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Abstracts

This dissertation studies how tax and regulatory policies affect household choices in housing and occupation when markets are incomplete and agents differ in risk tolerance, ability/skills and liquid means. Using micro data and quantitative life-cycle models, I show how changes in transaction taxes and capital insurance, and the way they are financed, shape mobility, selection, and aggregate outcomes.

The first chapter, “Aggregate and Inter-Generational Effects of Changing the Real Estate Transfer Tax”, investigates how unexpected permanent changes in the real estate transfer tax (RETT) affect housing transactions and consumption across generations. While RETTs might be a popular tool for local governments to increase revenue, they reduce transactions in the housing market and increase the lock-in effect for elderly home owners. Using the German Socio-Economic Panel (GSOEP) and local market indices, I estimate that a 1 percentage point (pp) increase in RETT reduces downsizing by 0.5 pp, while a 1 pp rise in local purchase prices increases it by 0.7 pp. A quantitative life-cycle model replicating German home ownership patterns (2006–2019) shows that financing lower RETT via income taxes benefits retirees but lowers long-run consumption by 0.54%. Financing the same tax cut via a property tax lowers house prices, increases younger households’ consumption, and raises average life-cycle consumption by 0.16% in the long run, with a smaller decline in home ownership.

The second chapter, “Heterogeneous Risk Preferences, Entrepreneurship, and Wealth”, studies how individual risk attitudes shape occupational choice and wealth accumulation. Using self-reported individual risk preferences from the GSOEP, we estimate that a one-unit increase in risk tolerance raises the probability of a worker transitioning to self-employment by 10 percent. We develop a life-cycle model of occupational choice with Epstein-Zin preferences and heterogeneous risk attitudes to examine how risk aversion interacts with entrepreneurial ability and wealth in determining entry into self-employment, the survival probability upon entry, and its

aggregate implications such as wealth inequality, the share of entrepreneurs in the population, and their ability distribution. Counterfactual simulations show that increasing business risk reduces entry but improves selection based on entrepreneurial skills. In contrast, Germany's "1-Euro GmbH" reform of 2008 weakened the role of risk tolerance for entry and increased participation by risk-averse individuals without compromising the mean entrepreneurial skill.

The third chapter, "Business Risk, Taxation and Economic Welfare", asks: how should a government tax business income when entrepreneurship is risky and imperfectly insurable, yet vital for output production and wealth accumulation? We study this question in a quantitative occupational-choice model where households differ in risk attitudes and face borrowing constraints. The government can impose a linear tax on profits and provide public insurance against capital losses at exit, with a labor income tax balancing the budget. If efficiency dominates equity concerns, low profit taxes and a generous loss insurance should encourage business entry financed through a high labor tax. Savings decrease, so not many individuals pass the entry threshold, yielding fewer but larger firms and greater wealth concentration. As equity concerns rise, higher profit taxes become optimal, supporting a broader but smaller-scale entrepreneurial sector. Abstracting from heterogeneous risk-aversion materially distorts optimal policy: it substantially overstates the business subsidy for an efficiency-oriented policymaker.

Zusammenfassung

Diese Dissertation untersucht, wie steuer- und regulierungspolitische Maßnahmen Haushaltsentscheidungen in den Bereichen Wohnen und Berufswahl beeinflussen, wenn Märkte unvollständig sind und sich Akteure in ihrer Risikobereitschaft, ihren Fähigkeiten/ihrer Produktivität und ihrem liquiden Vermögen unterscheiden. Mithilfe von Mikrodaten und quantitativen Lebenszyklusmodellen zeige ich, wie Veränderungen bei Transaktionssteuern und Kapitalversicherungen – sowie deren Finanzierungsweise – Mobilität, Selektion und aggregierte Ergebnisse beeinflussen.

Das erste Kapitel, „Aggregate and Inter-Generational Effects of Changing the Real Estate Transfer Tax“, untersucht, wie unerwartete und dauerhafte Änderungen der Grunderwerbsteuer Immobilientransaktionen und den Konsum verschiedener Generationen beeinflussen. Obwohl die Grunderwerbsteuer ein beliebtes Instrument für Gebietskörperschaften zur Einnahmenerzielung darstellt, reduziert ihre Erhöhung die Zahl der Immobilientransaktionen und verstärkt den Lock-in-Effekt bei älteren Eigenheimbesitzer:innen. Mithilfe des Sozio-oekonomischen Panels (SOEP) und lokaler Immobilienindizes schätze ich, dass eine Erhöhung der Grunderwerbsteuer um 1 Prozentpunkt (pp) die Wahrscheinlichkeit einer Wohnraumverkleinerung um 0,5 pp senkt, während ein Anstieg der lokalen Kaufpreise um 1 pp diese um 0,7 pp erhöht. Ein quantitatives Lebenszyklusmodell, das die deutschen Wohneigentumsquoten (2006–2019) repliziert, zeigt, dass eine über die Einkommensteuer finanzierte Senkung der Grunderwerbsteuer Rentnerhaushalten zugutekommt, den langfristigen Konsum jedoch um 0,54% senkt. Wird dieselbe Steuersenkung hingegen über eine Grundsteuer finanziert, sinken die Immobilienpreise, der Konsum jüngerer Haushalte steigt, und der durchschnittliche Konsum über den Lebenszyklus erhöht sich langfristig um 0,16%, bei einem geringeren Rückgang der Wohneigentumsquote.

Kapitel zwei, „Heterogeneous Risk Preferences, Entrepreneurship, and Wealth“, untersucht, wie individuelle Risikoeinstellungen die Berufswahl und Vermögensakkumulation beeinflussen. Mit-

hilfe von Selbstauskünften zur individuellen Risikobereitschaft aus dem SOEP schätzen wir, dass ein Anstieg der Risikobereitschaft um eine Einheit die Wahrscheinlichkeit, dass Arbeitnehmer:innen in die Selbstständigkeit wechseln, um 10 Prozent erhöht. Wir entwickeln ein Lebenszyklusmodell der Berufswahl mit Epstein-Zin-Präferenzen und heterogenen Risikoeinstellungen, um zu untersuchen, wie Risikoaversion mit unternehmerischen Fähigkeiten und Vermögen interagiert und dadurch den Eintritt in die Selbstständigkeit, die Überlebenswahrscheinlichkeit nach dem Eintritt sowie gesamtwirtschaftliche Kennzahlen – wie die Vermögensungleichheit, den Anteil der Selbstständigen an der Bevölkerung und die Verteilung ihrer Fähigkeiten – beeinflusst. Kontrafaktische Simulationen zeigen, dass eine Erhöhung des unternehmerischen Risikos den Eintritt in die Selbstständigkeit zwar verringert, die Selektion nach unternehmerischen Fähigkeiten jedoch verbessert. Demgegenüber schwächte die Einführung der „1-Euro-GmbH im Jahr 2008 die Rolle der Risikobereitschaft beim Übergang in die Selbstständigkeit und erhöhte die Beteiligung risikoaverser Personen, ohne dabei die durchschnittliche unternehmerische Fähigkeit zu beeinträchtigen.

Das dritte Kapitel, „Business Risk, Taxation and Economic Welfare“, untersucht die Frage: Wie soll eine Regierung Unternehmenseinkommen besteuern, wenn Selbstständigkeit riskant und nur unvollständig versicherbar, aber essenziell für Produktion und Vermögensaufbau ist? Wir analysieren diese Frage in einem quantitativen Modell der Berufswahl, in dem sich Haushalte in ihrer Risikoaversion unterscheiden und Kreditbeschränkungen unterliegen. Die Regierung kann eine lineare Steuer auf Unternehmensgewinne erheben und eine öffentliche Versicherung gegen Kapitalverluste bei Marktaustritt bereitstellen, wobei eine Steuer auf Arbeitseinkommen die Haushaltsausgaben ausgleicht. Wenn Effizienzüberlegungen Gerechtigkeitsüberlegungen dominieren, sollten eine niedrige Gewinnsteuer und eine großzügige Kapitalverlustversicherung den Markteintritt begünstigen, gegenfinanziert durch eine hohe Lohnsteuer. Sinkende Ersparnisse führen dazu, dass weniger Haushalte die Eintrittsschwelle überschreiten, woraus weniger, aber größere Unternehmen und eine stärkere Vermögenskonzentration resultieren. Mit zunehmenden Gerechtigkeitsüberlegungen werden höhere Gewinnsteuern optimal, was einen breiter aufgestellten Unternehmenssektor mit im Schnitt kleineren Betrieben begünstigt. Wird die Heterogenität in der Risikoaversion vernachlässigt, verzerrt dies die optimale Politik erheblich: Für einen effizienzorientierten politischen Entscheidungsträger werden die Subventionen für Unternehmensgründer deutlich überschätzt.

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General Introduction

This dissertation comprises three chapters that explore how fiscal policies and market regulations influence individual economic decisions and how these decisions feed back into the aggregate economy, shaping overall outcomes. I employ both empirical methods, which allow me to analyze individual behavior, and structural quantitative methods, which enable counterfactual analysis and provide insights where data limitations exist. A central theme across all chapters is the focus on heterogeneity in various dimensions. Chapter One examines heterogeneity in labor productivity, which drives different savings motives, particularly precautionary savings, and generates wealth inequality consistent with empirical observations. This builds on the seminal work of [Aiyagari \(1994\)](#) and [Bewley \(1986\)](#), incorporating a second, illiquid housing asset as in [Kaplan, Mitman and Violante \(2020\)](#) and [Kaas, Kocharkov, Preugschat and Siassi \(2021\)](#). Chapters Two and Three extend the heterogeneity by introducing differences in risk aversion and entrepreneurial ability. This adds a new motive for precautionary savings, as risk-averse agents save more than risk-loving individuals, and introduces a choice between two occupations based on agents' productivity in each. These chapters draw on the frameworks of [Kanbur \(1981\)](#), [Cagetti and De Nardi \(2006\)](#), and [Boar and Knowles \(2024\)](#).

All chapters contribute to informed policy design. In Chapter One, I highlight that a real estate transfer tax, primarily used to finance state budgets, has broader intergenerational implications that should be considered in policy discussions. In Chapter Two, my coauthors and I demonstrate how changes in access to limited liability influence the role of risk aversion in the decision to become self-employed. In Chapter Three, we find that the extent of a policymaker's concern for consumption inequality significantly shapes the optimal policy combination.

Methodologically, Chapter One uses survey data to estimate how elderly households respond to changes in the real estate transfer tax and develops a life-cycle model to analyze counterfactual scenarios and consumption responses. Chapter Two uses the same survey data to estimate the role of individual risk aversion in the transition to self-employment and constructs an occupa-

tional choice model to explore how sorting into entrepreneurship depends on risk aversion and reacts to policy changes. Chapter Three builds on Chapter Two, focusing on the fiscal side and adopts a normative perspective to determine the optimal combination of entrepreneurial profit tax and capital insurance. It further demonstrates how this optimal policy mix depends on the policymaker's concern for consumption inequality and on heterogeneous risk aversion.

1 Aggregate and Inter-Generational Effects of Changing the Real Estate Transfer Tax

Chapter One examines household responses to changes in the local real estate transfer tax and analyzes how reducing the transfer tax affects consumption across generations. The focus is on Germany, where home ownership is a choice rather than a necessity due to well-functioning rental markets, federal states set their own tax rates, and the GSOEP provides detailed household data that can be merged with location-specific real estate prices and rents. I combine a reduced-form estimation of the probability of downsizing for elderly households in Germany with a structural life-cycle model of housing and consumption choice. This chapter contributes to the literature by broadening the discourse on transfer taxes to include their intergenerational effects on consumption.

I find that a 1 percentage point increase in the local real estate transfer tax reduces the likelihood of elderly home owners downsizing by 0.5 percentage points (pp). Additionally, a 1 pp increase in local house price indices raises the likelihood of downsizing by 0.7 pp. These findings suggest two mechanisms at work: first, home owners respond to changes in transfer taxes, adjusting less when taxes are high; second, home owners aim to realize capital gains from higher house prices. The life-cycle model highlights the importance of how a potential decrease in the transfer tax is financed. If the budget deficit is financed through an increase in the income tax, retired households at the time of the policy change benefit, but overall lifetime consumption decreases for subsequent generations by 0.54%. Alternatively, if the government introduces a property tax to offset the lost revenue, young households' consumption increases immediately after the policy change, and long-run lifetime consumption rises by 0.16%.

2 Heterogeneous Risk Preferences, Entrepreneurship, and Wealth

Chapter Two investigates a fundamental question in economics: What role do risk preferences play in occupational choice? Colloquial wisdom suggests that risk-loving individuals are more likely to become self-employed but are less likely to start a business. From a macroeconomic perspective, entrepreneurs are crucial for driving economic growth and shaping wealth inequality. To analyze this question, we combine individual measures of risk aversion to estimate their importance for transitioning into self-employment and survival rates after entry with a quantitative model of occupational choice. We contribute to the literature on entrepreneurship and risk aversion by integrating empirical estimation into counterfactual model analysis. Our longitudinal data allows us to focus on transitions to self-employment rather than the stock of entrepreneurs. Additionally, we incorporate the empirically observed distribution of risk attitudes into a binary occupational choice model with Epstein-Zin preferences, providing a richer framework for understanding the interaction between risk aversion and occupational decisions.

We find that each unit increase in the willingness to take on risk raises the likelihood of transitioning into self-employment by 10%, with an average transition probability of 1%. Additionally, we observe that only large wealth holdings (above €700,000) significantly influence the transition, reinforcing previous findings in the literature that financial constraints may not be the primary obstacle for potential entrepreneurs. Our structural model examines the interaction among individual risk aversion, entrepreneurial ability, and financial constraints, showing that selection into entrepreneurship depends on both risk attitude and skill. We conduct two policy counterfactuals: one that varies the risk of business failure and another that replicates the introduction of the "1-Euro GmbH" in Germany by adjusting the level of capital insurance. The first counterfactual highlights how entrepreneurial sorting occurs along the dimensions of skill and risk, while the second shows that increasing capital insurance reduces the importance of risk attitudes for the decision to become self-employed.

3 Business Risk, Taxation and Economic Welfare

While entrepreneurs are an essential part of the economy, business failure poses a substantial risk to private wealth. Chapter Three investigates the largely undiversifiable risk entrepreneurs are subject to and demonstrates the competing dimensions a government faces: taxing profits

can redistribute income and finance public goods, but it may discourage risk-taking and entry into self-employment. We investigate this by incorporating differential and linear tax rates into a binary occupational choice model. A policymaker can choose a policy pair consisting of a partial capital insurance for failed entrepreneurs and an entrepreneurial profit tax. Using the social welfare function from [Boar and Midrigan \(2022\)](#), we compare how the optimal policy pair is affected by the policymaker's preference for permanent consumption equality.

We contribute to the optimal taxation literature by illustrating the importance of accounting for heterogeneity in risk aversion for the taxation of entrepreneurship through changes in wealth accumulation, minimal entry thresholds, and optimal policy pairs.

We find that a policymaker concerned solely with maximizing aggregate consumption will find an entrepreneurial subsidy and substantial capital insurance optimal. This requires a high labor tax to balance the budget, which limits entry into entrepreneurship to those who can accumulate sufficient wealth; those who do enter enjoy a favorable institutional setting and operate very large firms, generating strong wealth inequality. A policymaker who also values equity still finds high capital insurance optimal, but finances it by taxing entrepreneurial profits at up to 49%. The resulting lower labor tax enables more agents to start a business, though they operate firms less than half the size of those in the efficiency-focused scenario, yielding less aggregate output but a more equal wealth distribution.

Comparing these results to a model with homogeneous risk aversion, policymakers with identical preferences for consumption equality choose more extreme policy pairs — even going so far as to prefer a 10% entrepreneurial subsidy, which pushes the wealth Gini close to 1.

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Chapter 1

Aggregate and Inter-Generational Effects of Changing the Real Estate Transfer Tax

Abstract

This paper studies how unexpected changes in real estate transfer taxes (RETT) affect housing and consumption across generations. Local governments rely on RETT, higher rates can deter transactions and intensify lock-in among elderly home owners. Using the German Socio-Economic Panel (GSOEP) and local market indices, I estimate that a 1 pp increase in RETT reduces downsizing by 0.5 pp, while a 1 pp rise in local purchase prices increases it by 0.7 pp. A quantitative life-cycle model replicating German home ownership patterns (2006–2019) shows that financing lower RETT via income taxes benefits retirees but reduces long-run consumption by 0.54%. Financing via a property tax lowers house prices, increases younger households' consumption, and raises long-run consumption by 0.16%, with a smaller decline in home ownership.

JEL Classification: E21, E61, H31, R21

Keywords: housing consumption, transfer taxes, fiscal policy, life-cycle

1.1 Motivation

In times of rising budget deficits, governments at both the federal and state levels seek to balance their budgets either by cutting spending or increasing tax revenue. For state governments, fiscal decentralization often limits the available tax instruments to raise revenue. One major source of income for subnational governments is taxes related to real estate. A common example is the real estate transfer tax, which is levied whenever a house or apartment is sold. While the primary goal of this tax is to increase government revenue, it also has broader implications for house prices and transaction volumes (e.g., [Dolls, Fuest, Krolage and Neumeier \(2025\)](#) and [Han, Ngai and Sheedy \(2025\)](#)). However, policymakers may overlook an important consequence of raising transfer taxes: the distortion in housing allocation across generations. Economic theory suggests that rational agents should adjust housing consumption to changing household size over the life cycle. Yet many elderly home owners fail to downsize, even when doing so would improve their financial well-being. Real estate transfer taxes may act as a significant but often overlooked obstacle to these adjustments. Such a tax-induced rigidity has three major consequences. It exacerbates the well-documented retirement consumption drop (e.g., [Hurst \(2008\)](#), [Fernández-Villaverde and Krueger \(2011\)](#), and [De Nardi, French and Jones \(2016\)](#)), misallocates scarce housing resources away from young, expanding families, and traps financially constrained elderly in costly, underutilized properties. Understanding the broader effects of transfer taxes beyond their role in financing budget deficits is essential for explaining old-age consumption patterns, improving housing market efficiency, and addressing intergenerational aspects. Against this background, I address three key questions: To what extent do real estate transfer taxes (RETT) discourage elderly households from downsizing? How does this friction contribute to the consumption drop observed around retirement? And what are the distributional consequences of policy changes across generations?

Germany provides a compelling case for studying economic reactions to changes in the real estate transfer tax for several reasons. First, since 2006, German federal states have been allowed to set their own RETT rates independently, creating substantial variation across states, with rates ranging from 3.5% in Bavaria to 6.5% in Brandenburg, North Rhine-Westphalia, Saarland, and Schleswig-Holstein. This degree of variation is rare; within the European Union, only Bulgaria, Germany, and Luxembourg have such a system with state-specific RETT rates ([Bechtoldt, Freier, Geyer and Kühn, 2014](#)). Second, Germany has the lowest home ownership rate in the Euro-

pean Union (approximately 47% vs 70%¹), making home ownership a deliberate choice rather than a necessity due to an underdeveloped rental market. This distinction is particularly relevant for elderly households, where housing consumption relative to household size is highly divergent between tenant status. In addition to differences between tenants and home owners, there are notable generational differences. In the German population, only 35% of households have more than 50 square meters per household member, while among retired households living in Germany, this figure rises to 65% (Sagner, 2021). Moreover, a significant share of elderly home owners in Germany—around 25%—are classified as "wealthy hand-to-mouth" (wHtM) consumers.² These individuals own a substantial amount of illiquid assets, such as housing, but have only minimal liquid funds.³ For them, downsizing could be an opportunity to convert housing wealth into liquid assets, thereby improving their financial situation and making higher consumption during retirement possible. Third, the German Socio-Economic Panel (GSOEP) provides a rich longitudinal dataset, tracking approximately 30,000 individuals annually since 1984. It offers detailed information on housing decisions, wealth composition, and sociodemographic characteristics. The GSOEP's regional module also includes information on households' places of residence, allowing for the incorporation of local price indices to account for market trends and regional variation in real estate prices.

I make two main contributions to the literature on the consequences of unanticipated tax changes, life cycle consumption patterns, and housing decisions. First, I empirically demonstrate that downsizing decisions are influenced by changes in local real estate transfer taxes, an outcome rarely considered in tax policy debates. Using rich microdata, I can disentangle the effects of tax changes from personal and location-specific characteristics. I find that each percentage point increase in RETT reduces the probability of downsizing by 0.5 percentage points. Given that the baseline downsizing rate among elderly home owners is approximately 1% annually, this implies a 50% reduction in downsizing.⁴ I also find that a 1 percentage point increase in local house price indices raises the probability of downsizing by 0.7 percentage points, as wealthier home owners are more willing to realize capital gains and adjust their portfolios. These opposing forces highlight how transaction costs and housing wealth shape adjustment decisions. Higher transfer taxes make it harder for home owners to sell their property, while increased house prices

¹The home ownership rate has been approximately 70% in the European Union since 2010 Eurostat (2024)

²A household is defined as elderly if the head is over 65 years old.

³This definition follows Kaplan and Violante (2014), who classify wHtM consumers as those with less than half their monthly net income saved in liquid assets.

⁴This large proportional effect primarily reflects the low baseline probability of downsizing, with only 1% of elderly home owners downsizing annually, even modest absolute changes translate into substantial percentage effects.

incentivize some to downsize and reallocate their wealth. Moreover, [Dolls et al. \(2025\)](#) show that transfer tax burden shifting to the seller side reduces the net price home owners can realize, even though the tax is formally levied on buyers.

Second, I develop a quantitative life-cycle model to analyze the distributional consequences of RETT changes across generations. This structural approach allows for a clear distinction between steady-state effects and transitional dynamics, both of which are essential for comprehensive policy evaluation. Using a model calibrated to Germany (2006–2019), I show that an unanticipated, permanent 1 percentage point reduction in the real estate transfer tax (RETT) yields mixed intergenerational outcomes that depend on how the government balances its budget. If the government raises the labor income tax (reform 1), retired home owners at the time of the reform benefit from lower transaction costs, allowing a modest increase in old-age consumption. If instead the government introduces a modest property tax (reform 2), consumption rises slightly for younger households and falls for older households. In the long run, steady-state effects are moderate. Under reform 1, house prices return to their initial steady-state level, the home ownership rate declines slightly, and overall consumption decreases by about 0.54%. Under reform 2, house prices are lower, the home ownership rate declines by less than under reform 1, and average life-cycle consumption is largely unchanged at +0.16%. These results heavily depend on the government's financing scheme and highlight how small changes in transaction costs can produce sizable consumption effects across generations.

This paper is organized as follows: Section 1.2 situates my work within the existing literature. Section 1.3 gives an overview of the real estate transfer tax in Germany. Section 1.4 presents the data sources, the matching process, and descriptive statistics. Section 1.5 presents the estimation results. Section 1.6 introduces the quantitative model and the calibration procedure. Section 1.7 reports the benchmark results. Section 1.8 examines the effects of a tax rate change, discussing both steady-state comparisons and transitional dynamics. Section 1.9 concludes.

1.2 Literature

My project relates to two main strands of the literature, one that investigates RETT and home ownership, and another one that studies the retirement consumption puzzle.

Numerous studies focus on the relationship between RETT and housing. While many focus on market outcomes and price dynamics, a subfield examines the implications for household housing decisions. Both [Yang \(2009\)](#) and [Kaas et al. \(2021\)](#) investigate the importance of transfer taxes

over the life cycle. The former study focuses on the difference in consumption; when transfer taxes are zero, old-age consumption increases. The latter study explores why home ownership in Germany is lower compared to other countries. Among the main reasons is the RETT; however, the authors find that repealing the RETT would not be welfare enhancing because other taxes (especially labor) would have to be increased to balance the government's budget.

Buettner (2017), Dolls et al. (2025) and Han, Ngai and Sheedy (2025) focus on market outcomes, while Buettner (2017) and Han, Ngai and Sheedy (2025) find welfare loss and misallocation. Dolls et al. (2025) find that the tax increase reduces real estate prices, shifting the tax burden partly from the buyer to the seller. Not concerned with RETT, but reverse mortgages, Cocco and Lopes (2020) show that the low take-up in the US is partly due to high maintenance costs and risk of forced foreclosure.

Directly investigating downsizing behavior, Banks, Blundell, Oldfield and Smith (2012) find that US households downsize, while British households tend not to. They list geographical factors as well as institutional settings in the rental market as likely reasons. Additionally, Barczyk, Fahle and Kredler (2023) offer another explanation: parents may rely on their children for long-term care (LTC), enabling them to retain their homes rather than depleting their savings to finance LTC.

I add to this literature by empirically showing how RETT influence downsizing behavior in addition to institutional settings. Moreover, local house price and rent data allow me to control for regional characteristics of the housing market. Quantitatively, I show that a steady-state comparison ignores important dynamics that occur during the transition.

The retirement consumption puzzle has prompted many studies, which identified three main motives why consumption drops around retirement. Precautionary saving, especially for health shocks, bequest motive, and housing. Hurst (2008) and Schwerdt (2005) find that part of the drop is due to how we measure consumption. While consumption expenditure drops drastically, the sum of market consumption and home-production goods intake drops less, because retired households increase home-production. Aguiar and Hurst (2013) decompose consumption and show that work-related consumption expenditure drops, while consumption for entertainment increases. While both De Nardi, French and Jones (2016) and French, Jones and McGee (2023) identify the importance of uncertainty about medical expenses, the latter study also finds that housing contributes to the drop in nondurable consumption. Households dislike moving, especially in old-age. Moreover, they like to live in their house and might have special motives of

bequeathing their dwelling to their offspring.

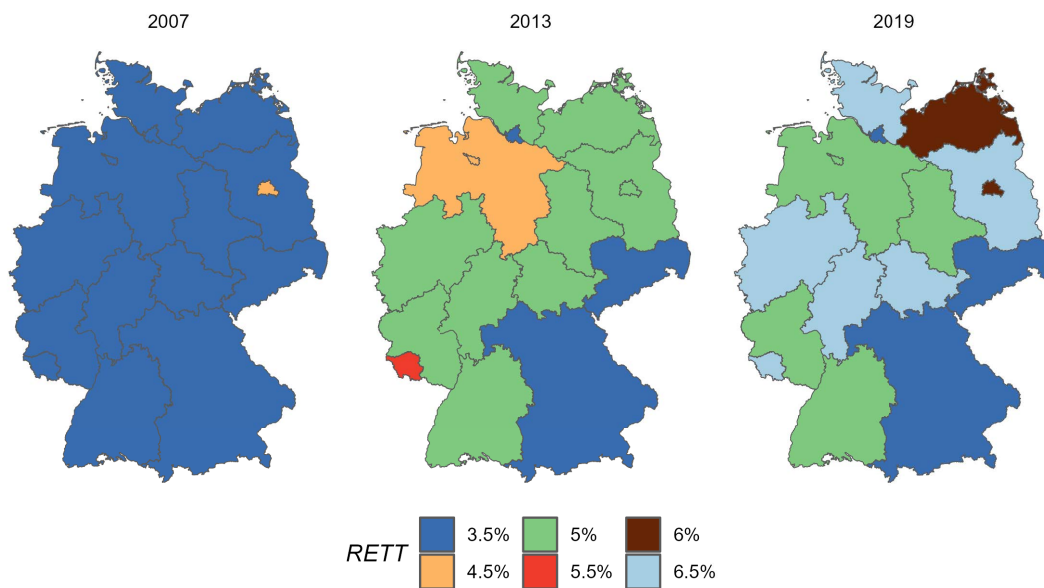
I contribute to this literature by analyzing the consumption patterns of different generations affected by a policy change and examining the role of government financing decisions. I show that if the government raises the labor tax, old-age consumption increases for generations surprised by the tax change but decreases for subsequent generations due to higher labor taxes. Alternatively, if the government introduces a property tax, younger households consume more because rents are cheaper, while old-age consumption declines in both the short and long run.

1.3 The Real Estate Transfer Tax

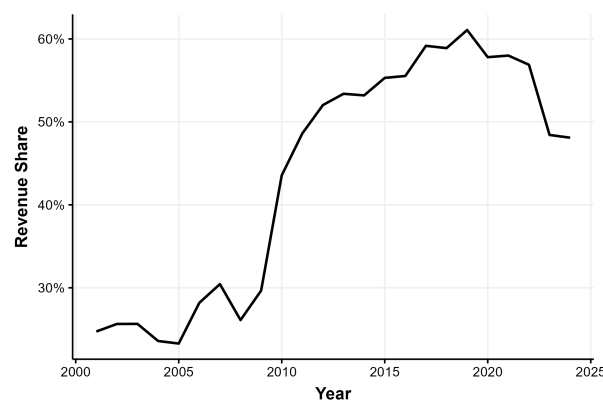
This section provides a brief overview of the real estate transfer tax (RETT) in Germany. Two major reforms occurred at the national level. In 1982, the federal government unified a previously complex RETT system, which had been set at the federal level with numerous exemptions. After the reform, every real estate transaction was taxed at a flat rate of 2%, with limited exemptions. In 1998, the tax rate was increased to 3.5%. In 2006, a significant policy change was introduced (*Föderalismusreform*), allowing federal states to set their own RETT rates.⁵ Since then, all states except Bavaria, Hamburg, and Saxony have increased their RETT rates at least once.⁶ Figure 1.1 illustrates how the RETT has evolved at the state level. There is no clear east-west trend or other discernible patterns that could explain the current tax environment across states.

⁵Grundgesetz für die Bundesrepublik Deutschland Art 105.

⁶Hamburg and Saxony raised their tax rate to 5.5% after the period under investigation (January 2023).

Figure 1.1 – German Real Estate Transfer Tax across States and Time

In addition to the variation between, the RETT has become an important financing tool for federal states in Germany.

Figure 1.2 – Share of RETT of total state tax revenue

Data: Statistisches Bundesamt (2025b), own calculation

Figure 1.2 reports the average share of RETT tax revenue of all state tax revenues. In Germany, besides RETT, state taxes include taxes on inheritance, gambling, fire safety, and beer. However, the RETT is the only one where states can set the rate autonomously. After the 2006 policy change, the share of RETT in the overall state taxes increased drastically. This is certainly not only due to the tax rate increases, but also due to an increase in house prices over the same time. Nevertheless, the importance of the RETT has increased over the years, be it because tax rates

or the tax base are higher. The revenue share of RETT has decreased in the last couple of years, probably due to a pandemic-related decrease in real estate sales.

1.4 Data

The empirical investigation combines multiple data sources to analyze the relationship between real estate transfer taxes and consumption. The primary data source is the German Socio-Economic Panel (GSOEP), supplemented with additional regional information. Secondary data sources include regional real estate prices, rental rates, and home vacancy rates. The first two are derived from [Ahlfeldt, Heblich and Seidel \(2023\)](#), while the vacancy rate data is obtained from [Empirica Regio \(2024\)](#).

The GSOEP is a longitudinal survey of individuals and households that is representative of the German population. For this study, I use a subsample of the GSOEP covering the years 2007 to 2020, as price data is only available for this period. The analysis focuses on the household level but incorporates individual characteristics, such as the age and education level of the household head. Since the three data sources operate at different regional levels, they have to be merged.

1.4.1 Merging the Data

Real estate market data is provided at the *Gemeindeverband* level (union of at least two municipalities), while vacancy rates are available at the spatial planning region level. The GSOEP data, on the other hand, is categorized by federal state and urbanization measures. For urbanization, I use the municipality size class (GGK), a discrete measure that divides municipalities into seven size classes. These size classes are outlined in Table 1.1. To integrate these different regional

Table 1.1 – Urbanization Index

GGK	Inhabitants
1	<2,000
2	2,000-4,999
3	5,000-19,999
4	20,000-49,999
5	50,000-99,999
6	100,000-499,999
7	≥ 500,000

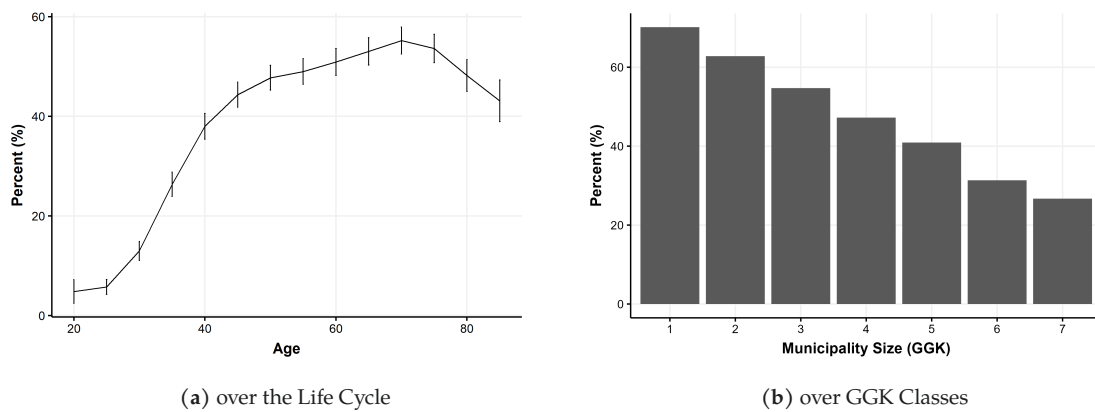
levels, I utilize data from [Bundesinstitut für Bau-, Stadt- und Raumforschung \(2024\)](#), which provides detailed information on all municipalities, including their membership in a *Gemeinde-*

verband and their various urbanization indices.⁷ I use the latest available measures from 2022. To match the real estate data with the SOEP data, I assign the same real estate price and rent to all municipalities within a given association. Then, using the GGK classification and federal state information, I calculate average prices for each urbanization and federal state pair.⁸ Each municipality within a spatial planning region is assigned the same vacancy rate. Subsequently, averages are calculated for each urbanization and federal state pair. The number of price observations per federal state varies; for instance, Berlin has only one GGK classification. In the end, this process results in 84 distinct prices for each year.

1.4.2 Home Ownership in Germany

Home ownership evolves over the life cycle and differs between GGK classes.

Figure 1.3 – Home Ownership Rate



Data: SOEP. Both figures show pooled averages of the home ownership rate. Panel (a) shows the home ownership rate with the vertical lines indicating the 95% confidence intervals associated with a particular age. Panel (b) over municipality size classes.

Figure 1.3a illustrates that the home ownership rate follows a slightly hump-shaped pattern over the life cycle. Initially, only a small percentage of households own their homes. As the household head ages, the home ownership rate increases, after about 45 years of age, the rate increases slower, and then declines slightly after the household head reaches 70. Figure 1.3b highlights significant differences in home ownership rates across GGK classes. In rural municipalities, over 60% of households own their homes, whereas in the most urbanized regions, less than 30% are home owners. This stark contrast can partly be attributed to the limited supply of rental

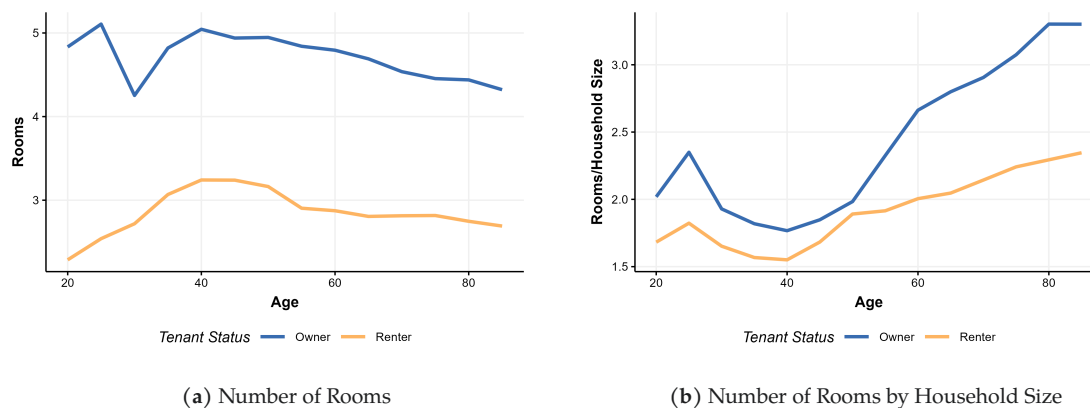
⁷In total, there are 4,600 associations of municipalities and 10,990 municipalities in Germany. The median association of municipalities consists of exactly one municipality, while the average is 2.4 municipalities per association. The largest association includes a maximum of 71 municipalities.

⁸Appendix A.1.1 provides an example of the matching procedure.

properties in rural areas.

1.4.3 Dwelling Size

Figure 1.4 – Number of Rooms over the Life-Cycle

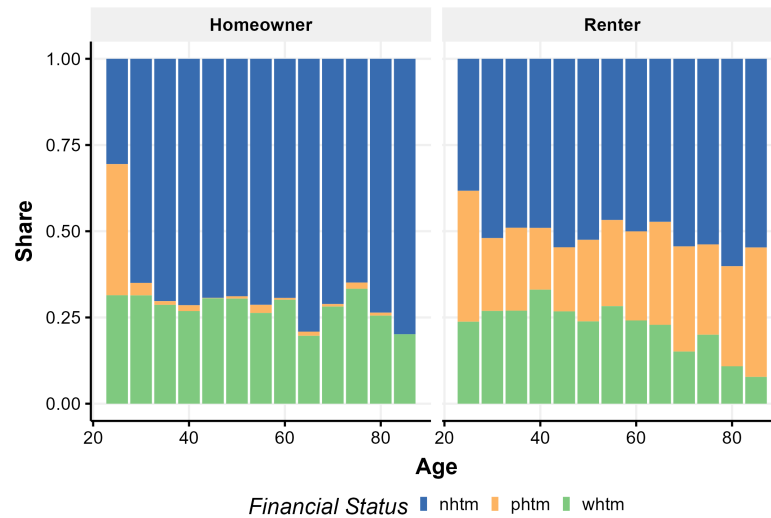


Data: SOEP. Both figures show pooled averages. Panel (b) shows the average number of rooms divided by the number of household members.

Figure 1.4a depicts how the number of rooms evolves over the life cycle in the pooled cross-section. For both renters and home owners, the number of rooms appears to decline after the age of approximately 45–50. However, when adjusting the number of rooms for the number of household members, a different pattern emerges. In Figure 1.4b, there is not only a level difference between renters and home owners, but the two curves also diverge after the age of 50. For instance, home owners at the age of 80 have, on average, one more room per household member compared to renters. This suggests a potential for downsizing among home owners. Renters, on the other hand, seem to adjust their dwelling size more closely to the change in household size.

1.4.4 Financial Constraints and Portfolio Composition

One potential reason for households to downsize is financial constraints, particularly for home owners with a substantial amount of illiquid assets. To measure financial constraints, I adopt the definition from [Kaplan and Violante \(2014\)](#), which classifies individuals as either wealthy Hand-to-Mouth (wHtM) or poor Hand-to-Mouth (pHtM). A household is considered wHtM if it holds illiquid assets but has liquid assets amounting to less than half of its monthly earnings. In contrast, pHtM households have no illiquid assets and equally low liquid assets. Figure 1.5 shows the shares of pHtM and wHtM households.

Figure 1.5 – Constraints by tenant status

Data: SOEP. Wealth data is available for 2002,2007,2012, and 2017 only. Data from these four waves are pooled.

Figure 1.5 reveals that the share of wealthy Hand-to-Mouth (wHtM) households among home owners remains relatively stable over the life cycle, with a slight increase after retirement. In contrast, for renters, the share of wHtM households declines during retirement. Overall, a significantly larger proportion of renters are financially constrained compared to home owners.

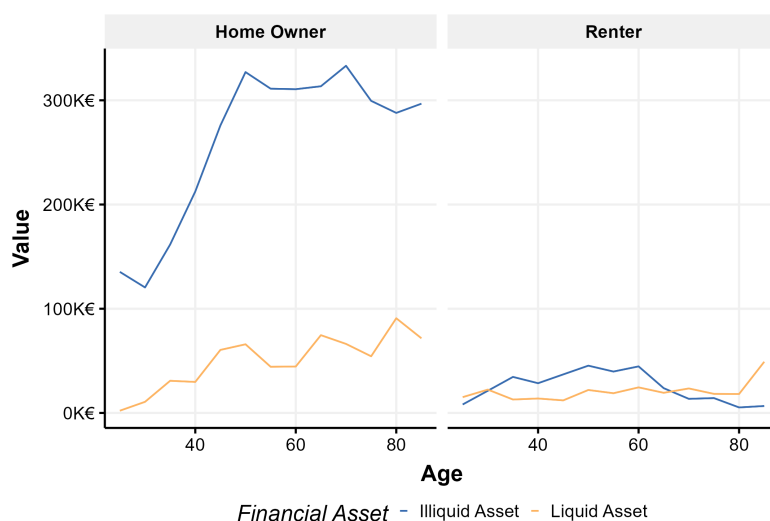
Table 1.2 – Portfolio Composition

Variable	Overall	Home owner	Renter
Real Estate	116,959	251,976	11,644
Financial Assets	21,110	33,611	11,358
Business Assets	17,401	32,768	5,414
Tangible Assets	4,999	7,845	2,778
Other Assets	18,904	29,834	10,176

Data: See Figure 1.5. € are converted to real values using CPI (2021=100). All values are averages. Overall includes both home owners and renters.

Table 1.2 demonstrates that home owners possess more assets across all reported asset classes compared to renters. The real estate category includes non-owner-occupied properties, which explains why renters also report some real estate holdings. A key takeaway from this table is that real estate is by far the most significant asset for the average German household.⁹ Figure 1.6 examines the composition of household portfolios over the life cycle.

⁹The SOEP variables on wealth do not include pension wealth, which is another important asset for Germans, especially for renters.

Figure 1.6 – Portfolio Composition over the Life Cycle

Data: See Table 1.2.

The left panel of Figure 1.6 illustrates how the stock of illiquid assets for home owners increases over the life cycle. This growth is primarily driven by mortgage repayment during their working years, which leads to a rise in net illiquid assets. Alongside this increase in illiquid assets, liquid assets also continue to grow for home owners over time.

Conversely, renters accumulate illiquid assets during their working years but begin to dissave after the age of 60. This pattern aligns more closely with the typical life-cycle behavior predicted by economic theory.

1.4.5 Characteristics of Downsizers

This section examines households in the year before downsizing, focusing on a restricted sample where the household head is older than 55 years. This is the same sample that will be used in the reduced-form empirical estimation. Table 1.3 provides a summary of the average characteristics of households that downsize in the following year. Given that downsizing is a relatively rare event, the standard deviation of all variables is quite large. Notably, the average liquid wealth of downsizing households is very low, highlighting the consumption potential of these households. For the 37% of downsizing households that are home owners, an important question is how many remain home owners after downsizing. Conversely, it is also relevant to ask how many renters downsize and subsequently become home owners. Table 1.4 presents these transition patterns. While only 6% of renters who downsize transition to becoming home owners, 27%

Table 1.3 – Descriptive Statistics

Variable	
Age	71 (19.5)
Home Owner	37% (0.484)
Net Income (monthly)	€2,234 (2,087)
Liquid Assets	€37,000 (222,546)
Rooms/HH Size	3 (1.34)
Formerly Married	62%

Data: SOEP. Restricted sample: Households head over 55 years old. Standard deviation in parentheses. Formerly married included: separated, divorced, and widowed household heads. € are converted to real values using CPI (2021=100).

Table 1.4 – Tenant Status Change

	Renter	Home Owner
Renter	94%	6%
Home Owner	73%	27%

Data: SOEP. Rows indicate tenant statuses today, and columns the two possible tenant statuses tomorrow and their frequency.

of home owners remain home owners after downsizing. This suggests a distinct preference for home ownership, as some households choose to retain ownership of their dwelling even after downsizing in old age. However, the majority of downsizing home owners transition to becoming renters.

1.4.6 Regional Mobility Patterns

This section examines mobility patterns among households that move. Table 1.5 presents the percentages of movers and downsizers who change the federal state and GGK class during the relocation process. Downsizers represent a subset of movers, as they are households that relocate to a dwelling with fewer rooms than their previous one. Overall, only 3% of movers change their federal state, while 7% change their GGK class. However, downsizers exhibit distinct mobility patterns: 13% of all downsizers change their federal state, and 35% change their GGK

Table 1.5 – Mobility Pattern

Status	Change Federal State	Change GGK
Mover	3%	7%
Downsizer	13%	35%

Data: SOEP.

class. It is important to note that, with the available regional information, I cannot calculate exact moving distances. For instance, even if a household does not change its GGK class, it could have moved to the opposite side of the federal state while remaining in a municipality within the same GGK class.

In addition to overall changes, Table 1.6 reports the average difference in GGK class for movers

Table 1.6 – Change in GGK class

Status	Change Federal State	Δ GGK
Mover	No	−0.013
	Yes	−1.6
Downsizer	No	0.09
	Yes	−0.39

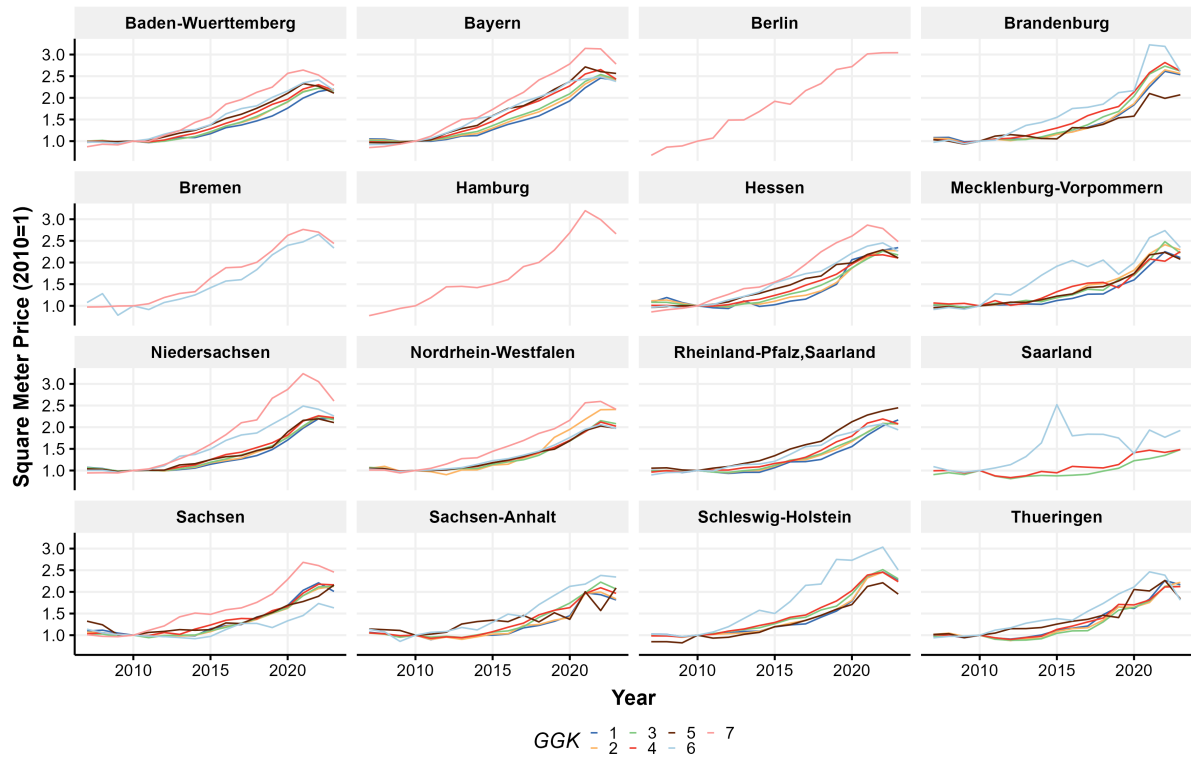
Data: SOEP.

and downsizers. For households that remain within the same federal state, the change in GGK class is minimal. However, households that relocate to a different federal state tend to move to municipalities with fewer inhabitants. Interestingly, the average change in GGK class is more pronounced for movers than for downsizers.

1.4.7 Price Trends at the GGK Level

This section presents general price trends based on the data provided by [Ahlfeldt, Heblich and Seidel \(2023\)](#). Figure 1.7 shows the average real estate prices by GGK class and federal state. Each GGK class price is normalized to 1 in 2010. What Figure 1.7 illustrates is the variation in growth rates across GGK classes and federal states over time. Over time, there is a clear upward trend in real estate prices across all federal states and GGK classes. The only exception is Saarland, where prices show minimal growth. In addition to differences between federal states, there are also variations in price growth among GGK classes within each federal state. However, there is no consistent pattern regarding which GGK class experienced the sharpest growth. For instance, in federal states such as Baden-Wuerttemberg, Bayern, and Hessen, GGK class 4 exhibited the

Figure 1.7 – Real estate prices by GKG and Federal State



Data: Ahlfeldt, Heblich and Seidel (2023). Normalized to 1 in 2010

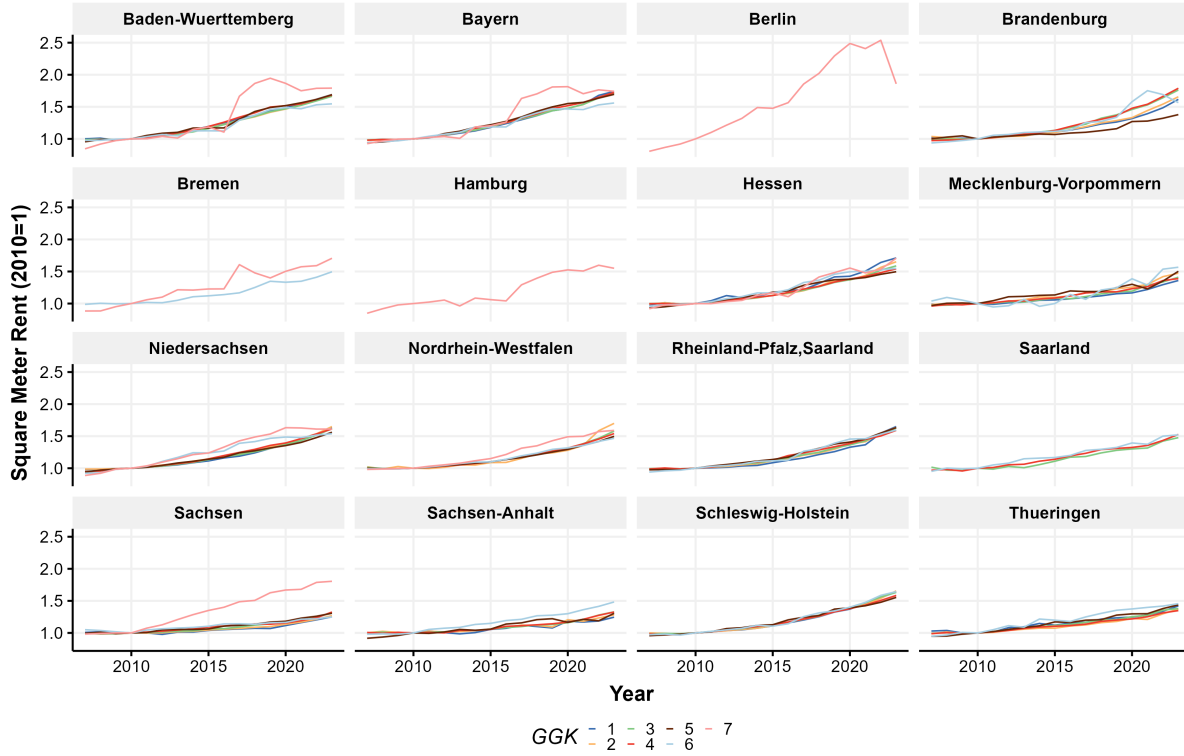
most significant growth. Meanwhile, in states like Brandenburg, Mecklenburg-Vorpommern, and Schleswig-Holstein, GKG class 3 saw the sharpest price increase.

Figure 1.8 presents trends of rental prices across federal states and GKG classes. These indices are normalized in the same way as the real estate prices in Figure 1.7, with each GKG class index set to 1 in 2010. The y-axis in Figure 1.8 reveals that rents did not rise as sharply as purchase prices. A notable outlier is Berlin, where rents experienced the most pronounced increase, followed by a clear decline after 2020. Additionally, the differences in rent trends between GKG classes within federal states are smaller compared to the differences observed for purchase prices. This suggests that rent increases were more uniform across GKG classes within federal states.

1.5 Empirical Estimation

This section examines the immediate impact of real estate transfer taxes (RETT) on the downsizing behavior of household heads older than 55 in Germany between 2006 and 2020. To analyze

Figure 1.8 – Rents by GGK and Federal State



Data: Ahlfeldt, Heblich and Seidel (2023). Normalized to 1 in 2010

this relationship, a fixed-effects Logit model is used to estimate how variations in RETT, along with other factors, influence downsizing decisions. The empirical specification of the model is as follows:

$$\text{logit}(p_{i,t+1}) = \log\left(\frac{p_{i,t+1}}{1-p_{i,t+1}}\right) = \beta_0 + \beta_1 * \Delta RETT_{state,t} * owner_{i,t} + \beta_2 * X_{i,t} + \delta_t + \delta_{state*GGK} + \epsilon_{i,t} \quad (1.1)$$

where $p_{i,t+1}$ is the likelihood that a household will downsize in the next period, $\Delta RETT_{state,t}$ is the difference between the tax in year t and $t-1$ in a particular state, $owner_{i,t}$ is a dummy indicating whether the household owns their dwelling, $X_{i,t}$ is a vector of control variables, and δ_t and $\delta_{state*GGK}$ are year and state fixed effects. In addition to household-specific controls, $X_{i,t}$ also includes state-level unemployment rates, which are intended to account for regional business cycles. The choice of using the first difference of RETT instead of the level is supposed to capture the immediate effect this tax change has on the downsizing probability.

The analysis focuses on a subsample of the SOEP, restricted to households with heads aged 55 to 85 years. Furthermore, the sample is limited to years after 2005, as this marks the period when

states were granted autonomy to adjust RETT rates.

Table 1.7 presents two model specifications. Model 1 excludes real estate price information,

Table 1.7 – Model Summary

	Model 1	Model 2
Age	−0.066 (0.130)	−0.050 (0.135)
Age ²	0.0004 (0.001)	0.0003 (0.001)
Children	0.080* (0.042)	0.074* (0.043)
Education Completed (years)	0.027 (0.022)	0.027 (0.023)
Health Status	0.163*** (0.062)	0.172*** (0.064)
Household Size	0.114 (0.096)	0.108 (0.101)
Owner	−0.565*** (0.137)	−1.437*** (0.502)
ΔRETT	0.164 (0.163)	0.148 (0.166)
ΔRETT*Owner	−0.543** (0.246)	−0.512** (0.248)
Net Income (log)	−0.049 (0.119)	−0.044 (0.125)
Single	0.286 (0.272)	0.318 (0.282)
Widowed	0.631*** (0.164)	0.663*** (0.171)
Divorced	0.504*** (0.172)	0.563*** (0.176)
Separated	0.839*** (0.273)	0.832*** (0.282)
Unemployment Rate (State Level)	0.061 (0.058)	0.030 (0.067)
Rooms first Observed	0.058*** (0.018)	0.058*** (0.020)
SM price (GGK)		0.039 (0.629)
Rent (GGK)		0.137 (0.948)
Vacancy Rate (GGK)		0.341 (0.621)
SM Price (GGK)*Owner		0.740* (0.380)
Constant	−17.509*** (4.632)	−17.995*** (4.873)
Observations	65,450	61,617
# Downsized	660	624
Fixed Effects	Year + State*GGK	Year + State*GGK
Log Likelihood	−3,413.770	−3,206.459
Akaike Inf. Crit.	7,055.540	6,642.918

Notes: *p<0.1; **p<0.05; ***p<0.01 All models estimate the probability of downsizing next year on a subsample of the SOEP where household heads are between 55 and 85 years old in the years 2006–2020. Models 2 include different real estate market indicators. Model 2 has fewer observations since my real estate price data only starts in 2007. *Rooms first Observed* is the number of rooms a household has the first time they appear in my data set.

while Model 2 incorporates coefficients related to the real estate market.¹⁰ The results indicate that a variety of factors influence the decision to downsize.

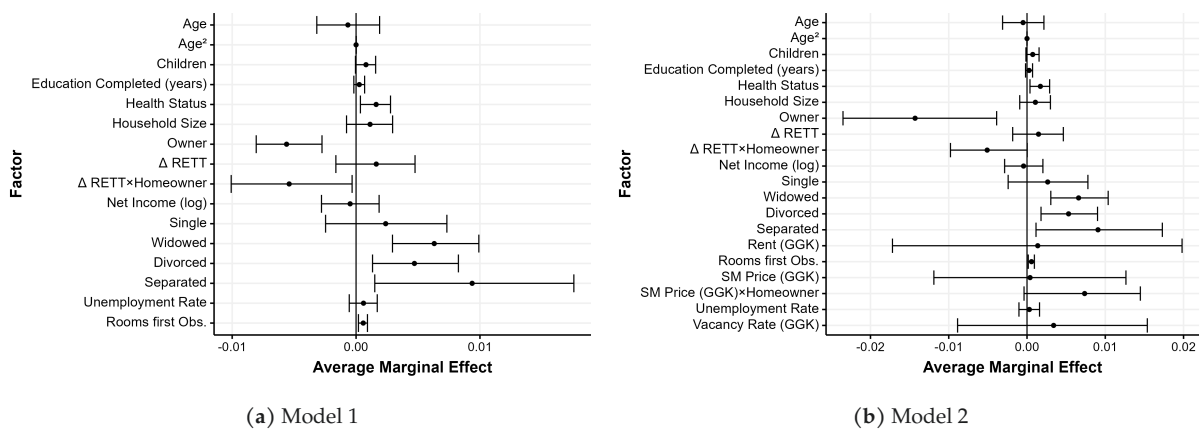
¹⁰Table A.1.2 in Appendix A.1.2 provides additional specifications, including national real estate prices and interaction terms.

The number of children positively affects the likelihood of downsizing, aligning with the hypothesis that larger households require more space during earlier stages in their life.¹¹ Once children leave the household, the potential to downsize increases. Additionally, better health status is associated with a higher probability of downsizing, possibly reflecting longer planning horizons or the ability to enjoy accumulated wealth.¹² Conversely, poor health may lead to survey attrition, reducing observations of such households. Marital status also plays a significant role. Widowed, divorced, or separated individuals are more likely to downsize compared to married individuals.

The primary variables of interest are related to changes in RETT. Home ownership significantly reduces the probability of downsizing, as home owners consume illiquid housing services that are difficult to adjust. Additionally, increases in RETT negatively impact downsizing among home owners. This effect may stem from reduced liquidity or lower expected sale prices, as part of the tax burden is passed on to sellers (Dolls et al., 2025). Model 2 further reveals that increases in square-meter prices positively influence downsizing behavior among home owners, as they may want to take advantage of the increased value of their home by selling it.

Figure 1.9 illustrates the average marginal effects (AME) for Models 1 and 2.¹³ For home own-

Figure 1.9 – Average Marginal Effects



ers, each marginal increase in RETT reduces the probability of downsizing by 0.5 percentage points (Figure 1.9a). Similarly, increases in house price indices raise the probability of downsizing by 0.7 percentage points for home owners (Figure 1.9b).

¹¹The number of children is defined as the number of children the household has, irrespective of their current place of residence. Since I focus on a subsample where the household head is over 55 years old, most children are no longer living in their parents' home.

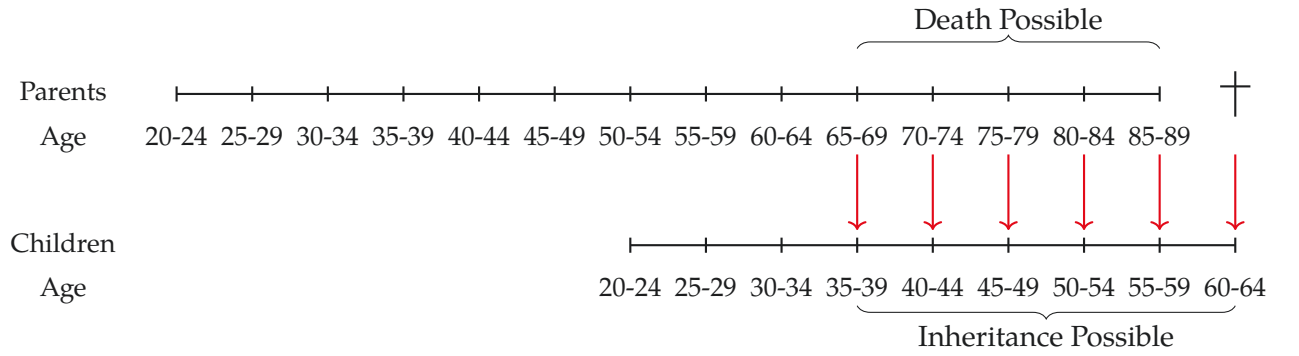
¹²Health status is indicated on a Likert scale by each household member. I take the worst health status in the household as a control.

¹³Table A.1.3 in Appendix A.1.2 provides numerical values for the AMEs.

1.6 Model

To analyze consumption responses and quantitatively evaluate policy changes, I develop a heterogeneous agent life-cycle model that captures key features of household behavior and housing decisions.

1.6.1 Demographics



Agents enter the model economy at age 20 with no initial assets. During their working years, which span from age 20 to 65, they survive with certainty and supply labor inelastically. Upon reaching retirement at age 65, agents face a probability p_t of dying in the following period. The maximum age in the model is 90, after which agents die with certainty. To simplify the analysis, the life cycle is divided into 14 discrete periods, each representing five years. This structure allows the model to capture long-term dynamics while maintaining computational tractability.

1.6.2 Preferences

Agents in the model derive utility from two sources: goods consumption (c_t) and housing consumption (s_t). Their preferences are represented by the following utility function:

$$U(c_t, s_t) = \frac{\left((c_t/\gamma_t)^\sigma * (\rho_{t,h} * s_t/\gamma_t)^{1-\sigma} \right)^{1-\eta}}{1-\eta} \quad (1.2)$$

This specification follows [Kaas et al. \(2021\)](#) and incorporates several key parameters. Here, c_t and s_t represent goods and housing consumption, respectively. The parameter η captures risk aversion, while σ denotes the elasticity of substitution between housing and non-housing consumption. The term γ_t is the household equivalence scale, which adjusts for household size,

and $\rho_{t,h}$ is a time-dependent utility shifter that reflects the additional utility derived from home ownership.

1.6.3 Bequests

Bequests in the model follow the framework of [De Nardi \(2004\)](#). The utility derived from leaving a bequest is represented by the following function:

$$B(a, h) = \phi_1 * \left(1 + \frac{a + hp}{\phi_2}\right)^{1-\eta} \quad (1.3)$$

In this formulation, a represents financial assets, and hp denotes housing wealth. The parameter ϕ_1 determines the overall strength of the bequest motive, while ϕ_2 governs the degree to which bequests are treated as a luxury good. The parameter η , consistent with the preferences in Equation 1.2, captures risk aversion.

1.6.4 Assets

Agents in the model can hold two types of assets: liquid risk-free bonds and housing wealth.

Risk-Free Bond

The risk-free government bond, denoted by a , is a liquid asset that agents can use to accumulate precautionary savings. These liquid assets are continuous and pay a constant interest rate r , providing a stable return over time.

Housing

Housing wealth, denoted by hp , is modeled as a discrete asset that does not generate interest. The discrete nature of housing reflects the indivisibility of real estate, as agents cannot make marginal adjustments to the size of their property.

1.6.5 Owning vs. Renting

Households can access housing services (s) either by owning or renting. Renters directly choose the level of housing services s they consume and pay rent, denoted by l . In contrast, home owners consume housing services determined by the size of their property, such that $s = \nu h$, where h represents house size and $\nu > 1$ represents that home owners like housing services more if

they own the dwelling. Home owners cannot rent out rooms in their dwelling, nor can they rent additional housing services. Home ownership comes with additional costs. Home owners incur maintenance expenses equal to δp , where $\delta \in (0, 1)$ represents the maintenance rate and p is the house price. These costs fully offset depreciation. Furthermore, home owners face transaction costs, including RETT, when buying or selling property, with sellers paying half the amount that buyers incur. To purchase real estate, households can take out a mortgage, borrowing up to $(1 - \lambda)$ of the house price, where $\lambda \in (0, 1)$ represents the required down payment rate. Borrowers must pay interest at the rate r and repay the entire loan before retirement. Households without housing wealth must rent and have the flexibility to choose their level of housing services over a broader range.

1.6.6 Housing Market

The housing market in this model follows the framework of [Kaplan, Mitman and Violante \(2020\)](#). Below, I focus on the key components of the rental and construction sectors.

Rental Sector

The rental sector is competitive and consists of firms that own housing and rent it out to households. Each firm incurs an operating cost ψ for every unit of housing they rent out. In addition, they pay transaction cost (τ_h) for the new housing stock. A representative rental firm solves the following optimization problem:

$$J(\tilde{H}) = \max_{\tilde{H}'} \left[l - \psi \right] \tilde{H}' - p \left[(\tilde{H}' - \tilde{H}) * (1 + \tau_h) + \delta \tilde{H} \right] + \left(\frac{1}{1 + r} \right) \mathbb{E}[J(\tilde{H}')] \quad (1.4)$$

where $\tilde{H}$ represents the firm's current housing stock, l is the rent charged per unit of housing services, ψ is a fixed cost for renting out apartments, p is the price of housing, τ_h is the transfer tax, δ is the depreciation rate, and r is the interest rate. The optimization leads to the following equation for the rent charged by competitive firms:

$$l = \psi + p - \left(\frac{1 - \delta + \tau_h}{1 + r} \right) \mathbb{E}p' \quad (1.5)$$

Rental prices depend on operating costs, current housing prices, and expectations about future prices. In the steady state, where $p = p'$, equation 1.5 simplifies to:

$$l = \psi + p(1 + \tau_h) - \left(\frac{1 - \delta + \tau_h}{1 + r} \right) * p$$

$$l = \psi + \left(\frac{r(1 + \tau_h) + \delta}{1 + r} \right) * p$$

Construction Sector

The construction sector is competitive and produces new housing using a production function:

$$I_h = (\Theta N_h)^\alpha \bar{L}^{1-\alpha} \quad (1.6)$$

where I_h is the amount of new housing investment, Θ is the productivity parameter, N_h is the labor input, $\bar{L}$ is the amount of new land permits, and $\alpha \in (0, 1)$ is the elasticity of housing production with respect to labor. The representative construction firm solves the following static maximization problem:

$$\max_{N_h} p I_h - w N_h \quad (1.7)$$

where p is the price of housing and w is the wage rate. This optimization leads to the following investment function if $\Theta = w$, which is what [Kaplan, Mitman and Violante \(2020\)](#) assume:

$$I_h = [\alpha p]^{\frac{\alpha}{1-\alpha}} \bar{L} \quad (1.8)$$

1.6.7 Income risk

Labor income in the model is represented by the following equation:

$$w(z, t) = e_t * p_z \quad (1.9)$$

where $w(z, t)$ is the labor income, e_t represents age-specific productivity, and p_z is idiosyncratic productivity. The idiosyncratic productivity p_z follows an autoregressive process of order one (AR(1)). The final productivity state z before retirement determines the household's pension income. Retired households receive a share of the mean income associated with their last productivity state, denoted by $Tr(z)$.

1.6.8 Households

Four distinct eras in a household's life cycle influence its decision-making. Parameter constraints (for a and s) are only reported in the first era. The only changing constraint is the no-borrowing constraint during retirement, which is stated in the respective subsection.

Prior to inheritance

This era is possible from period 1 to period 8. Agents experience productivity shocks, work, decide on their portfolio composition, and expect an inheritance from period 3 onward.

$$\begin{aligned}
 V_{pI}(a, h, z, t) &= \max_{c, s, a', h'} \left(u(c, s) + \beta \left[(1 - \pi_I) \mathbb{E}[V_{pI}(a', h', z', t + 1)] \right. \right. \\
 &\quad \left. \left. + \pi_I \mathbb{E}[V_I(a', h', z', t + 1)] \right] \right) \\
 a' + (1 + \mathbb{1}_{h \neq h'} \tau_h) h' p' &= w(z, t)(1 - \tau_l) + (1 + r)a + (1 - \delta)hp - c - (\mathbb{1}_{h=0} * l)s \\
 a &\begin{cases} \geq a_{min}, & \text{if } h' > 0 \\ \geq 0, & \text{otherwise} \end{cases} \\
 s &\begin{cases} = \nu h, & \text{if } h > 0 \\ > 0, & \text{otherwise} \end{cases}
 \end{aligned}$$

Inheritance

This era lasts from period 4 to period 9. Agents experience productivity shocks, work, decide on their portfolio composition, receive an inheritance, and could die next period in period 9.

$$\begin{aligned}
 V_I(a, h, z, t) &= \max_{c, s, a', h'} \left(u(c, s) + \beta \left[(1 - \pi_d) \left[\mathbb{E}[V_{dI}(a', h', z', t + 1)] * \mathbb{1}_{t < 9} + \mathbb{E}[V_R(a', h', z', t + 1)] * \mathbb{1}_{t=9} \right] \right. \right. \\
 &\quad \left. \left. + \pi_d B(a', h') \right] \right) \\
 a' + (1 + \mathbb{1}_{h \neq h'} \tau_h) h' p' &= w(z, t)(1 - \tau_l) + (1 + r)a + (1 - \delta)hp - c - (\mathbb{1}_{h=0} * l)s + I(z, t)
 \end{aligned}$$

After Inheritance

This era lasts from period 5 to period 9. Agents experience productivity shocks, work, decide on their portfolio composition, and could die the next period in period 9.

$$V_{aI}(a, h, z, t) = \max_{c, s, a', h'} \left(u(c, s) + \beta \left[(1 - \pi_d) \left[\mathbb{E}[V_{aI}(a', h', z', t + 1)] * 1_{t < 9} + \mathbb{E}[V_R(a', h', z', t + 1)] * 1_{t = 9} \right] + \pi_d B(a', h') \right] \right)$$

$$a' + (1 + \mathbb{1}_{h \neq h'} \tau_h) h' p' = w(z, t)(1 - \tau_l) + (1 + r)a + (1 - \delta)hp - c - (\mathbb{1}_{h=0} * l)s$$

Retired

This era lasts from period 10 to period 14. Agents decide on their portfolio composition and could die in the next period. Their worker productivity stays fixed at the value they had in period 9, the last period they worked. The worker productivity pins down their pension, $Tr(z)$.

$$V_R(a, h, z, t) = \max_{c, s, a', h'} \left(u(c, s) + \beta \left[(1 - \pi_d) V_R(a', h', z, t + 1) + \pi_d B(a', h') \right] \right)$$

$$a' + (1 + \mathbb{1}_{h \neq h'} \tau_h) h' p' = Tr(z) + (1 + r)a + (1 - \delta)hp - c - (\mathbb{1}_{h=0} * l)s$$

$$a \geq 0$$

1.6.9 Competitive Equilibrium

Consider an individual state vector $q = \{a, h, z, L\}$, where a represents a liquid and h an illiquid asset level, z worker productivity, and L describes the agent's stage in life (before inheritance, receiving inheritance, after inheritance, or retired). The decision rules resulting from the agents' optimization problems, combined with the exogenous Markov processes for worker productivity, yield a probability distribution of next period's state vector q' conditional on q .

Let $\mathbf{x}$ denote the aggregate state vector, where aggregation takes place across all individuals.

Definition 1. A stationary equilibrium is given by a wage w , prices for housing p , taxes on labor τ and housing transfer τ_h , allocations for consumption $c(s)$, assets $a(s)$, housing stock $h(s)$, and a constant distribution of agents over states s , $P^*(x)$, such that given w , p , τ_l and τ_h the following conditions are

fulfilled:

1. The allocations c , a , h , and expected bequests $b(s)$ solve the agents' maximization problems.
2. Housing investment equals the sum of replacement needs (to offset depreciation) and net additions required by demographic change (entries minus exits).
3. The government's budget is balanced, with tax income equaling pension expenses.
4. The distribution P^* is the invariant distribution for the economy.

1.6.10 Calibration

Table 1.8 – Externally calibrated parameters

Parameter	Value	Explanation/Source
β	0.95	Yearly frequency
δ	0.01	100-year housing lifespan
η	2	Standard parameter
π_d	Vector	Life-Expectancy Table Germany
π_l	Vector	Lagged π_d
Tr	30% of mean income of last state	Institutional approximation
ρ	0.922	Bayer and Juessen (2012)
σ^Y	0.172	Bayer and Juessen (2012)
λ	0.1	Institutional approximation
τ_h	9%	Institutional approximation
τ_l	37%	Institutional approximation
e_t	Vector	own estimation/SOEP
γ_t	Vector	own estimation/SOEP
r	2%	Yearly frequency

Notes: Yearly frequencies are converted to match the 5 year model period.

Age-dependent productivity vector, e_t , is calculated using the method developed by Hansen (1993). The household equivalence scale, γ_t , is computed as the square root of the average number of household members by age of household head.

There is no one-to-one mapping between the internally calibrated parameters and the target moments, but certain parameters are more informative for specific targets.

σ , v , ψ , and $\rho_{t,h}$ are all related to the consumption of housing services and, specifically, home ownership.¹⁴ However, by maintaining the home ownership rate at old age through $\rho_{t,h}$, more households leave a house, resulting in larger inheritances. In addition to old-age housing utility, ϕ_1 and ϕ_2 directly determine the bequest motive, influencing both the average bequests and

¹⁴The calibrated value of σ , which drives much of the housing consumption decision, is between the value from Kaas et al. (2021) (0.717 for Germany) and Yang (2009) (0.8615 for the USA).

Table 1.9 – Internally Calibrated Parameters

Parameter	Value
σ	0.832
v	1.93
$\rho_{t,h}$	1.07
ψ	0.0142
ϕ_1	−2.981
ϕ_2	15
Lp	0.231

Notes: Lp is adjusted to fix the house price to 1 in the steady state.

Table 1.10 – Targeted Moments

Moment	Data	Model
Home Ownership Rate (40-59)	47%	45%
Home Ownership Rate (60+)	51%	50%
Average Bequest	€226,000	€170,845
Gini	0.75	0.69
Share wHtM	26%	13%
Average Liquidity-to-Net-Worth Ratio	22%	26%

Notes: All data from SOEP. Average bequests in the data are calculated as the average net wealth of people 65+. Average bequests in the model are transformed from normalized assets to Euro values using the average household gross income of 2013 ([Statistisches Bundesamt, 2025a](#)).

the Gini coefficient. The share of wealthy hand-to-mouth (wHtM) households is influenced by all parameters. Since only home owners can be wHtM and housing is the only illiquid asset, a strong preference for home ownership prevents home owners from becoming renters and increasing their liquid wealth. Furthermore, when inheritances are concentrated at the top, more households have low liquid assets, which also increases the share of wHtM households. The average liquidity-to-net-worth ratio provides a summary measure of portfolio composition in my model. It extends the wHtM concept to the whole economy by comparing liquid assets to total net worth. This moment is shaped by both housing and bequest parameters: housing parameters mainly affect the share of illiquid assets, while bequest parameters also influence liquid asset holdings, jointly determining the aggregate liquidity share.

1.7 Results

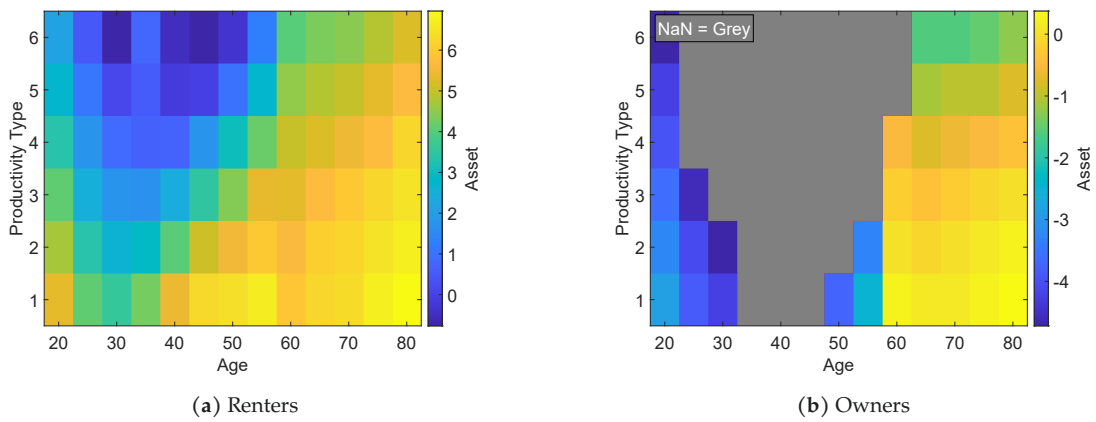
This section reports results from my benchmark model.

1.7.1 Renting or Owning?

Figure 1.10 presents the policy function for housing as a heatmap, illustrating the transitions between renting and owning. Panel 1.10a displays the minimum asset level required for households, based on their age and productivity, to transition from renting to owning in the next period. Conversely, Panel 1.10b shows the minimum asset level for current home owners to transition to renting in the next period. The gray areas represent age-productivity combinations where households never choose to rent in the next period, regardless of their current asset level.

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Figure 1.10 – Transition between Owning and Renting



Notes: Heatmap of the housing policy function. Panel (a) shows the transition from renting to owning. Panel (b) shows the transition from owning to renting. Negative liquid assets for renters are only possible after the purchase.

The transition from renting to owning, as shown in Panel 1.10a, reveals that households with higher productivity require fewer savings to become home owners. The variation over the life cycle for high-productivity households is driven by two factors: the hump-shaped efficiency profile, which peaks around age 45, and the substantial bequests received by productive households between ages 40 and 60. These income sources enable households to purchase homes with minimal or even negative assets, despite the borrowing constraints imposed on renters that prevent such cases.

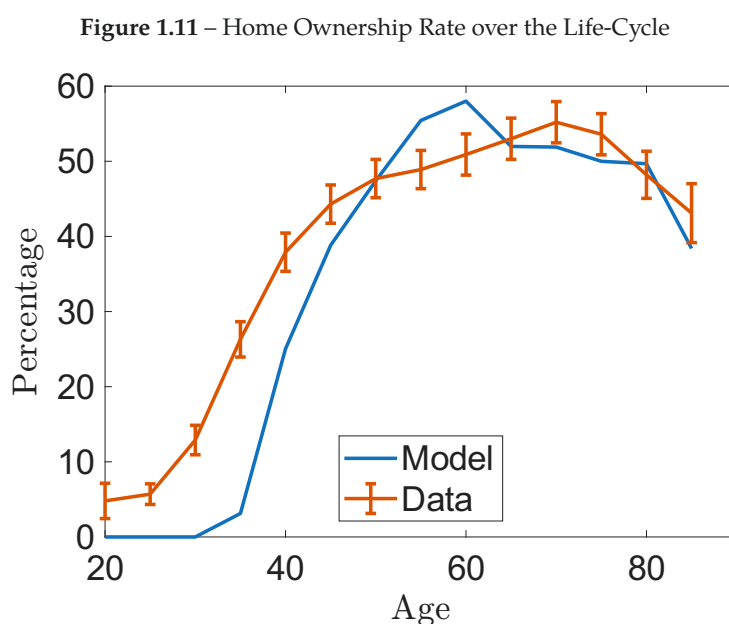
In contrast, the transition from owning to renting, depicted in Subfigure 1.10b, follows a different pattern. All households are unlikely to transition to renting during the middle of their life cycle, regardless of their savings. High-productivity households want to stay home owners for the longest time, while low-productivity households only want that for two periods when their

¹⁵The negative asset threshold for the highest productivity type in Panel 1.10b is a theoretical construct, as pensioners are not permitted to hold negative assets.

household is at its largest. In all other periods, lower-productivity households may choose to rent if their asset levels are sufficiently low, as this allows them to increase their consumption. Much of the movement over the life cycle, which will be explored in subsequent sections, can be explained by these two graphs. High-productivity households tend to become home owners, but if they experience adverse shocks in the future, they may transition to renting.

1.7.2 Home Ownership over the Life-Cycle

A key observation from the data is the trajectory of home ownership rates over the life cycle, a pattern the model can replicate. Figure 1.11 compares the empirically observed trend with the model's predictions. In calibrating the model, I place emphasis on matching the home ownership rate, though I do not target individual points along the life cycle. Instead, I focus on averages across distinct life-cycle stages. The model successfully captures several distinct patterns evident in the data. Notably, the trajectory exhibits a hump-shaped form: early in life, agents must save to afford a home, while later in life, some sell their homes, leading to a decline in the home ownership rate.



Notes: Data from SOEP. The y-axis shows the percentage of home owners.

However, Figure 1.11 highlights a notable discrepancy in the early stages of life. In Germany, some individuals own homes as early as age 20, a scenario that is absent in the model. This limitation arises because all agents in the model begin with zero assets, receive no inter-vivo transfers, and face a minimum equity requirement. Consequently, they must first accumulate

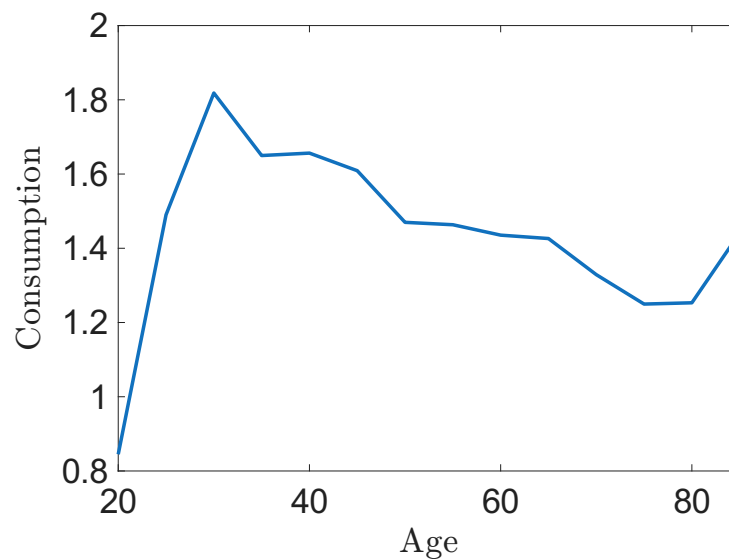
sufficient savings to secure a mortgage and purchase a home. The model aligns more closely with the data in the later stages of life. In particular, during retirement, the model effectively captures the downward trend in home ownership rates, mirroring the observed data.

1.7.3 Consumption over the Life-Cycle

Over the course of their lives, households in my model make consumption and savings decisions in each period, taking into account their household equivalence scale (see equation 1.2). Their consumption is divided between two categories: non-durable goods and housing services.

Non-Durable consumption

Figure 1.12 – Non-Durable Consumption over the Life-Cycle



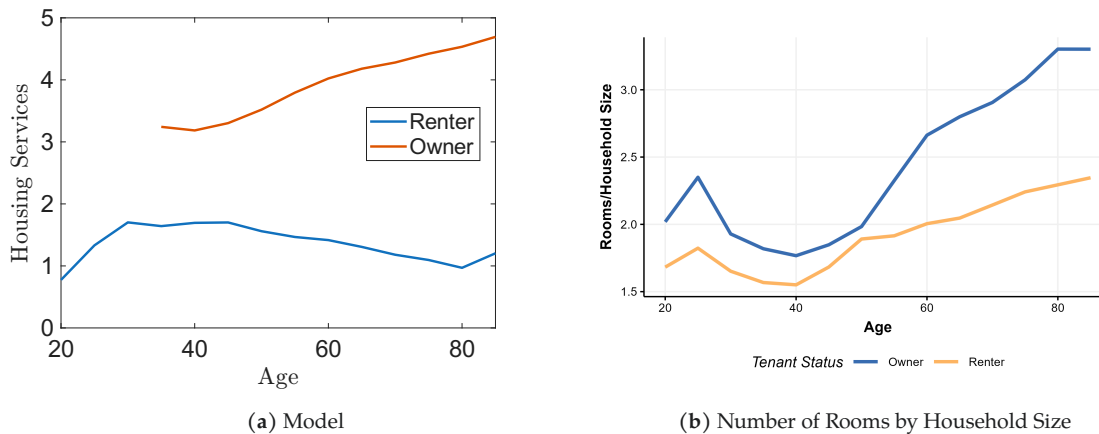
Notes: Non-durable consumption is normalized using the equivalent scale.

Figure 1.12 shows the average non-durable consumption by age, adjusted for the equivalence scale. Non-durable consumption rises sharply during the first two periods of the life cycle, followed by a sharp decline during middle age. It is only in the last two periods, when households are certain they will not live beyond the next period, that consumption increases drastically again. This figure goes against what a frictionless life-cycle model would suggest. Households do not smooth consumption perfectly. They maintain a buffer stock to mitigate longevity risk, which they only utilize in the last two periods, when death is almost certain to occur.

Housing Services

Housing services serve as a proxy for the number of rooms, which are not explicitly modeled. Figure 1.13 illustrates the average consumption of housing services by tenant status over the life cycle.

Figure 1.13 – Housing Services over the Life-Cycle



Notes: Panel (a): Housing services are normalized using the equivalent scale. The orange line (owner) only starts at 35 because nobody younger owns a home. Panel (b) is equivalent to Panel (b) of Figure 1.4.

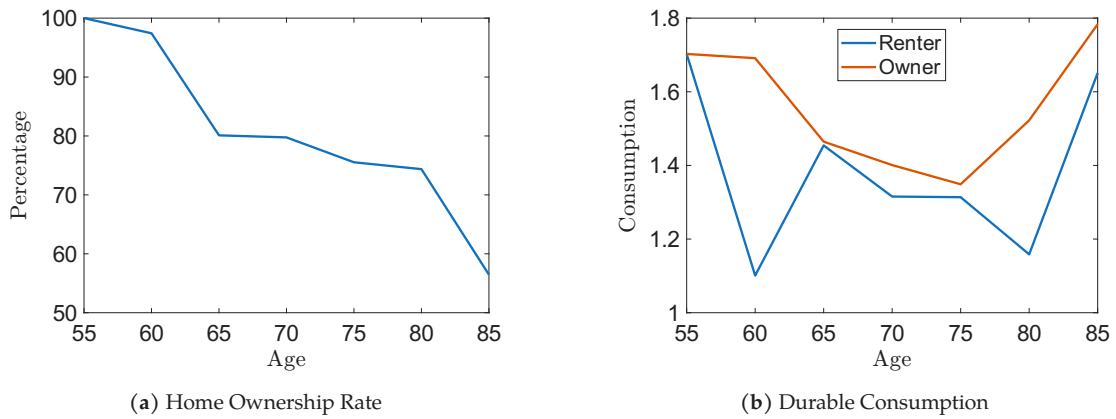
Panel (a) of Figure 1.13 shows that renters' consumption of housing services declines with age, whereas home owners experience a substantial increase as they grow older. The analysis adjusts for the household equivalence scale, making it directly comparable to Figure 1.4b, which is reproduced here for convenience. As a result, the model can qualitatively replicate the lack of downsizing behavior among German home owners, a pattern that is evident in the data.

Selling or Staying: Life After 55

One advantage of this quantitative model over a purely empirical analysis is its ability to explore special cases where data would otherwise be too limited. This subsection examines one such case: the changes in tenant status and consumption patterns of households that are home owners at the age of 55.

Figure 1.14 presents two key trends: the declining home ownership rate on the left and the evolving consumption patterns on the right.

Figure 1.14 – Owner at 55



Panel (a) of Figure 1.14 depicts the decline in home ownership rates among households that owned their homes at age 55. The x-axis extends to age 90, as some households choose to sell their homes in the final period, while others retain ownership to leave their property as a bequest. By the age of 85, approximately 40% of these former home owners have transitioned to renting. Once death becomes certain at age 85, most households opt to sell their homes, leaving only about 30% who still own their property. This behavior is a technical feature of the model: since households know they will die in the next period but can continue living in their homes during the current one, there is a strong incentive to sell their property. Meanwhile, Panel (b) of Figure 1.14 highlights the differences in average consumption between households that retain their homes and those that sell them. This pattern is not intuitive. Households that sell their house and become renters have lower average consumption levels compared to households that stay in their house. There is a selection effect due to bad productivity states and resulting low income in the households that sell their house. The relation between productivity states and willingness to sell can be observed in Panel (b) of Figure 1.10. At 60, when agents draw their last productivity state, those who become renters at some point after 55 have an average productivity level of 4.3, while stayers have an average productivity of 5.9.¹⁶ These households would have even lower consumption levels if they had stayed home owners.

1.8 Change in the Real Estate Transfer Tax

To evaluate the impact of a reduction in the real estate transfer tax on consumption, I reduce τ_h by one percentage point. Under a balanced-budget rule, the government must offset the resulting revenue loss by raising other taxes. I consider two financing schemes and discuss their

¹⁶The population average is normalized to 5. So that 1 asset equals one gross yearly income.

implications: increasing the labor income tax (reform 1) or introducing a property tax (reform 2).¹⁷ The labor income tax applies economy-wide, whereas the property tax is levied only on home owners.

Subsection 1.8.1 compares the benchmark equilibrium with the new steady states. Section 1.8.2 then examines the transition dynamics between these steady states. This transition is particularly informative about the mechanisms at work, because it involves households that did not anticipate the policy change when making decisions prior to the reform.

1.8.1 Steady State Comparison

In Section 1.7, I did not discuss prices because they are normalized to one; in this setting, only relative prices are meaningful. In the new steady state, price levels depend on whether the government balances its budget. If the government does not raise τ_l , house prices increase by 0.8%. Qualitatively, this is consistent with Dolls et al. (2025), who show that real estate transfer taxes depress house prices. In my counterfactual, lowering the transfer tax raises housing demand, driven primarily by renters rather than prospective buyers. As Equation 1.5 indicates, the competitive rental company pays τ_h and passes it through to tenants. With a 1 percentage point reduction in τ_h , and holding house prices fixed for the moment, rents decline by $\frac{\Delta\tau_h r}{1+r}$, because the rental company acquires housing at a lower transaction cost. In the new steady state without a balanced-budget adjustment, house prices rise by 0.8%, while the other rent determinants (r and δ) remain constant, implying a 0.1% reduction in rents.

Table 1.11 summarizes how key variables change under both financing schemes. In reform 1,

Table 1.11 – Changes in Taxes, Prices, and Rents

Reform	Labor Tax	Property Tax	House Price	Rent
1	+0.4ppt	0	0	-0.4%
2	0	+0.27ppt	- 0.2ppt	-0.56%

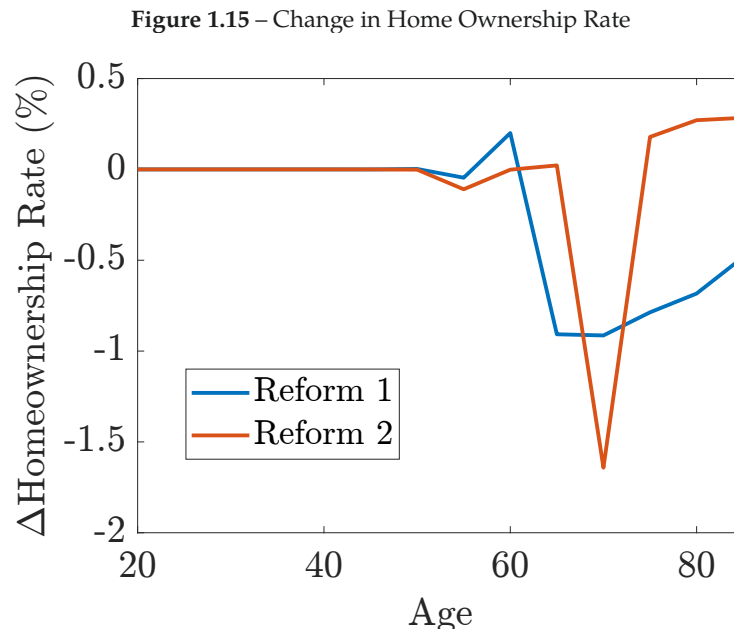
the labor income tax increases by 0.4 percentage points; house prices remain unchanged, and rents decline by 0.4%. In reform 2, a property tax of 0.27 percentage points per period (introduced from zero) is implemented; house prices fall by 0.2%, and rents by 0.56%. Note that the property tax is levied each model period, and one period corresponds to five years. Hence, the implied annual property tax rate is $\frac{0.27\%}{5} = 0.054\%$ of the current market value.¹⁸

¹⁷Appendix A.1.3 presents an exemplary household optimization problem to illustrate how the property tax affects home owners. In essence, home owners pay a fixed percentage of their housing stock as property tax.

¹⁸Germany levies a tax similar to a property tax, the *Grundsteuer*. However, it is based on a unit value rather than market value. As a result, the average property tax paid in Germany is €175 (Statistisches Bundesamt, 2022).

Home Ownership Rate

The overall home ownership rate declines under both reforms. In reform 1, it falls from 31.44% to 31.34% (-0.10 percentage points; $\approx -0.31\%$). In reform 2, it decreases by 0.16%. Figure 1.15 illustrates how these changes vary across the life cycle for both reforms.



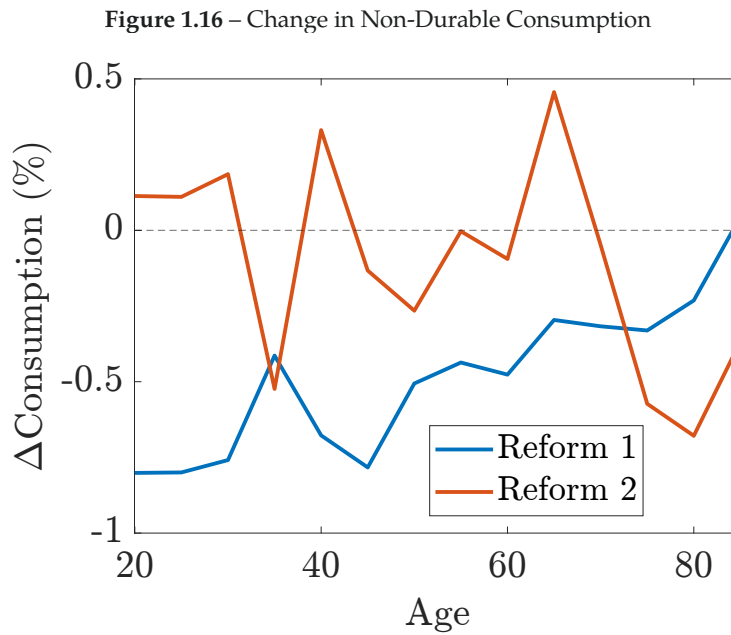
Notes: The y-axis shows the difference in home ownership rate between steady states.

Differences in the home ownership rate are negligible up to age 50 for both reforms. Beyond that, the rate declines under reform 1, whereas under reform 2 it drops sharply at first and then partially recovers. The underlying mechanisms differ across reforms. In reform 1, higher labor income taxes make renting relatively cheaper, while lower transfer taxes reduce transaction costs. In reform 2, home owners face a constant property tax; house prices are slightly lower, rents fall even more than in reform 1, and transaction costs are equally low. The reduction in transfer taxes amplifies the contrast between the two scenarios by facilitating reallocation. Figure 1.15 also shows that under reform 2 home owners adjust later in the life cycle but with greater intensity. Overall, the aggregate impact on the home ownership rate remains small in both reforms.

Consumption

Aggregate consumption responds differently depending on the financing scheme. Under reform 1, average consumption declines by 0.54%, whereas under reform 2 it increases by 0.16%. Figure 1.16 plots age profiles of average consumption, comparing the benchmark with both counterfac-

tuals.



For reform 1, the difference in consumption is larger in the early stages of the life cycle as these are the years where all households only consume and rent and there are no home owners. Since the income is higher in the benchmark scenario, they can consume much more, and households in the counterfactual have to save more if they want to buy a house.¹⁹ For reform 2 the differences in consumption oscillates around zero and only stay constantly below zero after the households turn 70. However, since fewer of these households are alive the aggregate consumption difference is still positive.

The steady-state comparison highlights three key results. First, the source of additional revenue matters for aggregate outcomes. When the government raises labor income taxes modestly (reform 1), which applies to the entire working population, both the home ownership rate and aggregate consumption decline. By contrast, introducing a property tax (reform 2) leads to a smaller reduction in the home ownership rate and a slight increase in aggregate consumption.

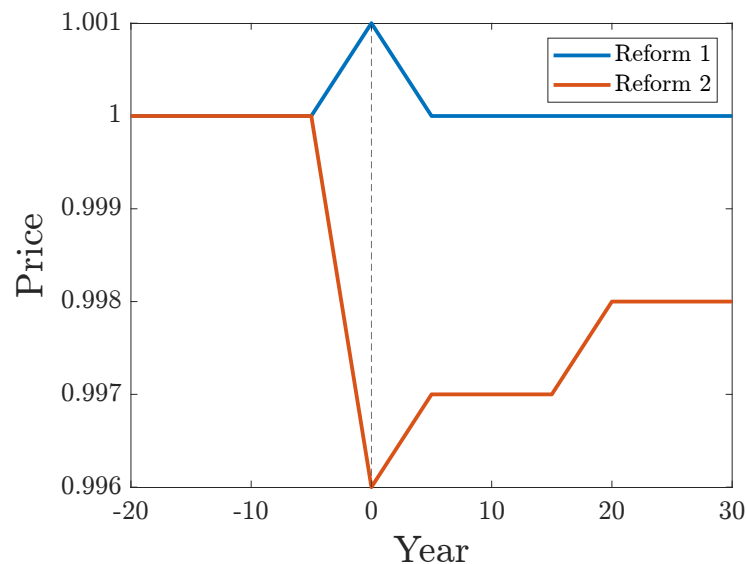
1.8.2 Transition

I have shown above that the two financing schemes have distinct effects on home ownership and consumption. Raising the labor income tax makes all workers, especially younger households reliant on earnings, slightly poorer, with direct implications for consumption. By contrast,

¹⁹Appendix A.1.3 depicts the change in consumption for the partial equilibrium setting where the housing market clears, but the government does not balance its budget. The effect on consumption in early years almost disappears, while elderly households can increase their consumption on average.

introducing a property tax targets home owners and changes the user cost of owner-occupied housing. I now analyze the transition between steady states. During the transition, cohorts born before the policy change had optimized under the assumption that both the transfer tax and the labor tax would remain unchanged. I continue to assume that all tax changes are unexpected. Moreover, the government knows *ex ante* the tax rate required to balance its budget in the new steady state and implements it simultaneously with the reduction in the transfer tax. The housing market clears each period; with sluggish supply, house prices must adjust to accommodate shifting demand from both owners and renters. The transition is complete once house prices stabilize. Figure 1.17 plots the price paths under both reforms, with the x-axis measuring time to the new steady state.

Figure 1.17 – Net House Prices during the Transition



Notes: These are net prices not including the new tax rates. The gross prices for sellers and buyers can be found in Appendix A.1.3.

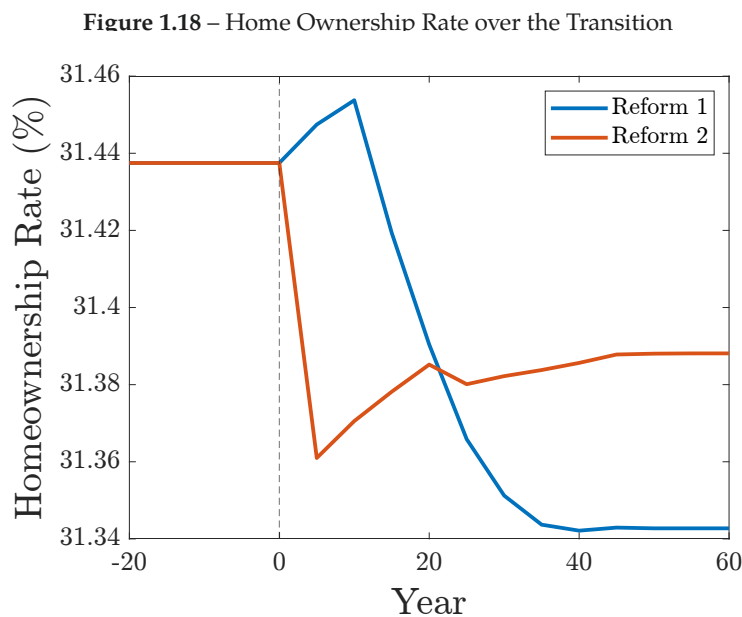
The transition requires house prices to adjust to clear the housing market, and households adapt their behavior accordingly, beyond the direct response to the lower transfer tax.

For reform 1, house prices jump up in the first period after the policy change and return to the initial steady-state level in the next period. This short-run spike indicates that some households were at the margin of purchasing: when transaction costs fall, they can afford to buy, but supply cannot adjust immediately, pushing prices up. At the same time, cheaper rents raise demand for housing services among renters. As the transition unfolds, prices revert to one because the decline in disposable income offsets the temporary demand pressure.

For reform 2, price dynamics reflect the differential incidence of the new tax. Prices initially drop

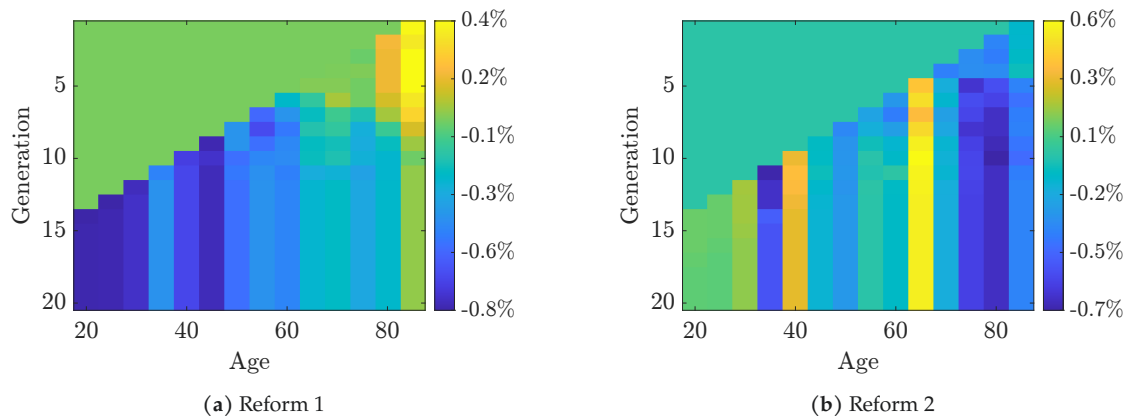
by 0.4%, then partially rebound, and settle about 0.2% below the initial steady state. Unlike reform 1—which makes all working-age households slightly poorer via higher labor taxes—reform 2 increases the user cost of owner-occupied housing. The stream of property taxes is capitalized into lower house prices. By contrast, the demand for rental housing services is largely unaffected by the introduction of the property tax.

Figure 1.18 shows the corresponding dynamics of the aggregate home ownership rate over the transition.



The dynamics mirror those of prices. In reform 1, the home ownership rate rises slightly at the outset because some households can now afford to buy. Over time, the higher labor income tax lowers home ownership. In reform 2, the property tax has a direct negative effect on home ownership by raising the user cost of owning. Its long-run impact is negative but smaller than in reform 1.

The transition also provides an opportunity to examine how the consumption of different generations changes compared to the old steady-state consumption. Since many generations experience the transition, Figure 1.19 presents these differences as a heatmap, making it easier to identify patterns and variations.

Figure 1.19 – Consumption in the Transition

Notes: The y-axis reports different generations who live through the transition. Generation 1 only experiences the first transition period in their last life cycle period. Generation 14 is the first generation who is fully exposed to the new tax rate when they enter the economy. A graphical representation can be found in Appendix A.1.3

Early cohorts experience no immediate change in consumption, since the policy has not yet taken effect and they continue to behave as in the old steady state. The first cohort is affected only in the last period of life.²⁰ Panel (a) shows consumption changes under reform 1. The earliest affected cohorts typically see a small increase in consumption in their final period, but for later cohorts the pattern reverses: average consumption over the life cycle is lower than in the old steady state. This decline is driven by the higher labor income tax. Panel (b) shows consumption changes under reform 2. Unlike panel (a), there is no clear late-life consumption increase for the first cohorts. Under this regime, younger households are slightly better off in terms of consumption because rents are lower and labor income is not taxed at a higher rate. Older households consume less on average than in the old steady state. In the counterfactual, they sell their homes slightly earlier and, with lower prices, realize smaller proceeds for consumption.

Examining the transition between steady states reveals dynamics that steady-state comparisons miss. While reform 1 appears to have only negative aggregate consumption effects in steady state, the transition shows that certain cohorts, especially those already retired, experience higher consumption for a period. Under reform 2, the financing choice shifts the incidence to home owners, which removes the late-life consumption gains observed under reform 1. Retired households do not increase consumption, while younger households consume more primarily because rents are lower and labor income is not taxed at a higher rate.

²⁰ A representation of the overlapping-generations dynamics during the transition is provided in Appendix A.1.3.

1.9 Conclusion

This paper examines unintended consequences of changes in the real estate transfer taxes. By integrating household-level data from the German Socio-Economic Panel (SOEP) with regional house price and rent data from [Ahlfeldt, Heblich and Seidel \(2023\)](#), I provide new insights into downsizing behavior of elderly households in Germany. Downsizing is interpreted as a form of adjustment in non-durable goods consumption. The analysis shows that increases in the real estate transfer tax discourage home owners from downsizing, even when controlling for local real estate market characteristics such as prices and vacancy rates. Given the scarcity of reliable data on durable consumption, particularly in Germany, I develop a quantitative life-cycle model with explicit housing decisions. The model successfully replicates the empirical observation that home ownership is relatively sticky. For a wide range of wealth, income, and age combinations, home owners rarely choose to transition to renting. Additionally, the model demonstrates that home owners consume more housing services, especially when adjusted for household equivalence.

The model evaluates how a 1 percentage point reduction in the real estate transfer tax affects macro aggregates and cohort-specific consumption under two alternative financing schemes. A steady-state comparison shows that house prices remain unchanged only if the government raises the labor income tax to balance its budget (reform 1). In this steady state, consumption is lower for all age groups and the home ownership rate declines. If instead the government introduces a property tax to supplement its budget (reform 2), house prices fall, consumption is broadly unchanged to slightly higher, and the home ownership rate decreases by less than under reform 1.

A transition analysis reveals important cohort dynamics that steady states alone miss. Under reform 1, house prices rise for one period and then return to the initial level. The only cohorts that experience consumption gains are those already retired, who are not affected by the higher labor tax. Under reform 2, house prices are depressed in the long run. During the transition, retired households do not gain, while younger households consume more because rents are lower and labor income is not taxed at a higher rate.

Overall, the results show that policies changing the transfer tax, and especially how the lost revenue is replaced, can have sizable and heterogeneous effects on consumption and home ownership across generations, even when the tax change is small.

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CHAPTER 1:
APPENDIX

A.1 Appendix

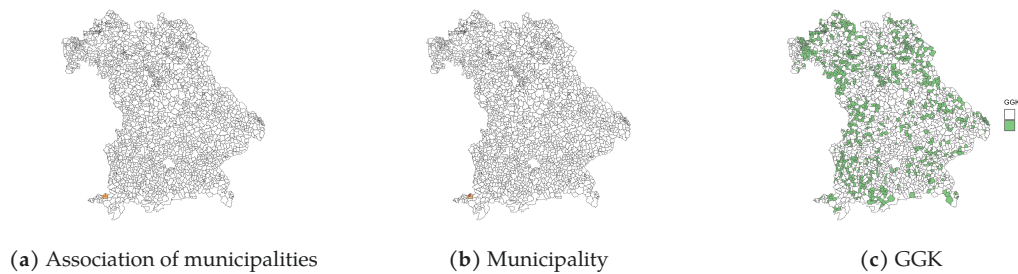
A.1.1 Data Definitions

Liquid assets are real financial assets and business assets. Illiquid assets are real estate, other assets, and tangible assets.

Matching Procedure

This section gives an example of a matching process for one municipality in Bavaria. The real estate data provides real estate prices and rents for associations of municipalities. Figure A.1.1a

Figure A.1.1 – Matching Example



shows Argental, one of the *Gemeindeverbände* in Bavaria. One of the municipalities of Argental is Gestratz, pictured in Figure A.1.1b in red. Gestratz is assigned Argental's overall real estate price. Gestratz had less than 2000 inhabitants in 2022 which means it is category one in the GGK scale. Figure A.1.1c shows all GGK 1 municipalities in Bavaria in green. This is the information that the SOEP provides. To assign each household a real estate price for their neighborhood, I calculate the average over all GGK 1 municipalities.

Summary Statistics by GGK

Table A.1.1 – Summary Statistics by GGK

GGK	Variable	Total	Home Owners	Renters
1	Age	57	59	52
	Education Completed (Years)	11.6	11.7	11.2
	Income (HH, net, monthly, €)	2,573	2,778	2,105
	Rooms	4.4	5	3.2
	HH size	2.2	2.2	1.8
7	Age	55	61	52
	Education Completed (Years)	12.5	13.4	12.2
	Income (HH, net, monthly, €)	2,767	3,708	2,424
	Rooms	3.1	4.2	2.6
	HH size	1.8	2.2	1.8

A.1.2 Empirical Results

Table A.1.2 – Model Summary - Additional Specifications

	Model 3	Model 4	Model 5
Age	−0.064 (0.135)	−0.065 (0.135)	−0.066 (0.135)
Age ²	0.0004 (0.001)	0.0004 (0.001)	0.0004 (0.001)
Children	0.084** (0.042)	0.083** (0.042)	0.083* (0.042)
Education Completed (years)	0.025 (0.023)	0.026 (0.023)	0.026 (0.023)
Health Status	0.165*** (0.063)	0.166*** (0.063)	0.166*** (0.063)
Household Size	0.099 (0.098)	0.098 (0.098)	0.098 (0.098)
Home Owner	−1.730** (0.761)	−1.474** (0.733)	−0.266 (0.736)
ΔRETT	0.151 (0.165)	0.153 (0.165)	0.165 (0.165)
ΔRETT*Home Owner	−0.521** (0.243)	−0.530** (0.243)	−0.563** (0.242)
Net Income (log)	−0.060 (0.125)	−0.059 (0.124)	−0.058 (0.124)
Marital Status:Single	0.304 (0.274)	0.301 (0.275)	0.302 (0.275)
Marital Status:Widowed	0.662*** (0.169)	0.662*** (0.169)	0.662*** (0.169)
Marital Status:Divorced	0.550*** (0.174)	0.545*** (0.174)	0.543*** (0.174)
Marital Status:Separated	0.776*** (0.278)	0.777*** (0.278)	0.777*** (0.278)
Unemployment Rate (State Level)	0.025 (0.064)	0.028 (0.064)	0.040 (0.065)
Rooms first Obs.	0.063*** (0.016)	0.063*** (0.016)	0.063*** (0.016)
SM price (GGK)		−0.131 (0.474)	−0.148 (0.476)
Rent (GGK)	0.431 (0.700)	0.192 (0.878)	0.505 (0.787)
Vacancy Rate (GGK)	0.443 (0.512)	0.359 (0.559)	0.438 (0.529)
SM Price (National)*Home Owner	1.074* (0.632)		
Rent (GGK)*Home Owner		0.886 (0.634)	
Vacancy Rate (2010)*Home Owner			−0.230 (0.797)
Constant	−3.805 (4.849)	−3.406 (4.883)	−3.868 (4.837)
Observations	61,617	61,617	61,617
# Downsized	624	624	624
Fixed Effects	Year + County*GGK	Year + County*GGK	Year + County*GGK
Log Likelihood	−3,272.480	−3,274.508	−3,276.371
Akaike Inf. Crit.	6,640.960	6,647.016	6,650.743
pseudo R ²	0.035	0.0347	0.0343

Notes: *p<0.1; **p<0.05; ***p<0.01 All models estimates the probability of downsizing next year on a subsample of the SOEP where household heads are between 55 and 85 years old in the years 2006-2020.

In Model 3 where the specification includes national square-meter prices, I cannot include the sole coefficient, since it would be absorbed in the fixed effects and the interaction with home ownership is only significantly different from zero using a 90% confidence interval. The interac-

tion between home ownership and rents (model 4) and vacancy rates (model 5) have no effect that is statistically different from zero. This indicates that only current local real estate prices play a role in the decision to downsize for home owners, while other aspects of the real estate market, such as rents or vacancy rates, seem to play no significant role.

Table A.1.3 – Average Marginal Effects

	Model 1	Model 2
Age	−0.0007 (0.0013)	−0.0006 (0.0013)
Age ²	0.000 (0.000)	0.000 (0.000)
Children	0.0008* (0.0004)	0.0007* (0.0004)
Education Completed (years)	0.0003 (0.0002)	0.0003 (0.0002)
Health Status	0.0016*** (0.0006)	0.0017*** (0.0006)
Household Size	0.0011 (0.001)	0.0011 (0.001)
Home Owner	−0.0056*** (0.0013)	−0.0143*** (0.0050)
ΔRETT	0.0018 (0.0016)	0.0015 (0.0016)
ΔRETT*Home Owner	−0.0054** (0.0025)	−0.0051** (0.0025)
Net Income (log)	−0.0005 (0.0012)	−0.0004 (0.0012)
Marital Status:Single	0.0024 (0.0025)	0.0026 (0.0026)
Marital Status:Widowed	0.006*** (0.0018)	0.007*** (0.0019)
Marital Status:Divorced	0.0047*** (0.0018)	0.0053*** (0.0018)
Marital Status:Separated	0.009*** (0.0041)	0.009*** (0.0041)
SM price (GGK)		0.004 (0.0063)
Rent (GGK)		0.0014 (0.009)
Vacancy Rate (GGK)		0.0034 (0.0062)
SM Price(GGK)*Home Owner		0.0074* (0.0038)

Notes: *p<0.1; **p<0.05; ***p<0.01

A.1.3 Model

Households with Property Tax

This section shows the optimization problem of a household prior to receiving an inheritance, as in section 1.6.8, with the only exception that home owners pay a per period property tax $\tau_{property}$.

$$V_{pI}(a, h, z, t) = \max_{c, s, a', h'} \left(u(c, s) + \beta \left[(1 - \pi_I) \mathbb{E}[V_{pI}(a', h', z', t + 1)] + \pi_I \mathbb{E}[V_I(a', h', z', t + 1)] \right] \right)$$

$$a' + (1 + \mathbb{1}_{h \neq h'} \tau_h) h' p' = w(z, t)(1 - \tau_l) + (1 + r)a + (1 - \delta - \tau_{property})hp - c - (\mathbb{1}_{h=0} * l)s$$

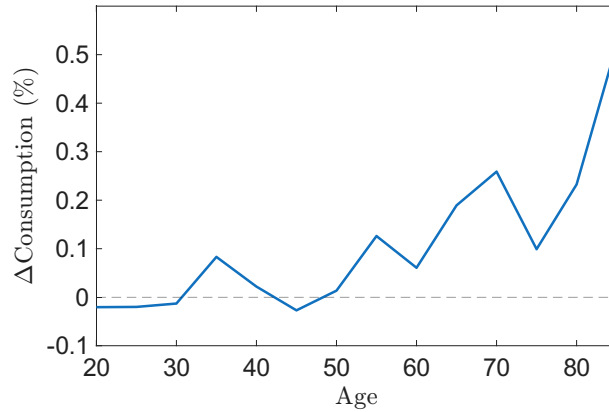
$$a \begin{cases} \geq a_{min}, & \text{if } h' > 0 \\ \geq 0, & \text{otherwise} \end{cases}$$

$$s \begin{cases} = \nu h, & \text{if } h > 0 \\ > 0, & \text{otherwise} \end{cases}$$

Real Estate Transfer Tax without Balanced Budget

This subsection provides some intuition of how strong the general equilibrium effect is in this model. Without adjusting the flat tax on labor income, the change in consumption is very different from what was shown in Figure 1.16 in the general equilibrium scenario.

Figure A.1.2 – Change in non-durable consumption



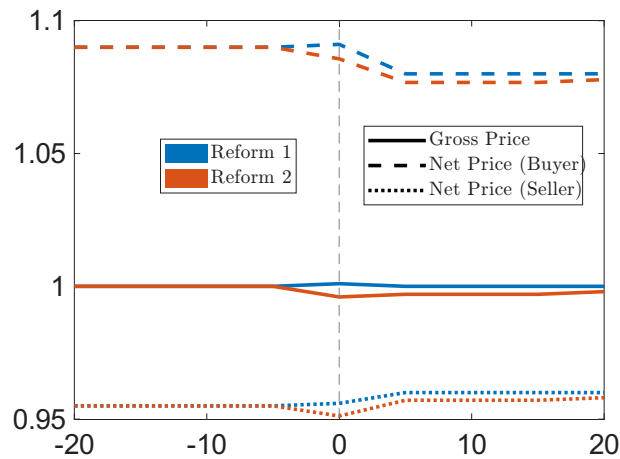
Note: Change in consumption from benchmark case to counterfactual without budget clearing.

The drop in consumption in earlier years persists, while at later stages of the life cycle, consumption increases in this scenario.

Transitions

Transaction tax rates for sellers and buyers are different and are added on top of the net price. Figure A.1.3 shows the buyers and sellers gross price, including the transaction tax.

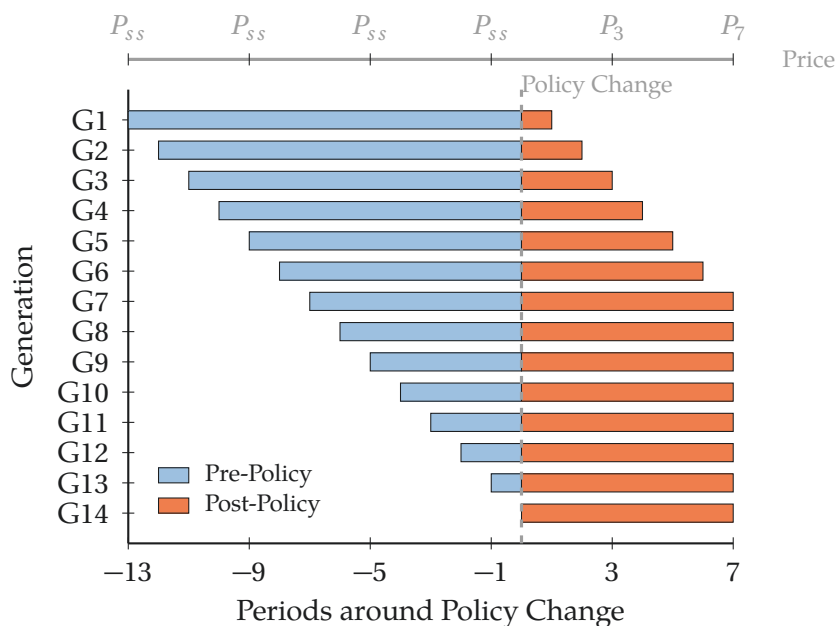
Figure A.1.3 – Prices in Transition



Note: Year 0 is the year of the policy change.

Figure A.1.4 illustrates how different generations are affected by the policy change. While $G1$ is only affected in their last period, $G14$ is never in the *Pre-Policy* era. At the top, we can also see the price evolution while P_{ss} is the old steady state price ($p = 1$), the price differs after the policy change.

Figure A.1.4 – Overlapping Generations in Transition



Even though $G14$ already internalizes the new tax from the beginning, they are not in the new steady state. This is due to the overlapping generations dynamics of the model. There are still 13 other generations whose actions change house prices and bequests. Only once house prices

have converged back to the new steady state price does the behavior of that particular generation resemble the new steady state behavior.

Chapter 2

Heterogeneous Risk Preferences, Entrepreneurship, and Wealth*

with Brigitte Hochmuth and Monika Merz

Abstract

This paper studies how individual risk attitudes shape occupational choice and wealth accumulation. Using self-reported individual risk preferences from the German Socioeconomic Panel (GSOEP), we estimate that a one-unit increase in risk tolerance raises the probability of a worker transitioning to self-employment by 10 percent. We develop a life-cycle model of occupational choice with Epstein-Zin preferences and heterogeneous risk attitudes to examine how risk aversion interacts with entrepreneurial ability and wealth in determining entry into self-employment, the survival probability upon entry, and its aggregate implications. Counterfactual simulations show that increasing business risk reduces entry but improves selection based on entrepreneurial skills. In contrast, Germany's "1-Euro GmbH" reform of 2008 weakened the role of risk tolerance for entry and increased participation by risk-averse individuals without compromising the mean entrepreneurial skill.

JEL Classification: E21, E24, J24

Keywords: recursive utility, individual risk preferences, occupational choice, business risk, limited liability

*Funding from the OeNB Jubiläumsfonds (grant number 18885) is gratefully acknowledged.

2.1 Introduction

What drives individuals to become entrepreneurs rather than wage workers, and how do risk preferences shape this choice? Although entrepreneurs represent only a small share of the population, they play a crucial role in the economy: they create jobs, drive innovation, and accumulate wealth, especially during the first few years following the launch of a successful business.¹ Transitions to self-employment are therefore not only key to understanding individual occupational choice but also central to explaining aggregate patterns including wealth accumulation and inequality.² Willingness to bear risk lies at the heart of entrepreneurship, but this willingness is unequally distributed across individuals. According to Metzger (2015), evidence from the *Entrepreneurship Monitor* of the Kreditanstalt für Wiederaufbau, Germany's main business development bank, reveals that "...the lack of willingness to accept financial risk is the highest hurdle facing budding entrepreneurs," ahead of financing constraints or regulatory red tape.³ Yet despite the likely importance of risk attitudes for occupational sorting, the survival probability of new enterprises, and wealth accumulation, they remain underexplored in quantitative macroeconomic analysis.⁴

Against this background, we address the following questions: How does an individual's risk attitude affect their occupational choice, and what role do other determinants, such as available assets or entrepreneurial skills, play? Does risk aversion deter able and potentially successful individuals from pursuing entrepreneurship, even if they possess sufficient financial means? Our analysis explicitly focuses on the heterogeneity of risk preferences across individuals, which we measure using survey data. We then examine how this heterogeneity shapes the sorting into self-employment, the survival probability of newly self-employed, and the resulting patterns of wealth accumulation and distribution.

We focus our analysis on Germany due to the availability of high-quality survey data from the German Socio-Economic Panel (GSOEP), which includes rich information on individual wealth and self-reported risk attitudes. Additionally, entrepreneurs play a significant role in the wealth distribution. The GSOEP is a longitudinal household survey tracking approximately 30,000 individuals annually since 1984, providing detailed data on labor market status, income sources, asset holdings, and risk attitudes (see Section 2.3 for details). Research by Dohmen, Falk, Huffman, Sunde, Schupp and Wagner (2011) has validated these risk attitude measures as reliable proxies for actual risk preferences. Germany is particularly well-suited for studying the link between risk preferences and entrepreneurship, as wealth is highly concentrated and entrepreneurship plays a key role in wealth accumulation. From 1998 to 2019, self-employed household heads

¹Haltiwanger, Jarmin and Miranda (2013) and Alon, Berger, Dent and Pugsley (2018) show for the U.S. that a firm's *age*, rather than its size, matters for its growth in productivity and employment, and that young firms matter most.

²This paper uses the terms entrepreneur, self-employed, and business owner interchangeably.

³The KfW Entrepreneurship Monitor is a representative telephone survey on entrepreneurial activity in Germany, which has been conducted annually since the year 2000 from August through December among the adult population. It is a sequence of cross-sections with information provided by 50,000 individuals randomly selected annually from Germany.

⁴Boar, Gorea and Midrigan (2025) emphasize the importance of uninsurable business risk for entrepreneurs and the macroeconomy, but they remain silent about the role of individuals' risk attitude.

accounted for just 9% of the workforce and 7% of the working-age population, but held over 30% of total wealth, with a median net wealth three times that of employed household heads.⁵ Entrepreneurs are significantly overrepresented at the top of the wealth distribution. These patterns highlight the importance of understanding who becomes an entrepreneur, what drives this choice, and how it contributes to wealth inequality.

We make three main contributions to the literature on entrepreneurship and wealth. First, by focusing on transitions to self-employment and measuring individual risk attitudes and wealth *prior* to a potential transition, we address endogeneity issues regarding wealth and generate reliable estimates of the effects of risk attitudes, ability differentials, and wealth on occupational choices. Second, we embed empirically validated heterogeneous risk attitudes in a binary occupational choice model with Epstein-Zin preferences. This allows us to disentangle risk aversion from the elasticity of intertemporal substitution (IES), a distinction that is crucial for isolating the role of risk attitudes, independent of intertemporal smoothing, in shaping occupational choice, the survival probability of new enterprises, and wealth accumulation. Our results are consistent with insights gained from the portfolio choice literature in macro / finance that studies how asset allocations over households' life-cycle vary with the shape of the distribution of risk preferences across agents.⁶ Third, we use the model to conduct counterfactual policy experiments, quantifying how changes in the risk environment, such as business risk or limited liability, affect not only the self-employment rate but also the composition of entrepreneurs and the distribution of wealth.

Our analysis combines an empirical investigation with a structural model to understand how individual risk preferences determine entrepreneurial decisions and wealth accumulation. In the empirical part, we use the GSOEP to investigate the links between individual risk attitudes, self-employment, and wealth accumulation. Departing from the observation that future self-employed individuals exhibit greater risk tolerance than salaried workers, we estimate a fixed-effects logit model that accounts for key confounding factors, including individual wealth, education, age, nationality, and labor market success. The AME for willingness to take risks suggests that for each unit increase in willingness to take risks, the probability of transitioning to self-employment increases by 0.15 pp for employed and by 2.94 pp for unemployed. Heterogeneity in risk preferences matters because it helps explain who enters and exits entrepreneurship.

To better understand the underlying mechanisms - and, in particular, which other factors can compensate for high risk aversion in the decision to become self-employed - we turn to a structural life-cycle model of occupational choice. Building on the framework of [Quadrini \(2000\)](#) and [Cagetti and De Nardi \(2006\)](#), we introduce [Epstein and Zin \(1989\)](#) preferences and incorporate empirically observed heterogeneity in risk attitudes from the GSOEP. We maintain capital as the only variable input into entrepreneurs' production function. That's mainly because we know

⁵Data source: GSOEP waves 2002, 2007, 2012, and 2017.

⁶See, e.g., [Coen-Pirani \(2004\)](#), or [Gomes and Michaelides \(2005\)](#). The latter authors demonstrate that, with a fixed cost of participating in the stock market, risk-averse agents are more likely to hold stocks, albeit to a lesser extent than risk-prone agents. Our work differs from theirs primarily in that we focus on how an individual's wealth interacts with her risk attitude when making an occupational choice, and our distribution of risk preferences is empirically grounded.

from the evidence provided by [Bonin, Krause-Pilatus, Rinne, Koch and Nenzel \(2022\)](#) that in Germany, ca. 70% of all startups are launched by self-employed without employees.⁷ The model captures how individuals with different preferences sort into entrepreneurship, conditional on their skill levels and asset positions, and how these choices shape aggregate wealth outcomes.⁸ In our model, risk-averse individuals face a higher utility cost associated with income uncertainty and, therefore, require either greater ability or more wealth to justify starting a business. Assets serve both as a consumption buffer and as collateral for productive investment. As a result, self-employment is more attractive for individuals who are either less risk-averse, more talented, or have accumulated sufficient wealth to self-insure against entrepreneurial risk. In our model, less risk-averse entrepreneurs run larger businesses, stay in business longer, and accumulate more wealth. The interaction between heterogeneous risk preferences, entrepreneurial ability, and financial constraints gives rise to selection along both the risk and skill dimensions, consistent with key features of the SOEP data: risk-prone individuals are overrepresented among entrepreneurs and stay in business longer than others; entrepreneurs are disproportionately concentrated at the top of the wealth distribution; and aggregate wealth inequality declines as the average level of risk aversion increases.

To quantify the policy relevance of this mechanism, we conduct two counterfactual experiments that illustrate how institutions and business risk affect entry into self-employment, the composition of entrepreneurs, and wealth. First, we increase the risk associated with entrepreneurship by varying the probability of going out of business. In this scenario, the overall self-employment rate declines, but the one-year survival rate of new businesses increases. The composition of entrepreneurs shifts toward individuals with lower risk aversion and higher ability, as more risk-averse or marginally qualified individuals are discouraged from entering. This highlights how heterogeneous risk preferences shape not only the extensive margin (i.e., the number of people entering entrepreneurship) but also the duration of entrepreneurship. Second, we examine a policy that reduces entry risk: the 2008 German "1-Euro GmbH" reform, which lowered capital requirements for incorporating a limited liability company. Empirically, we show that this reform weakens the magnitude of the effect of risk tolerance for entry by approximately 50 percent as it mitigates the downside risk associated with business failure. More risk-averse individuals are thus more willing to become entrepreneurs, expanding the pool of entrepreneurs without significantly lowering its average ability level. This demonstrates that policy can alter the selection margin by mitigating the deterring effect of risk aversion.

Our results show why modeling heterogeneous risk attitudes with Epstein-Zin preferences is essential for understanding entrepreneurial selection and wealth accumulation. By capturing how risk preferences interact with financial constraints and institutional settings, the model highlights how policies that reduce personal financial risk, such as limited liability provisions, can broaden access to entrepreneurship by enabling more risk-averse but capable individuals to en-

⁷The SOEP does not allow us to identify self-employed with or without employees.

⁸Epstein-Zin preferences formulate agents' indirect utility as a non-linear functional equation, thereby enabling us to meaningfully study the interaction between risk attitude and future expected uncertainty for individual choices. We maintain a constant intertemporal substitution elasticity that is identical for all agents.

ter without lowering the average quality of entrants.

The remaining paper is structured as follows. Section 2.2 connects our work to the existing literature. Section 2.3 explains the data and provides descriptive statistics. In Section 2.4 we illustrate and discuss our empirical results. Section 2.5 contains the formal model. Section 2.6 presents simulation results, and Section 2.7 reports the outcome of two counterfactual exercises. Section 3.5 concludes.

2.2 Related Literature

This paper bridges two main strands of the literature: an empirical literature on economic determinants of an individual's choice to enter self-employment, and a model-based one in quantitative macroeconomics on entrepreneurship and wealth.

On the empirical side, our work relates to the numerous studies of economic determinants of entrepreneurship and associated decisions that comprise micro-econometric as well as experimental investigations. They investigate either the selection into entrepreneurship or what determines entrepreneurs' decisions to expand or reduce an existing business. Although commonly viewed as crucial for self-employment, this literature has paid limited attention only to the role of individual risk attitude for starting or maintaining one's business. Noteworthy exceptions are [Cramer, Hartog, Jonker and Van Praag \(2002\)](#)'s study of the occupational choices of former school children in the Dutch province of Noord-Brabant and how their risk attitude and financial situation affected these choices, [Andersen, Di Girolamo, Harrison and Lau \(2014\)](#)'s field experiment on potential and actual small business entrepreneurs in Denmark, or [Hincapié \(2020\)](#)'s study of U.S. American men's occupational choice and how it relates to their risk attitude, or their expected business success. This literature has focused instead on the role of available assets for alleviating liquidity constraints ([Evans and Jovanovic \(1989\)](#), [Blanchflower and Oswald \(1998\)](#), and [Hurst and Lusardi \(2004\)](#)), or (potential) entrepreneurs' age or expected productivity ([Evans and Leighton \(1989\)](#)) as relevant variables. We add to this literature by exploiting unique information from the German SOEP on individuals' risk attitudes, accumulated wealth, and other characteristics relevant to entrepreneurship. Firstly, we use self-reported evidence on individual risk attitudes that [Dohmen et al. \(2011\)](#) corroborated as a reliable proxy for the unobserved true risk attitude for estimating the link between individual risk aversion and selection into (self-) employment.⁹ Secondly, to avoid timing and endogeneity issues, we exploit the panel structure of the SOEP, measure all variables within a narrow time frame, and thereby ensure that potential determinants of self-employment are taken *prior* to an individual's occupational choice.¹⁰

The quantitative macro literature on entrepreneurship and liquidity constraints, pioneered by

⁹[Dohmen et al. \(2011\)](#) carry out a controlled field experiment using a paid lottery on a small sample that closely resembles the one underlying the SOEP, thereby addressing concerns regarding the validity of responses based on hypothetical lottery questions. See, e.g., [Holt and Laury \(2002\)](#) on the hypothetical bias when eliciting risk attitudes.

¹⁰Our panel allows us to measure an individual's risk attitude at various points in time. Following [Schildberg-Hörisch \(2018\)](#), who discusses the stability of alternative risk measures across time, we check our measures for internal consistency and stability in Appendix A.2.2.

Evans and Jovanovic (1989), includes applications to development and growth (Banerjee and Newman (1993), Lloyd-Ellis and Bernhardt (2000)), wealth inequality (Quadrini (1999, 2000), Cagetti and De Nardi (2006), Tan (2022)), (potential) entrepreneurs' financing decisions (Herranz, Krasa and Villamil (2015), and Peter (2025)), or human capital accumulation considerations as a way to hedge against the risk involved Indraccolo and Piosik (2023). Models in this literature treat wage employment as tantamount to stable income and safe investment opportunities, and self-employment as synonymous with risky investment opportunities and variable income. Moreover, they typically use a time-additive expected utility setting, which mechanically restricts the coefficient of relative risk aversion to equal the inverse of the elasticity of intertemporal substitution (EIS). Except for Herranz, Krasa and Villamil (2015), they abstract from preference heterogeneity.

We add to this literature by studying how heterogeneous risk preferences impact individuals' selection into entrepreneurship and the resulting composition of entrepreneurs by wealth, ability, and risk aversion. We do so by implementing Epstein-Zin preferences in a binary occupational choice model. We allow for measurable heterogeneous risk preferences across agents, but maintain a constant, identical intertemporal substitution elasticity. We also assess how selection into entrepreneurship and its composition change when the business environment becomes riskier, or when potential entrepreneurs can limit their personal liability and, thus, reduce operational risk.

2.3 Data

We base our empirical analysis mainly on the German Socio-economic Panel (GSOEP). The GSOEP is a representative panel that interviews approximately 30,000 individuals and 15,000 households at an annual frequency and contains various socio-demographic characteristics as well as information on employment spells and different types of income. The GSOEP is especially suitable for our purpose since it reports self-reported individual risk attitudes at an annual frequency since 2008 and also at a quinquennial frequency since 2002, as well as information on a household's level and composition of wealth. Self-reported individual risk attitudes are a reliable proxy for an individual's actual risk preference, and measured wealth can be indicative of whether or not a potential entrepreneur is financially constrained before deciding about self-employment. Our sample covers the waves from 2000 to 2020. It includes all working-age household heads and their partners, i.e., those between 18 and 64 years old who live and work in Germany. Apart from an individual's risk attitude and accumulated wealth, our sample also contains information on individual characteristics, e.g., age, education completed, marital status, and nationality, as well as information about employment status, e.g., tenure at last employer. This leaves us with an unbalanced sample of 415,310 observations on 75,953 individuals.¹¹

¹¹As wealth information is available for the years 2002, 2007, 2012, and 2017 only, we impute data on wealth holdings between these waves to preserve the panel structure of the model. See Appendix A.2.5 for details regarding the wealth imputation procedure.

2.3.1 Summary Statistics

Table 2.1 presents a comprehensive summary of key individual characteristics, categorized by employment status. Within our sample, we distinguish between the stock of self-employed individuals and those who moved into self-employment during our sample period. We refer to the latter group as ‘founders’ and to the others as established entrepreneurs. We further subdivide founders into those who transitioned from salaried employment (Founder (E)) and those who were previously not employed (Founder (U)).^{12, 13} These two groups may systematically differ in their (unobserved) motivation for becoming self-employed. [Akcigit, Alp, Pearce and Prato \(2025\)](#) distinguish between transformative and subsistence entrepreneurs. While the former aim to grow their business over time and contribute to technological progress, the latter are driven by the need to make a living. Although we do not expect there to be a one-to-one mapping between their categories and ours, the overlap could be significant.

As highlighted in Table 2.1, established entrepreneurs possess on average over three times more net wealth than the general population. Moreover, their net liquid asset ratio is almost 40%, indicating that their businesses contribute to over one-third of their total wealth.¹⁴

Table 2.1 – Summary Statistics

Variable	Total sample	Employed	Self-employed	Founder
Share in sample	1.00	0.87	0.05	0.08
Age [y]	45.91 (11.63)	45.83 (11.79)	49.12 (9.93)	44.89 (10.58)
Education completed [y]	12.32 (2.66)	12.17 (2.59)	13.34 (2.88)	13.24 (2.86)
Monthly net income [€]	1,715 (2,421)	1,673 (1,087)	2,390 (9,278)	1,720 (1,890)
Mean net wealth [€]	141,731 (467,149)	118,157 (258,723)	470,258 (1,560,954)	194,251 (640,355)
Median net wealth [€]	28,795	24,717	170,592	37,744
Net liquid assets [f]	0.18	0.11	0.37	0.32

Notes: All variables relate to individuals in our sample. Self-employed represents the stock of self-employed who did not transition to self-employment during our sample period. Founders are entrepreneurs who transition to self-employment at least once in our sample. Income and wealth denoted in real (2015=100) €. [y] denotes years, [f] indicates fractions. Values in parentheses are standard deviations.

Table 2.2 provides a comprehensive analysis of the wealth distribution in Germany, with a particular emphasis on the subset of the self-employed. Examining this subsection unveils a notable over-representation of self-employed individuals within the upper percentiles of the wealth distribution. Specifically, within the top 5% of the wealth distribution, entrepreneurs account for 22% of the population. This contrasts starkly with the broader demographic, where the average

¹²It is important to note that the terms unemployment and non-employment are used synonymously in this context. The Socio-Economic Panel (SOEP) classifies individuals as employed, self-employed, or neither, without further differentiation within non-employment statuses.

¹³Figures A.2.2 and A.2.3 in Appendix A.2.1 depict the distribution of all self-employed and solo self-employed across the five most common one-digit occupation categories.

¹⁴Liquid assets include financial and business assets. Illiquid assets are real estate, tangible, and other assets.

prevalence of entrepreneurs in the German working-age population over the entire period of observation stands at 7.2%.

Table 2.2 – Wealth Distribution in Germany

	Wealth Percentile, Top			
	1%	5%	10%	20%
Overall Population				
Share Wealth	18%	39%	54%	74%
Self-employed				
Share of self-employed in percentile	36%	22%	16%	11%
Share of total net wealth in percentile	41%	29%	24%	19%

Notes: Figures are computed including individuals above the age of 65 to ensure comparability with other data sources. The share of self-employed in the percentile indicates the fraction of self-employed in each of the top percentiles. For details on the computation of wealth, see Figure 2.1.

2.3.2 Transitions to Self-Employment and Survival Probability

Figure 2.1 illustrates the annual transition rates to self-employment from employment and unemployment within our sample.¹⁵ The transitions out of employment are notably higher than those out of unemployment. Moreover, this figure shows that transitioning to self-employment is a rare event. On average, less than 1% of the working-age population undertakes the step to self-employment each year.¹⁶

Figure 2.2 depicts the average survival rate of founders in our sample. This rate indicates the proportion of founders who maintain their self-employment status over a given time period. It reflects the notion that self-employment is associated with a high risk of business failure. The survival rate of newly self-employed is around 60% after one year. After five years, this rate is down to below 40%.

2.3.3 Risk Measurement

Key to our work are measures of risk attitudes that have been available in the SOEP since the 2004 wave. To determine an individual's willingness to take risks, we use a survey question that deals with attitudes towards risk in general.¹⁷ The question asked in the GSOEP is:

Are you generally a person who is willing to take risks or do you try to avoid taking risks?

Respondents indicate their general willingness to take risks on an 11-point scale ranging from 0 (complete unwillingness) to 10 (complete willingness). We calculate each participant's average risk attitude across time and attribute this time-average to the individual for every year in our

¹⁵Figure A.2.4 in Appendix A.2.2 also reports the age distribution of founders.

¹⁶Figure A.2.1 in Appendix A.2.1 depicts the stock of self-employed over time, documenting a declining trend since around 2012.

¹⁷We have experimented with alternative questions on the willingness to take financial risks, but our results remained essentially unchanged. However, the sample size decreases considerably.

Figure 2.1 – Distribution of Founders by Year



Notes: The percentage refers to founders in our sample population. They transition either from employment or from unemployment.

dataset.¹⁸ By doing so, we can significantly increase the number of observed transitions, since this question was only posed in 2004, and 2006, and at a yearly frequency starting in 2008.¹⁹ In this section, we directly compare the self-reported willingness to take risks for individuals of different employment states; in our empirical analysis, we also account for household net wealth. Table 2.3 presents statistical moments of the distribution of the willingness to take risks by employment status. The moments for the continuously self-employed and founders are quite similar and uniformly exceed those associated with the group of salaried employees.

Table 2.3 – Willingness to Take Risks by Employment Status

Moment	Total Sample	Employed	Self-Employed	Founder
1st Quantile	3.27	3.20	4.00	3.91
Mean	4.59	4.49	5.35	5.17
Median	4.60	4.50	5.44	5.20
3rd Quantile	5.89	5.75	6.87	6.50
Standard Deviation	1.84	1.81	1.98	1.82

Notes: Self-Employed represents the stock of self-employed who did not transition to self-employment in our sample period. Founders are entrepreneurs who transition to self-employment.

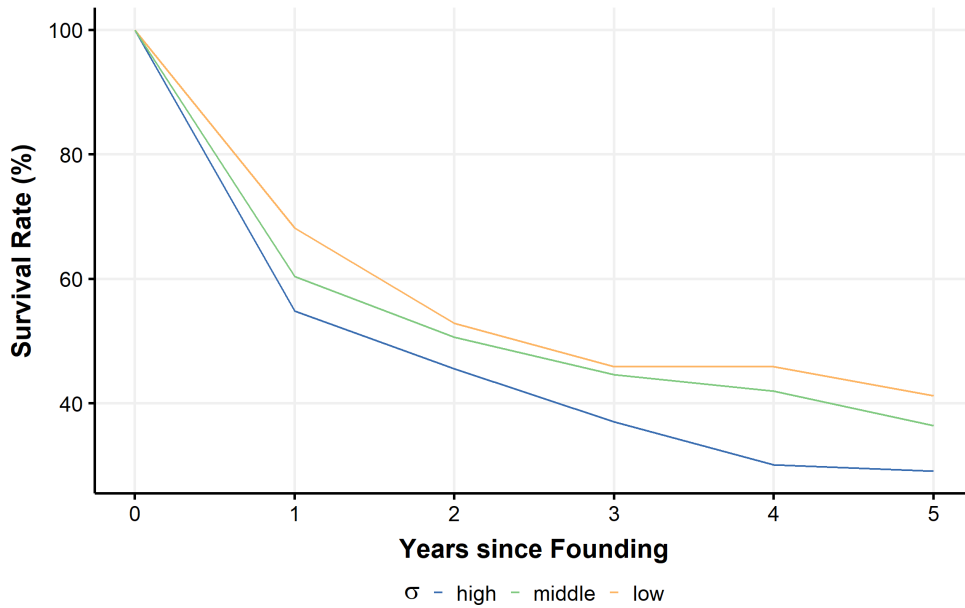
Figure 2.3 illustrates the distribution of the willingness to take risks by worker types.²⁰ While the

¹⁸For instance, if a participant is present in our dataset from 2000 to 2020 and recorded a willingness to take a risk of 8 in 2004 and 2006, but 7 from 2008 to 2020, their average willingness to take a risk is computed as 7.13. This average score is then applied to all the years from 2000 to 2020 for that individual.

¹⁹In model (4) and (7) of our empirical specifications we only consider transitions for which we observe the willingness to take risks in the preceding year. The results stay qualitatively the same.

²⁰Figure 2.3 depicts spikes around whole numbers, as a large number of SOEP participants do not alter their

Figure 2.2 – Survival Rate of Newly Self-Employed by Risk Aversion



Notes: The percentage refers to the share of founders who are still self-employed after a certain number of years. Underlying this figure are all individuals who are older than 18 years to ensure that we do not under-report the survival rate of older founders. We also only consider individuals who are still in the SOEP 5 years after founding.

distribution for salaried workers appears to be right-skewed, the distributions for those workers who eventually become self-employed are left-skewed. The dashed vertical lines with the corresponding 95% confidence intervals indicate that individuals who become self-employed at some point in our sample are on average more willing to take risks than those who remain workers. We map the empirical distribution of ordinal risk preferences from the SOEP to CRRA coefficients by discretizing the data into three risk types and assigning each group a corresponding σ_i based on the method of [Dohmen et al. \(2011\)](#). This procedure allows us to incorporate observed heterogeneity in risk attitudes directly into the model, as further detailed in Section 2.5.3 and Appendix A.2.8.

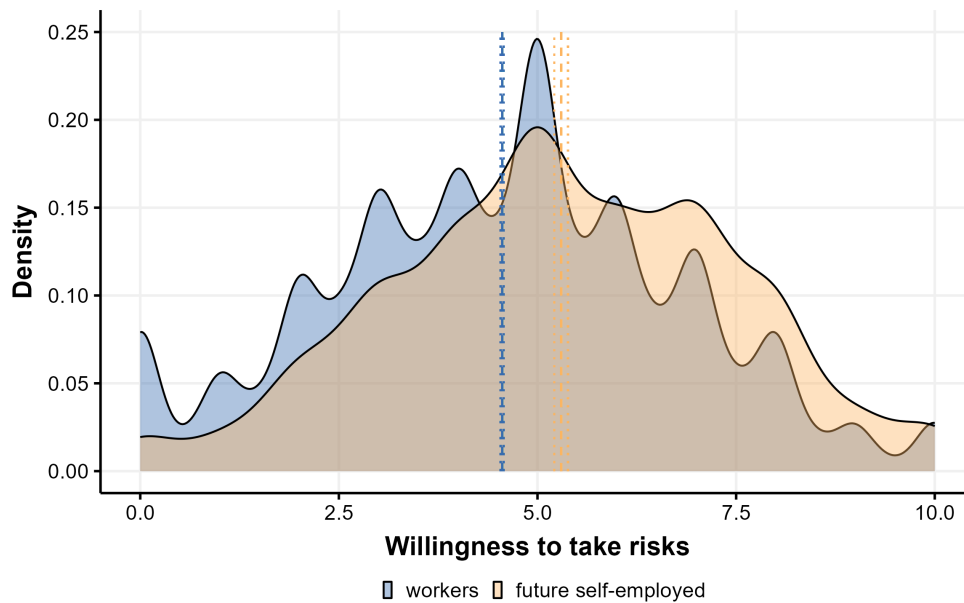
2.3.4 Success in the Labor Market (LMS)

One dimension that should influence the decision to become self-employed is how successful an individual is in the labor market. Therefore, we compute year-cohort-specific gross income distributions and assign each individual their rank in the distribution.²¹ This rank indicates how successful that individual is compared to their cohort. We expect that if the individual has a low rank, they are more likely to try self-employment.

responses.

²¹For the unemployed, we impute the LMS with the last known value.

Figure 2.3 – Distribution of Willingness to Take Risks by Worker Type



Notes: The dashed vertical lines surrounded by the 95% confidence bands represent the means of the distributions.

2.3.5 Wealth and Selection into Self-Employment

Investigating what determines the transition to self-employment is crucial, particularly in light of evidence showing that established entrepreneurs typically possess larger wealth holdings compared to non-entrepreneurs (see Table 2.1). By focusing on new entrepreneurs within our panel data structure, we gain valuable insights into the wealth accumulation process that occurs following their transition to self-employment.²²

Since the SOEP reports wealth data at a quinquennial frequency only, we focus on three founding cohorts. This allows us to observe their wealth one year *prior* to transitioning and at least once following the transition to self-employment.

Table 2.4 illustrates the development of all founders' net wealth holdings over the four SOEP waves that contain detailed wealth information regardless of how long those founders remain in business. Regarding the group who founded in 2003, we observe that 15 years later, only roughly 15% continue to be self-employed. Especially surviving entrepreneurs managed to increase the average net wealth significantly (see Table A.2.1 in Appendix A.2.2), a fact that underlines the view that successful entrepreneurship is essential for significant wealth accumulation in an economy.

2.4 Estimation Results

The aim of our empirical analysis is to identify the role of risk attitudes in individuals' decisions to become self-employed in Germany between 2000 and 2020. To this end, we employ a

²²We define *new* entrepreneurs as those who recently became self-employed.

Table 2.4 – All Founders' Net Wealth

Founded in	Year	Population	Mean	Median	Standard Deviation
2003	2002	140	185,194	35,819	699,725
	2007	91	543,193	178,904	886,970
	2012	46	797,316	181,897	1,352,617
	2017	21	1,239,902	356,617	1,370,570
2008	2007	118	188,622	43,815	353,523
	2012	85	161,765	64,853	230,406
	2017	51	406,989	329,353	420,965
2013	2012	183	153,228	28,358	327,416
	2017	126	481,098	124,378	441,865

Notes: Wealth is denoted in real €(2015=100). Similar to Figure 2.2 reported values relate to all founders at any age. The information is aggregated for both types of founders. Population refers to the number of founders who are still self-employed in the indicated year.

fixed-effects logit model to estimate the determinants of transitions to self-employment. We are especially interested in the qualitative and quantitative effect of an individual's risk attitude on the likelihood of transitioning to self-employment. We estimate the following empirical specification:

$$\text{logit}(p_{i,t}) = \log\left(\frac{p_{i,t}}{1-p_{i,t}}\right) = \beta_0 + \beta_1 X_{i,t} + \delta_t + \delta_{\text{sector}} + \varepsilon_{i,t} \quad (2.1)$$

where $p_{i,t}$ is the probability of an individual i transitioning to self-employment in period t , β_0 is the intercept, $X_{i,t}$ is a vector of explanatory variables (e.g. education, income, net wealth, risk attitude), and δ_t and δ_{sector} are time and sector fixed effects.²³

Table 2.6 presents the summary statistics for our logit models. Models 1 through 4 focus on the transitions from employment to self-employment. Models 5 through 7 analyze the transitions from unemployment to self-employment. We observe 1,087 transitions to self-employment that originate from employment and 316 that originate from unemployment.

Models 1 and 5 serve as our benchmark specifications. At this stage, the coefficients of the Logit models are not directly interpretable. However, we note that, aside from the willingness to take risks, the determinants for transitioning to self-employment vary significantly between individuals previously employed and those unemployed.

In Models 2 and 3, we introduce interactions between the willingness to take risks and the education level (Model 2), or Labor Market Success, LMS (Model 3). With the help of these interactions, we aim to investigate potential synergies, such as whether a combination of high risk-taking propensity and education, or risk-taking propensity and LMS influences the likelihood of transitioning to self-employment. However, none of these interaction terms are statistically significant. Furthermore, our results remain robust when restricting the sample to individuals

²³See Figure A.2.6 in Appendix A.2.2 for an overview in which sector self-employed are active.

who transition to self-employment only once ($N = 859$); see Appendix A.2.7 for details.

Caliendo, Fossen and Kritikos (2009) emphasize the importance of using the willingness to take risks in the year preceding the transition to self-employment. They argue that because entrepreneurs face greater risk, their risk perception shifts after they become self-employed. In our benchmark specification, we use the average willingness to take a risk for each participant, which raises the number of transitions observed by at least 40%. To validate that using the average does not qualitatively alter our findings, Models 4 and 7 replicate the benchmark models but restrict the sample to include only those transitions where we have data on the willingness to take risks in the year preceding the transition.

We compute average marginal effects (AME) to make evaluating the coefficients of our Logit models more intuitive. Table 2.5 summarizes the AME for Models 1 and 5, and Figure 2.4 graphically represents them. The AME for willingness to take risks suggests that for each unit increase in willingness to take risks, the probability of transitioning to self-employment increases by 0.1 pp.

Table 2.5 – Average Marginal Effects on the Probability to Transition to Self-Employment

	Model 1: E-S Transition	Model 5: U-S Transition
Age	0.0001 (0.0003)	0.0148 (0.0121)
Age ²	0.0000001 (0.000001)	−0.0001 (0.0001)
Education completed (years)	0.0011 (0.0002)***	0.015 (0.006)**
Female	−0.0037 (0.001)***	
LMS	−0.0090 (0.0019)***	
Household net income (log)	0.0022 (0.0007)***	0.0152 (0.021)*
Migration background	0.0023 (0.0009)**	−0.0240 (0.0372)
Net wealth > 700K	0.0085 (0.0011)***	0.2033 (0.0631)***
Number of children		0.0002 (0.0145)
Parents self-employed	0.0051 (0.0009)***	
Self-employed voluntary		0.1847 (0.0445)***
Tenure at last employer (years)	−0.001 (0.0001)***	0.0015 (0.003)
Willingness to take risks	0.0015 (0.0002)***	0.0294 (0.008)***

Note: * $p < 0.1$; ** $p < 0.05$; *** $p < 0.01$

Notes: Model 1 includes individuals who transitioned from employment to self-employment. Model 5 includes individuals who transitioned from unemployment to self-employment. LMS denotes labor market success.

Table 2.6 – Model Summary

	Model 1	Model 2	Model 3	Model 4	Model 5	Model 6	Model 7
Age	0.02 (0.04)	0.02 (0.04)	0.02 (0.04)	0.01 (0.05)	0.10 (0.08)	0.10 (0.12)	-0.03 (0.10)
Age ²	0.0001 (0.0004)	0.0001 (0.0004)	0.0001 (0.0004)	0.0001 (0.001)	-0.001 (0.001)	-0.0005 (0.001)	0.001 (0.001)
Education completed (years)	0.16 (0.02)***	0.23 (0.06)***	0.16 (0.02)***	0.17 (0.03)***	0.10 (0.04)**	0.06 (0.08)	0.13 (0.05)***
Female	-0.52 (0.12)***	-0.52 (0.12)***	-0.53 (0.12)***	-0.63 (0.15)***			
LMS	-1.31 (0.27)***	-1.30 (0.26)***	-1.80 (0.67)***	-1.51 (0.32)***		0.16 (0.75)	
Household net income (log)	0.32 (0.10)***	0.32 (0.10)***	0.31 (0.10)***	0.40 (0.12)***	0.11 (0.15)	0.33 (0.26)	0.12 (0.17)
Migration background	0.33 (0.13)**	0.34 (0.13)***	0.33 (0.13)**	0.51 (0.16)***	-0.17 (0.26)	0.02 (0.39)	-0.23 (0.33)
Net wealth > 700K	1.22 (0.16)***	1.23 (0.16)***	1.22 (0.16)***	1.09 (0.19)***	1.42 (0.45)***	2.67 (0.65)***	1.30 (0.62)**
Number of children					0.001 (0.10)	0.24 (0.15)	0.12 (0.12)
Parents self-employed	0.73 (0.12)***	0.73 (0.12)***	0.73 (0.12)***	0.86 (0.15)***			
Self-employed voluntary					1.29 (0.32)***	1.28 (0.47)***	1.39 (0.45)***
Tenure at last employer (years)	-0.14 (0.02)***	-0.14 (0.02)***	-0.14 (0.02)***	-0.13 (0.02)***	0.01 (0.02)	-0.06 (0.03)**	0.02 (0.02)
Willingness to take risks	0.21 (0.03)***	0.40 (0.13)***	0.18 (0.05)***	0.12 (0.03)***	0.21 (0.06)***	0.29 (0.09)***	0.15 (0.06)**
Interaction risk:education		-0.01 (0.11)					
Interaction risk:LMS			0.09 (0.11)				
Constant	-22.43 (1.23)***	-23.43 (1.50)***	-22.14 (1.28)***	-23.66 (1.47)***	-8.30 (2.12)***	-7.69 (3.45)**	-5.98 (2.56)**
Fixed Effects	Year+Sector	Year+Sector	Year+Sector	Year+Sector	Year+Sector	Year+Sector	Year+Sector
Number of transitions to S	1,087	1,087	1,087	748	316	197	172
Observations	137,214	137,214	137,214	95,662	1,423	730	974
Log Likelihood	-4,549.73	-4,547.03	-4,549.00	-3,043.80	-583.31	-263.44	-344.18
Akaike Inf. Crit.	9,225.47	9,222.07	9,225.99	6,213.61	1,286.61	644.89	798.36
pseudo R ²	0.167	0.1674	0.1672	0.1737	0.2181	0.2635	0.3106

Note: *p<0.1; **p<0.05; ***p<0.01

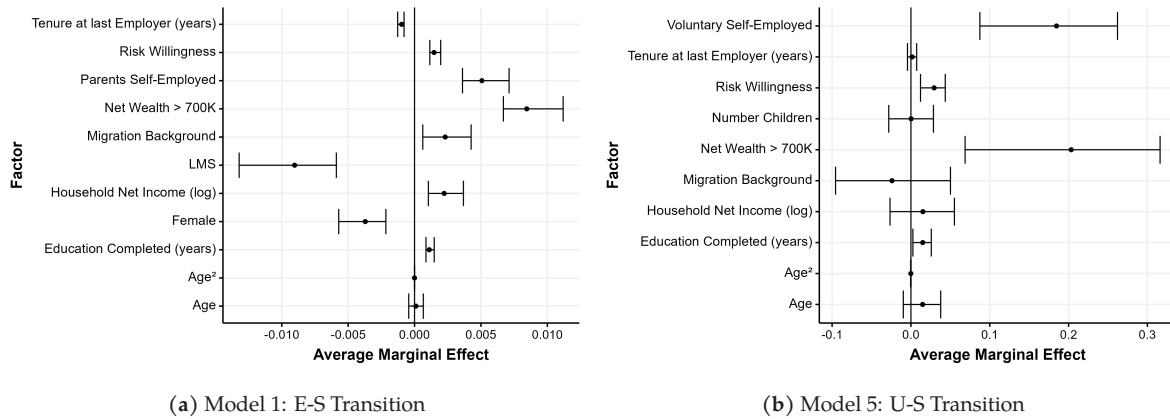
Model 1-4: Transitions from employment (E) to self-employment (S), Model 5-7: Transitions from unemployment (U) to self-employment (S). Models 1-3 and 5-6 use the time-average of an individual's willingness to take risks. Models 4 and 7 use the willingness to take a risk *prior* to the transition. LMS denotes labor market success.

Aside from the willingness to take risks, the effects for the two subgroups are quite different. Household net income increases the likelihood of transitioning to self-employment for the previously employed. That may be because total household net income serves as an insurance device. A person's financial safety net is stronger if they are part of a household with a larger net income. According to Figure 2.2, almost half of all newly created businesses fail within the first year. Having financial security in the form of a larger income is a plus during this turbulent period.

LMS decreases the transition probability for the employed.²⁴ It may be that the more successful a worker is in comparison to their cohort, the less likely they are to pursue self-employment. This is the inverse message of what we addressed for household net income; nonetheless, it is vital to distinguish between individual labor-market success and household net income. The former is used to assess individual performance in the labor market within one's cohort, while the latter assesses financial security.

The variable *Net Wealth > 700K* is a dummy that indicates if the individual's net wealth is greater than €700,000. When imputing wealth, we create eight broader wealth groups to reduce the imputation error.²⁵ Among all imputed wealth groups, this is the only one for which we find a statistically significant effect on the probability of transitioning to self-employment. This suggests that high levels of net wealth increase the likelihood of transitioning to self-employment, consistent with the findings of [Indraccolo and Piosik \(2023\)](#).

Figure 2.4 – Average Marginal Effects



2.5 The Model

For our quantitative analysis, we propose an occupational choice that extends the framework in [Quadrini \(2000\)](#) and [Cagetti and De Nardi \(2006\)](#) by incorporating heterogeneity in agents' risk preferences. We introduce [Epstein and Zin \(1989\)](#) preferences that break the tight link between individual risk attitudes and the elasticity of intertemporal substitution (EIS). Moreover, by for-

²⁴In the benchmark for the unemployed (model (5)), we exclude LMS because they have no income in the period before they transition, and even if we impute the LMS with the last known value, we lose almost half of all transitions.

²⁵Appendix A.2.5 provides details on the wealth imputation.

mulating an agent's lifetime utility as a non-linear function, they are very suitable for studying the role of heterogeneous risk preferences, varying risk, and the implied individual behavior. As in [Cagetti and De Nardi \(2006\)](#), agents in our model face earnings risk and mortality risk. In addition, we subject all entrepreneurs to the risk of going out of business. Time is discrete, and there is no aggregate uncertainty.

Demographics and the Labor Market The model is populated by a continuum of agents of measure one. Each agent experiences a life cycle that consists of two stages: young and old age. Those stages typically last for several periods. A young person faces the constant probability of remaining young in each period, π_y . Similarly, an old person remains old with probability π_o . Young agents make an occupational choice: they decide whether to work for pay or be self-employed. This choice is always reversible, so it is repeated in every period until retirement. Old agents, on the other hand, are retired and receive a fixed pension ξ . They face a constant risk of dying and exiting the model, which we denote by π_d . There is no bequest motive. Upon death, agents exit the model, and their assets are redistributed across the young generation, preserving the stationary distribution.

Entrepreneurs face the additional risk of going out of business which happens with probability π_u . Upon exiting, they lose a fraction κ of their capital stock, but they receive a uniform public transfer payment b that equals a fraction of the lowest wage in the economy. The risk of going out of business is large, mirroring the empirical fact that the survival rate of newly established enterprises is low, especially in their initial years (see Figure 2.2).

Preferences Agents derive utility from consumption, c , only. We employ [Epstein and Zin \(1989\)](#) preferences, which distinguish between risk aversion and the elasticity of intertemporal substitution. We allow agents to differ in their risk preferences and model this by assigning each individual a unique, innate, and constant risk aversion parameter, σ_i . The elasticity of intertemporal substitution, γ , is identical for everyone. Epstein-Zin preferences are represented by the following non-expected recursive utility function:

$$V(\sigma_i) = \left[c^{1-\frac{1}{\gamma}} + \beta \left[E V'(\sigma_i)^{1-\sigma_i} \right]^{\frac{1-\frac{1}{\gamma}}{1-\sigma_i}} \right]^{\frac{1}{1-\frac{1}{\gamma}}}, \quad (2.2)$$

with the common discount factor, β , lying strictly between 0 and 1, $\sigma_i > 0$ and $\gamma > 0$, where it is required that $\sigma_i \neq 1$ and $\gamma \neq 1$. Current utility is the aggregate of current consumption and the *certainty equivalent* of future utility.²⁶

Technology Each young person is endowed with two types of ability, which we treat as exogenous random variables that are positively auto-correlated over time but mutually uncorrelated. Worker ability, z , captures the capacity to produce income out of labor. Entrepreneurial ability,

²⁶Note that if the mean risk aversion σ equals the inverse of γ , the utility function in (3.1) would resemble the time-additive separable CRRA utility that is widely used in macroeconomics.

θ , is the capacity to generate returns from capital investment as an entrepreneur. By assumption, the realized values of z and θ are observable and known to everyone at the beginning of a period.

Output production occurs in two sectors, a (small) entrepreneurial sector and another one where many non-entrepreneurial firms operate a standard CRS production technology in a competitive environment. To produce output they use a given technology level A , salaried workers, L , and physical capital, K , as inputs:

$$Y = AK^\alpha L^{1-\alpha}. \quad (2.3)$$

A worker's effective wage income equals the product of the market wage rate – the marginal product of labor, $\bar{w}$ – and her individual productivity level, z . Workers cannot borrow but save at the risk-free market interest rate r . To operate as an entrepreneur, an agent can borrow at rate r and invest capital k in a technology whose return depends on her own entrepreneurial ability. When k is invested, output production equals $y = \theta k^\nu$, where ν lies within the interval $(0,1)$.²⁷

Borrowing Constraint We impose an exogenous borrowing constraint that keeps entrepreneurs from borrowing unlimited amounts.²⁸ It is defined as

$$k - a \leq (\lambda - 1)a, \quad (2.4)$$

where $\lambda \in [1, \infty)$. This implies that the amount of debt each entrepreneur can incur in a period to finance her working capital, k , is crucially determined by the available assets, a , which serve as collateral. All debt is cleared at the end of a period.

Government The government collects a lump sum tax τ from young agents in the economy except for failed entrepreneurs to finance subsistence pay and pension payments. By assumption, the government maintains a balanced budget:

$$N\tau = SE^f b + N^O \zeta, \quad (2.5)$$

where N denotes all young agents in the economy except for failed entrepreneurs. SE^f captures failed entrepreneurs, b their subsistence pay, and N^O denotes the mass of old agents who receive pension payments ζ .

2.5.1 Households

All agents know their innate risk preferences. Moreover, at the beginning of each period, before any economic decisions are made, the realized values of all ability levels are observed and known

²⁷Diminishing returns to scale of physical capital in output production imply a limited firm size, or "span of control," as noted by Lucas (1978).

²⁸In doing so, we follow Banerjee and Newman (2003), and Moll (2014). They motivate this form of constraint as arising, e.g., from a limited enforcement problem which lenders face.

to everyone, but next period's levels remain unknown.

Young Agents

Each young person starts the period with assets a , entrepreneurial ability θ , and worker ability z . In each period, she chooses whether to be an entrepreneur or a wage worker. She picks the occupation that maximizes her lifetime utility.

$$V_y(a, z, \theta; \sigma) = \max \left(V_e(a, z, \theta; \sigma), V_w(a, z, \theta; \sigma) \right) \quad (2.6)$$

The entrepreneur's decision problem can be expressed recursively as follows:

$$\begin{aligned} V_e(a, z, \theta; \sigma) = & \max_{c, k, a'} \left(c^{1-\frac{1}{\gamma}} + \beta \left[\pi_y \left((1 - \pi_u(e)) \mathbb{E}[V_y(a', z', \theta'; \sigma)^{1-\sigma}] + \right. \right. \right. \\ & \left. \left. \left. \pi_u(e) V_u(a', z', \theta'; \sigma)^{1-\sigma} \right) + (1 - \pi_y) V_o(a'; \sigma)^{1-\sigma} \right]^{\frac{1-\frac{1}{\gamma}}{1-\sigma}} \right)^{\frac{1}{1-\frac{1}{\gamma}}} \quad (2.7) \\ a' = & (1 + r)a + \theta k^\nu - c - (r + \delta)k - \tau \\ a \geq & 0 \\ k \geq & 0 \end{aligned}$$

With probability π_y , the agent remains young and again faces the occupational choice presented in Equation (3.7). Conversely, with probability $1 - \pi_y$, the agent transitions to old age and retires. In addition to voluntarily quit self-employment and become a salaried worker again, each young and active entrepreneur can be hit by a negative business shock in each period with probability π_u . In that case she exits from self-employment involuntarily, losing a fraction κ of her assets. This model feature reflects the possibility of entrepreneurs going bankrupt in which case they have to sell their remaining assets at a scrap value. The law of motion for assets features the sum of the risk-free rate r and the per-period depreciation rate δ as the per-unit cost of working capital, k .

The wage worker's decision problem is summarized below:

$$V_w(a, z, \theta; \sigma) = \max_{c, a'} \left(c^{1-\frac{1}{\gamma}} + \beta \left[\pi_y \left(\mathbb{E}[V_y(a', z', \theta'; \sigma)^{1-\sigma}] \right) \right. \right. \quad (2.8)$$

$$\left. \left. + (1 - \pi_y) V_o(a'; \sigma)^{1-\sigma} \right]^{\frac{1-\frac{1}{\gamma}}{1-\sigma}} \right)^{\frac{1}{1-\frac{1}{\gamma}}} \quad (2.9)$$

$$a' = z\bar{w} + (1 + r)a - c - \tau$$

$$a \geq 0$$

In case the wage worker remains young, she again chooses next period's occupation that maximizes her value function. She turns old and retires with probability $1 - \pi_y$.

An entrepreneur who has gone out of business solves the following decision problem:

$$\begin{aligned}
 V_u(a, z, \theta; \sigma) = & \max_{c, a'} \left(c^{1-\frac{1}{\gamma}} + \beta \left[\pi_y \mathbb{E}[V_y(a', z', \theta'; \sigma)^{1-\sigma}] \right. \right. \\
 & \left. \left. + (1 - \pi_y) V_o(a'; \sigma)^{1-\sigma} \right]^{\frac{1-\frac{1}{\gamma}}{1-\sigma}} \right)^{\frac{1}{1-\frac{1}{\gamma}}} \quad (2.10) \\
 a' = & b + (1 + r - \kappa)a - c \\
 a \geq & 0
 \end{aligned}$$

where $\kappa \in [0, 1]$ denotes the share of capital that is lost, and b captures a public subsistence pay. Having been out of business for one period, the agent either re-enters the labor market, facing the occupational choice problem again, or turns old and retires.

Old Agents

Old agents receive fixed pension payments ξ and choose consumption and next period's assets. They face uncertainty regarding the time of their death only. They either remain old with probability π_o or die with probability $1 - \pi_o$. In case of death, the value is zero, as they cease to exist, and their assets are distributed to young agents using the stationary distribution of productivity types.

$$\begin{aligned}
 V_o(a; \sigma) = & \max_{c, a'} \left(c^{1-\frac{1}{\gamma}} + \beta \left[\pi_o V_o(a'; \sigma)^{1-\sigma} \right]^{\frac{1-\frac{1}{\gamma}}{1-\sigma}} \right)^{\frac{1}{1-\frac{1}{\gamma}}} \quad (2.11) \\
 a' = & \xi + (1 + r)a - c \\
 a \geq & 0
 \end{aligned}$$

2.5.2 Competitive Equilibrium

Consider an individual state vector $s = \{a, z, \theta, \sigma, L\}$, where a represents an asset level, z worker ability, θ entrepreneurial productivity, σ risk preferences, and L describes the agent's stage in life (young and worker or entrepreneur – active or failed –, or old and retired). The decision rules resulting from the agents' optimization problems combined with the exogenous Markov processes for entrepreneurial ability and earnings yield a probability distribution of next period's state vector s' conditional on s .

Let $\mathbf{x}$ denote the aggregate state vector, where aggregation takes place across all individuals.

Definition 2. A stationary equilibrium is given by a market interest rate r , a wage w , lump sum tax τ , allocations for consumption $c(s)$, assets $a(s)$, occupational choice $e(s)$, entrepreneurial borrowing $k(s)$ and a constant distribution of agents over states s , $P^*(x)$, such that given r , w , and τ the following conditions are fulfilled:

1. The allocations c , a , e , and k solve the agents' maximization problems.
2. The markets for capital and labor clear.

3. *The government's budget is balanced, with tax income equaling subsistence pay and pension expenses.*
4. *The distribution P^* is the invariant distribution for the economy.*

2.5.3 Calibration

In this subsection, we outline the parameter choices used to match key moments of our empirical data. The model is calibrated to annual frequency. We normalize worker productivity z to one and set the capital share in production, α , to 0.33. We target an annual real interest rate of 3 percent. To ensure capital market clearing, we adjust the discount factor β , resulting in $\beta = 0.933$. The depreciation rate of capital, δ , to 0.06 (see [Cagetti and De Nardi \(2006\)](#)), and the elasticity of intertemporal substitution, γ , to 0.5, which is a standard value in the literature. π_y and π_o are calibrated to ensure that agents spend, on average, 39 years working and 20 years in retirement. These figures align with the observed durations of working life and retirement in Germany ([Eurostat, 2024](#); [Deutsche Rentenversicherung Bund, 2024](#)).

We use individual measures of risk aversion from the SOEP, as discussed in detail in Section 2.3. To incorporate the empirical distribution of willingness to take risks into our model framework, we discretize the data and map ordinal risk preferences to risk aversion parameters, σ_i . Specifically, we begin by analyzing the distribution of ordinal risk preferences and discretizing it into three grid points. Next, we apply the method developed by [Dohmen et al. \(2011\)](#) to compute the CRRA parameters for each grid point (see Appendix A.2.8 for details), leveraging additional information provided in the SOEP. Table 3.2 summarizes the CRRA parameters used in our model and the corresponding probability masses. We set fixed pension payments, ξ , to 60% of the lowest income, and the public subsistence pay, b , which is received by entrepreneurs who go out of business, to 10% of the lowest income. Both values are consistent with the German institutional framework. Note that the subsistence pay corresponds to the "Bürgergeld" in Germany. The value of the lump-sum tax τ arises endogenously in steady state by solving for the balanced budget as in Equation 3.4. Furthermore, we set the equity ratio λ to 4.64, which corresponds to the inverse of the balance sheet equity of the KfW Bankengruppe from the year 2014 (see [KfW Bankengruppe, 2023](#)).

The idiosyncratic worker productivity process is discretized into a 3-state Markov chain using the method of [Rouwenhorst \(1995\)](#).²⁹ We use moments estimated by [Bayer and Juessen \(2012\)](#), setting the autocorrelation ρ to 0.922 and the standard deviation σ^Y to 0.172.³⁰

Table 3.3 lists the parameters we calibrate internally. We calibrate a total of eleven parameters that jointly relate to self-employment. Note that θ_{Low} is externally calibrated, while θ_{Middle} and θ_{High} are determined within the model. We choose the same number of targets to ensure that our model is fully identified. We use a Generalized Method of Moments (GMM) approach to fit the model to the empirical targets.³¹

²⁹[Kopecky and Suen \(2010\)](#) argue that Rouwenhorst's method is suited best to discretize AR(1) processes with a very strong auto-correlation compared to other methods predominantly used in the literature.

³⁰Details on transition probabilities and grid points are provided in Appendix A.2.8.

³¹In our GMM strategy, we apply unequal weights to the moments by ranking them according to their relative

Table 2.7 – Externally Calibrated Parameters

Parameter	Value	Source
A	1	Normalization
α	0.33	Standard parameter
β	0.933	Annual real interest rate of 3 %
δ	0.06	Cagetti and De Nardi (2006)
γ	0.5	Standard parameter
π_y	0.9745	Average working duration of 39 years
π_o	0.9511	Average retirement duration of 20 years
σ_i	[3.05 5.26 10.04]	See text and Tab. 3.2
ξ	60% of lowest income	Institutional approximation
b	10 % of lowest income	Institutional approximation
τ		See text
λ	4.64	KfW Bankengruppe (2023)
ρ	0.922	Bayer and Juessen (2012)
σ^Y	0.172	Bayer and Juessen (2012)

Table 2.8 – Distribution of Risk Aversion

Willingness to Take Risks	Probability Mass	Risk Aversion (σ_i)
[0 – 3)	34%	10.04
[4 – 6)	53%	5.07
[7 – 10]	13%	3

Notes: The willingness to take risks is discretized into three intervals. The probability mass shows how these intervals are represented in the overall population. The parameter of relative risk aversion is the transformed willingness to take risks. Its mean equals 6.49 and its standard deviation is 2.64.

The targeted moments are displayed in Table 3.4, which compares them with the corresponding empirical data. The moments include characteristics of entrepreneurial activity, such as the share of entrepreneurs in the working-age population, their contribution to GDP, and survival rates, as well as measures of inequality, including the Gini coefficient and the distribution of entrepreneurial wealth and returns. The model matches most of the empirical moments closely. The data moments are based on the German Socio-Economic Panel (GSOEP) for demographic and economic indicators and the Household Finance and Consumption Survey (HFCS, second wave for the year 2014) for entrepreneurial returns and business assets.^{32,33}

Although all calibrated parameters jointly determine the targets, some are especially informative for certain moments. ν and θ heavily influence wealth outcomes and the relationship between the mean and the median of returns, since they govern the distribution of entrepreneurial returns

importance. The largest weight is assigned to matching the share of entrepreneurs in the working-age population (7.2 percent), while entrepreneurs' share in the 90th percentile of the wealth distribution (15.9 percent) receives one of the lowest weights. This unequal ranking reflects our focus on capturing the extensive margin of entrepreneurship more precisely, while moments related to the upper tail of the wealth distribution are considered less central to the model's core mechanisms.

³²Appendix A.2.3 contains an overview of percentile ratios and dispersion measures for business returns, self-employment income, and business assets for Germany.

³³We selected moments from the second wave (2014) as calibration targets, as it represents a "tranquil time" compared to 2010, when the economy was recovering from the Great Recession, or 2020, which was impacted by COVID. The values from the third wave (2017) are quantitatively similar.

Table 2.9 – Internally Calibrated Parameters

Parameter	Value
π_θ	$\begin{bmatrix} 0.9872 & 0.0126 & 0.0003 \\ 0.0766 & 0.9101 & 0.0133 \\ 0.3018 & 0.0560 & 0.6422 \end{bmatrix}$
θ	$[0 \ 0.238 \ 0.332]$
ν	0.9321
π_u	0.1504
κ	0.4559

Table 2.10 – Targeted Moments

Moment	Data	Model	Data Source
Share of entrepreneurs in working-age population	7.2%	6.7%	GSOEP
Share of GDP by entrepreneurs	10.0%	10.9%	BFB (2023)
Share of new entrepreneurs p.a. in working-age pop.	0.8%	1.0%	GSOEP
1-year survival rate of young entrepreneurs	60.6%	69.8%	GSOEP
Mean survival rate of entrepreneurs [yrs.]	3.58	3.60	GSOEP
Entrepreneurial earnings (mean/median)	2.02	2.39	HFCS Germany
Entrepreneurial earnings (std/mean)	1.72	2.21	HFCS Germany
Entrepreneurial earnings (P90/P50)	4.29	4.48	HFCS Germany
Business assets (std/mean)	3.52	2.56	HFCS Germany
Wealth Gini	0.75	0.82	GSOEP
Entrepreneurial share of P90 wealth	15.9%	18.7%	GSOEP

Notes: Data for entrepreneurial returns and business assets originate from the second wave (year 2014) of the HFCS for Germany. BFB is the acronym for [Bundesverband der Freien Berufe e. V. \(2023\)](#).

in our model. π_θ and π_u directly affect the survival rate of an enterprise and, hence, its stability. The target moments most affected by this are the share of young entrepreneurs out of all existing self-employed in a given year, and also the first-year survival rate of young entrepreneurs. κ indicates the severity of a going-out-of-business shock. This parameter matters most for the reported statistics capturing the wealth distribution.

2.5.4 Model Validation: Transition Probability with Simulated Data

To validate our model, we use it as the data-generating process and re-estimate our empirical model from Equation 2.1 with the simulated data. This exercise serves as a sanity check to verify whether the model produces a relationship between risk aversion and the probability of transitioning to self-employment that is consistent with the observed data.

$$\text{logit}(p_{i,t}) = \log\left(\frac{p_{i,t}}{1-p_{i,t}}\right) = \beta_0 + \beta_1 X_{i,t} + \epsilon_{i,t} \quad (2.12)$$

where p_i is the probability of an individual i transitioning to self-employment, β_0 is the intercept, X_i is a vector of explanatory variables. Unlike our specification using GSOEP data, this estimation does not include time or sector fixed effects and only controls for worker productiv-

ity, entrepreneurial ability and wealth larger than 700K.

Table 2.11 – Model Summary

	Theoretical Model	Theoretical Model AME	Empirical Model (1) AME
Risk Aversion (σ)	−0.065 (0.008)***	−0.0007 (0.0001)***	
Willingness to take Risks			0.0015 (0.0002)***
Entrepreneurial Ability (θ)	1.02 (0.008)***	0.011 (0.0001)***	
Wealth > 700K	1.07 (0.016)***	0.011 (0.0002)***	0.013 (0.0031)***
Worker Productivity (z)	−0.177 (0.008)***	−0.0019 (0.0001)***	−0.0105 (0.0018)***
Constant	−6.55 (0.033)***		
Transition to SE	40,398		
Observations	3,738,246		
Log Likelihood	−208,991		
Akaike Inf. Crit.	417,992		
pseudo R ²	0.063		

Note: *p<0.1; **p<0.05; ***p<0.01

Transitions from employment (E) to self-employment (S). The theoretical model presents results using simulated data from our quantitative model. Empirical Model (1) reports average marginal effects (AMEs) from our benchmark specification, which includes self-reported willingness to take risks instead of the transformed measure of risk aversion. Since a higher willingness to take risks corresponds to lower risk aversion, the AMEs for these variables exhibit opposite signs. The full specification of Empirical Model (1) is provided in Table 2.5.

Table 2.11 reports the coefficients from the logistic regression and the average marginal effects (AMEs) from our model-based regression, comparing them to the empirical estimates from Model 1. Importantly, the model replicates the qualitative relationship observed in the empirical data: higher risk aversion (or, equivalently, lower willingness to take risks) reduces the likelihood of transitioning to self-employment. Note that a higher willingness to take risks (WTR) corresponds to a lower level of risk aversion σ , so the signs of marginal effects differ by construction.³⁴ In the model, a one-unit increase in risk aversion decreases the transition probability by 0.07 percentage points. While this effect is smaller than in the empirical estimation, this difference reflects the inherent simplifications of the model, making an exact quantitative match challenging.

³⁴See Section 2.5.3 for how WTR maps into σ via [Dohmen et al. \(2011\)](#).

2.6 Results

This section presents the main findings from our quantitative model of occupational choice. We pay special attention to the ways in which alternative ability levels – z and θ –, accumulated assets, and risk preferences interact in determining agents' occupational choices and savings behavior. First, we graphically illustrate the interplay between those determining factors. Then, we report simulation results from the stationary equilibrium of our benchmark with heterogeneous risk preferences.

2.6.1 Occupational Choice

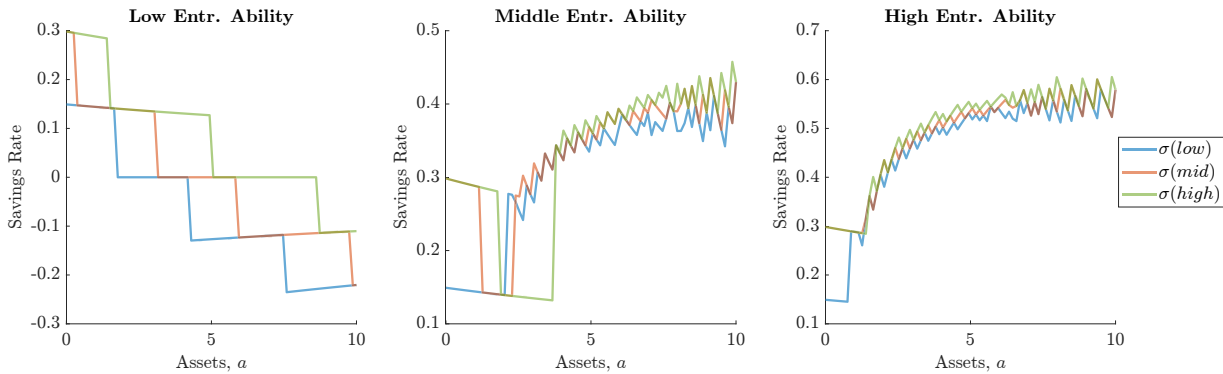


Several important facts stand out. Assets are required for self-employment due to borrowing constraints, but the threshold depends on entrepreneurial skill and risk aversion. For a given level of worker productivity, z , talented, risk-prone agents require the lowest asset level to transition to self-employment. However, having accumulated assets *per se* is not sufficient to start a business, especially if the productivity differential between self-employment and salaried employment, $\theta - z$, is small. In this case, it is optimal to be a salaried worker, regardless of one's assets or risk tolerance (depicted in the left panel). The other two panels show that as the productivity differential increases, the asset threshold for entering self-employment decreases for a given level of risk aversion. Taken together, Figure 2.5 illustrates that the decision to enter self-employment hinges crucially on assets, as well as a certain productivity differential that favors entrepreneurship. Moreover, from an agent's perspective, accumulated assets can compensate for risk aversion in her decision to enter self-employment, as wealth helps buffer capital losses. Next, we will characterize the different types of agents in our model by their predominant savings motives in an attempt to understand their actual savings behavior.

2.6.2 Savings Rates

Choosing how much income to save each period is a key decision agents face in our model. Three distinct savings motives drive this choice: precautionary savings, retirement savings, and savings for starting entrepreneurship. Irrespective of the underlying motive, savings increase with the degree of risk aversion. All agents engage in precautionary savings to safeguard against uninsurable earnings risk and longevity risk. The retirement savings motive is also the same for all agents, as they face an identical probability of transitioning to old age and, on average, their mean working-life income exceeds their pension income. The entrepreneurial savings motive, by contrast, varies with entrepreneurial ability—it is strongest for high-ability individuals, but absent for those with low entrepreneurial skills who never become self-employed (see Figure 2.5). All motives taken together shape the savings rates that are defined as $(a'-a)/\text{income}$ and shown in Figure 2.6 for a worker productivity level z equal to 2.³⁵

Figure 2.6 – Savings Rate by Entrepreneurial Ability and Risk Aversion



Note: Worker productivity is fixed at $z = 2$.

Several observations stand out. First, at low asset levels, all agents save a positive fraction of their income, which is similar across alternative entrepreneurial skills. Second, at any given asset level, savings rates rise in proportion to the degree of risk aversion, indicating that the precautionary savings motive is in effect for everyone. Third, when entrepreneurship is not a viable option, savings rates decline as assets increase. For agents with the lowest entrepreneurial ability, savings rates eventually turn negative, as accumulating more assets leads them to prioritize current consumption over further saving. Savings rates for all other agents start to *increase* beyond the asset level where entrepreneurship becomes attractive.

Given the perfect sorting of agents across occupations by their entrepreneurial skill, these observations are equivalent to saying that, *ceteris paribus*, (i) workers save less than entrepreneurs at a given asset level, and (ii) workers' savings rates decrease, whereas those of entrepreneurs rise in the level of accumulated assets. This is because assets serve as collateral for borrowing working capital. As long as the return from capital accumulation exceeds its total costs, entrepreneurs choose a capital stock such that the borrowing constraint is binding, i.e., they operate at maximal

³⁵The savings profiles are consistent with the ones documented by Cagetti and De Nardi (2006) whose model includes an additional bequest motive, but abstracts from heterogeneity in risk aversion.

leverage. Taken together, these stark differences in savings behavior by agents who differ in their occupations or in the degree of risk aversion contribute to the wealth inequality that our model implies. We will elaborate on this important aspect in more detail in Section 2.6.4 below.

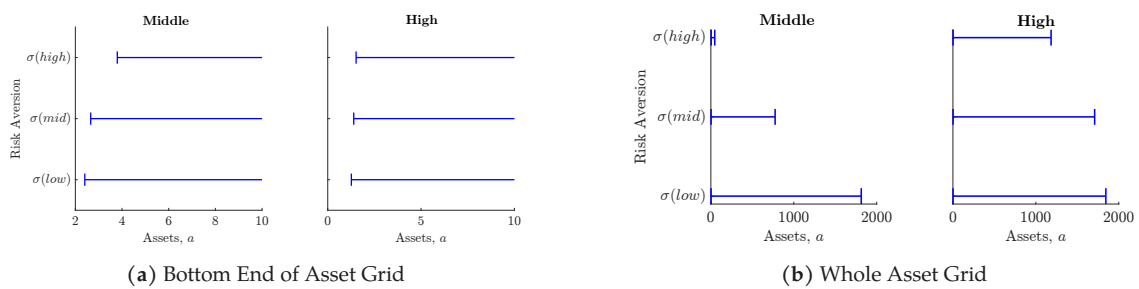
2.6.3 Stationary Equilibrium

We have simulated our model using the policy rules from Sections 2.6.1 and 2.6.2 and computed the stationary equilibrium for the cross-section of workers and entrepreneurs.

Our benchmark with heterogeneous risk preferences yields a share of entrepreneurs within the working-age population that equals 6.7%. This value lies in the range from 5.9% to 7.6%, which [Bonin et al. \(2022\)](#) report for Germany. In addition, our model predicts that entrepreneurs are disproportionately drawn from the less and moderately risk-averse segments of the population (see the distribution of risk aversion in Appendix A.2.9).

To better understand the underlying forces at work, it helps to look more closely at the interplay between capital accumulation, risk attitude, and entrepreneurship in our stationary equilibrium. Towards this end, Figure 2.7 illustrates this interaction for two alternative productivity differences – *middle- θ* , and *high- θ* –, along the lower end of the asset grid (panel *a*) where most entries occur, and also along the entire asset grid (panel *b*) to capture exits from self-employment. This figure conveys an important message. Although highly risk-averse agents accumulate more assets than other risk types before starting a business, they exit at lower asset levels than anybody else. That is mainly because they fear losing their wealth, and exiting is a way to safeguard against such a loss. In contrast, risk-prone agents require the lowest asset levels to start a business. Since they willingly accept higher business risks and capital losses in the event of failure, they tend to stay in business for a longer period than others, thereby benefiting from high business returns for an extended time and accumulating substantial wealth levels.

Figure 2.7 – Occupational Choice by Level of Risk Aversion and Entrepreneurial Skill



Notes: Worker productivity equals $z = 2$. *Middle* and *High* denote the entrepreneurial ability. Part (a) displays the bottom end of the asset grid (as in Figure 2.5) to highlight the asset thresholds at which entrepreneurship becomes optimal. The vertical axes depict the levels of risk aversion from our benchmark model. Part (b) replicates the same content for the whole asset grid.

These differences in agents' occupational choices along the asset grid also become apparent in Table 2.12, which presents detailed model-based characteristics of entrepreneurs by type of risk aversion. Risk-tolerant entrepreneurs make up the smallest group within the entrepreneurial population, but they are overrepresented relative to their share in the general population (see

Appendix A.2.9). Consistent with the evidence in Figure 2.2, they achieve the highest survival rates and accumulate a significant amount of entrepreneurial capital. More generally, entrepreneurs are overrepresented among the wealthy and contribute disproportionately to GDP, with those of medium risk aversion leading in output, wealth accumulation, and capital ownership.

Interestingly, our findings regarding the link between risk aversion, savings behavior, and risky entrepreneurship when agents have Epstein-Zin preferences mirror those reported by [Gomes and Michaelides \(2005\)](#) from studying empirically observed patterns of stock market participation over the life cycle in a model of asset allocation. When participating in the stock market is costly, risk-averse agents are most likely to accumulate the wealth required to enter the stock market, although they invest cautiously once participating, out of fear of losing accumulated wealth.

Table 2.12 – Entrepreneurs by Degree of Risk Aversion

	Overall	$\sigma(\text{Low})$	$\sigma(\text{Middle})$	$\sigma(\text{High})$
Share of Entrepreneurs in Working-Age Population [%]	6.7	14.58	61.94	23.48
Entrepreneurial Capital [k]	135	153	156	81
Share with $\theta(\text{Middle})$ [%]	85	13.8	59.5	26.6
Share of GDP [%]	10.9	12.9	63.3	23.8
Share in P90 of Wealth [%]	18.7	13.9	65.2	20.9
1-Year Survival Rate of Entrepreneurs [%]	69	74	74	61

Notes: Results are based on the stationary steady-state of our benchmark model.

2.6.4 Model-Based Wealth Distribution by Risk Aversion

Table 2.13 presents model-implied moments of the asset distribution that relate to the groups sorted by the degree of risk aversion, or to the entire model population. The mean exceeds the median by far for the entire population as well as for each subpopulation, indicating that all distributions are strongly right-skewed. Moreover, the mean and median are highest for agents with a moderate degree of risk aversion, while risk-loving agents exhibit the lowest median but the largest wealth inequality, as measured by the Gini. In contrast, highly risk-averse individuals display the most compressed distribution, with the mean closely aligned with the 75th percentile and the lowest Gini of all sub-groups. In fact, the Gini decreases as the degree of risk aversion rises, and this is consistent with the empirical evidence from the SOEP. When looked at through the lens of our model, that's because risk-prone agents require few assets to enter entrepreneurship, but conditional on having entered, they stay in business rather long and continue to accumulate wealth. Their implied wealth distribution is highly unequal. The situation for risk-averse agents is essentially the opposite, which explains their rather low Gini.

Table 2.13 – Population-Wide Asset Distribution by Degree of Risk Aversion

σ	P1	P10	P25	P50	Mean	P75	P90	P95	Gini	Gini (SOEP)
Low	0	0	0.51	2.40	18.70	7.08	18.15	58.43	0.876	0.81
Middle	0	0	1.01	3.42	21.69	8.98	25.41	83.36	0.852	0.75
High	0	0	1.52	4.94	10.94	11.56	22.74	38.66	0.68	0.72
Overall	0	0	1.01	3.79	17.70	9.49	24.04	55.98	0.820	0.75

2.7 Counterfactuals

This section examines how heterogeneous risk preferences determine the size and composition of the entrepreneurial sector and the resulting wealth distribution under alternative business environments. We do so with the help of two counterfactual exercises that are based on our quantitative model. First, we analyze the impact of an increase in business risk. For Germany, survey-based indicators such as the *ifo Business Climate Index*³⁶ provide information on entrepreneurs' assessments of the current business situation and expectations for the near future, reflecting changes in demand conditions and operational uncertainty. As this measure varies over the business cycle, we are motivated to study in a counterfactual setting how changes in business risk at different points in time (i.e., different steady states) affect transitions to entrepreneurship and wealth accumulation.

Second, we explore the implications of limiting entrepreneurs' private liability for business losses. This exercise mirrors the introduction of a new form of limited-liability companies (LLC), so-called *Unternehmergesellschaften (UG)*, in Germany in late 2008 with the intention of reducing personal risk, thereby rendering entrepreneurship more attractive. Since UGs require an initial minimum capital of just one euro, they are also referred to as "1-euro GmbH".

To assess the role of heterogeneity in risk aversion, we compare our benchmark model to two alternative specifications with homogeneous risk preferences. In the first variant (Homogeneous RA I), we fix the coefficient of relative risk aversion σ at 6.49 for all individuals—the population average in the benchmark model.³⁷ In the second specification (Homogeneous RA II), we set $\sigma = 2$ for everyone, which corresponds to the inverse of the elasticity of intertemporal substitution (EIS), replicating the standard case of CRRA utility with time-additive preferences. Appendix A.2.10 compares the occupational choice in our benchmark model to the homogeneous risk aversion cases.

When all agents are assigned the mean value of σ (Homogeneous RA I), the share of entrepreneurs closely matches that in the benchmark model. By contrast, setting $\sigma = 2$ (Homogeneous RA II) implies uniformly lower risk aversion across the population, leading to a marked increase in self-employment. In this case, the share of entrepreneurs in the working-age population rises to 8.67%, accompanied by a higher entrepreneurial contribution to GDP.³⁸

³⁶See the *ifo Business Climate Index* of the ifo Institute.

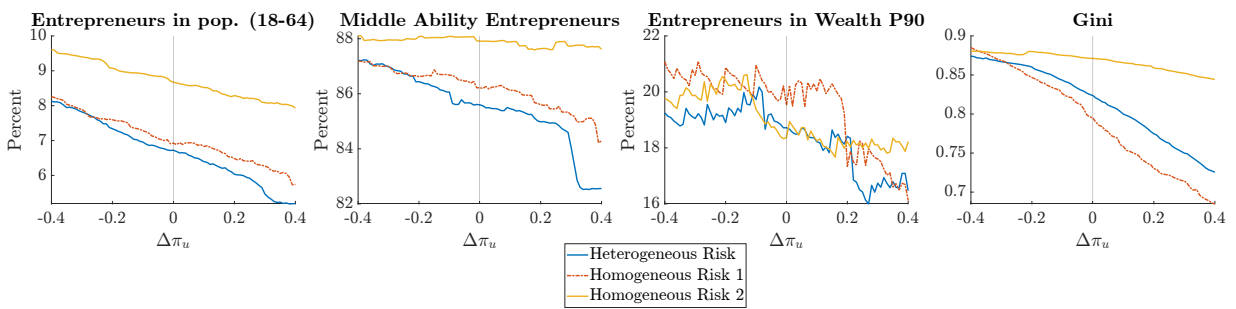
³⁷This value falls within the range reported in studies based on U.S. data, e.g., Kimball, Sahm and Shapiro (2009), Kimball, Sahm and Shapiro (2008).

³⁸In our counterfactual scenarios, we fix the tax rate at 31.7; rebalancing it would not meaningfully affect the results.

2.7.1 Increased Risk of Doing Business

We have argued all along that agents' risk attitude matters for individual choices and also for aggregate outcomes. In this section, we use our occupational choice model to investigate how a change in the riskiness of doing business affects the economy. To be specific, we vary the risk of going out of business, π_u , in the range of $\pm 40\%$ around its calibrated value of 0.15 and trace out the resulting changes in the quantitative importance of entrepreneurs as well as wealth inequality. We do so for our benchmark model (dashed blue line), and also for the two versions with homogeneous preferences, each (dashed orange line for $\sigma=6.49$ and solid yellow line for $\sigma=2$).

Figure 2.8 – Selected Model Outcomes by Varying π_u



Notes: Outcomes are deviations from the steady-state of our benchmark model (see Table 2.12). They originate from varying the risk of business failure, π_u , around its calibrated value 0.15 and imposing heterogeneous or homogeneous risk preferences, respectively. Markets always clear.

Figure 2.8 displays in four panels from left to right the resulting changes in the share of entrepreneurs (i) in the working-age population, (ii) with an intermediate ability level, (iii) in the top decile of the wealth distribution, and (iv) the wealth Gini of the total population. A few facts stand out. Except for when the risk of business failure is extremely low, under heterogeneous risk preferences, all shares of entrepreneurs are smaller and also more sensitive to a change in π_u than when risk preferences are homogeneous. These patterns reflect the underlying occupational sorting across asset levels for all agents, as well as across risk types when risk preferences are heterogeneous.

To understand this sorting better, recall that the distribution of risk preferences featured in our benchmark model is strongly right-skewed with the mean exceeding the median (see Table 3.2). We also know from Figure 2.7 that the less risk averse agents are, the fewer assets they accumulate before entering entrepreneurship and the longer they remain in business. Hence, it is not surprising that in steady state, the share of entrepreneurs is lowest in our benchmark model: risk-tolerant agents' savings are relatively low, while highly risk-averse agents avoid self-employment altogether—even when business risk varies. In contrast, when all agents are gamblers with a σ equal to 2, the share of entrepreneurs in the working-age population and that of entrepreneurs with an intermediate ability are significantly larger than in the other two preference scenarios. Moreover, these shares are the least sensitive to changes in the risk of doing business, simply because risk-prone entrepreneurs are least deterred by rising risk. For similar reasons, the share

of entrepreneurs whose wealth lies in the top decile is most resilient to changing business risk. Finally, the wealth Gini for the entire population decreases with a rise in business risk, since entrepreneurship becomes less attractive under all preference scenarios considered. However, this decline is weakest if all agents are risk-prone, and strongest if everyone is rather risk-averse. In the former case, precautionary savings are low, whereas the typical firm size tends to be large. The opposite holds true in the latter scenario. With additional occupational sorting by risk preferences, our benchmark model delivers a wealth Gini that lies between these two extremes.

2.7.2 Introduction of the €1 GmbH in Germany

In this subsection, we examine a real-world reform that resembles an insurance mechanism for entrepreneurial risk. In our model, agents cannot insure against business failure. If this happens, they lose a positive fraction κ of their assets. In many countries, legal structures are in place that act as an insurance device against personal liability in case a business fails. A common example are limited liability companies (LLC), designed to make entrepreneurship more accessible. In Germany, they are called *GmbH*. In 2008, the country launched a simplified version which is officially called *Unternehmergesellschaft (UG)*, but commonly referred to as "*€1-GmbH*". Unlike a traditional *GmbH*, which requires a minimum share capital of €25,000, the UG allows businesses to be established with as little as €1 in share capital. However, UGs are legally obligated to allocate a share of annual profits to a reserve until the standard minimum capital requirement of €25,000 is fulfilled. The main motivation for launching this new legal form was to facilitate entrepreneurship for sole proprietors by reducing the financial barrier to entry and also the downside risk of doing business.³⁹ In the context of our model, this policy has the potential to reduce the importance of an individual's willingness to take a risk for transitioning to self-employment.

In this section, we quantitatively assess the implications of this policy. To do so, we empirically re-estimate the importance of our risk measure for transitioning to self-employment after the introduction of the "*€1-GmbH*". Then we mimic limited liability in our benchmark model by varying the fraction of capital loss if entrepreneurs go out of business. This allows us to analyze the implications this insurance policy has for occupational sorting in general and the rate of young entrepreneurs in particular.

Empirical Investigation

Below, we estimate the effect that the launch of the *€1-GmbH* in 2008 has had on the individual probability of transitioning to self-employment. We augment Equation 2.1 by an interaction term that interacts our measure of risk tolerance with a shift-dummy that takes the value 1 starting in 2008. We include time-fixed effects to account for year-specific shocks, such as the Great

³⁹According to the KfW's *Entrepreneurial Monitor*, more than two-thirds of all young entrepreneurs are sole proprietors. They are personally liable for any losses they incur. Figure A.2.7 in Appendix A.2.4 shows that the share of "*€1-GmbH*" equals about 16 percent of all newly founded LLCs in a given year, while the overall share of LLCs among new businesses has steadily increased.

Recession, that may affect all observations in a given year.⁴⁰

Table 2.14 reports both the coefficients of the logistic regression and the average marginal effects. Prior to the reform in 2008, an increase in the willingness to take a risk increased the transition probability by 0.21 pp. This effect has dropped to 0.11 pp since the *€1 GmbH* was introduced. This significant reduction in the AME shows how much insurance against private liability matters for the decision to become self-employed. Put differently, by limiting individual liability, an individual's risk attitude becomes significantly less relevant for starting a business. This result aligns with the findings of [Klapper, Laeven and Rajan \(2006\)](#), who use the European Amadeus database to empirically document that higher costs associated with meeting regulatory requirements for establishing a limited liability company hinder firm entry.

Table 2.14 – Risk aversion and the €1-GmbH reform: Model Summary

	Model (8)	Model (8) AME	Model (1) AME
Willingness to take risks	0.30 (0.04)***	0.0021 (0.0003)***	0.0015 (0.0002)***
Interaction:Willingness to take risks*LLC	−0.13 (0.06)**	−0.001 (0.0004)**	
Constant	−23.19 (1.52)***		
Fixed effects	Year + Sector		
Number of transitions to S	1,087		
Observations	137,214		
Log Likelihood	−4,544.96		
Akaike Inf. Crit.	9,217.93		
pseudo R ²	0.168		

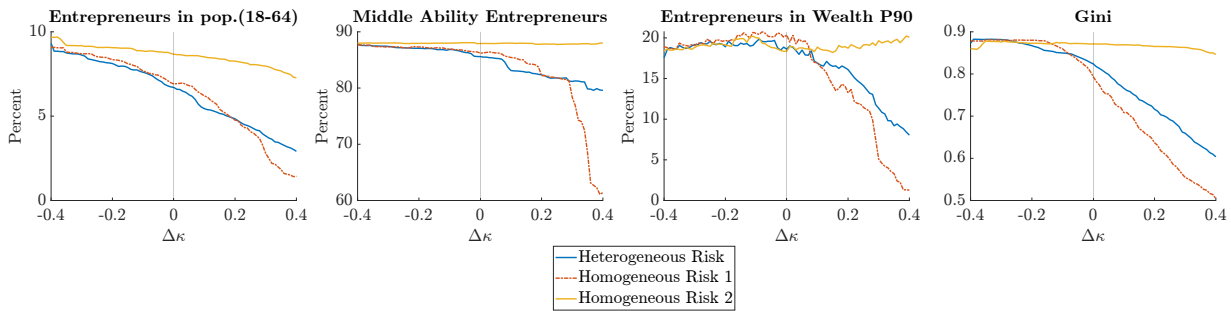
Note: * $p < 0.1$; ** $p < 0.05$; *** $p < 0.01$. The dependent variable is the individual probability of transition to self-employment from employment. The complete list of controls used in the regressions is identical to those reported in Table 2.6.

Model-based Analysis

To investigate the effect that varying levels of insurance against capital loss in case of business failure have for entrepreneurship and the implied wealth distribution, we vary κ continuously in the range $\pm 40\%$ around this parameter's calibrated value of 0.456. Figure 2.9 displays in four panels from left to right the resulting changes in shares of entrepreneurs (i) in the working-age population, (ii) with an intermediate ability level, (iii) in the top decile of the wealth distribution, and (iv) the wealth Gini of the total population. It does so for the three preference scenarios we consider.

All entrepreneurial shares are sensitive to a changing cost of business failure, κ , but the sensitivity is smallest if all agents are risk-prone. Moreover, as κ becomes very small, all entrepreneurial shares rise, and they rise to a similar level across the different risk types. Hence, entrepreneurship becomes more attractive, and the lower the fraction of capital lost in the event of failure, the less agents' risk attitudes influence their occupational choices.

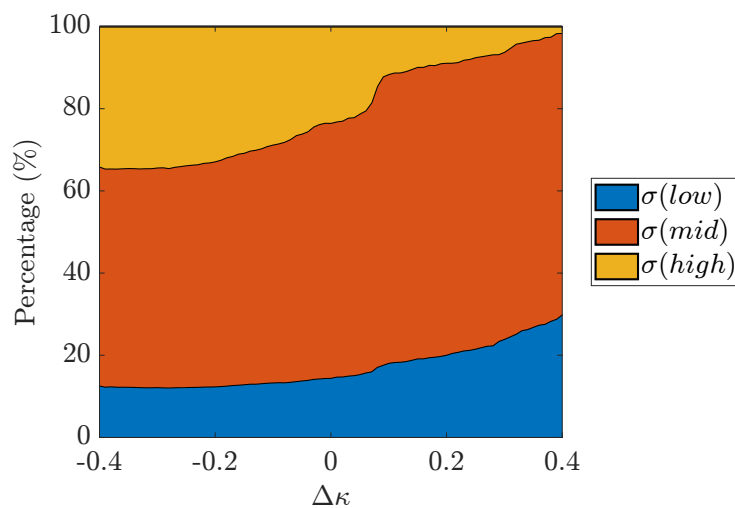
⁴⁰Note that the time-fixed effects absorb the shift-dummy itself, as it varies only over time.

Figure 2.9 – Selected Model Outcomes by Varying κ 

Notes: See Figure 2.8. Outcomes originate from varying the share of lost capital, κ , around its calibrated value 0.456 and imposing heterogeneous or homogeneous risk preferences, respectively. Markets always clear.

These developments are mirrored in the way the wealth Gini responds to changes in κ . As κ increases, wealth inequality declines, as fewer agents enter entrepreneurship and existing entrepreneurs face greater wealth losses in the event of failure. These dynamics are strongest when all agents are risk-averse and weakest when everyone is risk-prone. As discussed earlier, that's because a high degree of risk aversion lets agents withdraw from entrepreneurship well before others if failure becomes very costly. They accumulate much less capital than risk-prone agents. As heterogeneous preferences introduce an extra dimension of occupational sorting, the reaction of the Gini to a change in κ is more gradual than under homogeneous preferences. Figure 2.7 illustrates the entry and exit behavior by asset levels for alternative risk types. The strong aggregate responses are also due to the fact that a larger mass of entrepreneurs is concentrated in the wealth bins where middle and low risk aversion types are active, as shown in Table 2.13.

Figure 2.10 – Composition of Entrepreneurs by Degree of Risk Aversion



Notes: See Figure 2.9.

Finally, we address the question of who benefits most from liability insurance. Figure 2.10 depicts the changing composition of entrepreneurs by risk types as κ varies. The area left of $\Delta\kappa = 0$ corresponds to an environment with increasing liability insurance for entrepreneurs. As the level of insurance rises, the share of risk-averse agents increases most notably, up to a third of

all entrepreneurs, whereas the other shares slightly decrease. Hence, having access to insurance against personal liability tilts the occupational choice of risk-averse agents more towards self-employment than that of others. In other words, when the cost of business failure is lower, risk aversion plays a smaller role in determining occupational choice.

Taken together, our counterfactual exercises highlight why modeling heterogeneous risk aversion matters. Unlike with homogeneous risk preferences, where predictions are driven by the specific choice of σ , our model aligns the distribution of risk preferences with the data. This allows for more refined and empirically grounded predictions of occupational choices and macroeconomic responses to policy changes.

2.8 Conclusion

In this paper, we subject the conventional view that one's willingness to take risk matters for starting and succeeding with one's own business to a thorough quantitative investigation. We provide new evidence from the German Socioeconomic Panel (GSOEP) on the empirical distribution of individuals' willingness to take risk and find that future self-employed tend to be more risk-prone than individuals who remain workers throughout their professional life. We combine these risk measures with individual wealth for the workforce in Germany and empirically assess how important individual risk aversion is for selection into self-employment and the business' survival probability following entry. Our estimation results strengthen the view that risk aversion is a decisive determinant of individuals who choose to become self-employed. Risk aversion also matters for the implied wealth distribution: It is more equally distributed as agents turn more risk-averse, requiring more assets before entering business and staying for a shorter period than risk-prone individuals.

To interpret these findings and explore their macroeconomic relevance, we extend a canonical model of occupational choice by Epstein-Zin preferences and empirically grounded heterogeneity in risk attitudes. This framework allows us to disentangle risk aversion from intertemporal substitution and to quantify how risk preferences interact with individual wealth and ability to shape entrepreneurial entry and success. Our structural analysis highlights that self-employment is most attractive to individuals who are either less risk-averse, more talented, or wealthier.

We use the model to evaluate how changes in the business environment, such as heightened entrepreneurial risk or policies that reduce liability, affect entry into self-employment, the composition of entrepreneurs, and wealth distribution. Under increased business risk, entry rates fall, and the entrepreneur pool becomes more positively selected based on ability and risk tolerance, raising the average quality of entrants while reinforcing wealth concentration. In contrast, policies that reduce downside risk, such as limited liability reforms, broaden the entrepreneur base by encouraging entry from more risk-averse individuals, with limited deterioration in the average quality of entrants.

However, our findings reveal an important trade-off. While insurance-type policies increase

participation in entrepreneurship, particularly for the risk-averse, these individuals tend to stay in business for shorter periods and accumulate less wealth. As a result, such policies can unintentionally raise aggregate wealth inequality by expanding the lower tail of entrepreneurial outcomes without significantly altering the upper tail. A comprehensive welfare assessment of these policies that improve access but may also reinforce inequality, is therefore complex and beyond the scope of this paper.

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CHAPTER 2:
APPENDIX

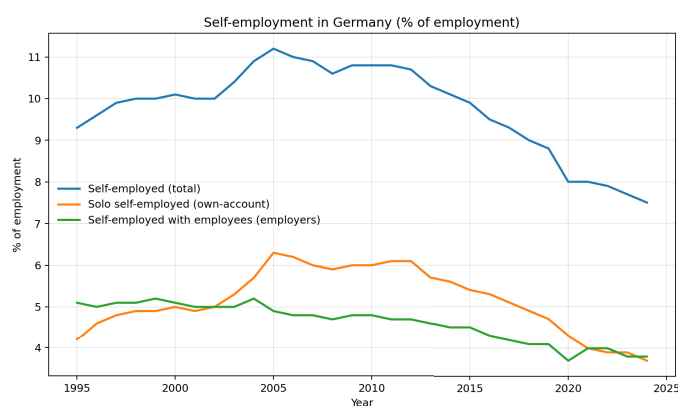
A.2 Appendix

A.2.1 *Mikrozensus* Data

The Stock of Self-Employed Across Time and by Occupations in 2019

The next figure depicts the dynamics of self-employment in Germany between 1995 and 2024.

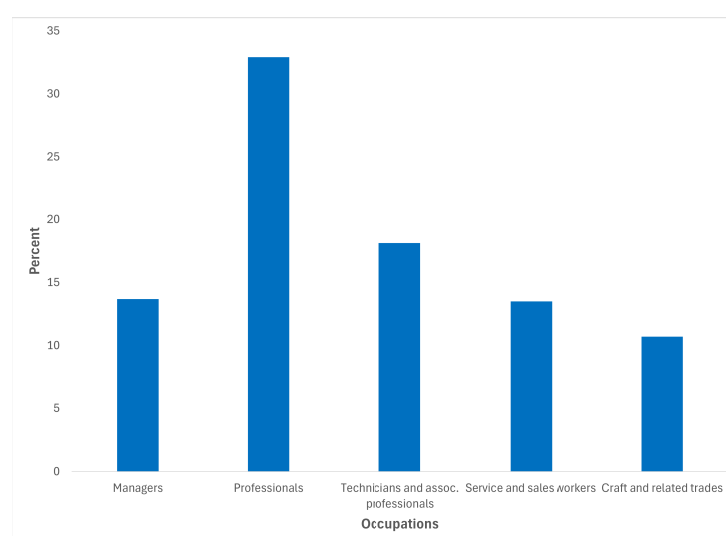
Figure A.2.1 – Self-Employed across Time in Germany



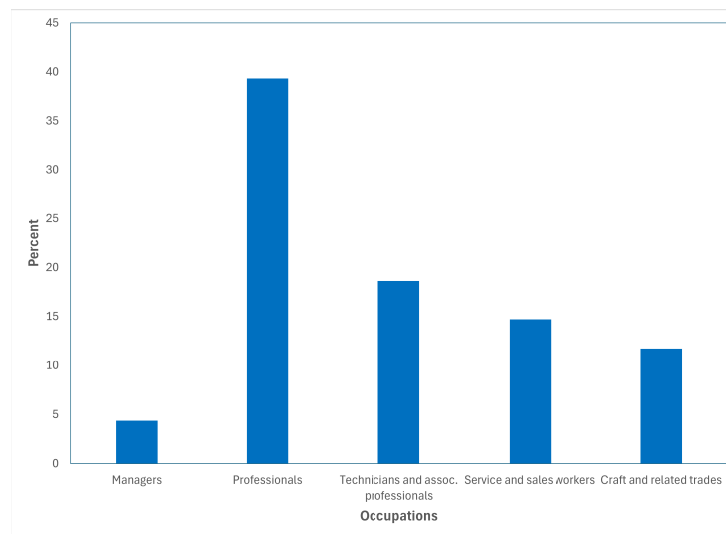
Notes: The underlying data are taken from Eurostat. They originate from the German *Mikrozensus*, a representative annual household survey of the population in Germany that is compiled by Statistisches Bundesamt, Wiesbaden.

The figures below show the distribution of the stock of all self-employed and solo self-employed, respectively, by occupations in 2019.

Figure A.2.2 – Self-Employed by Occupations as Shares of all Self-Employed in 2019



Notes: See Figure A.2.1. Percentages refer to the share of self-employed in the listed occupations relative to all self-employed. Occupations correspond to the categories O1-O8 from ISCO88.

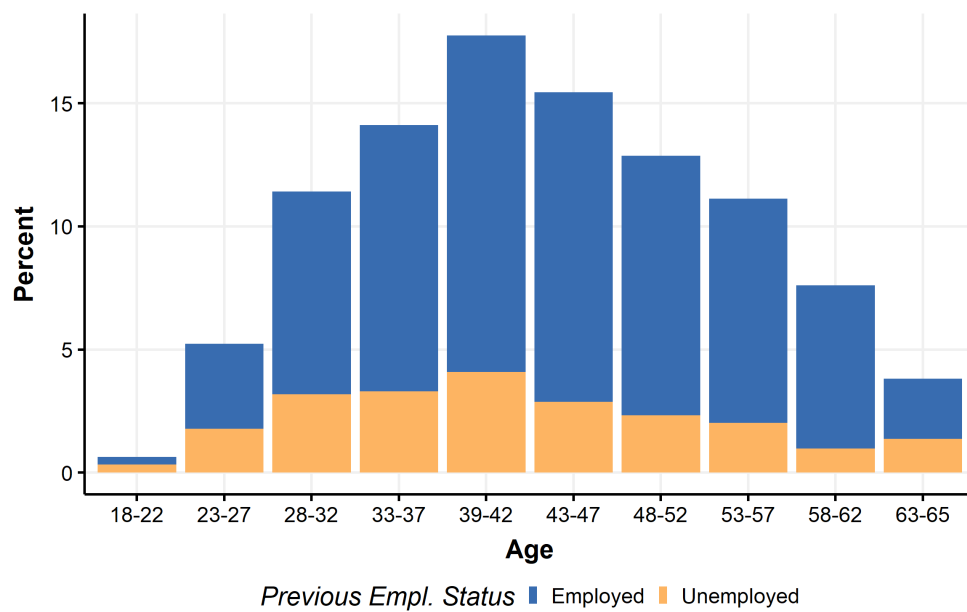
Figure A.2.3 – Solo Self-Employed by Occupations as Shares of all Solo Self-Employed in 2019

Notes: See Figure A.2.2.

A.2.2 SOEP Data

Age Distribution of Founders

Figure A.2.4 shows the age distribution of founders in our sample. Almost 20% of all founders are between 39 and 42 years old.

Figure A.2.4 – Age Distribution of Founders

Notes: The percentage refers to the share of founders in a specific age range out of all founders in our sample. They either transitioned from employment or from unemployment.

Net Wealth of Surviving Founders

Table A.2.1 depicts the net wealth of surviving founders. The table presents the mean, median, and standard deviation of net wealth for founders who remained self-employed, disaggregated by founding cohort, and observed at different points in time. This allows for a comparison to the net worth of all founders illustrated in Table 2.4 and over time.

Table A.2.1 – Surviving Founders' Net Wealth

Founded in	Year	Population	Mean	Median	Standard Deviation
2003	2002	27	497,989	86,651	1,232,170
	2007	17	900,482	424,657	1,160,527
	2012	15	1,737,019	1,411,492	1,801,254
	2017	11	1,224,156	369,950	1,503,524
2008	2007	48	221,822	136,164	259,372
	2012	25	210,857	70,530	26,241
	2017	15	450,518	328,358	557,137
2013	2012	125	191,451	67,579	386,554
	2017	53	527,666	131,940	476,769

Notes: Wealth is denoted in real €(2015=100). Similar to Figure 2.2 reported values relate to all founders at any age. The information is aggregated for both types of founders. Population refers to the number of founders who are still self-employed in the indicated year.

Variation in the Willingness to Take Risks

We assume that risk preferences are time-invariant at the individual level, allowing us to pool data across years.⁴¹ This significantly increases our sample size, as we no longer lose observations from years in which this question was not included in the SOEP. To justify this assumption, this subsection checks how much the individual willingness to take risks actually varies over time.

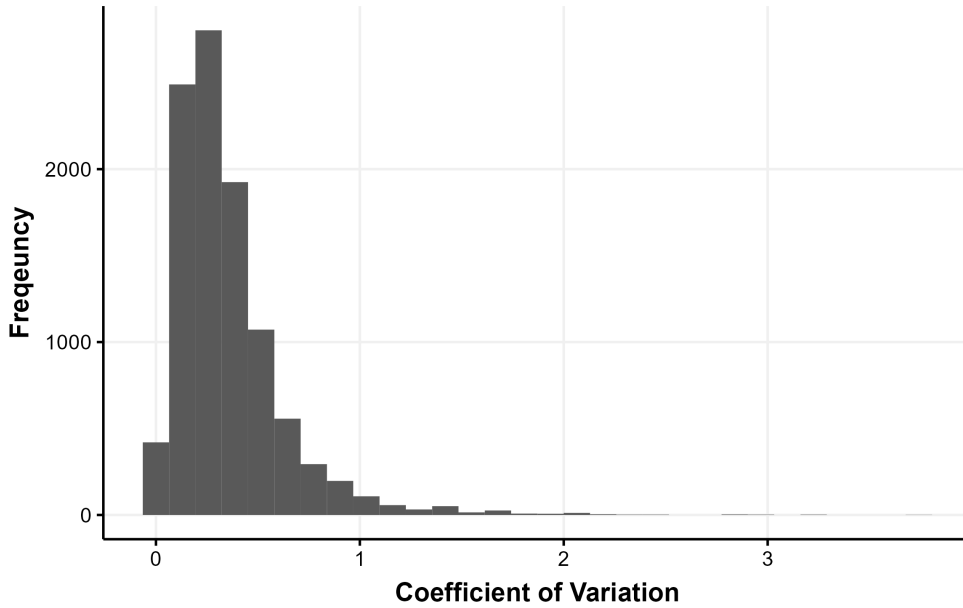
We provide two different indicators that suggest that the variation at the individual level is moderate. First, Figure A.2.5 reports the frequency of individual coefficients of variation for the variable willingness to take a risk.

$$CV_i = \frac{\eta_i}{\mu_i} \quad (\text{A.2.1})$$

where CV_i is the coefficient of variation, η_i is the standard deviation and μ_i is the individual time average.

⁴¹See Schildberg-Hörisch (2018) for a discussion on the stability of risk preferences over time.

Figure A.2.5 – Distribution of the Coefficients of Variation of Willingness to Take Risks



Notes: This figure plots the frequencies of the coefficient of variation for the willingness to take risks at the individual level.

Figure A.2.5 shows that most of the CV_i 's are below 0.5 indicating a low variation on the individual level.

As an alternative measure of variability, we calculate the intra-class correlation coefficient (ICC) using a mixed-effects model.

$$Risk_{i,t} = \mu + \alpha_i + \epsilon_{i,t} \quad (\text{A.2.2})$$

where $Risk_{i,t}$ is the individual and time-specific willingness to take risks, μ is the population average, α_i is the random effect of individual i , and $\epsilon_{i,t}$ is unobserved noise. From this mixed effects model, the ICC can be derived as follows:

$$ICC = \frac{\sigma_\alpha^2}{\sigma_\alpha^2 + \sigma_\epsilon^2} \quad (\text{A.2.3})$$

where σ_α^2 is the variation of α_i and σ_ϵ^2 is the variation of $\epsilon_{i,t}$. Using Equation A.2.3, we find an $ICC = 0.524$, which indicates modest stability at the individual level.

Correlation across Risk Measures

Table A.2.2 illustrates correlations across all available measures of risk in the GSOEP. Correlations are positive and sizable across domains—typically around 0.5, which is generally consistent with a common risk-attitude component. The correlation with the lottery investment share is more modest (about 0.26).

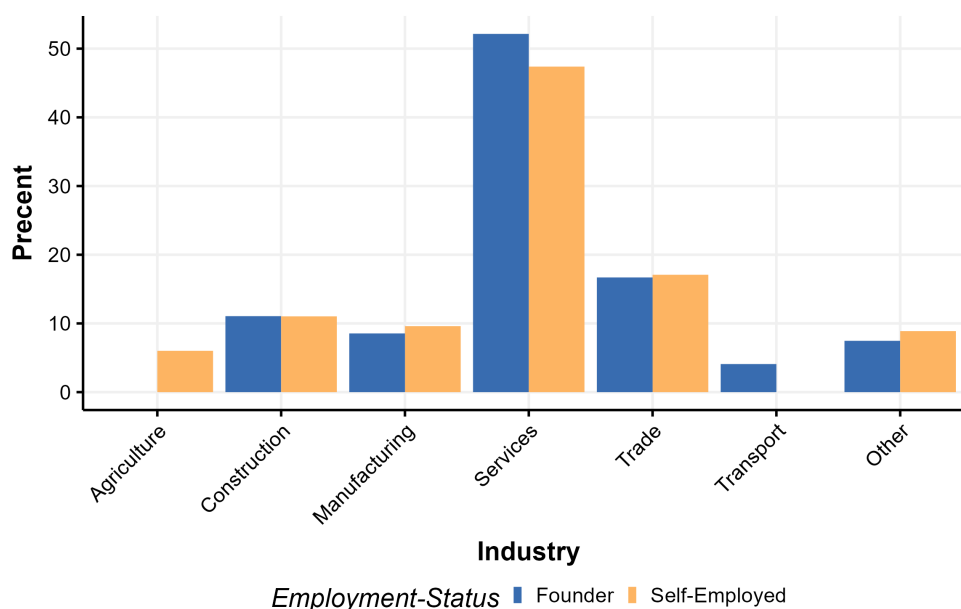
Table A.2.2 – Weighted correlations among risk attitudes, incl. lottery share

	Correlation matrix						
	General risk	Driving	Financial	Leisure	Career	Health	Lottery
General risk	1.000						
Car driving	0.480	1.000					
Financial matters	0.478	0.503	1.000				
Sports/Leisure	0.538	0.562	0.487	1.000			
Career	0.543	0.500	0.476	0.606	1.000		
Health	0.374	0.323	0.364	0.358	0.370	1.000	
Lottery investment (share)	0.262	0.194	0.303	0.206	0.197	0.182	1.000
Mean (weighted)	4.484	3.005	2.179	3.336	3.362	3.303	0.115
Observations (complete cases)	140,105						

Notes: Household-weighted Pearson correlations between stated variables. *Lottery* denotes the reported lottery investment (as a share), which is coded from the lottery question (plh0203) as a fraction of €100,000 (1 = invest all; 0 = invest nothing).

Sectors of Self-Employed

This subsection reports on the sectors in which self-employed and founders are active. We report the 1-digit industry code provided in the SOEP.

Figure A.2.6 – Industry Distribution by Employment-Status

Notes: Self-employed corresponds to the stock of self-employed individuals for whom we do not record a transition in our sample. Founder captures the flow of young entrepreneurs.

Figure A.2.6 reports the sectors for the stock and the flow of self-employed. We explicitly report the top 5 industries and aggregate the rest into *Other*. The percentage of entrepreneurs in the

sectors is very similar between the two groups. However, for self-employed agriculture is the fifth most popular sector, while for founders it is transport.

A.2.3 Evidence on Business Returns, Self-Employment Income and Business Assets

This subsection presents summary statistics and dispersion measures for self-employed individuals in Germany, derived from the Household Finance and Consumption Survey (HFCS) provided by the European Central Bank. Statistics are reported for self-employment income/entrepreneurial earnings (variable DI1200) and business assets (variable DA1200) from the second wave (2014) of the HFCS.^{42,43} Following [Cagetti and De Nardi \(2006\)](#), business returns are calculated as the ratio of self-employment income to business assets. All values are weighted using the cross-sectional household weight (HW0100) and are deflated using the Consumer Price Index (CPI). We use the 90th-to-median percentile ratio, the ratio of the mean to the median, and the ratio of the standard deviation to the median for self-employment income, as well as the ratio of the standard deviation to the mean for business assets, as targets in our model calibration (all marked in bold; see also Table 3.4).

Table A.2.3 – Summary Statistics

Statistic	Mean	Median	Std	P90/P50	Mean/Median	Std/Mean
Entrepreneurial Earnings	56.60	28.00	97.48	4.29	2.02	1.72
Business Assets	299.16	22.00	1,052.19	31.91	13.60	3.52
Business Returns	20,457.73	101.74	784,853.46	19.66	201.07	38.36

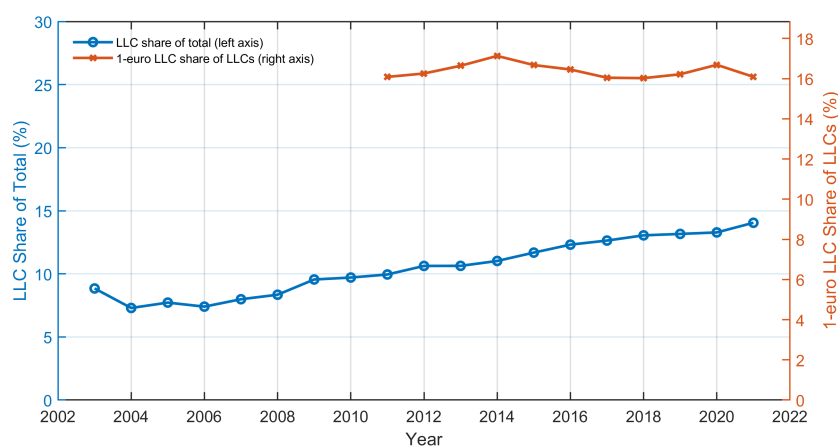
Note: This table displays summary statistics of business returns, self-employment income, and business assets for self-employed individuals in Germany, based on data from the Household Finance and Consumption Survey (HFCS, wave 2 for the year 2014). Business returns are calculated as the ratio of self-employment income (DI1200) to business assets (DA1200). All values are deflated to 2020 euros and weighted using household weights.

A.2.4 Development of Limited Liability Companies in Germany

Figure A.2.7 shows the share of Limited Liability Companies (LLCs) as a percentage of total new businesses between 2003 and 2021, as well as the share of 1-euro LLCs among all LLCs (as discussed in our counterfactual analysis in Section 2.7). We observe a steady increase in the share of LLCs, rising by approximately 6 percentage points over this period. The share of "1-euro GmbHs", which is available from 2011 onwards due to data limitations, accounts for more than 16 percent and remains relatively stable over time.

⁴²Self-employment income is defined as the total gross income (profits or losses) from unincorporated enterprises earned by all household members over the last 12 months.

⁴³Business assets include real estate properties used for business activities and the total value of self-employed business wealth.

Figure A.2.7 – Development of LLC and 1-euro LLC Shares Over Time

Data Source: Gründungsstatistik (KfW Gründungsmonitor), Business registrations (annual averages over monthly data) by legal form for Germany, 2003-2021.

A.2.5 Imputations

Wealth

Since the SOEP only provides detailed wealth data in 2002, 2007, 2012, and 2017 we impute household wealth between the waves using information on household capital income that is available at a yearly frequency. We illustrate our strategy using information for the years 2002 and 2003,

$$\text{Net Wealth}_{2003} = \text{Net Wealth}_{2002} + \text{Capital Gain}_{2003} \quad (\text{A.2.4})$$

we have to do this for all years in between waves for which we have information on wealth. Since this method is rather simple, we define wealth groups and assign each household to one. With these coarser groups, our imputation can approximate the households' wealth group reasonably well.

Table A.2.4 – Wealth Groups

Wealth Group	Interval
1	Debt
2	[0 – 1,000)
3	[1,000 – 5,000)
4	[5,000 – 15,000)
5	[15,000 – 50,000)
6	[50,000 – 200,000)
7	[200,000 – 700,000)
8	[700,000 +)

Table A.2.5 reports the difference between imputed and actual wealth groups of households in 2007, 2012, and 2017. On average, our imputation is very close to the actual wealth group in all

three years for which we conducted this consistency check.

Table A.2.5 – Difference between Imputed and Actual Wealth Groups

	2007	2012	2017
Difference	-0.058	0.015	0.004

Data: SOEP. The difference is the average distance between the wealth groups to which our imputation assigned households and their actual wealth groups.

A.2.6 Voluntary Self-Employment

This subsection describes how we define the variable voluntary self-employment, which is used in the estimation for transitions from unemployment to self-employment. With this variable we want to control for occupation groups that may not transition to self-employment because they have an intrinsic motivation for self-employment, but because it is common practice in their occupation. One example would be a taxi driver, who might prefer employment but the norm in this occupation is self-employment. Table A.2.6 reports how we classify the ISCO-88 occupation codes into those we believe to be voluntary self-employment and those we believe not to be.

Table A.2.6 – Classification of Occupations

Voluntary	Involuntary
11 Legislators and senior officials (all subgroups)	214 Architects, engineers and related professionals
12 Corporate managers (all subgroups)	222 Health professionals (except nursing)
13 Managers of small enterprises (all subgroups)	223 Nursing and midwifery professionals
211 Physicists, chemists and related professionals	245 Writers and creative or performing artists
212 Mathematicians, statisticians and related professionals	341 Finance and sales associate professionals
213 Computing professionals	342 Business services agents and trade brokers
221 Life science professionals	346 Social work associate professionals
23 Teaching professionals (All subgroups)	347 Artistic, entertainment and sports associate professionals
241 Business professionals	513 Personal care and related workers
242 Legal professionals	514 Other personal services workers
243 Archivists, librarians and related information professionals	521 Fashion and other models
244 Social science and related professionals	61 Skilled agricultural and fishery workers (all subgroups)
246 Religious professionals	712 Building frame and related trades workers
247 Public service administrative professionals	713 Building finishers and related trades workers
31 Physical and engineering science associate professionals (all subgroups)	714 Painters, building structure cleaners and related trades workers
32 Life science and health associate professionals (all subgroups)	72 Metal, machinery and related trades workers (all subgroups)
33 Teaching associate professionals	73 Precision, handicraft, craft printing and related trades workers (all subgroups)
343 Administrative associate professionals	74 Other craft and related trades workers (all subgroups)
344 Customs, tax and related government associate professionals	832 Motor vehicle drivers
345 Police inspectors and detectives	833 Agricultural and other mobile plant operators
348 Religious associate professionals	834 Ships' deck crews and related workers
41 Office clerks (all subgroups)	911 Street vendors and related workers
42 Customer services clerks (all subgroups)	912 Shoe cleaning and other street services elementary occupations
511 Travel attendants and related workers	913 Domestic and related helpers, cleaners and launderers
512 Housekeeping and restaurant services workers	914 Building caretakers, window and related cleaners
516 Protective services workers	915 Messengers, porters, doorkeepers and related workers
522 Shop, stall and market salespersons and demonstrators	92 Agricultural, fishery and related laborers (all subgroups)
711 Miners, shotfirers, stone cutters and carvers	93 Laborers in mining, construction, manufacturing and transport (all subgroups)
81 Stationary plant and related operators (all subgroups)	
82 Machine operators and assemblers (all subgroups)	
831 Locomotive engine drivers and related workers	
916 Garbage collectors and related laborers	
010 Armed forces	

A.2.7 Robustness: Single Transition Subsample

In this section, we rerun our empirical models with a restricted sample that features individuals who transition to self-employment only once during our period of observation, resulting in

N=859 single transitions. This robustness exercise ensures that the effects we find are not driven by individuals who transition to self-employment multiple times. The estimation results remain qualitatively unchanged, but several parameter estimates slightly increase in absolute value.

Table A.2.7 – Model Summary

	Model 1	Model 2	Model 3	Model 4	Model 5	Model 6	Model 7
Age	0.04 (0.05)	0.04 (0.05)	0.04 (0.05)	0.04 (0.06)	0.07 (0.09)	0.10 (0.13)	-0.07 (0.10)
Age ²	-0.0002 (0.001)	-0.0002 (0.001)	-0.0002 (0.001)	-0.0002 (0.001)	-0.0004 (0.001)	-0.001 (0.001)	0.001 (0.001)
Education completed (years)	0.13 (0.03)***	0.21 (0.07)***	0.13 (0.02)***	0.16 (0.03)***	0.11 (0.04)**	0.05 (0.08)	0.14 (0.05)***
Female	-0.53 (0.14)***	-0.53 (0.14)***	-0.54 (0.14)***	-0.55 (0.15)***			
LMS	-1.22 (0.29)***	-1.21 (0.29)***	-1.64 (0.71)**	-1.37 (0.34)***		0.24 (0.74)	
Household net income (log)	0.32 (0.11)***	0.33 (0.11)***	0.32 (0.11)***	0.40 (0.13)***	0.10 (0.15)	0.35 (0.26)	0.12 (0.17)
Migration background	0.30 (0.14)**	0.31 (0.14)**	0.29 (0.14)**	0.47 (0.17)***	-0.21 (0.26)	0.05 (0.39)	-0.38 (0.33)
Net wealth > 700K	1.03 (0.19)***	1.04 (0.19)***	1.03 (0.19)***	0.93 (0.22)***	1.53 (0.45)***	2.76 (0.65)***	1.34 (0.63)***
Number of children					0.01 (0.10)	0.22 (0.15)	0.14 (0.12)
Parents self-employed	0.65 (0.14)***	0.65 (0.14)***	0.65 (0.14)***	0.82 (0.17)***			
Self-employed voluntary					1.21 (0.32)***	1.33 (0.48)***	1.33 (0.45)***
Tenure at last employer (years)	-0.16 (0.02)***	-0.16 (0.02)***	-0.16 (0.02)***	-0.14 (0.02)***	0.01 (0.02)	-0.07 (0.03)**	0.02 (0.02)
Willingness to take risks	0.21 (0.03)***	0.42 (0.15)***	0.18 (0.06)***	0.12 (0.03)***	0.16 (0.06)***	0.26 (0.09)***	0.11 (0.06)*
Interaction risk:education		-0.02 (0.01)					
Interaction risk:LMS			0.08 (0.12)				
Constant	-22.53 (1.33)***	-23.67 (1.67)***	-22.28 (1.42)***	-23.73 (1.61)***	-7.34 (2.09)***	-7.64 (3.46)**	-4.99 (2.49)**
Fixed Effects	Year+Sector	Year+Sector	Year+Sector	Year+Sector	Year+Sector	Year+Sector	Year+Sector
Number of transitions to S	859	859	859	634	299	187	166
Observations	136,622	136,622	136,622	95,423	1,406	724	964
Log Likelihood	-3,858.72	-3,856.11	-3,858.10	-2,739.33	-561.95	-259.79	-330.45
Akaike Inf. Crit.	7,843.44	7,840.21	7,844.20	5,604.65	1,243.91	637.58	770.90
pseudo R ²	0.1584	0.1589	0.1585	0.1676	0.2129	0.2535	0.3052

Note: *p<0.1; **p<0.05; ***p<0.01

All models use the sample with individuals who transition to self-employment exactly once during our period of observation. Model 1-4: Transitions from employment (E) to self-employment (S), Model 5-7: Transitions from unemployment (U) to self-employment (S). Models 1-3 and 5-6 use the time-average of an individual's willingness to take risks. Models 4 and 7 use the willingness to take a risk *prior* to the transition. LMS denotes labor market success.

Table A.2.8 – Average Marginal Effects

	Model 1: E-S Transition	Model 5: U-S Transition
Age	0.0002 (0.0003)	0.0092 (0.012)
Age ²	-0.0000001 (0.000001)	-0.0001 (0.0001)
Education completed (years)	0.0008 (0.0001)***	0.015 (0.006)**
Female	-0.0031 (0.0008)***	
LMS	-0.0058 (0.0016)***	
Household net income (log)	0.0018 (0.0006)***	0.0142 (0.0205)
Migration background	0.0017 (0.0008)**	-0.0296 (0.0361)
Net wealth > 700K	0.0059 (0.0011)***	0.2127 (0.0614)***
Number of children		0.0014 (0.0143)
Parents self-employed	0.0037 (0.0008)***	
Self-employed voluntary		0.1684 (0.0437)***
Tenure at last employer (years)	-0.0009 (0.0001)***	0.0018 (0.003)
Willingness to take risks	0.0012 (0.0002)***	0.0229 (0.008)***

Note: *p<0.1; **p<0.05; ***p<0.01

Notes: All models use only individuals who transition to self-employment exactly once during our period of observation. Model 1 includes individuals who transitioned from employment to self-employment. Model 5 includes individuals who transitioned from unemployment to self-employment. LMS denotes labor market success.

A.2.8 Model

Parameters

Worker Productivity

$$\pi_y = \begin{pmatrix} 0.9235 & 0.075 & 0.0015 \\ 0.0375 & 0.925 & 0.0375 \\ 0.0015 & 0.075 & 0.9235 \end{pmatrix}$$

$$y = (0.3556 \quad 0.668 \quad 1.253)$$

The grid points are normalized such that the average productivity in the economy is one.

Mapping CRRA Parameter

The transformation of the ordinal willingness to take risks to the CRRA parameter follows [Dohmen et al. \(2011\)](#). The transformation includes four steps:

1. Utilize a lottery question in the SOEP where individuals were presented with the following

hypothetical scenario. They receive €100,000 now they have the opportunity to participate in a lottery in which with equal probability they either lose half their investment or double it. How much would they like to invest?

2. Calculate the average investment per willingness to take risks.
3. Calculate average liquid wealth per willingness to take risks.
4. Calculate the CRRA parameter using the following formula

$$\sigma_i = \frac{-\ln(0.5)}{\ln\left(\frac{wealth+100,000+investment}{wealth+100,000-0.5investment}\right)}$$

A.2.9 Distribution of Risk Aversion

Figure A.2.8 – Distribution of Risk Aversion

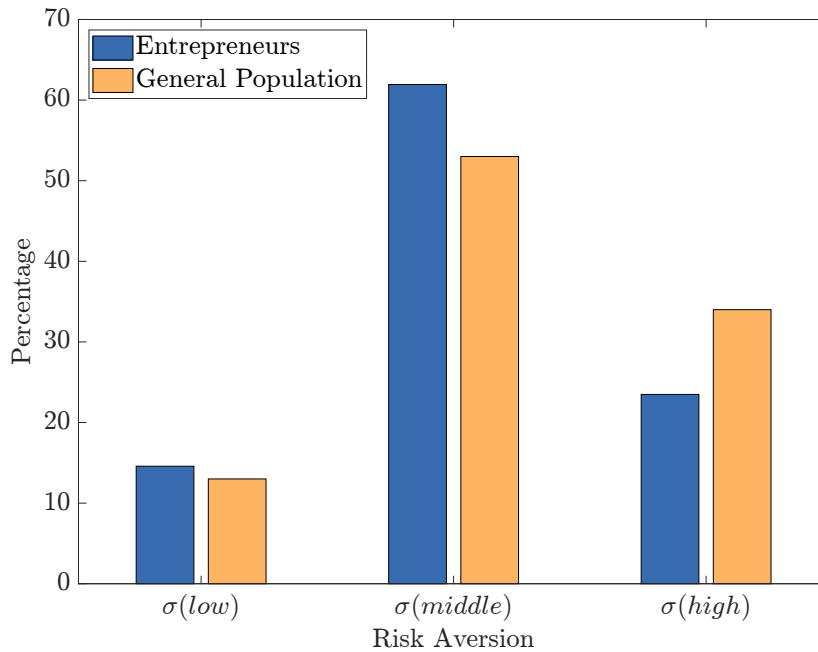


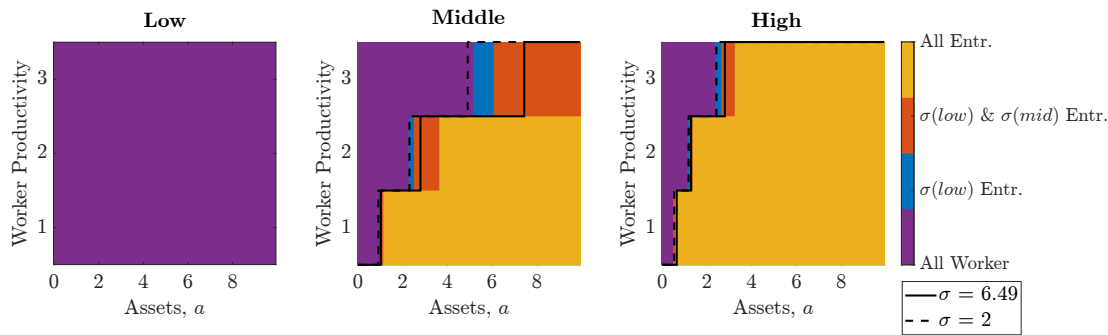
Figure A.2.8 highlights a central implication of our quantitative model regarding the role of individual risk preferences in occupational choice. Compared to the general population, risk-tolerant agents are more likely to be found among entrepreneurs, reflecting the fact that self-employment inherently involves greater income uncertainty. Similarly, agents with moderate risk aversion are also overrepresented among entrepreneurs, while those who are highly risk-averse are underrepresented, as they are more reluctant to accept the financial risks associated with entrepreneurship. This model prediction is consistent with the empirical evidence documented in Section 2.4 that individuals exhibiting lower risk aversion are more inclined to pursue self-employment than others.

A.2.10 Occupational Choice by Type

Figure A.2.9 illustrates occupational choices across the asset-productivity space for entrepreneurs with different levels of risk aversion. The three panels show the distribution of workers and entrepreneurs for the low, middle, and high risk aversion groups in our benchmark model. Individuals with low risk aversion never enter self-employment, while those with middle and high risk aversion do, but at different asset thresholds and productivity levels.

The figure also overlays occupational choices from two alternative scenarios with homogeneous risk aversion: Case 1 with high risk aversion ($\sigma = 6.49$) and Case 2 with low risk aversion ($\sigma = 2$). In Case 2, individuals transition to self-employment at very low asset levels, even earlier than the low-risk-aversion group in the benchmark model. In contrast, in Case 1, entry into self-

up.
Risk



Chapter 3

Business Risk, Taxation and Economic Welfare*

with Brigitte Hochmuth and Monika Merz

Abstract

How should a government tax business income when entrepreneurship is risky and imperfectly insurable, yet vital for output production and wealth accumulation? We study this question in a quantitative occupational-choice model where households differ in risk attitudes and face borrowing constraints. The government can impose a linear tax on profits and provide public insurance against capital losses at exit, with a labor income tax balancing the budget. If efficiency dominates equity concerns, low profit taxes and a generous loss insurance should encourage business entry financed through a high labor tax. Savings decrease, so not many individuals pass the entry threshold, yielding fewer but larger firms and greater wealth concentration. As equity concerns rise, higher profit taxes become optimal, supporting a broader but smaller-scale entrepreneurial sector. Abstracting from heterogeneous risk-aversion materially distorts optimal policy: it substantially overstates the business subsidy for an efficiency-oriented policymaker.

JEL Classification: D81, H21, H24, L26

Keywords: occupational choice, business failure risk, optimal taxation, public loss insurance, wealth inequality.

*Funding from the OeNB Jubiläumsfonds (grant number 18885) is gratefully acknowledged.

3.1 Introduction

Entrepreneurship is central to wealth accumulation, firm creation, and output production, but it exposes entrepreneurs to risks that are largely undiversifiable.¹ Business failure can destroy a substantial share of private wealth, and this downside risk, as well as the lack of diversification, cannot easily be smoothed through financial markets (Moskowitz and Vissing-Jørgensen, 2002). Governments therefore face the following policy problem: taxing entrepreneurial profits can redistribute resources and finance insurance, but it may discourage risk-taking, wealth accumulation, and entry into self-employment. Public insurance against business failure can encourage entrepreneurship by limiting downside exposure, but it must be financed through taxes that may affect workers' disposable income and households' ability to accumulate assets. The extent to which the optimal balance between these instruments depends on the distribution of risk preferences in the population remains an open question.

This paper asks how public policies should be designed to affect individual risk-taking in a world where agents differ in their risk attitudes, occupations differ in the level and riskiness of the associated income, and market insurance is absent if the goal is to maximize social welfare. We know since the work of Kihlstrom and Laffont (1979) and Kanbur (1981) that in such an environment, a market equilibrium is inherently inefficient. Policy can improve equilibrium efficiency by reducing distortions, while also reflecting the government's concern for redistribution. We let it tax earnings and profits and provide public insurance against capital losses upon business exit in its attempt to balance efficiency and equity concerns. Our analysis is novel in that it focuses on the design of optimal policy instruments in the presence of occupational risk when agents differ in their risk preferences.

We address this question in a computable binary-choice model of wage employment vs. self-employment, in which individuals differ in their risk attitudes and face borrowing constraints. Wage income is considered safe, whereas entrepreneurial income is risky because firms can fail, and exiting entails private wealth losses. Agents are assumed to know their innate risk preference. This assumption reflects the growing body of evidence that individual risk attitudes are heterogeneous, persistent over time (Schildberg-Hörisch, 2018), and consequential for economic decisions. The government observes individuals' employment status and income. It chooses a proportional profit tax and a partial insurance against capital losses upon an involuntary business exit to maximize the weighted sum of all individuals' permanent consumption. A linear tax on labor income adjusts endogenously to balance its budget. Weights vary with the chosen efficiency-equity trade-off: departing from an 'efficiency only' setting, we subsequently increase the weight on equity. To highlight the mechanism at work, we first conduct the analysis in a partial-equilibrium setting, holding the interest rate constant, and consider feedback effects from capital market clearing via a sensitivity analysis. As in Hochmuth, Merz and Prettenhaler (2025), we calibrate the heterogeneous risk preferences with individual data from the German

¹We subsequently use the terms entrepreneur and self-employed interchangeably.

Socio-Economic Panel.²

Our paper makes two contributions. First, we study the implications of income taxes and a public insurance against capital losses of entrepreneurs for risk-taking in an occupational choice model, and characterize optimal policies for alternative governmental objectives. In this setting, a linear profit tax reduces returns from doing business without altering the associated risk while a public loss insurance transfers a part of this private risk to the Treasury.³ Naturally, the optimal policy mix varies with the weight the policymaker assigns to efficiency vs. equity concerns. If efficiency considerations dominate, low or negative profit taxes combined with generous capital loss insurance encourage entrepreneurship. These policies are financed through high labor taxes which depresses disposable income and asset accumulation for much of the population. As a result, rather wealthy households clear the threshold and enter self-employment. The economy, therefore, features fewer but substantially larger firms and greater wealth concentration. As equity concerns rise, higher entrepreneurial taxes become optimal, reducing the yield from doing business and lowering the labor tax required for balancing the budget. Hence, the dispersion of the wealth distribution increases and a larger fraction of the population qualifies for self-employment which leads to a larger entrepreneurial sector with smaller-scale firms. We show that if entrepreneurship is crucial for risk-taking, public policies can influence the equity-efficiency trade-off by setting incentives for starting one's business in addition to redistributing market income.

Second, we demonstrate that abstracting from heterogeneous risk-aversion materially changes the optimal policy prescription. With homogeneous risk preferences, an efficiency-oriented policy sets a much larger entrepreneurial subsidy than in the benchmark economy with heterogeneous risk attitudes. Heterogeneous risk preferences generate differential savings behavior: more risk-averse households accumulate more wealth through precautionary saving and are therefore more likely to pass the entry threshold, even when entrepreneurial subsidies are modest. Removing this heterogeneity shuts down an important sorting margin due to risk attitudes and makes the policymaker rely more heavily on subsidies to induce business entry. Hence, calibrations based on a representative risk-preference parameter can mislead normative conclusions about the desirable level of entrepreneurial taxation.

The remainder of the paper is organized as follows. Section 3.2 reviews the related literature. Section 3.3 presents the model and its calibration to Germany. Section 3.4 presents the partial-equilibrium policy analysis: we characterize the optimal policy surface, trace the underlying mechanism through wealth accumulation and entry thresholds, quantify output foregone due to risk-driven occupational sorting, and show that abstracting from heterogeneous risk-aversion distorts optimal policy. Section 3.4.6 closes with a sensitivity check that imposes capital-market clearing (detailed in Appendix A.3.2). Section 3.5 concludes.

²Dohmen et al. (2011) use incentivized experiments to validate survey-based risk measures for the German population. They document systematic variation in risk attitudes. Hochmuth, Merz and Prettenhaler (2025) show that incorporating these heterogeneous risk measures in a quantitative occupational-choice model changes both the composition of the entrepreneurial sector and the wealth distribution.

³Profit tax schemes in the real world often allow for (partial) loss-offsetting which effectively introduces some public insurance against entrepreneurial losses.

3.2 Related Literature

This paper contributes to the literature on entrepreneurship, risk, and optimal taxation. The fiscal policy changes we study not only affect entrepreneurial returns, but also the extent of exposure to business risk. They influence savings, borrowing-constraint clearance, occupational choice, firm scale, and welfare. Thus, the paper relates to quantitative models of entrepreneurship and wealth accumulation, optimal taxation of risky entrepreneurial income, and occupational sorting under heterogeneous risk attitudes.

Our work foremost relates to the public finance literature that has examined positively and normatively how direct taxes interact with individual risk-taking. Implicitly assuming risk averse investors, [Domar and Musgrave \(1944\)](#) in their seminal paper establish that proportional income taxation reduces the yield and possibly also the risk involved in a project. Income taxes reduce risk if capital losses can at least be partially offset against capital gains so that the Treasury shares in a part of her private risk, thereby encouraging risk-taking. [Stiglitz \(1969\)](#) extends their analysis to wealth and capital-gains taxation and shows that the impact on individual risk-taking hinges on the extent of loss offsets via the tax system. Studies that investigate the implications of profit taxation for entrepreneurs' decisions about their financial structure typically assume them to be risk-neutral (see [Atkinson and Stiglitz \(1980\)](#)). Subsequent work applies this insight to entrepreneurial activity, emphasizing that policy affects risk taking through the joint treatment of upside returns and downside losses, see [Cullen and Gordon \(2007\)](#), [Gordon and Sarada \(2018\)](#), and [Haufler, Norbäck and Persson \(2014\)](#).

In the quantitative general-equilibrium branch of this literature started by Ramsey, and Diamond and Mirrlees, [Quadrini \(2000\)](#) and [Cagetti and De Nardi \(2009\)](#) show that entrepreneurship, borrowing constraints, and business ownership are central for understanding saving behavior and wealth concentration. [Meh \(2005\)](#) shows that whether the income tax is linear or progressive impacts the consumption-savings decision and has significant aggregate and distributional effects when entrepreneurship drives wealth inequality.

Building on the optimal taxation literature initiated by [Ramsey \(1927\)](#) and [Diamond and Mirrlees \(1971\)](#), [Scheuer \(2014\)](#) uses an occupational choice model to show that when agents have private information and differ in their preferences and skills, a differential income tax for workers and entrepreneurs dominates a uniform tax treatment in welfare terms. [Panousi and Reis \(2021\)](#) provide a unified analytical framework for optimal linear capital taxation under idiosyncratic, undiversifiable risk; in our setting, entrepreneurial profits and capital losses at exit are also undiversifiable, so their characterization offers a theoretical benchmark for the policy instruments we study. The closest structural predecessor to our work is [Boar and Knowles \(2024\)](#). They build a quantitative model with safe and risky investment projects, endogenous borrowing constraints, private information, and occupational choice. They calibrate the model to the U.S. economy and characterize jointly optimal linear taxes on wealth, capital, and labor income. Our paper differs in both mechanism and policy focus. We abstract from private information and instead isolate how entrepreneurial risk interacts with heterogeneity in risk aversion. This al-

allows us to study a distinct policy margin: the joint design of taxes on entrepreneurial returns and partial insurance against capital losses upon exit. Relative to [Boar and Knowles \(2024\)](#), who emphasize the insurance role of taxation, we quantify the effect of this insurance margin on savings, investment, occupational choice, and welfare in a heterogeneous-agent economy. Our contribution is to characterize the policy mix that balances risk sharing against distorted entrepreneurial incentives when households differ in their willingness to bear business risk.

3.3 Model

The fiscal problem is central in our occupational-choice economy. The government finances pension payments and partially insures entrepreneurs against capital losses at forced business exit. It chooses a proportional tax on entrepreneurial profits and a labor income tax on workers to fund its expenses. These policy instruments shape occupational choice, firm size, business survival, aggregate output, and wealth accumulation by affecting both the returns to entrepreneurship and the distribution of risk across households. On the household side, we build on [Hochmuth, Merz and Prettenthaler \(2025\)](#): agents differ in worker productivity, entrepreneurial ability, assets, and risk aversion, and repeatedly choose between wage work and self-employment. Relative to that earlier framework, our contribution is to endogenize and discipline the fiscal block, so that redistribution and insurance are explicitly financed and feed back into individual decisions and aggregate outcomes.⁴

Demographics and the Labor Market A unit mass of households lives in perpetual youth. At any point in time an agent is either of working age or retired. A working-age agent remains young with probability π_y , whereas a retiree survives into the next period with probability π_o and otherwise dies. There is no bequest motive, so the assets of deceased retirees are redistributed to the young in a way that preserves stationarity. While young, households decide every period whether to work for wages or to run a business, so occupational status is a recurring choice rather than a once-and-for-all entry decision.

Self-employment is exposed to involuntary exit risk. An active entrepreneur is forced out of business with probability π_u . Following such an exit, the household loses a fraction κ of assets and receives a public transfer b , defined as a fraction of the lowest wage in the economy. The policy parameter κ therefore measures residual private exposure after failure: lower κ implies more generous downside protection. This shock is quantitatively important and is meant to capture the low survival rates of young firms documented in [Hochmuth, Merz and Prettenthaler \(2025\)](#).

Preferences Preferences are central to the fiscal problem because taxes and failure insurance affect both the expected return to entrepreneurship and households' exposure to downside risk.

⁴In [Hochmuth, Merz and Prettenthaler \(2025\)](#), all young agents pay a flat tax equal to a proportional share of the lowest possible income. This tax finances pensions only, while compensation for failed entrepreneurs is effectively unfunded, since these transfers do not enter the government budget constraint.

We therefore allow households to differ in risk attitudes and retain [Epstein and Zin \(1989\)](#)'s preference structure, which separates risk aversion from intertemporal substitution. Each household is endowed with a fixed risk-aversion type σ_i , while the elasticity of intertemporal substitution, γ , is common across agents. Lifetime utility is given by

$$V(\sigma_i) = \left[c^{1-\frac{1}{\gamma}} + \beta \left(E[V'(\sigma_i)^{1-\sigma_i}] \right)^{\frac{1-\frac{1}{\gamma}}{1-\sigma_i}} \right]^{\frac{1}{1-\frac{1}{\gamma}}}, \quad (3.1)$$

where $\beta \in (0, 1)$ is the common discount factor, $\sigma_i > 0$, and $\gamma > 0$, with $\sigma_i \neq 1$ and $\gamma \neq 1$. This formulation is useful in our setting because fiscal policy changes not only the level of future payoffs, but also their risk. Taxes and public failure insurance jointly shape the distribution of entrepreneurial outcomes, so welfare depends on both intertemporal trade-offs and attitudes toward risk.⁵

Technology Worker productivity and entrepreneurial ability are distinct state variables. Each young household draws worker ability z and entrepreneurial ability θ from exogenous, positively persistent, and mutually independent processes. These realizations are observed at the start of the period and determine the current profitability of wage work and self-employment. The non-entrepreneurial sector is competitive and combines aggregate capital and labor according to

$$Y = AK^\alpha L^{1-\alpha}. \quad (3.2)$$

A worker supplies efficiency units z and therefore earns labor income $z\bar{w}$, where $\bar{w}$ is the market wage per efficiency unit. Workers can save at the risk-free rate r but cannot borrow. A prospective entrepreneur instead chooses business capital k and produces according to $y = \theta k^\nu$, with $\nu \in (0, 1)$. Diminishing returns limit firm scale and make the return to entrepreneurship depend jointly on talent, wealth, and policy.

A worker's effective wage income is thus proportional to both the market wage and the worker's productivity type. Entrepreneurial income is risky because it depends on both idiosyncratic business ability and the possibility of involuntary exit.

Borrowing Constraint Entrepreneurs cannot scale up arbitrarily through external finance. We impose a reduced-form collateral constraint⁶

$$k - a \leq (\lambda - 1)a, \quad (3.3)$$

where $\lambda \in [1, \infty)$. The constraint links business scale directly to internal funds: with assets a , the entrepreneur can finance at most $k \leq \lambda a$. Wealth accumulation, therefore, relaxes borrowing limits and is a prerequisite for business expansion. At the same time, higher asset holdings

⁵If $\sigma_i = 1/\gamma$, preferences collapse to the standard time-separable CRRA case commonly used in macroeconomics.

⁶In doing so, we follow [Banerjee and Newman \(1993\)](#) and [Moll \(2014\)](#). They motivate this form of constraint as arising, e.g., from a limited-enforcement problem faced by lenders.

provide a buffer against uninsured business risk. As a result, the tax and insurance instruments matter not only for current disposable income but also for future access to entrepreneurial scale.

Government The government taxes labor income of young workers at a rate τ^W and entrepreneurial profits at a rate τ^E . It uses these revenues to pay pensions to retirees, the subsistence transfer b to failed entrepreneurs, and the insurance payment associated with the protected share $1 - \kappa$ of assets lost at exit. Every policy experiment is evaluated under budget balance, so for any given pair (τ^E, κ) , the labor tax closes the government budget:

$$\int \tau^W \bar{w} z dF(z) + \int \tau^E \pi(\theta, a) dG(\theta, a) = \int (b + (1 - \kappa)a) dC(a) + N^O \zeta, \quad (3.4)$$

where $dF(z)$ is the distribution of worker-productivity types, $\pi(\theta, a)$ denotes entrepreneurial profits, $dG(\theta, a)$ is the joint distribution of entrepreneurial ability and asset holdings among entrepreneurs, $dC(a)$ is the distribution of failed entrepreneurs over assets, and N^O denotes the mass of retirees receiving pension payments ζ .

Social Welfare Function We compute welfare as in [Boar and Midrigan \(2022\)](#) but use the Epstein-Zin preference function in equation 3.1. ω_i equals the constant consumption stream that provides the same life-time utility as the value function V_i , associated with a unique individual state vector.⁷ This state vector includes productivity type z , entrepreneurial ability θ , asset level a , and risk aversion σ . Since we consider constant consumption streams, we use only the value functions of young agents. The parameter Δ is the policymaker's distaste for inequality. If $\Delta = 0$, only efficiency matters. As Δ rises, inequality concerns matter increasingly. γ denotes the IES. The social welfare function, SWF in brief, is defined as follows:

$$\text{SWF} = \left(\int \omega_i^{1-\Delta} \right)^{\frac{1}{1-\Delta}} \quad (3.5)$$

$$\omega_i = V_i(1 - \beta)^{\frac{1}{1-\gamma}} \quad (3.6)$$

3.3.1 Households

Households take prices and fiscal policy parameters as given. At the beginning of a period, they observe current assets, worker productivity, entrepreneurial ability, and their innate risk type. Young households then choose consumption, savings, and an occupation, understanding that taxes and public insurance affect both the return to salaried work and entrepreneurship as well as the consequences of failure.

Young Agents

A young household enters the period with state (a, z, θ, σ) and compares the lifetime value of wage work to that of self-employment. Occupational choice is therefore shaped by after-tax

⁷Appendix A.3.1 contains the derivation of ω_i using Epstein-Zin preferences.

returns, current wealth, and exposure to entrepreneurial downside risk:

$$V_y(a, z, \theta; \sigma) = \max \left(V_e(a, z, \theta; \sigma), V_w(a, z, \theta; \sigma) \right) \quad (3.7)$$

The entrepreneur's decision problem can be expressed recursively as follows:

$$\begin{aligned} V_e(a, z, \theta; \sigma) = & \max_{c, k, a'} \left(c^{1-\frac{1}{\gamma}} + \beta \left[\pi_y \left((1 - \pi_u(e)) \mathbb{E}[V_y(a', z', \theta'; \sigma)^{1-\sigma}] + \right. \right. \right. \\ & \left. \left. \left. \pi_u(e) V_u(a', z', \theta'; \sigma)^{1-\sigma} \right) + (1 - \pi_y) V_o(a'; \sigma)^{1-\sigma} \right]^{\frac{1-\frac{1}{\gamma}}{1-\sigma}} \right)^{\frac{1}{1-\frac{1}{\gamma}}} \quad (3.8) \\ a' = & (1 + r)a + \theta k^\nu - (r + \delta)k - \tau^E[\theta k^\nu - \delta k - r(k - a)] - c \\ a \geq & 0 \\ k \geq & 0 \end{aligned}$$

If the household remains of working age, which happens with probability π_y , it re-enters next period with the option to reconsider its occupational choice. With probability $1 - \pi_y$ it retires. The entrepreneurial budget equation illustrates that the profit tax τ^E applies only to positive operating profits, so losses are not offset by the tax system. In the expression above, $k - a$ denotes the share of business capital financed externally rather than from the entrepreneur's own assets. Hence, when $k > a$, the entrepreneur borrows $k - a$ and pays financing costs of $r(k - a)$ on that borrowed amount, while δk captures depreciation of installed capital. Involuntary exit occurs with probability $\pi_u(e)$ and moves the household to the failed-entrepreneur state, so the choice of whether to operate a business depends on both after-tax profits and the policy-controlled loss parameter κ . A lower κ means that the government insures a larger share $1 - \kappa$ of the failed business's capital.

The wage worker's decision problem is summarized below:

$$V_w(a, z, \theta; \sigma) = \max_{c, a'} \left(c^{1-\frac{1}{\gamma}} + \beta \left[\pi_y \left(\mathbb{E}[V_y(a', z', \theta'; \sigma)^{1-\sigma}] \right) \right. \right. \quad (3.9)$$

$$\left. \left. + (1 - \pi_y) V_o(a'; \sigma)^{1-\sigma} \right]^{\frac{1-\frac{1}{\gamma}}{1-\sigma}} \right)^{\frac{1}{1-\frac{1}{\gamma}}} \quad (3.10)$$

$$\begin{aligned} a' = & z \bar{w} (1 - \tau^W) + (1 + r)a - c \\ a \geq & 0 \end{aligned}$$

For workers, the relevant fiscal wedge is the labor income tax τ^W . A worker who remains young again solves the occupational choice problem next period; otherwise, she retires.

An entrepreneur who has gone out of business solves the following decision problem:

$$\begin{aligned}
 V_u(a, z, \theta; \sigma) = & \max_{c, a'} \left(c^{1-\frac{1}{\gamma}} + \beta \left[\pi_y \mathbb{E}[V_y(a', z', \theta'; \sigma)^{1-\sigma}] \right. \right. \\
 & \left. \left. + (1 - \pi_y) V_o(a'; \sigma)^{1-\sigma} \right]^{\frac{1-\frac{1}{\gamma}}{1-\sigma}} \right)^{\frac{1}{1-\frac{1}{\gamma}}} \\
 & a' = b + (1 + r - \kappa)a - c \\
 & a \geq 0
 \end{aligned} \tag{3.11}$$

The failed-entrepreneur state captures the immediate aftermath of involuntary exit. The transfer b provides a subsistence level of income, while the term $(1 + r - \kappa)a$ determines the amount of private wealth remaining after the loss on business assets. Having remained in this state for one period, the household either returns to the regular occupational choice problem if it stays young or retires.

Old Agents

Retirees no longer face occupational risk. They receive the pension ξ , choose consumption and next period's assets, and are exposed only to survival risk. With probability π_o , they remain retired; with probability $1 - \pi_o$, they die, and their remaining assets are redistributed to young households in a way that is consistent with the stationary distribution of productivity and risk types.

$$\begin{aligned}
 V_o(a; \sigma) = & \max_{c, a'} \left(c^{1-\frac{1}{\gamma}} + \beta \left[\pi_o V_o(a'; \sigma)^{1-\sigma} \right]^{\frac{1-\frac{1}{\gamma}}{1-\sigma}} \right)^{\frac{1}{1-\frac{1}{\gamma}}} \\
 & a' = \xi + (1 + r)a - c \\
 & a \geq 0
 \end{aligned} \tag{3.12}$$

3.3.2 Competitive Equilibrium

Definition 3. Fix policy parameters (τ^E, κ, b) . A stationary competitive equilibrium consists of prices $(r, \bar{w})$, a labor tax rate τ^W , policy functions for consumption $c(s)$, next-period assets $a'(s)$, occupational choice $e(s)$, and entrepreneurial capital $k(s)$, together with a stationary distribution μ^* over individual states s , such that:

1. Given $(r, \bar{w}, \tau^W, \tau^E, \kappa, b)$, the policy functions solve the households' optimization problems.
2. The labor tax rate τ^W satisfies the government budget constraint in (3.4).
3. Given the policy functions and the exogenous transition processes, μ^* is invariant.

3.3.3 Parametrization

Our calibration strategy follows that from [Hochmuth, Merz and Prettenhaler \(2025\)](#) where we distinguish between externally and internally calibrated parameters. Below we report how our

model augmented by fiscal policies does in terms of the targeted moments. Table 3.1 reports all exogenous parameters. We consider the initial value of τ^E as a starting point. For the optimal

Table 3.1 – Externally Calibrated Parameters

Parameter	Value	Source
A	1	Normalization
α	0.33	Standard parameter
β	0.933	Annual real interest rate of 3 %
δ	0.06	Cagetti and De Nardi (2006)
γ	0.5	Standard parameter
π_y	0.9745	Average working duration of 39 years
π_o	0.9511	Average retirement duration of 20 years
σ_i	[3.00 5.07 10.04]	See text and Tab. 3.2
ξ	60% of lowest income	Institutional approximation
b	10 % of lowest income	Institutional approximation
τ^W	endogenous	See text
λ	4.64	KfW Research (2024)
ρ	0.922	Bayer and Juessen (2012)
σ^Y	0.172	Bayer and Juessen (2012)
τ^E	0.15	Institutional approximation

policy comparison in a partial equilibrium setting it is relevant, because it helps pin down the discount rate β . Table 3.2 presents the approximation of the empirical distribution of risk aversion from Hochmuth, Merz and Prettenhaler (2025), and Table 3.3 summarizes all internally

Table 3.2 – Distribution of Risk Aversion

Willingness to Take Risks	Probability Mass	Risk Aversion (σ_i)
[0, 3]	34%	10.04
[4, 6]	53%	5.07
[7, 10]	13%	3.00

Notes: The willingness to take risks is discretized into three intervals. The probability mass shows how these intervals are represented in the overall population. The parameter of relative risk aversion is the transformed willingness to take risks. Its mean equals 6.49 and its standard deviation is 2.64.

calibrated parameters.

We summarize our model's performance in terms of fitting targeted moments in Table 3.4. In general, augmenting our occupational choice model with public policies does not drastically change the model fit. The earnings dynamics and entrepreneurial survival rates are very stable. Notably, our modified model better replicates key moments of the wealth distribution in Germany than our model without taxes and public loss insurance. We replicate the wealth Gini almost exactly and are very close to the share of entrepreneurs in the wealth P90. However, we undershoot the number of entrepreneurs in the economy by almost 3 percentage points and overshoot the share of GDP these entrepreneurs produce.

Table 3.3 – Internally Calibrated Parameters

Parameter	Value
π_θ	0.9872 0.0126 0.0003
	0.0766 0.9101 0.0133
	0.3018 0.0560 0.6422
θ	[0 0.238 0.332]
ν	0.9321
π_u	0.1504
κ	0.4559

Table 3.4 – Targeted Moments

Moment	Data	Model	Data Source
Share of entrepreneurs in working-age population	7.2%	4.7%	GSOEP
Share of GDP by entrepreneurs	10.0%	17.8%	BFB (2023)
Share of new entrepreneurs p.a. in working-age pop.	0.8%	0.8%	GSOEP
1-year survival rate of young entrepreneurs	60.6%	69.9%	GSOEP
Mean survival rate of entrepreneurs [yrs.]	3.58	3.62	GSOEP
Entrepreneurial earnings (mean/median)	2.02	1.93	HFCS Germany
Entrepreneurial earnings (std/mean)	1.72	1.91	HFCS Germany
Entrepreneurial earnings (P90/P50)	4.29	3.42	HFCS Germany
Business assets (std/mean)	3.52	2.27	HFCS Germany
Wealth Gini	0.75	0.75	GSOEP
Entrepreneurial share of P90 wealth	15.9%	16.8%	GSOEP

Notes: Data for entrepreneurial returns and business assets originate from the second wave (year 2014) of the HFCS for Germany. BFB is the acronym for [Bundesverband der Freien Berufe e. V. \(2024\)](#).

3.4 Optimal Policies in Partial Equilibrium

Next, we perform an optimal policy analysis. We consider three alternative objectives a policy-maker can pursue and ask which combinations of income taxes and public loss insurance are needed to reach a particular goal. We perform this analysis in a partial equilibrium setting, i.e., we depart from the benchmark calibration and determine the optimal policy instruments for a chosen objective while holding β and, thus, the interest rate fixed. Proceeding this way allows us to isolate welfare changes that arise from variations in κ , τ^W , and τ^E .⁸

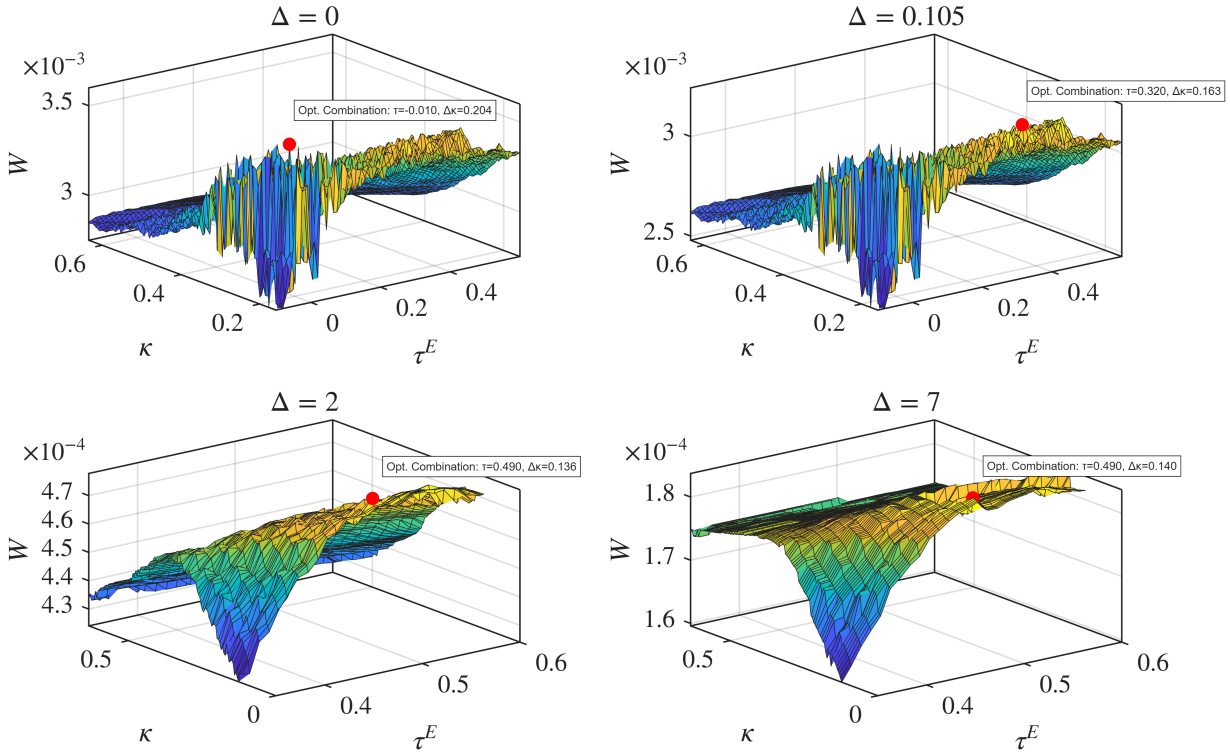
3.4.1 Optimal Policy Surface

We evaluate welfare over a grid of policy pairs (τ^E, κ) , where κ is the share of assets lost after business failure. For each pair, the labor income tax τ^W adjusts endogenously to satisfy the government budget constraint. Figure 3.1 plots the resulting welfare surface for different values of the policymaker's inequality-aversion parameter Δ .

The optimal policy mix systematically shifts with the policymaker's concern for inequality. An

⁸Since we ignore feedback effects from factor price adjustments, capital markets do not clear. In Section 3.4.6, we assess the sensitivity of our results to capital-market clearing.

Figure 3.1 – Optimal Policy



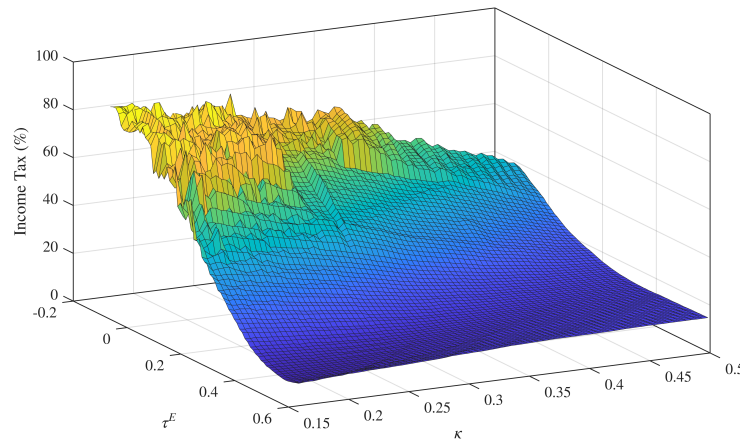
Notes: Each panel plots the social welfare surface over the policy grid (τ^E, κ) for one value of the policymaker's inequality aversion Δ , with the labor income tax τ^W clearing the government budget at each point. The red marker indicates the welfare maximum. The top panel spans $\kappa \in [0.158, 0.634]$ and $\tau^E \in [-0.1, 0.6]$; the bottom panels zoom in to the region of positive profit taxes, $\kappa \in [0.122, 0.634]$ and $\tau^E \in [0.35, 0.6]$.

efficiency-focused policymaker ($\Delta = 0$) prefers a small entrepreneurial subsidy ($\tau^E = -1\%$) together with substantial failure insurance ($\kappa = 0.204$). As Δ rises, the optimum moves toward positive profit taxation: across the optima in Figure 3.1, τ^E rises from -1% to 49% while κ falls from 0.204 to 0.140 .

The *mechanism* behind this pattern is a three-way fiscal trade-off. Lower entrepreneurial taxes stimulate entry and firm growth, and lower κ insures downside risk, making entrepreneurship more attractive, especially for risk-averse households. Both instruments, however, reduce tax revenue: any policy that cuts entrepreneurial taxes or raises public insurance must be financed through the labor income tax on workers. The efficiency-focused policymaker accepts the implied high labor tax to encourage entrepreneurship; by contrast, more inequality-averse policymakers raise profit taxation, which both redistributes and reduces the dispersion of after-tax income, while maintaining generous failure insurance. In this sense, the main adjustment margin is the profit tax, while optimal insurance varies more moderately. A central implication is that optimal policy requires the joint design of taxation and downside protection, rather than treating them as independent tools.

Because all residual expenditures are financed through labor income taxes (Equation 3.4), the implied variation in τ^W across the policy grid is substantial (Figure 3.2).

Across the grid, τ^W ranges from 7.9% to 86.8% , with the highest rates arising when entrepreneurial

Figure 3.2 – Variation in the Labor Income Tax Rate

Notes: Each grid point reports the endogenous labor income tax rate τ^W that satisfies budget balance for the corresponding (τ^E, κ) pair. Grid: $\kappa \in [0.158, 0.634]$ and $\tau^E \in [-0.1, 0.6]$.

subsidies must be financed entirely by workers.

3.4.2 From Efficiency to Redistribution: Economic Implications

The policy surface identifies the policymaker's preferred (τ^E, κ) pair for each redistributive weight, but it does not by itself reveal how the associated allocation changes as redistributive concerns increase. We therefore summarize the economic implications at three selected optima on the redistributive-weight grid: a low-redistribution case ($\Delta = 0$; $\tau^E = -1\%$, $\kappa = 0.204$), an intermediate case ($\Delta = 0.105$; $\tau^E = 32\%$, $\kappa = 0.16$), and a high-redistribution case ($\Delta = 7$; $\tau^E = 49\%$, $\kappa = 0.14$). Tables 3.5 and 3.6 report the corresponding entrepreneurial-sector outcomes.

Table 3.5 – Entrepreneurial Sector under Optimal Policy: Levels by Scenario

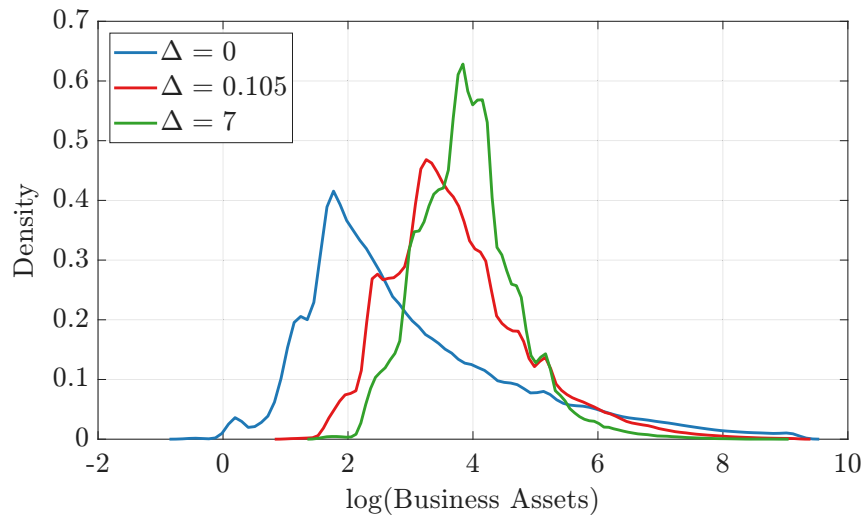
	$\Delta = 0$	$\Delta = 0.105$	$\Delta = 7$
Share of entrepreneurs in working-age population [%]	3.74	5.94	5.64
Mean entrepreneurial capital [k]	176.46	109	75
Share with θ (Middle) [%]	83	82	80
Entrepreneurial share of GDP [%]	23	25	20
Entrepreneurial share in P90 of wealth [%]	17.1	21.0	19.7
1-year survival rate of entrepreneurs [%]	75	75	74

Notes: Each column reports characteristics of the entrepreneurial sector at the optimal policy pair for the corresponding policymaker's objective: $(\tau^E = -1\%$, $\kappa = 0.204)$ for $\Delta = 0$, $(\tau^E = 32\%$, $\kappa = 0.16)$ for $\Delta = 0.105$, and $(\tau^E = 49\%$, $\kappa = 0.14)$ for $\Delta = 7$. Mean entrepreneurial capital k is reported in model assets, which are normalized to 1.

The central pattern across a policymaker's objective that emerges from Table 3.5 is not simply more or less entrepreneurship, but a shift between a small number of large firms and a larger number of smaller firms. If a policymaker focuses on efficiency only, fewer households enter self-employment, yet those who do operate at more than twice the capital scale than they would if equity was more of a concern. Figure 3.3 illustrates the distribution of business assets in the three

scenarios. Apparently, a higher profit tax that arises from increased equity concerns changes sav-

Figure 3.3 – Distribution of Business Assets



Notes: Business assets are equivalent to entrepreneurial capital k .

ings behavior and occupational choice such that it reduces the variation in business assets and, with that, also gross entrepreneurial profits. In scenario 1, entrepreneurs enter with lower assets because the conditions are favorable and their business grows fast because they pay no profit taxes. In the scenarios that increasingly focus on equity, entrepreneurs enter self-employment with higher assets because it only becomes profitable to run a business with larger capital stock, but they cannot accumulate wealth because their profits are taxed at rates of up to 49%. This implies a low variation in business assets. This difference maps directly into aggregate production: the entrepreneurial share of GDP falls from 23% to 20% as policy shifts from efficiency to equality orientation. Survival rates, by contrast, are nearly identical across regimes, indicating that policy primarily reshapes entry and scale rather than short-run survival.

Table 3.6 shows that the internal composition of the entrepreneurial sector by risk group is rather stable. The middle-risk group consistently accounts for roughly half of all entrepreneurs. What shifts is the composition of output: the GDP share produced by high-risk entrepreneurs rises as policy becomes more equity-oriented, partly because lower labor taxes encourage wealth accumulation among more workers.

Table 3.6 – Entrepreneurial Sector under Optimal Policy: Composition by Risk Group

	Δ	$\sigma(\text{Low})$	$\sigma(\text{Middle})$	$\sigma(\text{High})$
Share among entrepreneurs [%]	0	8.3	52.86	38.85
	0.105	11.0	52.0	37.0
	7	10.0	51.0	38.0
Mean entrepreneurial capital [k]	0	107	157	217
	0.105	77	100	130
	7	53	69	90
Share with $\theta(\text{Middle})$ among entrepreneurs [%]	0	8.0	53.0	39.0
	0.105	10.7	51.4	37.9
	7	9.9	50.7	39.4
GDP contribution within entrepreneurship [%]	0	9.3	53.9	36.8
	0.105	9.1	49.3	41.6
	7	8.0	47.0	45.0
P90-wealth composition within entrepreneurs [%]	0	8.0	49.0	43.0
	0.105	9.4	50.0	40.6
	7	7.8	48.2	44.0
1-year survival rate of entrepreneurs [%]	0	75	75	75
	0.105	75	75	75
	7	73	73	74

Notes: Entries in this table are conditional on being an entrepreneur, so the risk-group shares in each block sum to 100 up to rounding.

The macroeconomic consequences which we report in Table 3.7 make the policymaker's trade-off transparent. The efficiency-first regime delivers the highest output but requires a labor income tax of 71% and produces a wealth Gini of 0.97. The equity-focused regime cuts output but also compresses the wealth distribution and reduces the earnings tax rate to less than 10%. Policies that encourage large-scale entrepreneurship thus raise output at the cost of substantial inequality and high taxes on workers.

Table 3.7 – Aggregate Statistics for Alternative Optimal Policies

Δ	τ^W	Wealth Gini	Wealth (mean)	SE Spell (mean)	GDP
0	71%	0.97	12.46	4.15	2.20
0.105	28.2%	0.83	9.85	4.10	1.94
7	9.8%	0.63	6.85	4.01	1.48

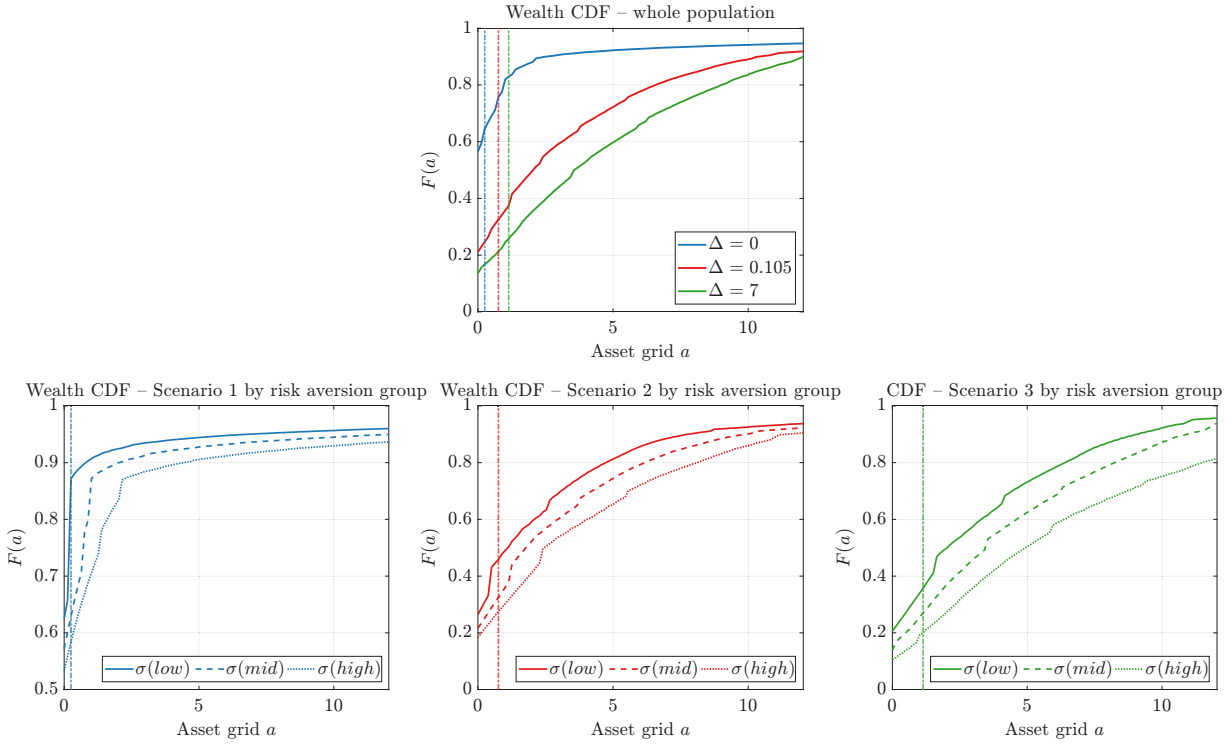
Notes: Each row reports aggregate statistics at the optimal policy pair for the corresponding policymaker's objective. Wealth (mean) and GDP are in model units. 'SE Spell' denotes the mean duration of a self-employment spell in years.

3.4.3 Mechanism: Wealth, Entry Thresholds, and Risk Aversion

Why does the entrepreneurial sector change so sharply along the redistributive-weight grid? The key mechanism operates through the interaction of wealth accumulation and the entry margin

into entrepreneurship. Figure 3.4 plots the wealth CDF, $F(a)$, up to the 90th percentile at the three selected optima. The vertical lines mark the lowest asset level at which an agent with the most favorable ability combination (high θ , low z) would choose to enter. This provides a common financial lower bound on the wealth required for entering self-employment.

Figure 3.4 – Wealth Distribution and Entry into Entrepreneurship



Notes: The top panel plots the wealth CDF, $F(a)$, at the three selected optima, truncated at the 90th percentile. Vertical lines show the financial lower bound for entry by the most favorable ability type (high θ , low z). The bottom panels decompose the CDFs by risk-aversion group.

The top panel of Figure 3.4 reveals a key insight: entrepreneurship is limited in the efficiency-focused regime not because the entry threshold is high, but because the high labor tax needed to finance the entrepreneurial subsidy depresses wealth accumulation for most households. The threshold is, in fact, lowest in this regime, yet only about 40% of the population lies above it. As equity concerns increase, the threshold is slightly higher, but lower labor taxes support broader asset accumulation around the entry margin, so 70–75% of the population clears it.

The bottom panels decompose this mechanism by risk group. The financial lower bound shown in the figure is common across risk types for a given ability combination, but the wealth distributions differ markedly. More risk-averse households accumulate more wealth through precautionary saving and are therefore more likely to clear the threshold. In the efficiency-focused regime, this contrast is most pronounced: only 13% of $\sigma(\text{low})$ agents exceed the threshold, compared to over 40% of $\sigma(\text{high})$ agents. Heterogeneous risk aversion thus matters for entrepreneurship primarily through its effect on savings, not because risk types face different technological barriers.

Taken together, these patterns reveal why the efficiency-focused regime produces fewer but larger firms. The policy mix creates strong incentives for entrepreneurship, but financing it through high labor taxes prevents most households from accumulating enough assets to enter. Entry is therefore concentrated among a small subset of households that save a lot which is disproportionately drawn from the more risk-averse groups. Those who enter operate at a large scale. More equity-oriented regimes, by contrast, support broader wealth accumulation and therefore a wider entrepreneurial base, even though profits are taxed more heavily. To better understand the savings dynamics underlying these distributions, Appendix A.3.3 traces life-cycle asset profiles at the three selected optima along the redistributive-weight grid.

3.4.4 Output Foregone under Income-Maximizing Occupational Assignment

Next, we ask how much output is foregone because households factor in risk when making occupational choices rather than selecting the occupation with the highest current gross income. For each agent, we compute the hypothetical income in the unchosen occupation and measure the positive gap relative to actual income:

$$M_{\text{worker}} = \int \max\{0, \pi^*(\theta, a) - \bar{w}z\} dH(z, \theta, a) \quad (3.13)$$

$$M_{\text{entr}} = \int \max\{0, \bar{w}z - \pi^*(\theta, a)\} dR(z, \theta, a) \quad (3.14)$$

where $dH(z, \theta, a)$ and $dR(z, \theta, a)$ are the joint distributions over ability and assets for young workers and entrepreneurs, $\pi^*(\theta, a) = \theta [k^*(\theta, a)]^\gamma - \delta k^*(\theta, a) - r(k^*(\theta, a) - a)$ is the shadow profit at the optimal capital choice, and $\bar{w}z$ is wage income. We report $m_{\text{occupation}} = M_{\text{occupation}}/Y$ as the share of output foregone. Table 3.8 presents the results for the three regimes.

Table 3.8 – Output Foregone under Income-Maximizing Occupational Assignment

Δ	m_{worker}	m_{entr}
0	0.012%	0%
0.105	1.36%	0%
7	5.54%	0%

Notes: $m_{\text{worker}} = M_{\text{worker}}/Y$ is the share of output foregone by workers who remain in wage employment despite having higher potential entrepreneurial income. $m_{\text{entr}} = M_{\text{entr}}/Y$ is the analogous measure for entrepreneurs. $m_{\text{entr}} = 0$ by construction: risk ensures that only agents whose expected profits exceed their wage alternative enter self-employment.

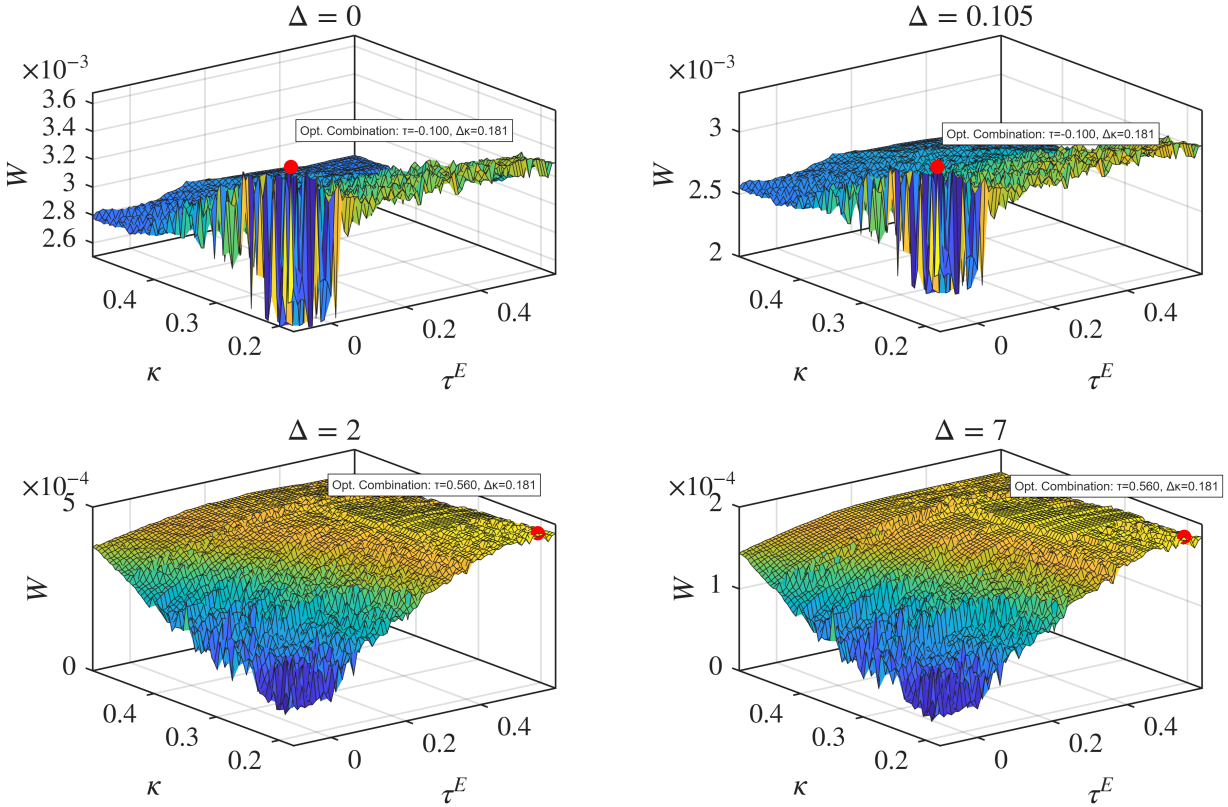
Under the efficiency-focused government, the output-foregone measure for workers is essentially zero: the entrepreneurial subsidy makes self-employment sufficiently attractive that few workers forgo entrepreneurial opportunities with a higher income. Under the equity-focused policymaker, by contrast, m_{worker} exceeds 5% because high profit taxes discourage entry and leave more households in wage work despite their higher potential entrepreneurial income. For entrepreneurs, $m_{\text{entr}} = 0$ by construction, since the capital-loss risk (κa) ensures that only agents

whose expected profits strictly exceed their wage alternative choose self-employment. This measure should not be interpreted as a misallocation of welfare. The counterfactual intentionally shuts down the risk dimension that drives occupational choice in the model. It isolates an output gap under income-maximizing assignment, not an inefficiency in welfare terms, and it abstracts from general-equilibrium feedback.

3.4.5 The Role of Heterogeneous Risk Aversion in Optimal Policy

How much does the optimal policy mix depend on dispersion in risk preferences? To answer this, we compare the benchmark economy to a version in which all households share the same risk aversion, $\sigma = 6.68$, equal to the population means from [Hochmuth, Merz and Prettenthaler \(2025\)](#). Figure 3.5 reports the optimal policy surface under this homogeneous-risk preference economy. Removing heterogeneity in risk-aversion materially changes the policymaker's pre-

Figure 3.5 – Optimal Policy without Heterogeneous Risk Aversion



Notes: Each panel plots the social welfare surface for one value of Δ in an economy where all households share the population mean risk aversion ($\sigma = 6.68$). The red marker indicates the welfare maximum. All panels span $\kappa \in [0.1811, 0.4981]$ and $\tau^E \in [-0.1, 0.6]$.

ferred policy. Under homogeneous risk preferences, only two distinct optima emerge: policymakers with $\Delta < 2$ choose one pair, while those with $\Delta \geq 2$ choose another. The biggest difference appears for the efficiency-focused policymaker, who now selects the largest entrepreneurial subsidy on the grid ($\tau^E = -10\%$, $\kappa = 0.181$), compared to only -1% in the heterogeneous bench-

mark.⁹ For more inequality-averse policymakers, the differences are smaller but still meaningful. That's because risk heterogeneity creates a richer mapping from policy to wealth accumulation and entry. In the benchmark, more risk-averse households self-insure through precautionary saving and are therefore more likely to clear the entry threshold even under modest subsidies. Once this dispersion is removed, the policymaker faces a compressed behavioral response and must rely more heavily on blunt subsidy instruments to reshape occupational choice. Heterogeneity in risk aversion thus changes the policy problem itself, not just the distribution of outcomes.

Table 3.9 – Entrepreneurs by Policy Objectives

	Δ	Overall
Share of Entrepreneurs in Working-Age Population [%]	0	2.77
	7	5.01
Entrepreneurial Capital [k]	0	219
	7	69
Share with θ (Middle) [%]	0	82
	7	78
Share of GDP [%]	0	23
	7	16.6
Share in P90 of Wealth [%]	0	16.6
	7	18.0
1-Year Survival Rate of Entrepreneurs [%]	0	75
	7	73

Notes: Homogeneous-risk economy in which all households have risk aversion $\sigma = 6.68$ (population mean). Only policymakers $\Delta = 0$ and $\Delta = 7$ are reported because the homogeneous-risk optimal policy surface has just two distinct optima: one for $\Delta < 2$ and one for $\Delta \geq 2$. Mean entrepreneurial capital k is in model units.

Table 3.9 is the homogeneous-risk counterpart to Table 3.5. For $\Delta = 0$, the homogeneous economy has 26% fewer entrepreneurs and 24% higher mean firm capital than the heterogeneous benchmark. What matters here is mainly the policy response, not the removal of risk heterogeneity by itself. The homogeneous economy differs from the benchmark largely because the policymaker chooses a more aggressive policy mix. If we instead evaluate the homogeneous economy at the policy pair chosen in the heterogeneous benchmark, it would actually generate slightly more entrepreneurs. Risk heterogeneity, therefore, matters primarily because it changes the policy the policymaker finds optimal.

Table 3.10 reports the corresponding aggregate statistics.

⁹For policymakers with $\Delta < 2$, the optimal point lies at the lower bound of the entrepreneurial profit tax. We tried to broaden the interval in this direction but encountered numerical instabilities. A subsidy above 10% would imply worker income taxes approaching 100%, which does not yield a stable solution within our model framework.

Table 3.10 – Aggregate Statistics under Optimal Policy and Homogeneous Risk Aversion

Δ	τ^W	Wealth Gini	Wealth (mean)	SE Spell (mean)	GDP
0	79.75%	0.98	12.0	4.12	2.17
7	6.1%	0.55	6.7	3.88	1.42

Notes: Homogeneous-risk economy; see notes to Table 3.9. Wealth (mean) and GDP are in model units. ‘SE Spell’ denotes the mean duration of a self-employment spell in years.

The homogeneous economy qualitatively moves in the same direction as the heterogeneous benchmark but produces more extreme outcomes. For $\Delta = 0$, the labor income tax rises from 71% to almost 80%, reflecting the larger subsidy needed to stimulate entry without differential precautionary saving. For $\Delta = 7$, the homogeneous economy delivers a lower labor tax and lower wealth Gini than the benchmark. Even when average risk aversion is held fixed, eliminating heterogeneity thus changes both the government’s chosen policy and the resulting equilibrium allocation. The core mechanism of the paper, the interaction of risk-preference heterogeneity with wealth accumulation and occupational sorting, cannot be captured by a representative-risk household.

3.4.6 Sensitivity to Capital-Market Clearing

A natural concern is whether the partial-equilibrium policy rankings survive once capital markets clear. To gauge this, Appendix A.3.2 reports an exploratory exercise in which we re-calibrate the discount factor β for each (τ^E, κ) pair on a restricted grid so that aggregate saving equals aggregate capital demand. Because β varies across policy experiments, the exercise changes preferences alongside policy and therefore does not constitute a fully comparable general-equilibrium welfare analysis. We treat it as a sensitivity check.

The main findings can be summarized as follows. First, the feedback on the labor tax is modest: market clearing shifts τ^W by roughly $\pm 4\%$ relative to partial equilibrium. Second, the market-clearing exercise compresses cross-policymaker differences in the optimal policy: nearly all policymakers select $\tau^E = 0$ with generous capital insurance, whereas the partial-equilibrium optimum places the profit tax between 18% and 20% on the same grid. The shift occurs because the re-calibrated β absorbs part of the variation that, in partial equilibrium, is generated by the policy instruments themselves. Third, at a common policy pair the market-clearing allocation is slightly less entrepreneurial, with lower wealth and output than its partial-equilibrium counterpart. Despite these quantitative differences, the qualitative role of risk-aversion heterogeneity in shaping occupational sorting and the equity-efficiency trade-off is preserved.

3.5 Conclusion

In this paper, we build on our previous work on heterogeneous risk aversion and occupational choice to quantify optimal income tax parameters and capital loss insurance for policymakers who weigh efficiency vs. equity differently. Using the occupational choice model developed in

Hochmuth, Merz and Prettenhaler (2025), we allow for differential linear taxation across entrepreneurs' and workers' income. The policymaker's instruments are the entrepreneurial profit tax, τ^E , and the capital-insurance parameter, κ , defined as the share of capital lost when an entrepreneur exits. We evaluate policy using the social welfare function of Boar and Midrigan (2022), considering three levels of aversion to permanent consumption inequality.

In partial equilibrium, the optimal policy pair varies markedly with the policymaker's aversion to consumption inequality. An efficiency-focused policymaker opts for an entrepreneurial subsidy ($\tau^E < 0$) financed by a labor income tax exceeding 70% on workers. As a result, fewer than 4% of the working-age population become entrepreneurs, but they run firms more than twice as large as in the equality-oriented case. This concentrated entrepreneurial sector generates substantially higher wealth inequality in the efficiency scenario.

Even though we take the role of heterogeneous risk aversion in occupational choice as given, we compare our heterogeneous-risk model to a version that collapses preferences to the population's average risk aversion to assess whether heterogeneity matters for the optimal policy mix. We find that ignoring risk heterogeneity yields an even more extreme policy for the efficiency-oriented policymaker—preferring an entrepreneurial subsidy of 10%—which results in even fewer entrepreneurs who operate larger firms than in the heterogeneous-risk benchmark.

One caveat of our current setup is that we abstract from the progressivity of German income taxation and instead impose a linear tax for both workers and entrepreneurs. A natural extension is to incorporate a realistic, progressive tax schedule that closely mirrors the German system. This would allow us to reassess the incidence and optimality of policies when marginal rates rise with income and when tax liabilities differ more systematically across workers and entrepreneurs.

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CHAPTER 3:
APPENDIX

A.3 Appendix

A.3.1 Solving for ω_i under Epstein–Zin preferences

Let

$$v \equiv 1 - \frac{1}{\gamma}, \quad \gamma \neq 1, \quad \sigma_i \neq 1,$$

and consider the EZ recursion (with constant consumption ω_i each period):

$$V_i = \left[\omega_i^v + \beta \left(\mathbb{E}[V_{i+1}^{1-\sigma_i}] \right)^{\frac{v}{1-\sigma_i}} \right]^{\frac{1}{v}}.$$

Step 1: Raise both sides to the power v :

$$V_i^v = \omega_i^v + \beta \left(\mathbb{E}[V_{i+1}^{1-\sigma_i}] \right)^{\frac{v}{1-\sigma_i}}.$$

Step 2: Isolate ω_i^v :

$$\omega_i^v = V_i^v - \beta \left(\mathbb{E}[V_{i+1}^{1-\sigma_i}] \right)^{\frac{v}{1-\sigma_i}}.$$

Step 3: Raise both sides to the power $1/v$:

$$\omega_i = \left[V_i^v - \beta \left(\mathbb{E}[V_{i+1}^{1-\sigma_i}] \right)^{\frac{v}{1-\sigma_i}} \right]^{\frac{1}{v}}$$

This solution requires the bracketed term to be nonnegative, i.e. $V_i^v \geq \beta \left(\mathbb{E}[V_{i+1}^{1-\sigma_i}] \right)^{v/(1-\sigma_i)}$.

Step 4: If $V_i = V_{i+1}$ and consumption is constant we can isolate V_i :

$$\omega_i = \left[V_i^v - \beta (V_i^v)^{\frac{v}{1-\sigma_i}} \right]^{\frac{1}{v}}$$

$$\omega_i = V_i (1 - \beta)^{\frac{1}{v}}$$

According to this solution ω_i depends on the original value function, time preferences, and the EIS.

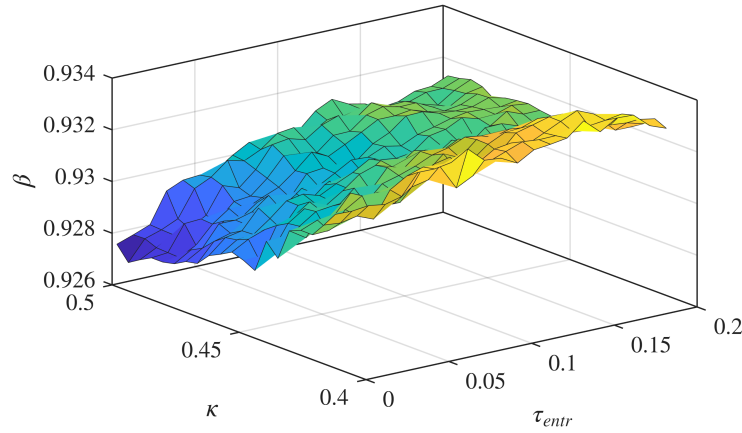
A.3.2 Exploratory Market-Clearing Exercise

This appendix details the market-clearing exercise summarized in Section 3.4.6. For each (τ^E, κ) pair on the restricted grid $\kappa \in [0.412, 0.498]$ and $\tau^E \in [0, 0.20]$, we solve for the discount factor β that equates aggregate saving to aggregate capital demand. Because β varies across policy experiments, preferences are not held constant, and welfare comparisons across grid points should be interpreted with this caveat.

Market clearing and the labor tax. Figure A.3.1 shows that higher entrepreneurial taxes and more generous failure insurance require a higher β to clear the capital market. The intuition

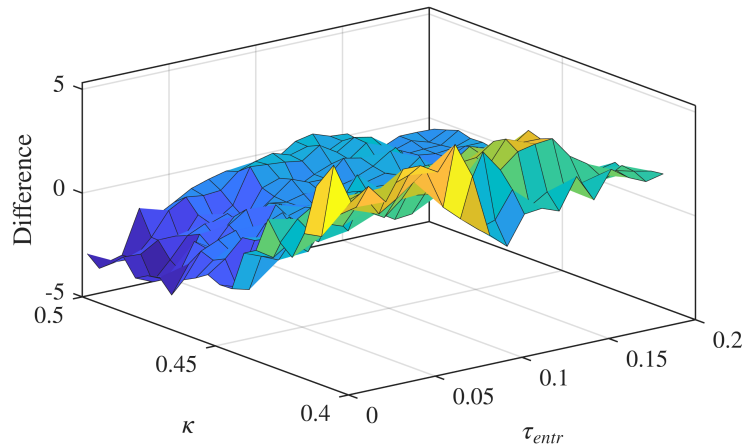
is that these policies reduce the incentive to accumulate entrepreneurial wealth, so households must be more patient to generate the same aggregate capital stock. Figure A.3.2 translates this into the labor tax: the market-clearing recalibration shifts τ^W by roughly -4% to $+4\%$ relative to partial equilibrium, with the largest differences appearing at high κ .

Figure A.3.1 – Variation in β across the restricted grid



Notes: Each grid point reports the value of β that clears the capital market. The explored grid is $\kappa \in [0.412, 0.498]$ and $\tau^E \in [0, 0.20]$.

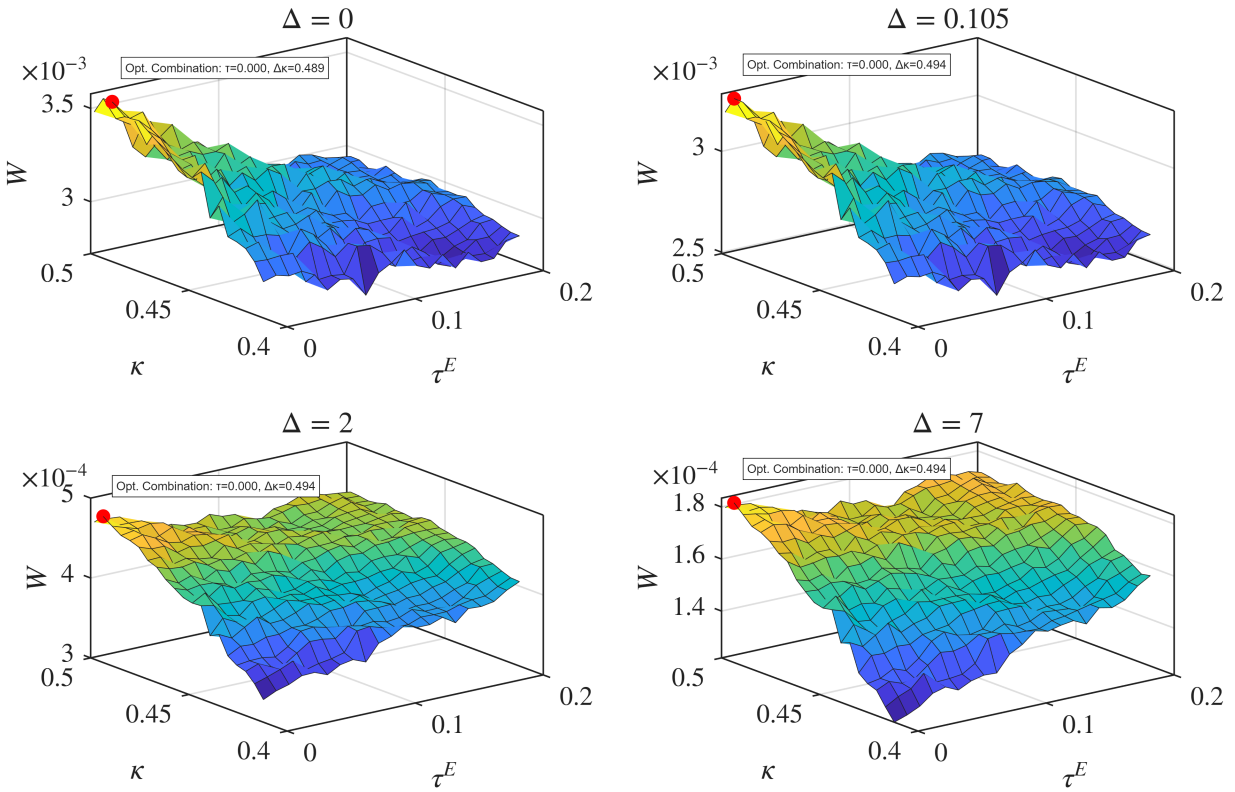
Figure A.3.2 – Labor tax difference: market clearing vs. partial equilibrium



Notes: The plotted object is $100 \times (\tau^W(\text{MC}) - \tau^W(\text{PE})) / \tau^W(\text{PE})$ on the same restricted grid as Figure A.3.1, where MC denotes the market-clearing exercise and PE the partial-equilibrium benchmark.

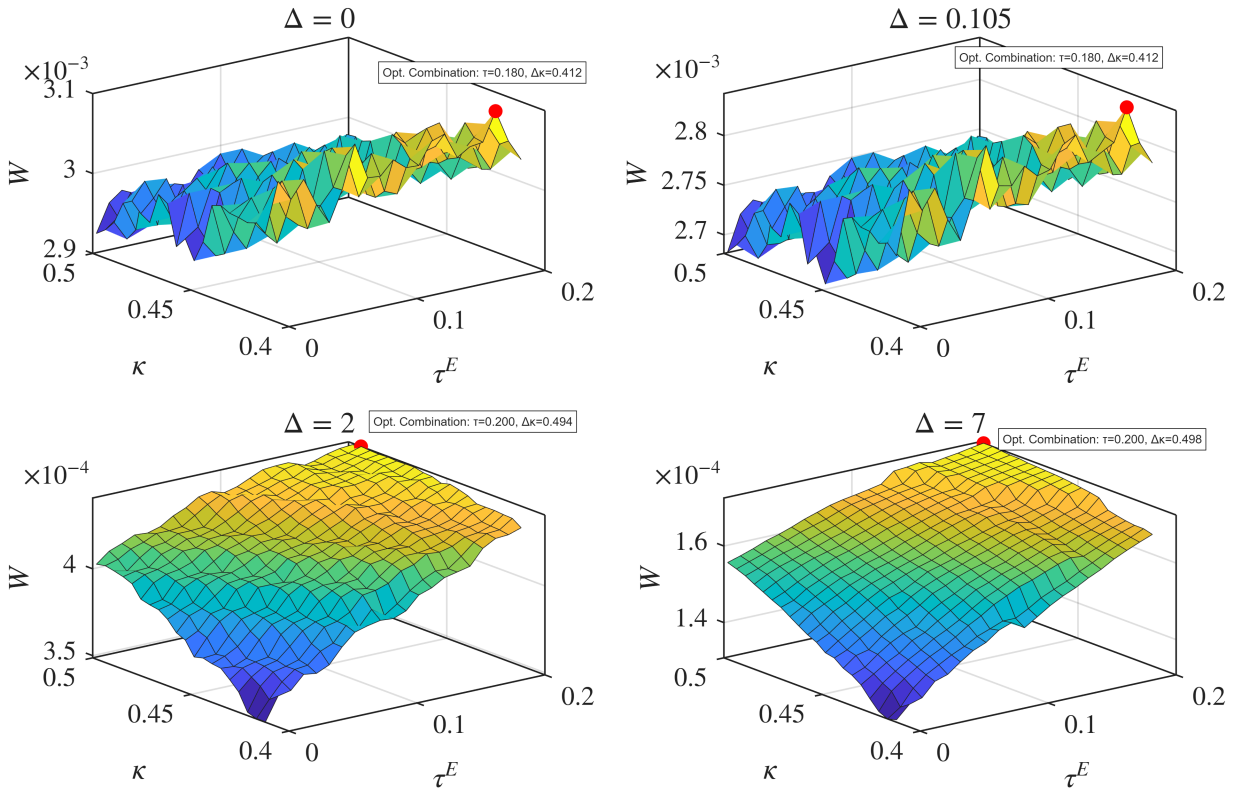
Optimal policy on the restricted grid. Figure A.3.3 reports the welfare surface under market clearing. Nearly all policymakers select $(\tau^E, \kappa) = (0, 0.494)$; only the efficiency-focused policymaker ($\Delta = 0$) chooses a modestly lower κ . On the same grid, the partial-equilibrium optimum places τ^E between 18% and 20% (Figure A.3.4). The divergence reflects the fact that recalibrating β channels part of the policy variation through altered patience and saving behavior rather than through the direct incentive effects of taxes and insurance alone.

Figure A.3.3 – Welfare surface under market clearing



Notes: Each panel plots welfare on the restricted grid $\kappa \in [0.412, 0.498]$ and $\tau^E \in [0, 0.20]$. For each policy pair, β is re-calibrated to clear the capital market. The red marker indicates the grid maximum.

Allocations at a common policy pair. To isolate the effect of market clearing from the effect of different optimal policies, Tables A.3.1 and A.3.2 compare the two equilibria at the common policy $(\tau^E, \kappa) = (0, 0.494)$. The market-clearing allocation features slightly fewer entrepreneurs (4.46% vs. 4.72%), lower mean capital (75 vs. 77), and lower GDP (1.40 vs. 1.47). The source is a lower β in the market-clearing solution (0.927 vs. 0.9312), which reduces wealth accumulation and tightens borrowing constraints.

Figure A.3.4 – Optimal Policy in Partial Equilibrium

Notes: Each panel plots the partial-equilibrium welfare surface on the same restricted grid as Figure A.3.3: $\kappa \in [0.412, 0.498]$ and $\tau^E \in [0, 0.20]$. The red marker indicates the grid maximum. This figure enables direct comparison with the market-clearing welfare surface in Figure A.3.3.

Table A.3.1 – Entrepreneurs by Degree of Risk Aversion: Market Clearing vs. PE

	Equilibrium	Overall	σ_{low}	σ_{middle}	σ_{high}
Share of Entrepreneurs in Working-Age Population [%]					
	MC	4.46	14.95	62.74	22.31
	PE	4.72	14.6	60.9	24.5
Entrepreneurial Capital [k]					
	MC	75	78	88	45
	PE	77	84	91	45
Share with θ_{middle} [%]					
	MC	80	14.56	60.2	25.2
	PE	81	14	58.3	27.7
Share of GDP [%]					
	MC	17.8	22.5	68.7	8.8
	PE	17.6	23.2	67	9.8
Share in P90 of Wealth [%]					
	MC	16.2	14	64.6	21.4
	PE	16.4	13.6	63.6	22.8
1-Year Survival Rate of Entrepreneurs [%]					
	MC	70	75	73	61
	PE	70.2	75	73	63

Notes: 'MC' denotes the market-clearing allocation at $(\tau^E, \kappa) = (0, 0.494)$. 'PE' denotes the partial-equilibrium allocation at the same policy pair.

A.3.3 Simulated Life-Cycle

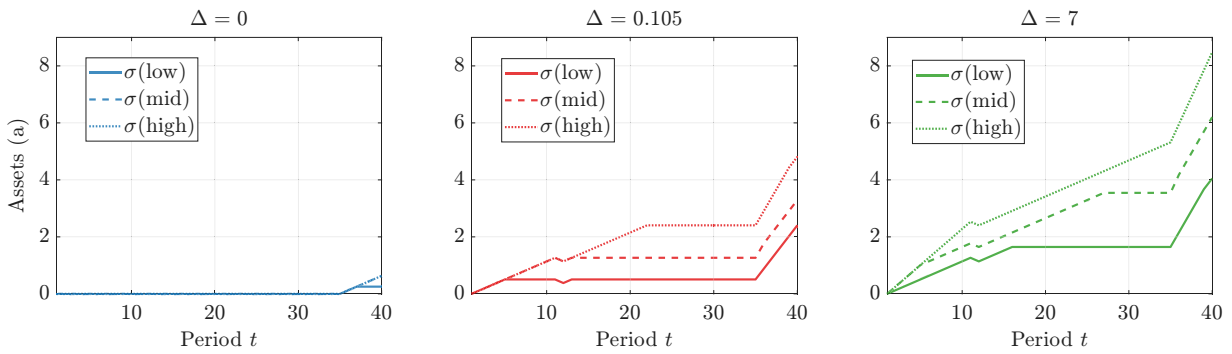
To understand the implications of the different tax schedules, we simulate a life-cycle for all three risk groups across all scenarios. Using a Markov procedure, we generate a series of shocks

Table A.3.2 – Aggregate Statistics: Market Clearing vs. PE

Equilibrium	τ^W	β	Wealth Gini	Wealth (mean)	SE Spell (mean)	GDP
MC	29.4%	0.927	0.82	6.42	3.61	1.40
PE	30.4%	0.9312	0.81	7.00	3.61	1.47

Notes: ‘MC’ and ‘PE’ refer to the same policy comparison as in Table A.3.1. ‘SE Spell’ denotes the mean duration of a self-employment spell in years.

for θ (entrepreneurial ability) and z (corporate sector productivity), with starting values $\theta = 2$ and $z = 2$, and assign this shock series to all nine hypothetical agents. These agents begin with zero assets, and the only differences are their risk aversion levels and, between scenarios, their respective tax rates. Figure A.3.5 illustrates the first 40 years of their life cycle and how their savings evolve over time.

Figure A.3.5 – Asset Evolution by Risk Aversion

Notes: Within each panel, lines differ only in risk aversion (σ low, mid, high). All agents start with zero assets and face a common simulated shock path for entrepreneurial ability θ and worker productivity z over 40 periods.

Figure A.3.5 demonstrates how high income taxes hinder agents from saving any portion of their paycheck. In the leftmost panel, which depicts the efficiency-focused planner, workers only begin to save some of their income after 35 years. In this case, the difference between risk aversion groups is negligible because the income taxes are excessively high (71%).

In contrast, the middle and right panels show scenarios with lower income taxes (28.2% and 9.8%, respectively), where agents start saving much earlier. Here, the differences between risk aversion groups become apparent. Agents with higher risk aversion engage in more precautionary savings, leading to a divergence in their net wealth over time, even though they have identical income streams.