, household goods and appropriate owner-occupied housing, do not affect benefit eligibility.

[9] Households can claim this retirement allowance only if contractual arrangements make sure that retirement assets cannot be accessed prior to retirement.

5 Conclusion

Asset testing regulations are a prominent design element of welfare programs to provide public support to individuals in need. On the basis of a stylized two-period model, we have shown that the optimal level of asset testing balances the benefit of well-targeted welfare provision against the reduction of tax revenue through behavioral reactions. First, a higher asset limit reduces work-incentives for those individuals who are already benefit recipients. Second, a higher asset limit attracts additional individuals into welfare programs, for which the cost of reducing their wealth is now outweighed by the benefit receipt in case of adverse circumstances.

The German basic income system, which features age-specific asset testing regulations, will be the primary focus of our quantitative analysis. In particular, we plan to

1. assess the effect of asset testing through the lens of a quantitative life-cycle model,
2. study the welfare implications of asset testing reforms — taking into account the interdependencies between the tax rate, benefit level and asset limit,
3. discuss the potential of non-standard asset testing rules which depend on age, the employment history, the duration of unemployment and the asset type,
4. show how deviations from the assumption of rational behavior affects the optimal design of asset testing,
5. describe how partial observability of assets by the government influences the welfare-maximizing asset test.

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A Derivations

A.1 Monotonicity of Savings at the Optimum

In order to be able to separate the problem of the asset limit into the three areas, it is necessary to show, under which conditions the optimal savings are increasing in the skill level θ. We thereby start with the first order condition

$$\begin{aligned} u'(c_1) = \beta\Bigg[&\frac{\partial\bar{\delta}(\theta,A_1)}{\partial A_1}\Big(u(c_{2,E}) - \bar{\delta}(\theta,A_1)\Big)f(\bar{\delta}(\theta,A_1)|\theta) + \int_{\delta_{min}}^{\bar{\delta}(\theta,A_1)} u'(c_{2,E})(1+r)g(\delta|\theta)d\delta\Bigg] \\ &+ \beta\Bigg[-\frac{\partial\bar{\delta}(\theta,A_1)}{\partial A_1}\Big(u(c_{2,U})\Big)f(\bar{\delta}(\theta,A_1)|\theta) + \int_{\bar{\delta}(\theta,A_1)}^{\delta_{max}} u'(c_{2,U})(1+r)g(\delta|\theta)d\delta\Bigg] \end{aligned} \tag{1}$$

By generating the total differential with respect to A_1 and θ, we obtain

$$\begin{aligned} &\underbrace{-u''(c_1)}_{>0}\ dA_1 \\ &\underbrace{-\beta(1+r)\Bigg[F(\bar{\delta}(\theta,A_1))u''(c_{2,E})(1+r) + (1-F(\bar{\delta}(\theta,A_1))u''(c_{2,U})(1+r)\Bigg]}_{>0}\ dA_1 \\ &\underbrace{-\beta(1+r)\Bigg[\frac{\partial\bar{\delta}(\theta,A_1)}{\partial A_1}F'\big(\bar{\delta}(\theta,A_1)\big)u'(c_{2,E}) + \Big(1-\frac{\partial\bar{\delta}(\theta,A_1)}{\partial A_1}F'\big(\bar{\delta}(\theta,A_1)\big)\Big)u'(c_{2,U})\Bigg]}_{<0}\ dA_1 \\ &= \\ &\underbrace{-u''(c_1)(1-\tau)\bar{l}}_{>0}\ d\theta \\ &\underbrace{+\beta(1+r)\Bigg[F(\bar{\delta}(\theta,A_1))u''(c_{2,E})(1-\tau)\bar{l}\Bigg]}_{<0}\ d\theta \\ &+\underbrace{\beta(1+r)\Bigg[\frac{\partial\bar{\delta}(\theta,A_1)}{\partial\theta}F'\big(\bar{\delta}(\theta,A_1)\big)u'(c_{2,E}) + \Big(1-\frac{\partial\bar{\delta}(\theta,A_1)}{\partial\theta}F'\big(\bar{\delta}(\theta,A_1)\big)\Big)u'(c_{2,U})\Bigg]}_{>0}\ d\theta \end{aligned} \tag{2}$$

Since $u''(c_1) > u''(c_1)$, savings increase monotonically in θ if the effect of an increase in savings on marginal utilities is larger than the secondary effect via the cost threshold $\bar{\delta}$.

A.2 Effect of Asset Limit L on Threshold $\overline{\theta}$

The threshold $\theta = \overline{\theta}$ is defined as the point where the utilities of the corner solution V_C and the upper interior solution $V_{\bar{I}}$ coincide, i.e. it must hold that

$$G(\overline{\theta}, L) = 0 = V_C - V_{\bar{I}},$$

Applying the total differential to $G(\overline{\theta}, L)$, the threshold reaction to a change in the asset limit reads

$$\frac{\partial \overline{\theta}}{\partial L} = -\frac{\frac{\partial V_C}{\partial L} - \frac{\partial V_{\bar{I}}}{\partial L}}{\frac{\partial V_C}{\partial \theta} - \frac{\partial V_{\bar{I}}}{\partial \theta}}.$$

Reactions of the indirect utility functions with respect to θ read

$$\frac{\partial V_{\bar{I}}}{\partial L} = 0$$

$$\frac{\partial V_C}{\partial L} = \frac{-1}{1+r} u'\Big(C_{1,C}\Big) + \beta \Big[\int_{\delta_{min}}^{\overline{\delta}(\theta, A_{1,C})} u'\Big(C_{2,E,C}\Big) g(\delta|\theta) d\delta + \int_{\overline{\delta}(\theta, A_{1,C})}^{\delta_{max}} u'\Big(C_{2,U,C}\Big) g(\delta|\theta) d\delta \Big]$$

For the evaluation of $\frac{\partial V_{\bar{I}}}{\partial \theta}$ and $\frac{\partial V_C}{\partial \theta}$, we differentiate the indirect utility function with respect to θ:

$$\frac{\partial V_{\bar{I}}}{\partial \theta} = (1-\tau)\bar{l} \Big[u'(C_{1,\bar{I}}) + \beta \int_{\delta_{min}}^{\overline{\delta}(\theta, A_{1,\bar{I}})} u'(C_{2,E,\bar{I}}) g(\delta|\theta) d\delta \Big]$$

$$\frac{\partial V_{\bar{C}}}{\partial \theta} = (1-\tau)\bar{l} \Big[u'(C_{1,C}) + \beta \int_{\delta_{min}}^{\overline{\delta}(\theta, A_{1,C})} u'(C_{2,E,C}) g(\delta|\theta) d\delta \Big]$$

Combining the expressions, we can rewrite $\frac{\partial \overline{\theta}}{\partial L}$ as follows:

$$\frac{-\left(\frac{-1}{1+r}u'\Big(C_{1,C}\Big)+\beta\Big[\int_{\delta_{min}}^{\bar{\delta}(\theta,A_{1,C})}u'\Big(C_{2,E,C}\Big)g(\delta|\theta)d\delta+\int_{\bar{\delta}(\theta,A_{1,C})}^{\delta_{max}}u'\Big(C_{2,U,C}\Big)g(\delta|\theta)d\delta\Big]\right)}{\underbrace{(1-\tau)\bar{l}\Big[u'(C_{1,C})-u'(C_{1,\bar{I}})\Big]}_{<0}+\underbrace{\beta(1-\tau)\bar{l}\Big[\int_{\delta_{min}}^{\bar{\delta}(\theta,A_{1,C})}u'(C_{2,E,C})g(\delta|\theta)d\delta-\int_{\delta_{min}}^{\bar{\delta}(\theta,A_{1,\bar{I}})}u'(C_{2,E,\bar{I}})g(\delta|\theta)d\delta\Big]}_{?,<0}}$$

We know that the numerator is negative, i.e. $\frac{\partial V_C}{\partial L} > 0$, because increasing L brings the corner solution agents closer to their Euler equation. Further, it must hold that the denominator is negative, i.e. $\frac{\partial V_{\bar{I}}}{\partial \theta} > \frac{\partial V_C}{\partial \theta}$.

- In the *first period*, corner solution (C) people benefit *less* from an increase in θ than people in the upper interior solution ($\bar{I}$), because agents in C work the same amount as agents in $\bar{I}$ but consume more in the first period given their lower savings. Agents in C thus have a lower marginal utility of consumption in the first period than agents in $\bar{I}$.

- In the *second period*, corner solution (C) people benefit *more* from an increase in θ than people in the upper interior solution ($\bar{I}$), because agents in C work the same amount but consume less in the second period (and thus have higher marginal utility from consumption) than $\bar{I}$ people. However, agents in the interior solution are more likely to work ($\bar{\delta}(\bar{\theta}, A_{1,C}) < \bar{\delta}(\bar{\theta}, A_{1,\bar{I}})$). If the employment effect outweighs the differential in marginal utilities, the second effect is also negative. Furthermore, the first period effect is larger than the second period effect since agents discount the future and because agents can be also not employed in the second period which reduces the expected benefit of a higher θ in the second period.

A.3 Effect of Tax Rate τ on Threshold $\overline{\theta}$

The threshold $\theta = \overline{\theta}$ is defined as the point where the utilities of the corner solution V_C and the upper interior solution $V_{\bar{I}}$ coincide, i.e. it must hold that

$$G(\overline{\theta}, \tau) = 0 = V_C - V_{\bar{I}},$$

Applying the total differential to $G(\overline{\theta}, \tau)$, the threshold reaction reads

$$\frac{\partial \overline{\theta}}{\partial \tau} = -\frac{\frac{\partial V_C}{\partial \tau} - \frac{\partial V_{\bar{I}}}{\partial \tau}}{\frac{\partial V_C}{\partial \theta} - \frac{\partial V_{\bar{I}}}{\partial \theta}}.$$

Reactions of the indirect utility functions with respect to τ read

$$\begin{aligned}
\frac{\partial V_C}{\partial \tau} &= u'(c_{1,C}) \left[-\overline{\theta}\overline{l}\right] \\
&\quad + \beta \Big[\int_{\delta_{min}}^{\overline{\delta}(\overline{\theta}, A_{1,C})} u'\Big(C_{2,E,C}\Big) g(\delta|\overline{\theta}) d\delta \left[-\overline{\theta}\overline{l}\right] \Big] \\
\frac{\partial V_{\bar{I}}}{\partial \tau} &= u'(c_{1,\bar{I}}) \left[-\overline{\theta}\overline{l}\right] \\
&\quad + \beta \Big[\int_{\delta_{min}}^{\overline{\delta}(\overline{\theta}, A_{1,\bar{I}})} u'\Big(C_{2,E,\bar{I}}\Big) g(\delta|\overline{\theta}) d\delta \left[-\overline{\theta}\overline{l}\right] \Big]
\end{aligned}$$

Reactions of the indirect utility functions with respect to θ read

$$\begin{aligned}
\frac{\partial V_C}{\partial \theta} &= u'(C_{1,C}) \left[(1-\tau)\overline{l}\right] \\
&\quad + \beta \int_{\delta_{min}}^{\overline{\delta}(\theta, A_{1,C})} u'(C_{2,E,C}) g(\delta|\theta) d\delta \left[(1-\tau)\overline{l}\right] \\
\frac{\partial V_{\bar{I}}}{\partial \theta} &= u'(C_{1,\bar{I}}) \left[(1-\tau)\overline{l}\right] \\
&\quad + \beta \int_{\delta_{min}}^{\overline{\delta}(\theta, A_{1,\bar{I}})} u'(C_{2,E,\bar{I}}) g(\delta|\theta) d\delta \left[(1-\tau)\overline{l}\right]
\end{aligned}$$

Combining the expressions, we can rewrite the numerator as follows:

$$\frac{\partial V_C}{\partial \tau} - \frac{\partial V_{\bar{I}}}{\partial \tau} = \underbrace{-\overline{\theta}\bar{l}\left[u'(c_{1,C}) - u'(c_{1,\bar{I}})\right]}_{>0}$$
$$\underbrace{-\overline{\theta}\bar{l}\beta\left[\int_{\delta_{min}}^{\overline{\delta}(\overline{\theta},A_{1,C})} u'(C_{2,E,C})g(\delta|\overline{\theta})d\delta - \int_{\delta_{min}}^{\overline{\delta}(\overline{\theta},A_{1,\bar{I}})} u'(C_{2,E,\bar{I}})g(\delta|\overline{\theta})d\delta\right]}_{?,>0}$$

- The first part of the numerator is unambiguously larger than zero, since $u'(c_{1,C}) < u'(c_{1,\bar{I}})$. This results from the fact that agents in the interior solution have more resources at their disposal given their lower savings.
- The second part of the numerator is ambiguous. On the one hand, $u'(C_{2,E,C}) > u'(C_{2,E,\bar{I}})$. On the other hand, $\overline{\delta}(\overline{\theta}, A_{1,C}) < \overline{\delta}(\overline{\theta}, A_{1,\bar{I}})$. Under the assumption that the marginal effect is outweighed by the employment effect, the second part of the equation is larger than zero. The employment effect stems from the fact that unemployment is more attractive in the corner solution while employment is more attractive in the interior solution.

Combining the expressions, we can rewrite the denominator as follows:

$$\frac{\partial V_C}{\partial \theta} - \frac{\partial V_{\bar{I}}}{\partial \theta} =$$
$$= \underbrace{(1-\tau)\bar{l}\left[u'(C_{1,C}) - u'(C_{1,\bar{I}})\right]}_{<0}$$
$$+ \underbrace{\beta(1-\tau)\bar{l}\left[\int_{\delta_{min}}^{\overline{\delta}(\theta,A_{1,C})} u'(C_{2,E,C})g(\delta|\theta)d\delta - \int_{\delta_{min}}^{\overline{\delta}(\theta,A_{1,\bar{I}})} u'(C_{2,E,\bar{I}})g(\delta|\theta)d\delta\right]}_{?,<0}$$

- The first part of the denominator is unambiguously smaller than zero, since $u'(c_{1,C}) < u'(c_{1,\bar{I}})$. This results from the fact that agents in the interior solution have more resources at their disposal given their lower savings.
- The second part of the denominator is ambiguous. On the one hand, $u'(C_{2,E,C}) > u'(C_{2,E,\bar{I}})$. On the other hand, $\overline{\delta}(\overline{\theta}, A_{1,C}) < \overline{\delta}(\overline{\theta}, A_{1,\bar{I}})$. Under the assumption that the marginal effect is outweighed by the employment effect, the second part of the equation is smaller than zero. The employment effect stems from the fact that unemployment is more attractive in

the corner solution while employment is more attractive in the interior solution.

$$\frac{\partial \overline{\theta}}{\partial \tau} = -\frac{\overbrace{\frac{\partial V_C}{\partial \tau} - \frac{\partial V_{\bar{I}}}{\partial \tau}}^{>0}}{\underbrace{\frac{\partial V_C}{\partial \theta} - \frac{\partial V_{\bar{I}}}{\partial \theta}}_{<0}} > 0$$

A.4 Welfare Effects

In the following, we derive the sign of the welfare effects of an increase in the asset limit L.

Direct Utility Effect (>0) First, an increase in L directly benefits those agents which are constrained in their savings decision by closing the intertemporal marginal utility gap.

$$\int_{\underline{\theta}}^{\overline{\theta}} \left[\frac{-1}{1+r}u'\Big(C_{1,C}\Big) + \beta\Big[\int_{\delta_{min}}^{\overline{\delta}(\theta,A_{1,C})} u'\Big(C_{2,E,C}\Big)g(\delta|\theta)d\delta + \int_{\overline{\delta}(\theta,A_{1,C})}^{\delta_{max}} u'\Big(C_{2,U,C}\Big)g(\delta|\theta)d\delta\Big]\right] f(\theta)d\theta$$
$$= \int_{\underline{\theta}}^{\overline{\theta}} \left[\frac{-1}{1+r}u'\Big(C_{1,C}\Big) + \beta E\Big[u'\Big(C_{2,C}\Big)\Big]\right] f(\theta)d\theta$$

We can approximate $u'\Big(C_{2,E}\Big)$ by a first order Taylor approximation, which implies

$$\int_{\underline{\theta}}^{\overline{\theta}} \left[\frac{-1}{1+r}u'\Big(C_{1,C}\Big) + \beta E\Big[u'(C_{1,C}) + u''(C_{1,C})\Delta R\Big]\right] f(\theta)d\theta$$

ΔR thereby represents the difference in resources between the second and the first period, i.e. $\Delta R = C_{2,C} - C_{1,1}$. We can pull $u'(C_{1,C})$ and $u''(C_{1,C})$ out of the expectation operator to obtain

$$\int_{\underline{\theta}}^{\overline{\theta}} \left[\frac{-1}{1+r}u'\Big(C_{1,C}\Big) + \beta u'(C_{1,C}) + \beta u''(C_{1,C})E\Big[\Delta R\Big]\right] f(\theta)d\theta$$

Since $u''(c) = \frac{-\gamma u'(c)}{c}$, we can rewrite the term as

$$\int_{\underline{\theta}}^{\overline{\theta}} \left[\frac{-1}{1+r}u'\Big(C_{1,C}\Big) + \beta u'(C_{1,C}) - \beta\gamma\frac{u'(C_{1,C})}{C_{1,C}}E\Big[\Delta R\Big]\right] f(\theta)d\theta$$

We factor out $u'(C_{1,C})$ and get

$$\int_{\underline{\theta}}^{\overline{\theta}} u'(C_{1,C})\left[\frac{-1}{1+r} + \beta - \beta\gamma\frac{E\Big[\Delta R\Big]}{C_{1,C}}\right] f(\theta)d\theta$$

We can rewrite $E\Big[\Delta R\Big]$ as $E\Big[C_{2,C} - C_{1,C}\Big] = E\Big[C_{2,C}\Big] - C_{1,C}$ and therefore obtain:

$$\int_{\underline{\theta}}^{\overline{\theta}} u'\big(C_{1,C}\big)\Big[\frac{-1}{1+r} + \beta - \beta\gamma\Big[\frac{E\big[C_2\big]}{C_{1,C}} - \frac{C_1}{C_1}\Big]\Big] f(\theta)d\theta$$

Rearanging sings we finally obtain

$$\int_{\underline{\theta}}^{\overline{\theta}} u'\big(C_{1,C}\big)\Big[\frac{-1}{1+r} + \beta + \beta\gamma\Big[1 - \frac{E\big[C_2\big]}{C_{1,C}}\Big]\Big] f(\theta)d\theta$$

Net Tax Revenue of Constrained Agents (< 0) Since agents in the corner solution are allowed to save more, this decreases their endogenous probability to chose to work in the second period, i.e. it decreases the cost threshold up to which agents are willing to work in the second period. Thus, net tax payments from second period decrease.

$$\underbrace{\lambda\tau\int_{\underline{\theta}}^{\overline{\theta}}\left[\frac{\partial\overline{\delta}(\theta,A_{1,C})}{\partial L}\Big(\theta\overline{l} - \frac{B}{\tau}\Big)g(\overline{\delta}|\theta)\right]f(\theta)d\theta}_{\text{2a. Change in tax revenue from employed agents in } C \text{ (-)}} + \underbrace{\lambda\int_{\underline{\theta}}^{\overline{\theta}}\left[\frac{\partial\overline{\delta}(\theta,A_{1,C})}{\partial L}\big(B\big)g(\overline{\delta}|\theta)\right]f(\theta)d\theta}_{\text{2b. Change in benefit payments to agents in } C \text{ (-)}} \quad (3)$$

$$\lambda\int_{\underline{\theta}}^{\overline{\theta}}\left[\frac{\partial\overline{\delta}(\theta,A_{1,C})}{\partial L}\Big(\tau\theta\overline{l}\Big)g(\overline{\delta}|\theta)\right]f(\theta)d\theta \quad (4)$$

For agents in the corner solution, an increase in L is equivalent to an increase in unearned income. Defining the semi-elasticity of employment with respect to exogeneous income as $\eta(\theta) = \frac{dG(\overline{\delta}|\theta)}{dL}\frac{1}{G(\overline{\delta}|\theta)} = g(\overline{\delta}|\theta)\frac{d\overline{\delta}(\theta,A_{1,C})}{dL}\frac{1}{G(\overline{\delta}|\theta)}$, we can rewrite the expression as

$$\lambda\int_{\underline{\theta}}^{\overline{\theta}}\Bigg[\underbrace{\eta(\theta)}_{\text{Semi-Elasticity}}\;\underbrace{G(\overline{\delta}|\theta)}_{\text{Employed Agents}}\;\underbrace{(\tau\theta\overline{l})}_{\text{Part. Tax}}\Bigg]f(\theta)d\theta \quad (5)$$

Given the CRRA-utility function, η is negative, i.e.

$$\eta = \frac{d\overline{\delta}(\theta,A_{1,C})}{dL}\frac{g(\overline{\delta}|\theta)}{G(\overline{\delta}|\theta)} \quad (6)$$

$$\eta = (1+r)\left[\left((1+r)L + (1-\tau)\theta\bar{(l)} + B\right)^{-\gamma} - \left((1+r)L + B\right)^{-\gamma}\right]\frac{g(\bar{\delta}|\theta)}{G(\bar{\delta}|\theta)} < 0 \qquad (7)$$

Tax Revenue Effect of Switchers (< 0) An increase in L induces some agents to switch from the upper interior solution to the corner solution. This increases tax revenue from the second period, because savings under the corner solution are lower and the marginal utility of working is thus higher.

$$\lambda\frac{\partial\bar{\theta}}{\partial L}\tau\left(\int_{\delta_{min}}^{\bar{\delta}(\theta,A_{1,C})}\left(\theta\bar{l} - \frac{B}{\tau}\right)g(\delta|\theta)d\delta - \int_{\delta_{min}}^{\bar{\delta}(\theta,A_{1,\bar{I}})}\left(\theta\bar{l} - \frac{B}{\tau}\right)g(\delta|\theta)d\delta\right)f(\bar{\theta}) \qquad (8)$$

The sign of the effect can be derived by looking at a comparison between the cost margin $\bar{\delta}$ at the corner solution and at the upper interior solution.

$$\bar{\delta}(\theta, A_{1,C}) = \frac{\left((1+r)L + \theta\bar{l} - \tau\theta\bar{l} + B\right)^{1-\gamma}}{1-\gamma} - \frac{\left((1+r)L + B\right)^{1-\gamma}}{1-\gamma} \qquad (9)$$

$$\bar{\delta}(\theta, A_{1,\bar{I}}) = \frac{\left((1+r)A_{1,\bar{I}} + \theta\bar{l} - \tau\theta\bar{l} + B\right)^{1-\gamma}}{1-\gamma} - \frac{\left((1+r)A_{1,\bar{I}}\right)^{1-\gamma}}{1-\gamma} \qquad (10)$$

There are two effects at play. First, agents at the corner solution have an unambiguously lower utility when working given their lower savings. This reduces the employment probability (the cost threshold). Second, when $B > (1+r)A_{1,\bar{I}} - L$, working becomes less attractive, which further reduces the employment probability. Under these assumptions, $\bar{\delta}(\theta, A_{1,C}) < \bar{\delta}\theta, A_{1,\bar{I}})$. Therefore we can rewrite the tax revenue effect of switchers as

$$-\lambda\frac{\partial\bar{\theta}}{\partial L}\left(\int_{\bar{\delta}(\theta,A_{1,C})}^{\bar{\delta}(\theta,A_{1,I})}\left(\tau\theta\bar{l}\right)g(\delta|\theta)d\delta\right)f(\bar{\theta}) \qquad (11)$$

We can introduce another semi-elasticity $\xi(\bar{\theta}) = \frac{\partial F(\bar{\theta})}{\partial L}\frac{1}{F(\bar{\theta})} = \frac{\partial\bar{\theta}}{\partial L}\frac{f(\bar{\theta})}{F(\bar{\theta})}$ which indicates the percentage change of people saving at the asset limit with respect to an increase of the asset limit L. Therefore, we can rewrite the equation as

$$-\lambda \underbrace{\xi(\bar{\theta})}_{\text{Asset Limit Elasticity}} \underbrace{F(\bar{\theta})}_{\text{Agents below the Asset Limit}} \underbrace{\left(\int_{\bar{\delta}(\bar{\theta},A_{1,C})}^{\bar{\delta}(\bar{\theta},A_{1,I})}\left(\tau\bar{\theta}\,\bar{l}\right)g(\delta|\bar{\theta})d\delta\right)}_{\text{Net Tax Difference}} \qquad (12)$$

$$-\lambda \underbrace{\xi(\overline{\theta})}_{\text{Asset Limit Elasticity}} \underbrace{F(\overline{\theta})}_{\text{Agents below the Asset Limit}} \left(\underbrace{G\big(\overline{\delta}(\overline{\theta}, A_{1,\overline{I}})\big) - G\big(\overline{\delta}(\overline{\theta}, A_{1,\overline{C}})\big)}_{\text{Difference in Employment Probability}}\right) \underbrace{\tau\overline{\theta}\,\overline{l}}_{\text{Part. Tax}} \tag{13}$$

If η is constant, we can further rewrite the term as

$$\lambda \underbrace{\xi(\overline{\theta})}_{\text{Asset Limit Elast.}} \underbrace{F(\overline{\theta})}_{\text{Agents below } L} \underbrace{\eta(\overline{\theta})}_{\text{Empl. Semi-Elast.}} \underbrace{G\big(\overline{\delta}(\overline{\theta}, A_{1,\overline{I}})\big)}_{\text{Empl. Share of } \overline{I} \text{ at } \overline{\theta}} \underbrace{[L + B - (1+r)A_{1,\overline{I}}]}_{\text{Asset Difference}} \underbrace{\tau\overline{\theta}\,\overline{l}}_{\text{Part. Tax}} \tag{14}$$

Benefit Payment Effect of Switchers (< 0) An increase in L induces some agents to switch from the upper interior solution to the corner solution. This increases mechanically the benefits payments to agents.

$$-\lambda\, \xi(\overline{\theta})\; F(\overline{\theta}) \int_{\overline{\delta}(\overline{\theta}, A_{1,C})}^{\delta_{max}} \big(B\big) g(\delta|\overline{\theta}) d\delta \tag{15}$$

$$-\lambda\, \xi(\overline{\theta})\; F(\overline{\theta}) \left[1 - G\big(\overline{\delta}(\overline{\theta}, A_{1,C})\big)\right] B \tag{16}$$