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Personal Bankruptcy and Wage Garnishment

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Personal Bankruptcy and Wage Garnishment*

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Abstract

Contrary to Chapter 7 bankruptcy in the U.S., many European bankruptcy regimes are stricter and force bankrupts to repay some outstanding debt through wage garnishment. Since wage garnishment raises the effective marginal tax rate, it distorts labor supply. Explicitly modeling the garnishment period and endogenizing labor supply, this paper examines the optimal garnishment regime for Germany: optimal garnishment rates are 18 percentage points lower and the garnishment duration increases from six to ten years. Consequently, repayment during bankruptcy increases and interest rates fall. Welfare improves by 3.3%. Low-income households gain the most due to better access to cheaper credit.

JEL Codes: D14, E44, K35

Keywords: Consumer Debt, Personal Bankruptcy, Garnishment

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1 Introduction

Policy makers face a fundamental trade-off when designing personal bankruptcy laws: when bankruptcy laws are very lax, consumers have a powerful tool to insure against adverse events such as job loss, illness, or divorce by not repaying their debts. However, higher default will translate into increasing interest rates in equilibrium because lenders face higher non-payment risk. Whereas countries such as the U.S. and the U.K. grant debt relief rather easily, countries such as Germany have much harsher regimes.

While in "Fresh Start" regimes such as Chapter 7 bankruptcy in the U.S. lenders do not have claims towards the future income of bankrupts, the German bankruptcy system features harsh wage garnishment rules for six years. Only after fulfilling these repayment requirements can households receive debt relief. In garnishment, 70% of annual net income exceeding 12,600€ is garnished. Income in excess of 38,500€ is fully garnished.[1] Garnishment might reduce risk premia because lenders recover more resources upon default. However, households that are subject to wage garnishment might reduce labor supply significantly, potentially undermining higher intended recovery. Thus, when evaluating bankruptcy regimes that feature income garnishment, endogenous labor supply plays an important role to determine how much is repaid through garnishment, default premia and interest rates, and welfare.

Allowing for endogenous labor supply, I investigate the optimal garnishment policy for the German economy. For this purpose, I explore the properties of a bankruptcy regime with labor income garnishment. I focus on the trade-off between insurance against adverse shocks and access to unsecured credit if loan prices incorporate the risk of default. While wage garnishment effectively reduces moral hazard, it may also reduce the amount of insurance that bankruptcy offers to individuals and it reduces the incentive to work in subsequent periods.[2] On the one hand, garnishment makes bankruptcy more costly to individuals. This reduces the value of using bankruptcy as insurance against adverse income shocks or unforeseen expenditures. On the other hand, banks expect some repayment even after declaring bankruptcy and price loans more favorably under garnishment.[3] Cheaper loans mean households gain greater access to credit.

[1] See §850c ZPO (civil process order).

[2] See, e.g. Rea (1984). In a three-period setting that ignores negative work incentives, Dye (1986) shows that optimal bankruptcy regimes garnish future income.

[3] Indeed, Lin and White (2001) find evidence of this mechanism. They show that in U.S. states where banks expect higher repayment (through lower exemption levels), consumers are more likely to gain access to loans.

To quantify these effects and assess welfare implications, I set up a limited commitment model with equilibrium bankruptcy and endogenous labor supply. I explicitly model the time in bankruptcy during which households are subject to harsh wage garnishment. The quantitative model is calibrated to match important facts of household income, debt, and bankruptcy filings in Germany. I answer the following questions: What are the individual labor supply effects of wage garnishment? How does garnishment affect loan prices and access to credit? Finally, which garnishment regime is optimal for the German economy?

In order to answer the first two questions, I compare the current German garnishment regime with a "Fresh Start" bankruptcy regime without any wage garnishment. In a "Fresh Start" regime, I find that labor supply distortions due to bankruptcy are reduced. However, abolishing wage garnishment makes bankruptcy more favorable for households and lenders expect higher write-offs. Thus, interest rates significantly increase and the amount of debt supported in equilibrium drops by 20%. Lower total debt actually leads to a small decrease in bankruptcy filings. Resulting from more restricted access to credit, German households would suffer a 0.8% welfare drop if garnishment were abolished. No income group would gain from the reform.

The answer to finding the optimal garnishment regime is in line with typical prescriptions in public economics:[4] the optimal garnishment regime features lower marginal effective tax rates (i.e. lower garnishment rates) and the tax base is widened (i.e. longer time in bankruptcy). More specifically, in the optimal garnishment regime, garnishment rates are lowered by 18 percentage points and the duration of garnishment is increased from six to ten years. This yields significantly higher repayment because distortions are reduced and the duration of garnishment is increased. In response, lenders reduce interest rates and households borrow significantly more. Due to higher equilibrium debt, bankruptcies increase. On average, households enjoy a 3.3% welfare improvement. Comparing ex-ante welfare, no income class loses from this policy and low-income households gain up to 7%.

Most quantitative research has focused on models representing the "Fresh Start" bankruptcy system (i.e. bankruptcy under Chapter 7 in the U.S.), which shields bankrupts from claims towards their future labor income. Hence, papers in the tradition of Chatterjee, Corbae, Nakajima, and Ríos-Rull (2007) and Livshits, MacGee, and Tertilt (2007) do not consider labor supply effects. Despite both models including a garnishment component for better model fit, labor supply is exogenously set, abstracting from potential distortions.

In the absence of labor supply effects, there is some evidence that increasing commitment through garnishment might be welfare-improving. However, it is unclear whether

[4]See, for example, OECD (2010).

these findings hold true in a framework with endogenous labor supply. Livshits, MacGee, and Tertilt (2007) argue that the benefits of insurance versus access to credit critically depend on the nature of income and expenditure risk. In a setup without unexpected expenditures, Chatterjee and Gordon (2012) find that the positive effects of garnishment – mainly increased access to credit – outweigh the negative effects of reduced insurance. Under the authors' garnishment regime, households are forced to repay outstanding debt in full, which leads to cheaper and larger lines of credit. Allowing no debt forgiveness at all is an extreme case. While European bankruptcy regimes typically mandate partial repayment through wage garnishment, they still allow for significant debt forgiveness.[5] Hence, European regimes lie somewhere between "Fresh Start" regimes and Chatterjee and Gordon's full commitment regime.

Empirical research trying to identify the labor supply effect of garnishment focuses on the effect of removing garnishment once debtors enter Chapter 7 bankruptcy and thereby are shielded from individual lenders' claims towards their income. The evidence on the effect of garnishment on labor supply is mixed. On the one hand, Dobbie and Song (2015) use variation in the propensity of judges to accept a bankruptcy petition in order to identify labor supply reactions. They show significant negative effects of income garnishment on future annual gross earnings and multiple other welfare indicators. On the other hand, Han and Li (2007) use data from the PSID and find no effect of Chapter 7 filings on hours worked.

While these papers estimate the effect of shielding labor income from garnishment, there is little work investigating the labor supply effects of bankruptcy regimes with a garnishment component. One notable exception is Chen and Zhao (2017) who use a quantitative model of labor search and unsecured credit to document positive labor supply effects when debtors enter Chapter 7 bankruptcy protection. The authors model garnishment as a linear income tax and exit from garnishment is modeled stochastically.[6] Other work that analyzes the link between credit markets and labor markets includes Herkenhoff (2019), who shows that cyclical access to credit deepened recessions in the last decades and Athreya, Sánchez, Tam, and Young (2015), who analyze how labor market risk and bankruptcy regulation affected debt and default during the Great Recession.

I add to this literature by incorporating a realistic garnishment regime with non-linear garnishment schedules and explicitly modeling the duration of garnishment. This allows

[5]European bankruptcy regimes generally also feature less generous asset exemptions (Gerhardt, 2009).

[6]Abstracting from interest rates that reflect individual default risk and introducing an exogenous borrowing limit, Li and Sarte (2006) also model labor supply and Chapter 13 bankruptcy.

me to search for a welfare-optimal garnishment regime, taking into account labor supply effects during all periods of bankruptcy.

The remainder of the paper is structured as follows. Section 2 provides some background information on the details of the German bankruptcy law, before the model is presented in Section 3. I present the calibration in Section 4. Section 5 discusses the main features of the benchmark economy. The effects of abolishing the current garnishment regime are explored in Section 6, before Section 7 discusses the features of the optimal garnishment regime. Finally, Section 8 concludes.

2 German Bankruptcy Code

Germany introduced its personal bankruptcy law in 1999. Contrary to the U.S. system – which grants debt forgiveness and a "Fresh Start" – the German bankruptcy code tries to deter consumers from defaulting and promotes repayment (Gerhardt, 2009; Niemi, 2009). Before insolvent households can file for personal bankruptcy, they must exhibit substantial effort to settle their debts directly with their creditors. Only if an out-of-court settlement fails (which it does in more than 98% of all cases) can consumers proceed to seek bankruptcy protection.

Being granted bankruptcy protection typically entails asset seizures and a six-year repayment period. There are some exemptions to asset and housing seizures to allow for basic needs. During the repayment period, a significant part of income is garnished and distributed among creditors. As discussed in further detail in Section 4.1, garnishment rates for a typical household are 70% and they apply to all net income in excess of ca. 13,000€ per year. Above 38,500€, the garnishment rate is 100%.

If households show good conduct during six years by sticking to the repayment plan and not taking on new debt, remaining debt is forgiven at the end of the garnishment period (Gerhardt, 2009). Households are free to repay more than required by law. If they end up repaying all outstanding debt before the end of the period of good conduct, households can exit bankruptcy earlier than six years.

Figure 1 shows the bankruptcy filing rate in Germany. After the introduction of personal bankruptcy legislation in 1999, German bankruptcy rates rose quickly and remained stable since. From 2006 to 2012, on average 0.25% of German households filed for bankruptcy each year.

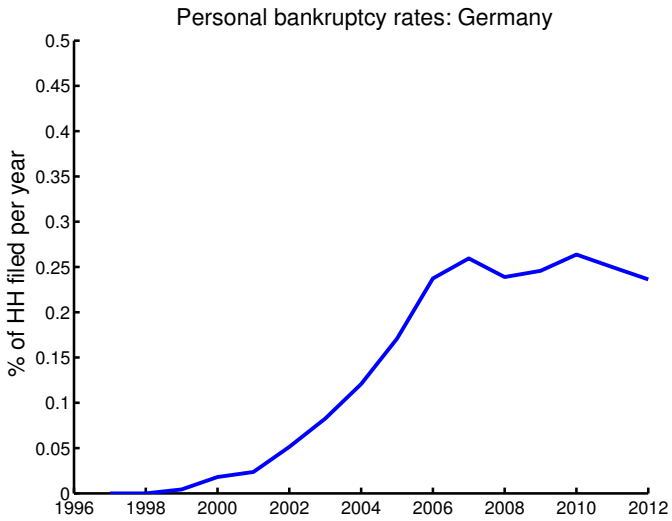


Figure 1: Annual bankruptcy filings per household, in %.
Source: German Federal Statistical Office (2014a,b) and author's calculations.

3 Model

I set up a limited commitment model with equilibrium bankruptcy. In line with most of the literature, the model abstracts from secured lending (e.g. mortgages or car loans) and focuses on unsecured credit such as credit card debt or overdraft loans. The economy is populated by a continuum of heterogeneous households in an overlapping generations framework, similar to Livshits, MacGee, and Tertilt (2007). Each agent faces idiosyncratic risk in labor productivity and expenditure shocks. Households can consume, save or borrow, file for bankruptcy and decide how much to work. Financial intermediaries operate competitively and offer loans that are priced depending on household characteristics and loan size.

Wages and the risk-free interest rate are set exogenously. Since unsecured borrowing and lending only account for a small fraction of capital in the economy, this is arguably not a strong assumption. Changes in borrowing and lending behavior in these markets do not significantly influence the marginal product of labor or the aggregate capital stock.[7]

[7]Indeed, when running their policy experiment, Chatterjee, Corbae, Nakajima, and Ríos-Rull (2007) conclude that general equilibrium effects do not create noticeable dynamics.

3.1 Households

Households derive utility from consumption c and disutility from hours worked h. Their life-time utility is the expected discounted sum of one-period CRRA utility functions. For a household of type i and age $j = 1$ it can be written as

$$U\left(\{c_j^i, h_j^i\}_{j=1}^J\right) = \mathbb{E}\sum_{j=1}^{J} \beta^{j-1} u(c_j^i, h_j^i) = \mathbb{E}\sum_{j=1}^{J} \beta^{j-1}\left(\frac{(c_j^i)^{1-\sigma}}{1-\sigma} - \psi\frac{(h_j^i)^{1+\phi}}{1+\phi}\right), \quad \psi > 0 \tag{1}$$

In each period, solvent households (i.e. those not in bankruptcy):

1. observe their persistent and transitory labor productivity z and ε, expenditure shock κ, and assets a;
2. optimally choose whether to default ($d(a', s') = 1$) or not ($d(a', s') = 0$); and
3. choose consumption, savings (i.e. next period's asset holdings) and labor supply optimally.

The solvent household's state is thus fully represented by (a, s), with $s = \{j, z, \varepsilon, \kappa\}$.[8] Households enter the model at age 21 ($j = 1$) and die with certainty at the age of 80 ($j = J = 60$).

For solvent households, the recursive formulation of the life-time maximization problem given state (a, s) and conditional on not declaring bankruptcy ($d = 0$) is $V^S(a, s, 0)$:

$$\begin{aligned} V^S(a, s, 0) = \max_{c,h,a'} &\left[u(c, h) + \beta\mathbb{E}\max\left\{V^S(a', s', 0), V^D(a', s', 1)\right\}\right] \\ \text{s.t.} \quad & c + q(a', s)a' = y + a - \kappa \\ & h \in (0, 1),\ c > 0. \end{aligned} \tag{2}$$

The budget constraint in solvency simply states that expenditures cannot exceed labor income (y) plus initial wealth (a) minus the expenditure shock (κ). $q(\cdot)$ denotes the bond price that households are offered for saving/borrowing a'. It will be discussed in detail in Section 3.2.

An important part of the policy analysis in this paper will center around wage garnishment rules and how households adjust their labor supply to it. In order to create realistic effective marginal tax rates under garnishment, labor income taxes have to be taken into account. Thus, a household's gross income is subject to a progressive income tax. Gross

[8] Note that due to the OLG structure, age j enters the state space.

labor income comprises the wage rate w, which is multiplied by the household's labor supply h. I apply the labor income tax function proposed by Benabou (2002) such that net labor income is

$$y = \lambda_0 (wh)^{1-\lambda_1}. \tag{3}$$

Following Livshits, MacGee, and Tertilt (2007, 2010), the wage rate w comprises $w = p \cdot x(j)$, where labor productivity p is multiplied by an age-dependent experience premium $x(j)$. The productivity component p of (log) wages represents the idiosyncratic wage risk that a household faces. It is modeled as a persistent AR(1) process $z_{i,t}$ and transitory white noise $\varepsilon_{i,t}$. For household i at time t, it reads:

$$\begin{aligned} \log(p_{i,t}) &= z_{i,t} + \varepsilon_{i,t} \\ z_{i,t} &= \varrho z_{i,t-1} + \eta_{i,t}, \end{aligned} \tag{4}$$

where $\varrho \in [0,1]$, $\varepsilon \sim \mathbb{N}(0, \sigma_\varepsilon^2)$ and $\eta \sim \mathbb{N}(0, \sigma_\eta^2)$.

Upon default, households enter the phase of good conduct and labor income is subject to garnishment for T periods. Upon deciding to file for bankruptcy ($d = 1$), $t = \{1, 2, ..., T\}$ keeps track of the household's time in bankruptcy.

The recursive formulation in default is

$$\begin{aligned} V^D(a,s,t) = \max_{c,h,a'} & \left[u(c,h) - d\zeta + \beta \mathbb{E}\left(V^D(a',s',t') \right) \right] \\ \text{s.t.} \quad & c = [1 - g(y)]\, y - g^* \\ & (1+\bar{r})^{-1}\, a' = a + g(y)y + g^* \\ & g^* \geq 0 \\ & t' = t + 1. \end{aligned} \tag{5}$$

When defaulting, agents incur a utility cost of ζ. Once in bankruptcy, households are not free to borrow but have to comply with wage garnishment and repay at least $g(y)y$. Hence, consumption can at most be as large as labor income minus garnishment $[1 - g(y)]\, y$. Households can choose to repay more than mandated by garnishment. Additional repayment (denoted by $g^* > 0$) further reduces consumption. In total, repayment amounts to $g(y) + g^*$ and is transferred to the creditors to pay down outstanding debt. The remainder of debt is rolled over at rate $\bar{r}$.[9]

[9]Note that it is assumed that households are protected from expenditure shocks during bankruptcy. Since these are very rare and bankruptcy rates are around 0.25% per year, this assumption has no measurable implications.

Allowing the two aforementioned ways of exiting bankruptcy, all outstanding debt is forgiven upon completion of the period of good conduct

$$V^D(a, s, T+1) \equiv V^S(0, s, 0)$$

or early exit is allowed if all outstanding debt is repaid in full. Hence

$$V^D(a, s, t) \equiv V^S(a, s, 0) \quad if \quad a \geq 0$$

With the value functions from equations (2) and (5) at hand, the value function for solvent households in the beginning of each period – after observing the household state (a, s) but before deciding whether to default or not – can be expressed as

$$V(a, s) = \max_{d(a,s)\in\{0,1\}} (1 - d(a, s))\ V^S(a, s, 0) + d(a, s)\ V^D(a, s, 1) \tag{6}$$

For households in their t-th year of default, the value function is given in equation (5).

3.2 Financial Intermediaries

Banks operate in a perfectly competitive market with free entry. Each bank can refinance or invest at the exogenous risk-free rate r outside the model economy. Upon emitting loans, banks face proportional transaction costs of γ. At each point in time, a schedule of one-period contracts is offered. Each contract is defined as a quantity-price bundle $(a', q(a', s))$. Since current household states are observed by the financial intermediary, prices vary not only by loan size but also by household type.

Due to perfect competition, the expected profits of offering any loan contract are zero, given any type of household. This condition is used to pin down the loan price as a function of loan size and household type. The expectations of next period's repayment rate $\tilde{\rho}$ are a function of the size of the loan a' and next period's state of the household s', given state s today. It is denoted by $\mathbb{E}\left[\widetilde{\rho}\left(a', s'\right) \mid s\right]$. Accordingly, the expectations of profits $\pi\left(a', q(\cdot)\right)$ can be written as

$$\mathbb{E}\left[\pi\left(a', q(a', s)\right) \mid s\right] = q(a', s)a' - \left(1 + r + \gamma \cdot \mathbf{I}_{a'<0}\right)^{-1} \mathbb{E}\left[\widetilde{\rho}\left(a', s'\right) \mid s\right] a' = 0 \qquad \forall s, \forall a'. \tag{7}$$

Expected profits are expected revenue minus expected cost. In case of offering a savings contract $(a' \geq 0)$, revenues are defined by the first term: $q(\cdot)a'$. Costs are derived from the second term and amount to $a'/\left(1 + r\right)$. Here, the indicator function is equal to zero

and $\mathbb{E}\left[\widetilde{\rho}\left(\cdot\right) \mid s\right] = 1$ since banks do not face default risk for savings contracts. Savings are therefore secure and paid the risk-free interest rate. Hence, $q(a', s) = (1+r)^{-1}$ if $a' \geq 0$.

If banks provide loans, repayment might be lower: $\mathbb{E}\left[\widetilde{\rho}\left(a', s'\right) \mid s\right] \in [0, 1]$. Hence, revenues are uncertain and read $-\left(\mathbb{E}\left[\widetilde{\rho}\left(a', s'\right) \mid s\right] a'\right) / \left(1 + r + \gamma\right)$. The costs of a loan contract (a',$q(a', s)$) are simply the amount that households receive, $-q(a', s)a'$.

Denote the risk-free loan price where loans are fully repaid (i.e. $\mathbb{E}\left[\widetilde{\rho}(\cdot) \mid s\right] = 1$) as $\bar{q} = \left(1 + r + \gamma\right)^{-1}$. $\bar{q}$ captures banks' refinancing and transaction costs per unit of loan. Solving equation (7) for $q(\cdot)$, one can then write

$$\begin{aligned} q(a', s) &= \bar{q} \cdot \mathbb{E}\left[\widetilde{\rho}\left(a', s'\right) \mid s\right] \\ &= \bar{q} \cdot \mathbb{E}\left[\widetilde{\rho}\left(a', s'\right)\left(1 - d\left(a', s'\right)\right) \mid s\right] + \bar{q} \cdot \mathbb{E}\left[\widetilde{\rho}\left(a', s'\right) d\left(a', s'\right) \mid s\right] \\ &= \bar{q}\left(1 - \mathbb{E}\left[d\left(a', s'\right) \mid s\right]\right) + \bar{q} \cdot \mathbb{E}\left[\widetilde{\rho}\left(a', s'\right) d\left(a', s'\right) \mid s\right] \qquad \forall s, \forall a' < 0, \end{aligned} \tag{8}$$

where the last step in equation (8) uses the fact that repayment is full given no default occurring:

$$\mathbb{E}\left[\widetilde{\rho}\left(a', s'\right)\left(1 - d\left(a', s'\right)\right) \mid s\right] = \begin{cases} 1, & \text{if} \quad d(\cdot) = 0. \\ 0, & \text{if} \quad d(\cdot) = 1. \end{cases}. \tag{9}$$

Finally, denoting the fraction that is repaid conditional on defaulting $\rho\left(a', s'\right) = \widetilde{\rho}\left(a', s'\right) d\left(a', s'\right)$, the full price schedule can be written as

$$q(a', s) = \begin{cases} \left(1 + r\right)^{-1}, & \text{if } a' \geq 0. \\ \bar{q}\left(1 - \mathbb{E}\left[d\left(a', s'\right) \mid s\right]\right) + \bar{q} \cdot \mathbb{E}\left[\rho\left(a', s'\right) \mid s\right], & \text{if } a' < 0. \end{cases} \tag{10}$$

The fraction of recovered loans is the discounted sum of garnished incomes (and voluntary repayment g^*), normalized by the original loan size, denoted here by a'_0.[10] The banks' discount factor is $\bar{q}$, taking into account refinancing and transaction costs.

$$\begin{gathered} E\left[\rho(a'_0, s_0) \mid s_0\right] = \frac{\sum_{i=1}^{\widetilde{T}} E\left[g(y_i) y_i + g_i^* \mid s_0\right] \cdot \bar{q}^i}{|a'_0|} \\ \text{with} \quad \widetilde{T} = \min\{T, J - j_0\}. \end{gathered} \tag{11}$$

Garnishment ends after $\widetilde{T}$ periods if either garnishment has been completed after T periods or if the household dies before.

[10] In a slight abuse of notation, I introduce time indices into recursive formulation to capture $\widetilde{T}$ periods of repayment.

3.3 Equilibrium

Given a bankruptcy code, a risk-free rate r and a wage process $w = p \cdot x(j)$, a financial market equilibrium is the set of value functions V^S and V^D, policy functions $c(\cdot)$, $a'(\cdot)$, $d(\cdot)$, $h(\cdot)$, a set of default probabilities $\mathbb{E}\left[d\left(\cdot\right) \mid s\right]$ and expected repayment rates $\mathbb{E}\left[\rho\left(\cdot\right) \mid s\right]$, where $s = \{j, z, \varepsilon, \kappa\}$, as well as an asset pricing function $q(\cdot)$ such that:

1. Households maximize V, V^S and V^D, where $c(a, s)$, $a'(a, s)$, $d(a, s)$, $h(a, s)$ are the resulting optimal policy functions.

2. The bond price $q(a', s)$ is determined in a competitive market with free entry, taking as given the expected default and repayment rates $\mathbb{E}\left[d\left(a', s'\right) \mid s\right]$ and $\mathbb{E}\left[\rho\left(a', s'\right) \mid s\right]$.

3. The measure of households over states (a, s, t) is constant.

4 Calibration

In order to provide a useful tool for policy recommendations, I calibrate the model to the German economy between 2012 and 2014. The model reproduces important facts on income, debt and bankruptcy filings. Some parameters are directly specified (see Table 1), while others are jointly chosen to match the data on income, debt and bankruptcy filings (see Tables 2 and 3).

4.1 Direct Specification

4.1.1 Preferences

The period utility function is assumed to be additively separable in consumption and hours worked. Discounting and the CRRA parameter of consumption are set to standard values. To obtain the coefficient of labor supply, I use the Frisch elasticity of labor supply estimated in Hall (2009). One can argue that this is a conservative estimate, since Hall accounts for the external margin, which I abstract from.[11]

4.1.2 Income Process

The idiosyncratic productivity component p of household (log) wages corresponds to the residual of regressing wages on observables such as age and education. It is assumed to

[11] Households can decide whether to participate in the market or not. The Frisch elasticity of labor supply is then calculated conditional on participating and captures labor supply responses to shifts in the wage rate.

Table 1: Direct Specification

	Var		Value	Source
Discount	β		0.97	Standard
CRRA conspt	σ		2	Standard
Frisch elasticity	ϕ		0.7^{-1}	Hall (2009)
Wage autocorrelation	ϱ		0.92	GSOEP:
Persistent wage std. dev.	σ_η		0.12	Bayer and Juessen (2012)
Transitory wage std. dev.	σ_ε		0.17	
Expenditure shock (€)	κ_0	0	98.6%	Over-indebtedness
	κ_1	7,800	0.9%	statistic
	κ_2	24,500	0.5%	
Risk-free rate	r		2%	Bond rate
Income tax level	λ_0		0.78	German Tax Code:
Income tax progressivity	λ_1		0.20	Holter, Krueger, and Stepanchuk (forthcoming)
Income exemption (€)	$\underline{y}$		12,600	Bankruptcy law
Income cap (€)	$\overline{y}$		38,500	Bankruptcy law
Garnishment rate	τ		70%	Bankruptcy law

follow a combination of a persistent AR(1) process $z_{i,t}$ and transitory white noise $\varepsilon_{i,t}$, as described in equation (4). Using GSOEP data (German Socioeconomic Panel), Bayer and Juessen (2012) estimate the AR(1) coefficient (ϱ) and the standard deviations of ε and η for the 1984-2006 period. I report the results in Table 1.

Both components of the idiosyncratic wage process are discretized. The persistent component $z_{i,t}$ is approximated by a five-state Markov chain using the Rouwenhorst method for highly correlated processes described in Kopecky and Suen (2010). The white noise term $\varepsilon_{i,t}$ is discretized to take three possible values.

I estimate the age-dependent experience component $x(j)$ from data on monthly gross wages in Germany by age in 2006 and 2010 (German Federal Statistical Office, 2013). The data bins are interpolated to yield yearly values using cubic splines. The mean $1/J \sum_{j\in\{1,\dots J\}} x(j) = 1$ is normalized to one. The experience profile is plotted in Figure A.1 in the appendix.

4.1.3 Expenditure Shocks

Following Livshits, MacGee, and Tertilt (2007), I assume that the expenditure shock is independently and identically distributed and discretize it into three realizations: $\kappa \in \{\kappa_0, \kappa_1, \kappa_2\}$. Besides no expense shock ($\kappa_0 = 0$), the authors calculate a moderate and a large realization. The moderate realization comprises family disruptions (such as unwanted children or divorce), whereas the large realization mainly covers medical bills (see Livshits, MacGee, and Tertilt, 2007, Table 1).

Using data from the statistic on over-indebtedness (German Federal Statistical Office, 2014c), I follow the author's categorization and sort the reasons for over-indebtedness into reasons causing moderate and large debt, respectively. Households cite reasons such as family disruptions and poor financial planning, which create debts of around $\kappa_1 = 7{,}800$€. Larger expenses of around $\kappa_2 = 24{,}500$€ are mainly related to health reasons (addiction and disabilities) and failed housing investments. I exclude reasons that are related to labor market outcomes such as job loss or failed businesses. Job loss is a reason associated to the income process in my model, whereas I abstract from business filings.

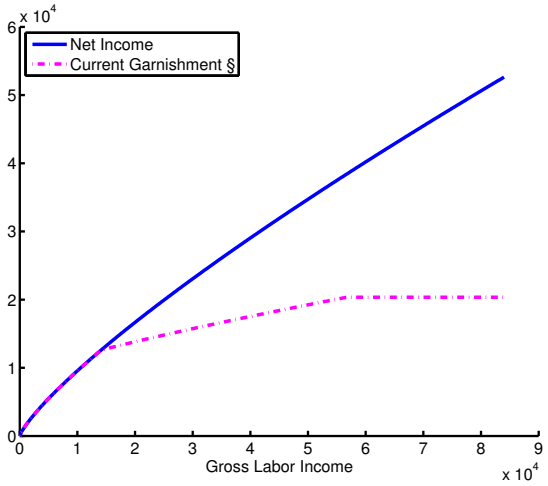
In order to calculate the probabilities of each of these shocks, I calculate the share of over-indebtedness caused by either of the two kinds of reasons discussed above. Subsequently, I multiply these shares with the unconditional probability of filing for bankruptcy. I obtain probabilities of $\pi(\kappa_1) = 0.9\%$ and $\pi(\kappa_2) = 0.5\%$, respectively.

4.1.4 Wage Garnishment

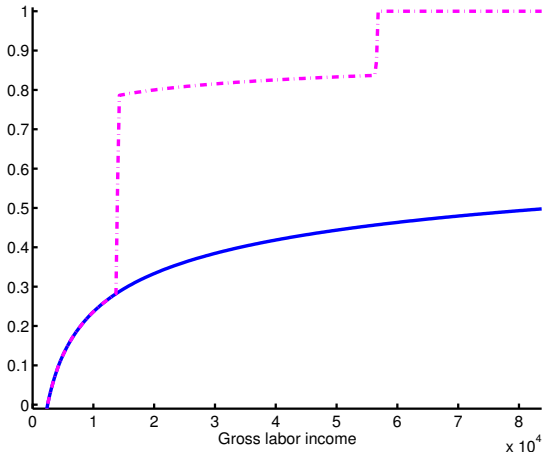
According to the German bankruptcy code ("Pfändungsgrenzenbekanntmachung 2013"), agents enter a period of good conduct for $T = 6$ years upon declaring bankruptcy. During this period, a household faces wage garnishment of $\tau = 70\%$ for all *net* labor income in excess of $\underline{y} = 12,600$€. Above a *net* income of $\overline{y} = 38,500$€, 100% additional income is garnished. Figure 2 depicts disposable labor income with and without garnishment and marginal garnishment rates as a function of *gross* labor income. As is apparent from the figure, total effective marginal tax rates in garnishment (i.e. income taxes plus income garnishment) jump to 80% at a *gross* income of 15,000€ and reach 100% at a *gross* income of 59,000€.

4.1.5 Risk free rate and taxation

Banks are assumed to have access to outside financing at the risk-free interest rate, which is set to the yields of German government bonds around the 2012 value of 2%. Following



(a) Disposable Income after Tax and Garnishment.



(b) Effective Marginal Tax Rates.

Figure 2: Garnishment Schedule according to German Insolvency Law.

the functional form proposed by Benabou (2002), Holter, Krueger, and Stepanchuk (forthcoming) estimate $[\lambda_0, \lambda_1] = [0.78, 0.20]$ to represent the progressive German labor income tax.

4.2 Jointly-Targeted Moments

The model closely matches bankruptcy filings, average debt in bankruptcy (i.e. bad debt) and average income in Germany (see Table 2). In order to compute aggregate statistics, the model is solved by backward iteration over the life-cycle. The model economy is then simulated in a Monte-Carlo fashion with $N = 100,000$ random life-cycle draws of the wage process and expenditure shocks. In a last step, the model moments are aggregated from this sample. In order to match the model to the data, the following objective function is solved

$$\min_{\theta} \sum_{i} \omega_i \left(M_i(\theta) - D_i \right)^2 \tag{12}$$

Hence, optimal parameter values (θ) are chosen such that the sum of squared differences between the model moments $M_i(\theta)$ and data targets (D_i) is minimized. The parameters to be jointly determined are $\theta = \{\zeta, \gamma, \psi\}$, which correspond to the utility cost (i.e. stigma) of declaring bankruptcy, the transaction cost of banks when creating loans, and the utility weight of labor in the period utility function. Deviations are weighted equally (i.e. $\omega_i =$

Table 2: Jointly-Targeted Moments

	Data	Model
Bankruptcy filings per 1,000 HH	2.5	2.44
Average bad debt (€)	55,000	55,150
Average Labor Income (€)	37,300	32,000

Source: German Federal Statistical Office (2014b, 2015)

Table 3: Internally-Determined Parameters

	Parameter	Value
Stigma cost	ζ	2.788
Transaction cost	γ	0
Utility weight labor	ψ	2.004

$1 \; \forall i$). The three parameters are chosen to match three data targets: bankruptcy filings per thousand, debt when filing for bankruptcy and labor income.

4.2.1 Bankruptcy Statistics

As discussed in Section 2, German bankruptcy rates were very stable between 2006 and 2012. On average, 2.5 per one thousand German households filed for bankruptcy per year (see Figure 1). The model hits this target very closely. The resulting stigma cost of 2.8 are equivalent to the utility loss induced by taking 1,000€ from a 21-year-old median income individual with a prior net worth of 0€.

4.2.2 Bad Debt

The model does a very good job in matching average debt when declaring bankruptcy (i.e. "'bad debt"). Defaulted debt is any unsecured debt that households hold ($a < 0$) plus potential unforeseen expenditures (κ).

Despite only targeting the average value, the model captures the shape the distribution extremely well. Figure 3 shows the distribution of bad debt in the model and the data. The model slightly over-estimates debts below 100,000€, while very high amounts of debt (above 300,000€) are not captured. Since only unsecured lending is modeled, very high debt holdings are difficult to obtain in the model. Furthermore, one might argue that large debt might be reported in the bankruptcy statistic. While I exclude bankruptcy filings

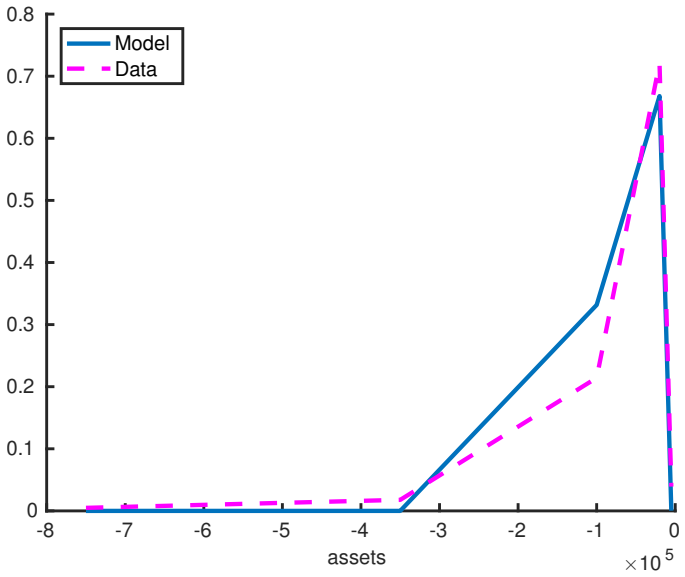


Figure 3: Distribution of Bad Debt
Source: German Federal Statistical Office (2014c).

declared as business filings, it might be difficult to identify liabilities from failed businesses that are carried over into private bankruptcy in practice. Hence, the data might over-state very high debt realizations.

To induce sufficiently high amounts of borrowing, the proportional transaction cost between saving and (secure) lending is $\gamma = 0$. However, this does not mean that all loans come at the safe rate of 2%. The default premium drives a wedge between the safe interest rate and interest rates actually charged for loans (see Section 5.2).

4.2.3 Labor Income

In the benchmark case, households earn around 32,000€ per year. This is below the data equivalent of 37,300€. The resulting utility weight of labor is roughly $\psi = 2$. Reducing this parameter would increase labor supply, albeit at the cost of increasing both bankruptcy filings and average bad debt. Thus, income remains below target. This link cannot be broken by higher default cost because while they directly reduce bankruptcy filings, they increase average bad debt even further.

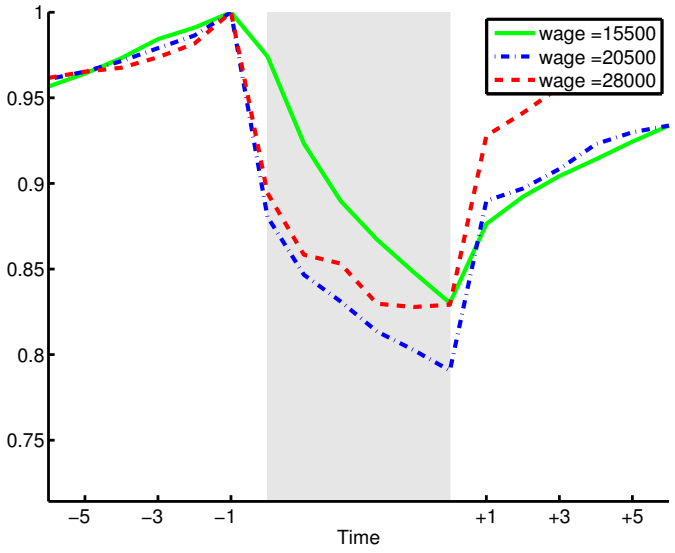


Figure 4: Labor Supply Decisions Before, During, and After Bankruptcy.

5 Benchmark

In the benchmark economy described above, about 2.5 per thousand households file for bankruptcy. More than 80% of filers have outstanding loans of around 30,000€ and about 10% have debts in excess of 80,000€. The average debt that is carried into bankruptcy amounts to around 55,000€.

5.1 The Effect of Garnishment on Endogenous Labor

Garnishment rates in Germany are very high. Figure 2b depicts the evolution of effective marginal tax rates under garnishment as a function of gross labor income. An effective marginal tax rate in excess of 70% is levied for gross incomes above 15,000€ and the marginal rate increases to 100% for gross incomes above 59,000€.

Endogenous labor supply emerges as a key margin along which households adapt in response to (planning to file for) bankruptcy. Figure 4 shows the average realized labor supply of households before, during, and after filing for bankruptcy and being subject to wage garnishment. The gray area depicts the six years of wage garnishment that follow the declaration of bankruptcy in period 0. Left (right) of the gray area, the six years before (after) being subject to garnishment are depicted. Labor supply is normalized to 1 in the year prior to filing for bankruptcy (i.e. year -1).

In the years prior to bankruptcy, households of any income level increase their labor supply. By increasing labor earnings, households try to repay their outstanding debt and avoid bankruptcy. Once repayment becomes undesirable (or impossible) households declare bankruptcy in period 0. Labor supply drops by up to 10% in response to wage garnishment in the first period of bankruptcy (indicated by the beginning of the gray area).

During the garnishment spell, labor supply drops by another 10 percentage points to roughly 80% of pre-bankruptcy levels. This effect is mainly a composition effect: since households are allowed to leave garnishment early if they fully repay their debts, some households work hard to achieve this early repayment. The remaining bankrupts are not able (or willing) to repay their debts early and thus wait for debt relief after six years of garnishment. As a result, average labor supply drops with the duration of the garnishment spell because the pool of bankrupts includes a decreasing amount of bankrupts working hard in order to repay early.

Since households that become subject to wage garnishment significantly reduce their labor supply one can conclude that the current garnishment regime creates substitution effects (labor becomes less desirable relative to leisure) that outweigh the income effect (poorer households tend to work more).

Upon completion of the period of good conduct, households exit garnishment, the remainder of their debt is forgiven and their labor supply returns to previous levels.

Finally, Figure 4 documents that garnishment mainly discourages labor supply by higher-income individuals.[12] Low-income individuals are close to the income exemption level and consequently exhibit weaker reactions. Once their labor income drops below the exemption level, garnishment does not distort their labor supply decision further.

5.2 Equilibrium Loan Price

Evading garnishment has a stark impact on loan prices, as documented in Figure 5. Using notation from equation (2), one can interpret the loan price as $q = 1/(1+r)$. Hence, $q \to 1$ means a low interest rate $r \to 0$, while $q \to 0$ means increasing interest rates $r \to \infty$.

Loan prices are (weakly) decreasing in loan size. However, there is a sharp drop at the threshold of sustainable debt. This comes from the fact that banks understand the incentives for households to default and reduce working hours, avoiding high amounts of garnishment. Hence, the expected repayment for these loans is very low.

[12] I do not report labor supply responses by top income earners because the number of observed bankruptcy filings by high-income individuals is low. Consequently, average labor supply of these bankrupts is measured quite noisily in the ergodic distribution.

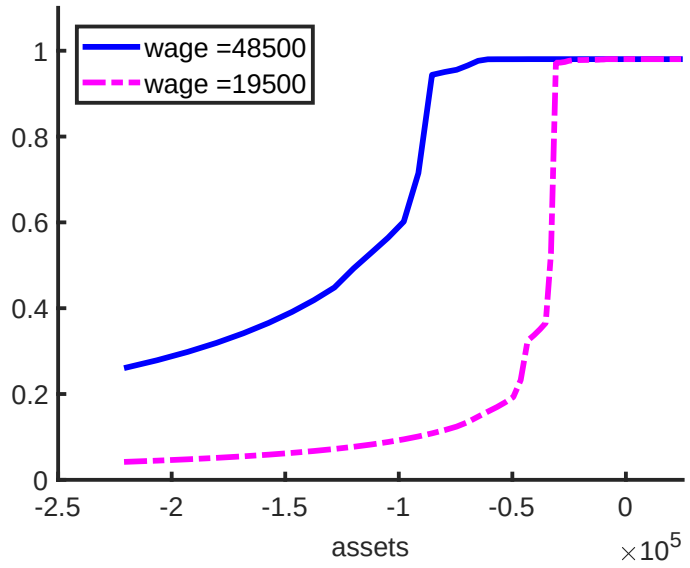
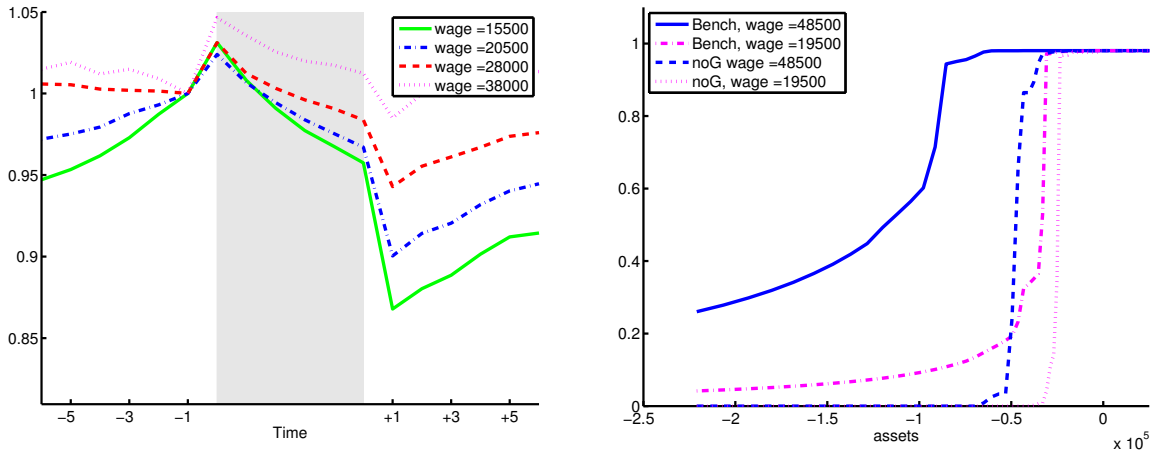


Figure 5: Equilibrium Loan Prices, Age 50.

Comparing high and low wage earners, unsurprisingly, the former have considerably higher access to credit. This manifest along two dimensions: first, credit prices only deteriorate at higher levels of debt; and second, the plunge in loan prices is less pronounced for high-income individuals. Higher disposable income allows higher repayment of loans without the necessity to default. Furthermore, filing for bankruptcy is more costly for high-wage households relative to not filing, owing to the distortions to labor income. As a result, default becomes optimal at much higher levels of debt. Even if highly-productive individuals file for bankruptcy, banks can recoup a larger fraction of the outstanding loans. This means that expected losses are smaller, which leads to a less pronounced drop in credit prices.

6 Abolishing Garnishment

Before discussing the welfare-maximizing garnishment regime in Section 7, it is instructive to study an alternative reform to the bankruptcy code. The proposed "no garnishment" regime resembles "Fresh Start" regimes such as Chapter 7 in the U.S. These regimes do not feature wage garnishment but bankruptcy obtain a bankruptcy flag in their credit record for some time. Hence, I set the marginal garnishment rate to zero. This allows us to study the effects of garnishment on labor supply, as well as how claims towards future income influence credit prices. Besides suffering the stigma of declaring bankruptcy, bankrupts



(a) Labor Supply Decisions.

(b) Equilibrium Loan Prices, Age 50.

Figure 6: Effects of Abolishing Garnishment.

will be excluded from additional borrowing to capture the effect of the bankruptcy flag. This is in line with (Chatterjee, Corbae, Nakajima, and Ríos-Rull, 2007; Livshits, MacGee, and Tertilt, 2007).

The "no garnishment" regime corresponds to the following parameter setup: under the reformed bankruptcy code, labor income is not subject to garnishment. During the period of good conduct, individuals are only prevented from increasing debt. Effectively, bankrupts are thus excluded from borrowing. After $T = 6$ years, all outstanding debt is forgiven and bankrupts have a "Fresh Start". Technically, I set $\underline{y} = \overline{y} = \infty,\ \tau = 0$.

Abolishing garnishment has a strong impact on effective (marginal) tax rates during bankruptcy. Since there is no garnishment, net income and marginal tax rates in bankruptcy are equal to those in solvency. In Figure 2, income and marginal taxes under "no garnishment" correspond to the "net income" plots.[13]

6.1 Labor Supply and Interest Rates

The effects of abolishing wage garnishment on labor supply and the loan price schedule are shown in Figure 6. Removing wage garnishment removes distortions to labor supply during bankruptcy (see Figure 6a) compared to the benchmark with wage garnishment (see Figure 4). There is a slight increase in labor supply when declaring bankruptcy because bankrupts effectively become hand-to-mouth consumers for $T = 6$ years. Towards the

[13] Appendix C discusses two additional garnishment regimes: "lenient garnishment" and "mean garnishment."

Table 4: Equilibrium Outcomes, Benchmark vs. "No Garnishment"

	Benchmark	No Garnishment
Bankruptcy filings per 1,000 HH	2.44	2.43
Fraction of HH in debt (in %)	56	51
Average debt (€)	30,550	23,850
Average bad debt (€)	55,150	56,965
Average savings (€)	42,184	42,146
Average labor income (€)	32,000	32,000

end of the garnishment period, labor supply declines back to the levels prior of filing for bankruptcy. On average, labor supply remains relatively stable.

When debts are relieved in period +1 after six years of good conduct, labor supply drops significantly. Households experience a positive income effect (because their debt is forgiven) and thus reduce labor supply.

Credit prices react in two ways (see Figure 6b): first, interest rates start increasing (i.e. the loan price schedule q drops) at lower levels of debt; and second, interest rates rise more steeply.

Relating to the first point, abolishing garnishment increases the incentives to default at any given debt level. This leads households to prefer default at lower levels of debt. Due to higher expected losses, lenders react by increasing interest rates at lower levels of debt.

Relating to the second point, without garnishment, households have no way to (partially) pledge future labor income as securities for banks. Credit prices deteriorate quickly as soon as default is optimal since banks lose all of the outstanding loans and do not recover anything through garnishment. This effect is more pronounced for high-income households. These are strongly affected by garnishment and hence change default behavior more radically.

6.2 Aggregate Effects

The aggregate effects of moving from the current German bankruptcy law to a regime without any garnishment are summarized in Table 4. Since default is less painful without garnishment, financial intermediaries fear that households might default earlier and interest rates might rise (see before). Consequently, less debt can be sustained in the "no garnishment" economy, where default is easier: the fraction of borrowers drops by 10% and average debt in the economy drops by more than 20%.

Interestingly, the effect of removing wage garnishment on bankruptcies is rather small. Both, the number of bankruptcies and the amount of bad debt remain rather constant. There are two opposing effects that cancel each other out: on the one hand, less painful bankruptcy requirements make households more likely to default; and on the other hand, financial intermediaries respond by increasing interest rates, which in turn makes households less likely to borrow. If households borrow less, they are less likely to default.

6.3 Welfare Effects

All possible reforms face the trade-off between higher punishment (e.g. through wage garnishment), allowing greater and cheaper access to credit versus greater leniency and thus better insurance against adverse events at the cost of more expensive credit. In the case of Germany, the current system is particularly harsh on high-income individuals and – as previously discussed – creates serious labor supply distortions.

I employ two different kinds of welfare measures to assess the desirability of the "no garnishment" reform. First, I evaluate welfare effects if the reform was introduced into the equilibrium of the current German economy (i.e. including the transition), c.f. Figure 7. Second, I evaluate ex-ante welfare effects, c.f. Figure 8.

When evaluating the welfare effects including the transition, I assume that all new credit contracts are signed under the new law immediately. Banks thus take into account that wage garnishment is abolished. Since only one-period loans exist in the model, existing debt has to be rolled over under the new regime. Thus, the simulated economy starts to transition to the new ergodic debt and asset distribution immediately.

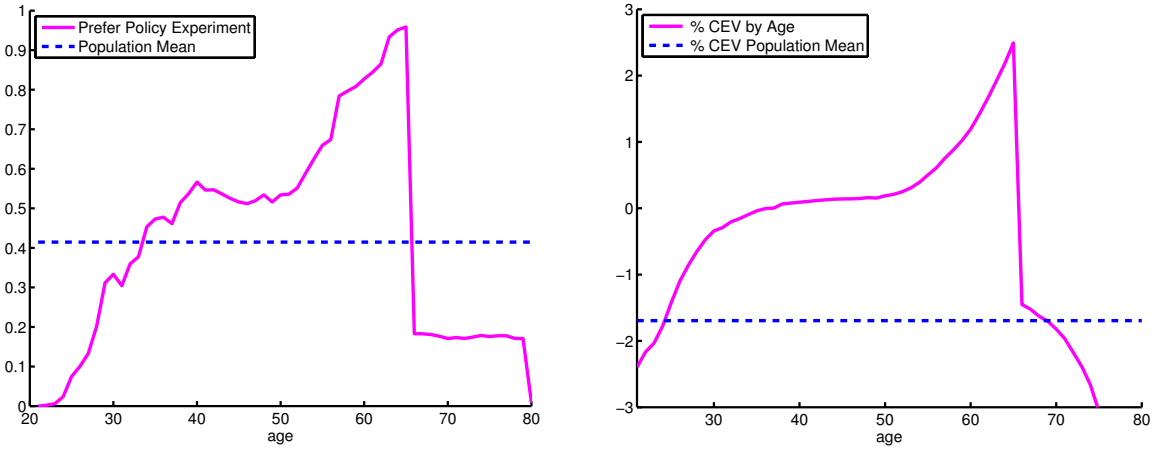
Figure 7 presents two ways to evaluate the welfare effects of introducing the reform into the benchmark economy. Panel 7a shows – by age – the fraction of individuals who are in favor of the reform. A solvent household with assets a and household state s prefers the policy shift if

$$\widetilde{V}(a,s) > V(a,s), \tag{13}$$

where $\widetilde{V}(a,s)$ indicates the value function under the new regime for given asset holdings a and household state s, which includes age.

40% of the population prefer a bankruptcy system without garnishment when introduced in the steady state of the benchmark economy. However, very young and very old households are clearly against this policy.

Panel 7b depicts the average CEV by age. In order to compute the CEV, I determine the factor ξ by which consumption in the benchmark case needs to be increased annually



(a) Fraction in Favor.

(b) CEV in %.

Figure 7: Introducing "No Garnishment" into the Benchmark Economy.

to make a household indifferent between the benchmark and introducing the reform into the benchmark economy:

$$V_\xi(a,s) = \mathbb{E}\sum_{i=j}^{J} \beta^{i-j} u(c_i(1+\xi), h_i) = \widetilde{V}(a,s). \tag{14}$$

This means that any $\xi > 0$ implies that households prefer the reform, given their current state (a,s). All households are equally weighted to construct this measure and I report the economy-wide average (i.e. $\mathbb{E}(\xi)$) and the average by age (i.e. $\mathbb{E}(\xi \mid j), j \in \{1,60\}$).

Young households are worse off – and consequently not in favor of the reform – since "no garnishment" forces them to forgo current consumption to start building up assets. Credit is more expensive after the reform. However, under the benchmark garnishment regime, young households had much larger credit lines since garnishment made them less likely to exercise default. Additionally, they could partly pledge future income as collateral. It was thus easier to smooth consumption over the life-cycle and start repaying loans once wages increased with age.

Prime-age individuals overwhelmingly prefer abolishing wage garnishment. These households are net-savers and credit prices do not impact their welfare directly. Debt becomes relevant when very bad shocks realize. Under the new regime, they have an improved option of insurance since bankruptcy is much less painful. Hence, "no garnishment" reduces the negative effect of adverse shocks considerably and households prefer it over the current garnishment regime.

Figure 8: Ex-ante Welfare of "No Garnishment."

Finally, retirees suffer more from losing access to credit than they gain from easier bankruptcy. Since their income is low and they face significantly smaller risks, the insurance option of bankruptcy is not very relevant to them. Thus, a deterioration of credit conditions outweighs the positive effects of the reform. As depicted in Panel 7b, the average welfare effect of abolishing garnishment in the old benchmark economy would be -1.7%.

As a second welfare measure, I compare ex-ante welfare – measured as the consumption equivalence variation (CEV) for a newborn household – between the benchmark and the "No Garnishment" economy. How would newborns fare when being born into the "No Garnishment" economy relative to being born into an economy with the current German bankruptcy law? Figure 8 presents the ex-ante CEV, both controlling for persistent income and behind the veil of ignorance. It is calculated similar to equation (14), but only for newborns of age 21 ($j = 1$) who enter the economy with zero assets ($a = 0$). The average ex-ante effect is roughly -0.8% and low-income households suffer the most. They experience very sharp increases in interest rates and gain relatively little since garnishment was not very hard on them. No income group is better off without garnishment.

Even when explicitly taking into account endogenous labor supply effects, I find that "no garnishment" is not a favorable regime. This is in line with Livshits, MacGee, and Tertilt (2007), who suggest that if income risk was lower than in the U.S., garnishment might be welfare-enhancing.

Table 5: Planner Solution: Optimal Garnishment Regime

	Current Law	Optimal Regime
Time in Bankruptcy (T)	6 years	10 years
Garnishment Rate (τ)	70%	52%
Exempt Income (€) ($\underline{y}$)	12,600	50
Income Cap (€) ($\overline{y}$)	38,500	29,200

7 Optimal Garnishment Regime

After investigating the effects of completely repealing wage garnishment, this section describes the optimal garnishment regime within the benchmark's class of policies. The social planner's welfare function equally weights each newborn's life-time utility. This welfare measure is equivalent to the expected ex-ante welfare of an individual born into the economy.

In order to maximize social welfare, the planner optimally chooses all four parameters of the garnishment regime: duration of garnishment T, income exemption $\underline{y}$, income cap $\overline{y}$, and the fraction garnished above the income exemption τ. This amounts to assuming that the social planner cannot change the class of garnishment functions itself but optimizes within the current class of garnishment functions. However, choosing an exemption level, a garnishment rate, and an income cap provides sufficient flexibility to define a linear or progressive garnishment regime.

This approach nests three important bankruptcy regimes: setting $T = 0$, there is no commitment in the lending market (besides the utility cost of declaring bankruptcy). Hence, borrowing will be minimal. Setting $T = \infty$ corresponds to no debt forgiveness; debtors are fully committed to repay their debts (except if they die before full repayment). Finally, as shown in the previous section, a "Fresh Start" regime comparable to U.S. Chapter 7 is also nested.

The maximization problem of the social planner is

$$\max_{\{T,\underline{y},\overline{y},\tau\}} \sum_{z\in\mathcal{Z},\varepsilon\in\mathcal{E},\kappa\in\mathcal{K}} V\left(a=0,j=1,z,\varepsilon,\kappa\right)\times\mu(z,\varepsilon,\kappa). \tag{15}$$

Here, $\mu(z,\varepsilon,\kappa)$ denotes the probability at birth of receiving persistent wage $z\in\mathcal{Z}$, transitory wage $\varepsilon\in\mathcal{E}$, and expenditure shock $\kappa\in\mathcal{K}$.[14]

[14]See Appendix B.2 for a detailed description of my computational approach.

When designing the optimal garnishment regime, the social planner faces a fundamental trade-off between readily offering insurance to unlucky households through a cheap bankruptcy option (i.e. low levels of garnishment) and ensuring low interest rates by discouraging default through a tough bankruptcy option (i.e. high levels of garnishment). Additionally, garnishment rates not only influence the trade-off between insurance and interest rates by making default more or less painful but also influence the write-offs that lenders experience conditional on default.

Table 5 presents the optimal garnishment regime, solving the planner's problem in equation (15). The optimal regime features a garnishment period of ten years, a garnishment rate of 52%, basically no income exemption and an income cap of roughly 30,000€. While the income exemption is basically set to zero and the income cap is lowered, the time in bankruptcy rises by more than half. At the same time, the garnishment rate drops by 26% to a rate of 52%.

As noted above, the space of possible garnishment regimes includes a full repayment regime similar to the garnishment regime in Chatterjee and Gordon (2012). Although Chatterjee and Gordon find it to be welfare superior to Chapter 7 bankruptcy, I do find that debt forgiveness is part of the optimal regime.[15]

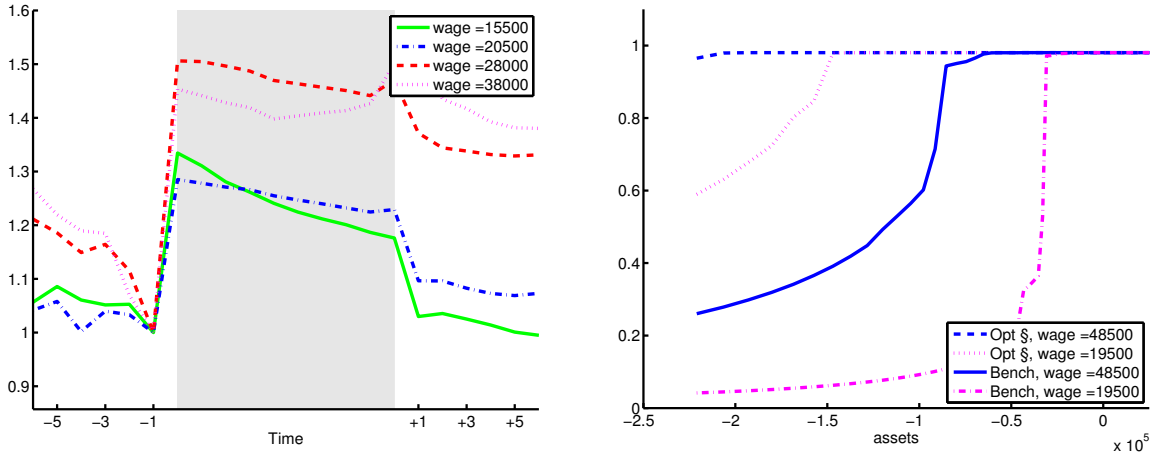
7.1 Labor Supply and Interest Rates

Lower marginal garnishment rates reduce the distortions to labor supply. In the calibrated economy, the combination of lower marginal garnishment rates and longer garnishment duration drives up labor supply in bankruptcy. The substitution effect of garnishment is reduced due to lower marginal rates and the income effect becomes stronger due to a longer garnishment duration. Both effects work to increase labor supply, even relative to no garnishment which was discussed in the previous section.

The positive effects on labor supply are depicted in Figure 9a. Individuals of all income classes increase hours worked as a response to being subject to garnishment under the optimal regime. Under the optimal regime, there is less bunching around the income exemption (because it is basically zero) such that even low-income households increase labor supply and repay some of their debt.

Ceteris paribus, lower marginal garnishment rates lead to less recovery and higher write-offs. However, despite lower marginal garnishment rates, repayment increases under the optimal garnishment regime due to the positive labor supply effect and a longer garnish-

[15]Households in my economy face the additional risk of expenditure shocks relative to Chatterjee and Gordon. Consequently, I do not claim that my optimal regime would fare better in the author's setting.



(a) Labor Supply Decisions.

(b) Equilibrium Loan Prices, Age 50.

Figure 9: Effects of Optimal Garnishment Regime.

ment period. That means that lenders face lower write-offs due to default. Consequently, interest rates decrease and access to credit increases under the optimal garnishment regime (i.e. q increases). Figure 9b depicts the increase of q. The reduction in interest rates is visible along two dimensions. First, bankruptcy becomes less attractive for households. Both low-income and high-income households only declare bankruptcy for higher levels of debt, below which households always repay. Compared to the benchmark, credit is cheaper for much larger amounts of debt. In other words, q only drops for higher amounts of debt.

Second, in case of bankruptcy, repayment under the optimal law is higher than repayment under the current law. Hence, even if households file for bankruptcy, banks expect lower write-offs. Higher expected repayment means that q drops less steeply above debt levels where households start filing for bankruptcy.

Reducing garnishment rates and increasing garnishment duration resembles findings on optimal taxation in the public finance literature. Optimal tax codes generally feature moderate marginal tax rates to reduce distortions but a wider tax base (c.f. OECD, 2010). By reducing the garnishment rate, distortions are reduced. A longer time in bankruptcy effectively lets the planner widen the base for repayment of debt by including more future household income.

7.2 Aggregate Outcomes

In reaction to cheaper access to credit, households hold significantly more debt. Table 6 presents key statistics in the benchmark and under optimal garnishment. While aggregate

Table 6: Equilibrium Outcomes, Benchmark vs. Optimal Regime

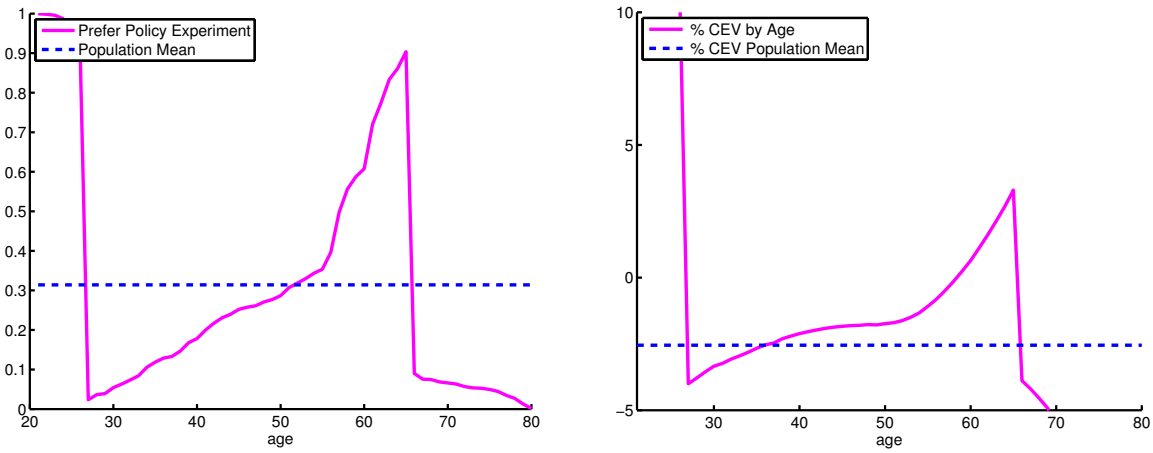
	Benchmark	Optimal Regime
Bankruptcy filings per 1,000 HH	2.44	5.71
Fraction of HH in debt (in %)	56	71
Average debt (€)	30,550	93,009
Average bad debt (€)	55,150	209,518
Average savings (€)	42,184	40,180
Average Labor Income (€)	32,000	32,890

labor income slightly increases, average debt holdings increase by a factor of 3. The fraction of households in debt increases by 15 percentage points. As a result of higher indebtedness, more households are at risk of filing for bankruptcy in response to adverse expenditure or wage shocks. Consequently, bankruptcies more than double in equilibrium. Furthermore, the amount of bad debt in bankruptcy increases nearly three-fold. These sharp increases in default do not lead to higher interest rates, as discussed above. Since garnishment recovers more resources than in the benchmark, interest rates are lowered.

7.3 Welfare Effects

Figure 10 shows that once households have made borrowing and savings choices under the current German garnishment system, a shift to the optimal regime would not be supported by the majority of households (see Panel 10a). While literally every newborn would vote for such a reform, many middle-aged households are not in favor of the reform. When examining Panel 10b, it is striking how much welfare of young households increases. However, those opposing the reform are only slightly worse off. These households have already paid back their initial debts and only need to borrow in the face of adverse shocks. When suffering adverse shocks, the option value of bankruptcy is lower in the optimal regime: repayment takes much longer. Thus, without taking advantage of cheaper credit early in life, middle-aged households do not prefer the policy shift.

Consistent with the very strong increase in the welfare of newborns, ex-ante welfare effects are large and positive. As depicted in Figure 11, being born into an economy with the optimal garnishment regime increases aggregate welfare and no income group suffers from the reform. In terms of CEV, individuals born into an economy with the optimal garnishment law gain 3.3% in expectations relative to those born into an economy with the benchmark garnishment law. When controlling for persistent wage at the age of 21, low-income household gain up to 7% while the highest wage individuals still gain 0.8%.



(a) Fraction in Favor.

(b) CEV in %.

Figure 10: Introducing the Optimal Regime into the Benchmark Economy.

High-income households gain the least from this garnishment reform, because their credit prices only improve significantly for very high amounts of debts. These households already faced favorable credit prices prior to the reform. Additionally, very productive households rarely file for bankruptcy. Hence, changes in garnishment law do not have a large impact on their welfare.[16]

Low-income households strongly benefit from cheaper and more credit. Taking advantage of upside wage risk, they are better able to smooth consumption over the life-cycle. While being more likely to file for bankruptcy, the new garnishment schedule creates lower labor supply distortions. These positive effects outweigh having to repay debts for a longer time when declaring bankruptcy.

8 Conclusion

This paper sets up a quantitative model of consumer bankruptcy and endogenous labor supply in a regime with wage garnishment. It is able to match key statistics concerning bankruptcy and debt and it also fits the distribution of bad debt, which is not directly targeted. It clearly documents the negative effects of the German garnishment regime on labor supply of households that declared bankruptcy. Since households evade garnishment by strongly reducing labor supply, banks only recoup a small fraction of defaulted

[16]Note that the income cap $\overline{y}$ serves as a strong punishment for high incomes. The induced upper bound of labor income prevents bankruptcy filings by highly productive individuals. Despite not raising funds for repayment, keeping the income cap and thereby creating commitment to repay actually proves to be welfare-superior.

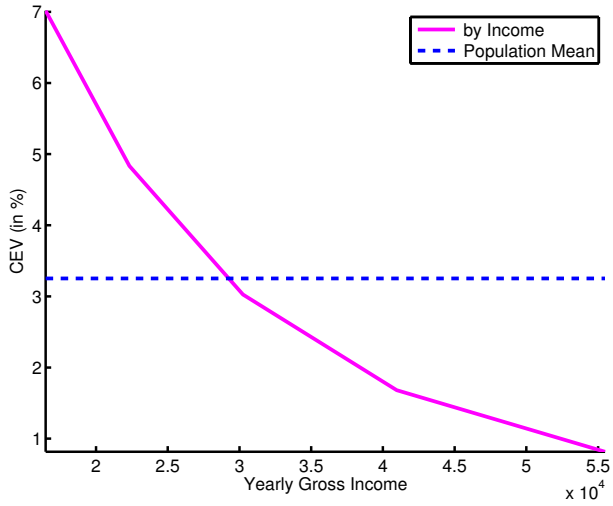


Figure 11: Ex-ante Welfare of Optimal Regime.

loans. Hence, banks expect low repayment upon default. This leads to a steep increase in borrowing interest rates at debt levels where households start to file for bankruptcy.

Under the optimal garnishment law, garnishment rates are reduced by more than 26% while at the same time bankruptcy duration is increased from six to ten years. This shift reduces labor supply distortions while at the same time widening the "tax base" for debt repayment through garnishment. As a result, labor supply under the optimal garnishment regime increases, total recovery through garnishment increases and interest rates drop, especially for low-income households.

The optimal garnishment regime increases aggregate welfare by 3.3%. Under the new law, low-income households' welfare increases by up to 7% by granting access to larger and cheaper lines of credit. High-income individuals gain 0.8% since these households already face favorable credit prices prior to the reform. By lowering interest rates, the optimal law leads to higher outstanding debt in the economy, which actually produces more equilibrium default.

By contrast, shifting to a "Fresh Start" regime without any income garnishment reduces welfare by 0.8% on average. The amount of debt in the economy declines and default rates slightly decline, which results from a strong increase in credit prices since banks expect lower repayment in equilibrium. Households react by borrowing less and saving more, making them less likely to default.

In light of these results, it is doubtful if a reduction of the period of good conduct and thereby the duration of garnishment would be beneficial for households. These policies are currently discussed by the European Parliament and merit further research.

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Appendices

A Life-Cycle Profile of Wages

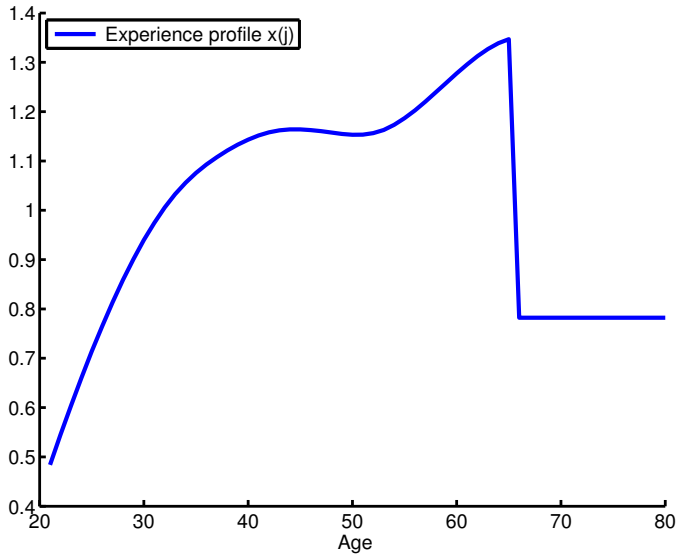


Figure A.1: Experience Profile in Monthly Wages.
Source: German Federal Statistical Office (2013).

B Computational Approach

The numerical solution is computed in MATLAB 2014b using resources of the "MLS & WISO bwForCluster." The solution algorithm is parallelized and solved on multiple sixteen core Intel Xeon nodes.

B.1 Model Solution and Calibration

The model is solved numerically by iterating backwards on the value function. The state space is discrete: $A \times Z \times \mathcal{E} \times \mathcal{K} \times J \times T$, denoting the set of asset holdings, persistent income realizations, transitory income realizations, expenditure shocks, age, and time in bankruptcy. The income shock processes are discretized using Rouwenhorst's method (Kopecky and Suen, 2010).

A. Pick structural parameters θ_0 of length $I = 3$.

B. Let $\widetilde{\theta}_i = \theta_0 + \hat{\imath}\, d$ for each $i = \{1, 2, \ldots, I\}$, where $\hat{\imath}$ is the standard unit vector with ith element equal to one and d is the stepsize. For all $\widetilde{\theta}_i$:

I. Do Value Function Iteration

1. Set $j = J$. Let $\mathbb{E}\left[V(j+1, \cdot) \mid z\right] = 0$ and $q(j, \cdot) = 0$ for all $z \in Z$.
2. Compute current period value functions $V^S(j, \cdot), V^D(j, \cdot)$ by maximizing over c, a', h for both $d = \{0, 1\}$, given $\mathbb{E}\left[V(j+1, \cdot) \mid z\right]$.
3. Compute $V(j, \cdot)$ by solving for optimal d^*.
4. Compute expected repayment in garnishment $\mathbb{E}\left[\rho(j, \cdot)\right]$, taking household choices c^*, a'^*, h^*, d^* as given.
5. Compute previous period credit price $q(j-1, \cdot)$, taking repayment as given.
6. Compute $\mathbb{E}\left[V(j, \cdot) \mid z\right]$ for all $z \in Z$.
7. If $j = 0$, end.
   Else, set $j = j - 1$ and go to 2.

II. Calculate model moments

1. Simulate the invariant distribution over $A \times Z \times \mathcal{E} \times \mathcal{K} \times J \times T$.
2. Calculate model moments $M(\widetilde{\theta}_i)$.

C. Update structural parameters

I. Pick $\theta^* = \arg\min_i \sum_n w_n \left(M_n(\widetilde{\theta}_i) - D_n\right)^2$ to minimize the sum of squared residuals to the data targets D_n.

II. If $i \in \{1, \ldots, I\}$, update $\theta_0 = \theta^*$ and increase step size d.
   Else, $i = 0$. Keep initial θ_0 and decrease step size d.

III. If $d > \epsilon_d$, go to B. Else, end.

B.2 Optimal Garnishment Regime

In order to solve equation (15), I take the structural parameters determined according to Section B.1 as given. Let $\mathcal{T} = \{0, 1, 2, \ldots, 20, \infty\}$ be the set of possible garnishment durations.

Note that $T = 0$ is the no commitment case. Upon filing for bankruptcy, no monetary cost or utility cost are suffered and all debts are forgiven. Households remain solvent. Consequently, only low debt can be sustained in equilibrium. At the other extreme, $T = \infty$ is defined as the full repayment case without debt forgiveness. Households can only exit garnishment, if they either repay their debts in full ($a \geq 0$) or die ($j = J + 1$).

- For each time in bankruptcy $T \in \mathcal{T}$

  A. Pick garnishment parameters $p_0 = \left[\underline{y}, \Delta y, \tau\right]$ and define $\overline{y} = \underline{y} + \Delta y, \quad \Delta y \geq 0$.

  B. Let $\widetilde{p}_i = p_0 + \hat{\imath}\ d$ for $i = \{1, 2, 3\}$, where $\hat{\imath}$ is the standard unit vector with ith element equal to one and d is the stepsize. For all $\widetilde{p}_i$:

     I. Do Value Function Iteration

        1. Set $j = J$. Let $\mathbb{E}\left[V(j+1, \cdot) \mid z\right] = 0$ and $q(j, \cdot) = 0$ for all $z \in Z$.
        2. Compute current period value functions $V^S(j, \cdot), V^D(j, \cdot)$ by maximizing over c, a', h for both $d = \{0, 1\}$, given $\mathbb{E}\left[V(j+1, \cdot) \mid z\right]$.
        3. Compute $V(j, \cdot)$ by solving for optimal d^*.
        4. Compute expected repayment in garnishment $\mathbb{E}\left[\rho(j, \cdot)\right]$, taking household choices c^*, a'^*, h^*, d^* as given.
        5. Compute previous period credit price $q(j-1, \cdot)$, taking repayment as given.
        6. Compute $\mathbb{E}\left[V(j, \cdot) \mid z\right]$ for all $z \in Z$.
        7. If $j = 0$, end.
           Else, set $j = j - 1$ and go to 2.

     II. Calculate newborns expected life-time utility

        1. Using stationary distribution μ, let
           $\mathcal{V}(\widetilde{p}_i, T) = \sum_{z \in \mathcal{Z}, \varepsilon \in \mathcal{E}, \kappa \in \mathcal{K}} V\left(a = 0, j = 1, z, \varepsilon, \kappa\right) \times \mu(z, \varepsilon, \kappa)$.

  C. Update garnishment parameters

     I. Pick $p_T^* = \arg\max_i \mathcal{V}(\widetilde{p}_i, T)$ to maximize expected life-time utility $\mathcal{V}$ given garnishment duration T.

     II. If $i \in \{1, \ldots, I\}$, update $p_0 = p_T^*$ and increase step size d.
     Else, $i = 0$. Keep initial p_0 and decrease step size d.

     III. If $d > \epsilon_d$, go to B. Else, end.

- Choose optimal bankruptcy duration

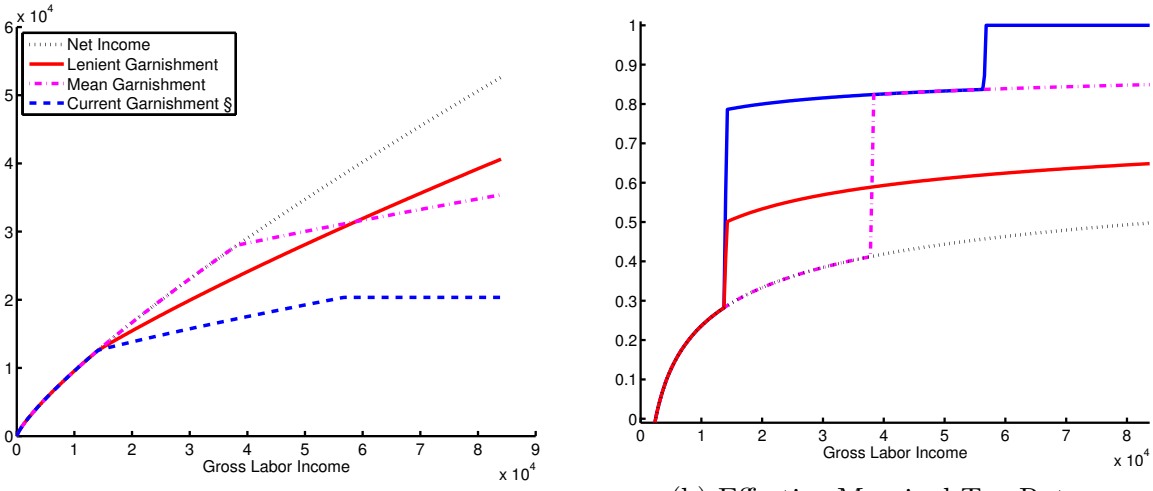
  A. Pick $T^* = \arg\max_T \mathcal{V}(p_T^*, T)$ to maximize expected life-time utility $\mathcal{V}$.

  B. Optimal set of policy parameters is $\{T^*, p_{T^*}^*\}$.

I use a multi-start approach when picking initial garnishment parameters p_0. I also verify that ex-ante welfare – given optimal garnishment parameters p^* – decreases constantly for all persistent income classes when the bankruptcy duration exceeds $T = 15$

years. While I am not able to prove the optimality of my result, I am reasonable certain that the reported optima are actually the solution to the planner's problem.

C Two Additional Policy Experiments



(a) Net Income.

(b) Effective Marginal Tax Rates.

Figure C.1: Garnishment under Alternative Policy Experiments.

Here, I analyze two additional policy experiments. Case 1 ("Mean Income Exemption") represents an intermediary case between the current German legislation and U.S. legislation. In this policy experiment, only income in excess of average income is subject to garnishment. Case 2 ("Lenient Garnishment") resembles the legal limits on income seizure in the U.S. for households that are not protected under Ch. 7 bankruptcy. For those households, 30% of income is seized by their creditors to repay outstanding debt. Figure C.1 depicts disposable income and marginal tax rates under both regimes.

In both experiments, I remove the income cap during garnishment to reduce the distortionary effects on labor supply by highly-productive households. The policy regimes to be analyzed correspond to the following parameter setup:

1. "Mean Income Exemption": The income exemption in garnishment is increased to mean labor income, hence $\underline{y} = 29,800$ EUR, $\overline{y} = \infty$, $\tau = 70\%$.

2. "Lenient Garnishment": Exempt income is kept constant, but upon entering garnishment, only 30% of net income is subject to garnishment. Thus, $\underline{y} = 12,600$ EUR, $\overline{y} = \infty$, $\tau = 30\%$.

Table C.1: Equilibrium Outcomes, Benchmark vs. Policy Experiments

	Benchmark	Mean Exemption	Lenient Garnishment
Bankruptcy filings per 1,000 HH	2.44	2.48	2.20
Fraction of HH in debt (in %)	56	52	55
Average debt (€)	30,550	24,001	27,366
Average bad debt (€)	55,150	56,963	58,527
Average savings (€)	42,184	44,889	45,016
Average Labor Income (€)	32,000	31,884	31,951

C.1 Mean Income Exemption

Figure C.2 depicts the labor supply effects, equilibrium loan price schedules, and welfare effects of Case 1, "mean income exemption." Since most low-income households are exempt and high-income households no longer face an income cap, the negative labor supply effects of garnishment become weaker. Panel C.2a shows that, on average over six years of garnishment, labor supply remains relatively constant around pre-filing levels. The slight labor supply increase upon filing for bankruptcy is compensated by lower labor supply during the garnishment period. On the lender side, recovery through garnishment declines. Consequently, lenders increase interest rates (i.e. q drops), as displayed in Panel C.2b.

In equilibrium, bankruptcies slightly increase (see Table C.1). Since default is less costly, lenders expect more bankruptcies and raise interest rates. Hence, the fraction of borrowers and the amount borrowed are both reduced. Average bad debt slightly increases because high-income households no longer face an income cap.

Panel C.2c shows the aggregate welfare effects: ex-ante, households are 0.75% worse off. When controlling for income, especially low-income households suffer from the reform. These households are exempt from garnishment, face the strongest increase in interest rates and consequently face the steepest welfare decrease.

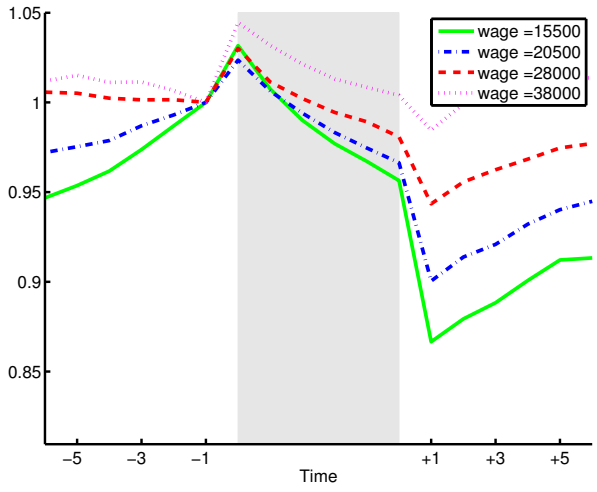
C.2 Lenient Garnishment

Figure C.3 presents the labor supply effects, interest rate changes, and welfare effects induced by Case 2, "lenient garnishment." The effects are similar to Case 1, "mean income exemption." However, lenient garnishment distorts labor supply downward during the garnishment period (c.f. Panel C.3a). Due to lower repayment in bankruptcy, interest rates rise. The drop in q is not as pronounced for low incomes as in Case 1, as under

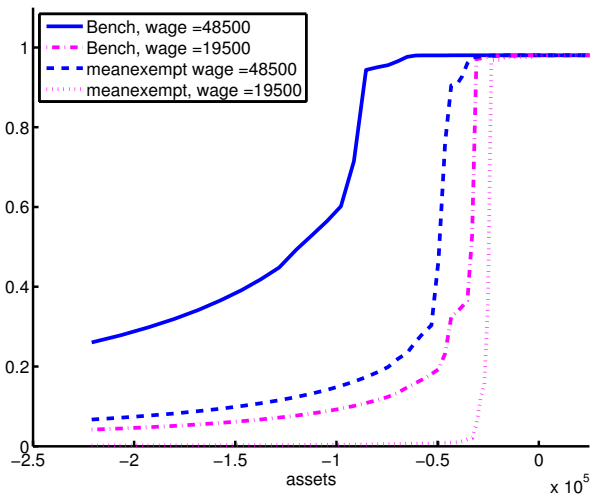
the current policy experiment these households are forced to repay some of their bad debt through garnishment (c.f. Panel C.3b).

As presented in Table C.1, the introduction of "lenient garnishment" slightly reduces bankruptcies. Since default is less costly, lenders increase loan prices and the fraction of borrowers and the amount borrowed are both reduced. As a result, fewer households are pushed into bankruptcy by negative shocks.

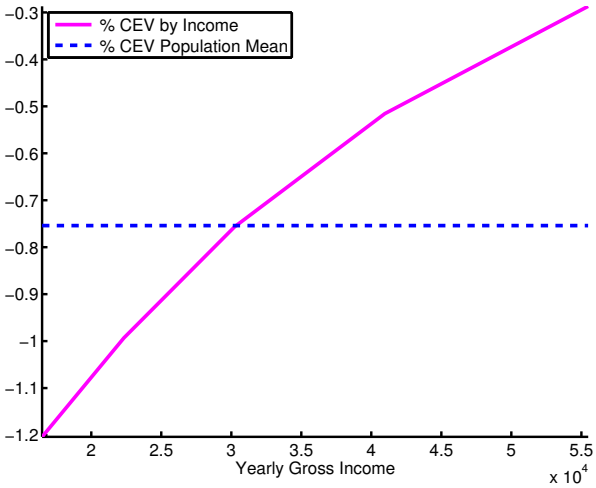
Panel C.3c shows that the "lenient garnishment" regime also makes households worse off, measured by CEV at birth. Again, low-income households suffer the most from worsening credit conditions.



(a) Labor Supply Decisions.

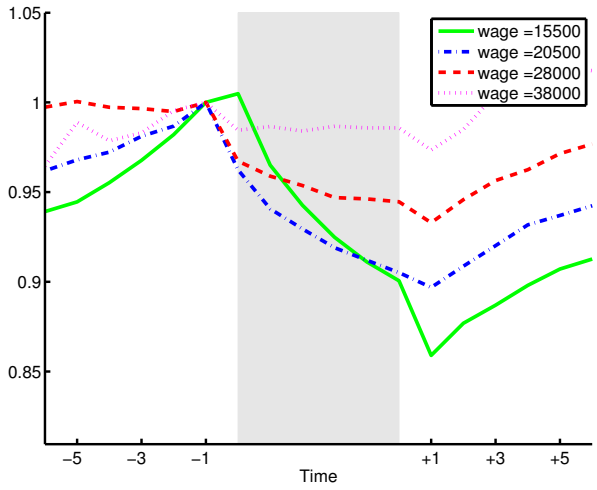


(b) Equilibrium Loan Prices, Age 50.

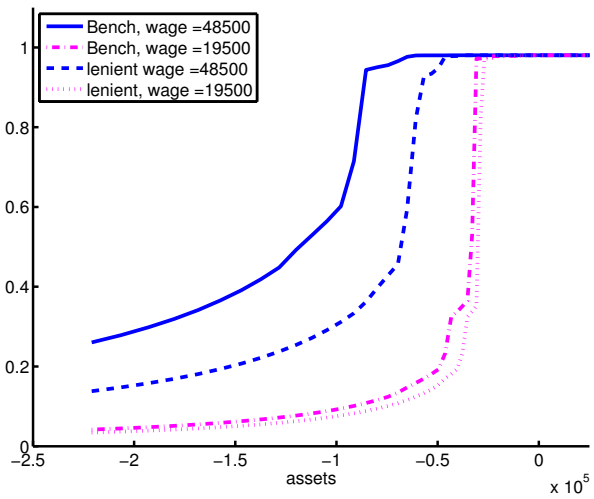


(c) Ex-ante Welfare.

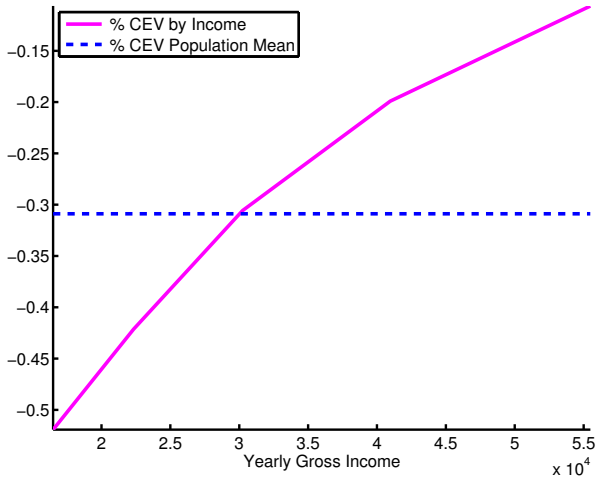
Figure C.2: Effects of Introducing "Mean Income Exemption."



(a) Labor Supply Decisions.



(b) Equilibrium Loan Prices, Age 50.



(c) Ex-ante Welfare.

Figure C.3: Effects of Introducing "Lenient Garnishment."