Labor Market Reforms in Open Economies: Current Account Dynamics and Consumer Heterogeneity[†]

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Abstract

This paper establishes a link between labor market reforms and an increase in the reforming country's net foreign asset position via a precautionary savings channel. Specifically, we evaluate the current account effects of a major German labor market reform that reduced the generosity of unemployment benefits. Using a heterogeneous agent model of a small open economy with labor market frictions, we show that accounting for precautionary savings is qualitatively and quantitatively important for current account dynamics. In the first five years following its implementation, the reform contributed 12 percent to the dynamics of the German current account. Furthermore, welfare gains and losses are distributed unequally among agents. Compared to a closed economy, the reform is more detrimental.

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1 Introduction

How do economies respond to structural labor market reforms, and what role do precautionary savings play when insurance against unemployment is incomplete? While past studies have explored these dynamics in closed economies using heterogeneous agent models, a significant gap exists in understanding their impact in open economies, particularly regarding the international effects of reducing unemployment benefits.[1] In contrast, studies that do evaluate labor market reforms in open economies typically rely on representative agent models, which miss the incentive to accumulate precautionary savings due to perfect consumption insurance.[2]

This paper fills this gap by introducing a small open economy model with incomplete insurance and a frictional labor market. Our model includes a detailed unemployment benefit system and realistic wealth inequality to capture the international effects of labor market reforms.[3] Our analysis links the reduction in unemployment benefit generosity to the build-up of net foreign assets through a *precautionary savings channel.* As a case study, we examine the German Hartz IV reform, which cut long-term unemployment benefits in 2005 and shortened short-term benefits in 2006.[4] We proceed in two steps. First, using fixed effects regressions at the household level with data from the German Socioeconomic Panel (GSOEP), we estimate that, following the reform, the aggregate savings rate increased by approximately one percentage point. Moreover, we document that the more severely workers were affected by the entitlement cut, the greater the increase in their savings rates. Whereas civil servants, who face (almost) no unemployment risk in Germany, exhibit no change in their savings behavior. We then use our model to quantify the reform's contribution to Germany's current account surplus and net foreign asset position and contrast the macroeconomic and welfare effects with those under complete insurance and in a closed economy.

Germany's experience provides a particularly relevant case for understanding the broader international macroeconomic impacts of domestic policy changes. Often referred to as the "world champion in exporting capital (Exportweltmeister)",[5] Germany maintained the world's largest current account surpluses in absolute terms for a decade, up until 2019. In contrast to China, where the current account surplus decreased in 2008, Germany's surpluses have persisted since the early 2000s (see Figure 1). This trend implies an increase in the net foreign asset position and a growing divergence between aggregate savings and domestic investment (see Figure 13 in Appendix A.1). These developments have attracted worldwide attention.[6] The German Hartz IV reform has been repeatedly cited for contributing to the observed current account surpluses.[7]

[1] The role of precautionary savings due to incomplete insurance against the risk of becoming unemployed has been stressed by Krusell, Mukoyama, and Şahin (2010), Krueger, Mitman, and Perri (2016b), Krause and Uhlig (2012), Krebs and Scheffel (2013), Launov and Wälde (2013), and Nakajima (2012) among others.

[2] See Cacciatore, Duval, Fiori, and Ghironi (2016).

[3] An earlier version of this paper circulated under the title "Labor Market Reforms, Precautionary Savings, and Global Imbalances". The current version fundamentally differs from the earlier version, featuring full consumer heterogeneity in a small open economy.

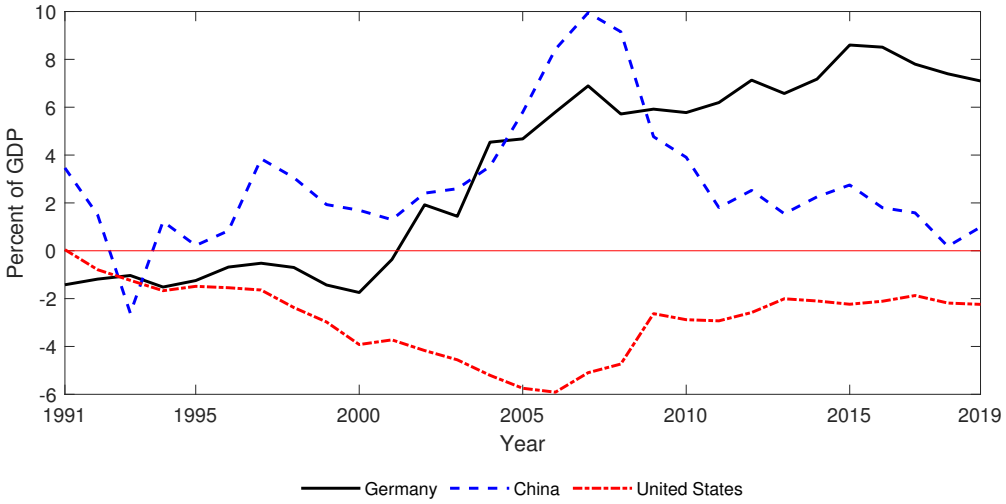
[4] A detailed description of the Hartz reforms and the developments of the German current account, as well as its net foreign asset position, can be found in Appendix A.

[5] See Hünnekes, Konradt, Schularick, Trebesch, and Wingenbach (2025), who show that despite its vast capital exports, Germany performs poorly in terms of investment returns on its exported capital.

[6] See, for example, The Economist, 2017b and International Monetary Fund, 2020.

[7] For example, in October 2014, Paul Krugman said: "As they [the Germans] see it, their economy was in the doldrums

Figure 1: Current Account in percent of GDP for Germany, China, and the United States, 1991-2019



Notes: The Figure depicts the Current Account in percent of GDP for Germany (black, solid line), China (blue, dashed line), and the United States (red, dashed line) for the years 1991 to 2019. Data source: The World Bank Data (2021).

While existing macroeconomic studies have quantified the domestic effects of these reforms,[8] their potential international consequences have received less attention in the literature.

Our model of a small open economy accounts for consumer heterogeneity in asset holdings, employment status, and skills. The labor market features matching frictions, as described by Pissarides (2000), and includes a two-tier unemployment benefit system reflecting the institutions in Germany, with both short-term and long-term unemployment benefits. Workers enter the labor force as low-skilled and accumulate skills over time, while a labor union negotiates wages with firms for low-skilled and high-skilled workers. Risk-averse agents aim to smooth consumption over their lifetime. When unemployment benefits are reduced, consumption risk in case of unemployment increases due to imperfect insurance. Under incomplete asset markets, consumers respond by accumulating assets for self-insurance. In an open economy, access to international asset markets allows consumers to purchase international bonds, thereby increasing the reforming country's net foreign asset position.

By simulating the German Hartz IV reform within our model, we quantify how labor market reforms shape international macroeconomic outcomes, challenging the predictions of traditional models with complete insurance. To link our model to empirical estimates, we construct simulated panel data that mirrors the empirical data and estimate the same regression, targeting the observed one percentage point increase in the aggregate savings rate following the reform. Our findings highlight that the Hartz IV reforms played a significant role in shaping Germany's net foreign asset position and broader (international) macroeconomic outcomes. In the short run, the reform contributed to a rise in the German current account, accounting for approximately 12% of its changes, around 22% of real exchange rate fluctuations, and over 40% of the decline

at the end of the 1990s; they then cut labor costs, gaining a huge competitive advantage, and began running gigantic trade surpluses."

[8] See Krause and Uhlig (2012), Krebs and Scheffel (2013), Launov and Wälde (2013), Hochmuth, Kohlbrecher, Merkl, and Gartner (2021), and Hartung, Jung, and Kuhn (2024).

in unemployment within the first five years.

We emphasize the importance of consumer heterogeneity in evaluating the macroeconomic consequences of labor market reforms by comparing model responses to those of a complete insurance framework. Our model features a precautionary savings channel that is absent in canonical small open economy representative agent models (see Obstfeld and Rogoff, 1995). These models typically highlight two opposing mechanisms in response to reduced unemployment benefits: a competitiveness channel, where lower wages boost exports, and a demand channel, where higher employment increases aggregate consumption.[9] We show that in the absence of a precautionary savings motive, the demand channel dominates, leading to a decline in the reforming country's current account. However, by introducing a precautionary savings motive, the model dynamics change fundamentally, resulting in *qualitatively different* current account responses and demonstrating the broader relevance of self-insurance in evaluating labor market reforms that go beyond the German case. We document that the incomplete insurance model not only better captures the post-reform dynamics of macroeconomic variables but also correctly predicts the empirically consistent signs of the current account and net foreign asset positions. Additionally, consumer heterogeneity plays a crucial role in assessing the redistributive effects of labor market reforms. In particular, low-skilled workers respond by increasing their savings to move away from the borrowing constraint, leading to higher wealth accumulation in the post-reform steady state. As a result, overall wealth inequality in the economy declines.

Welfare effects of the reform are highly heterogeneous, with the most significant losses concentrated among low-skilled and unemployed workers, particularly those with low asset holdings. These consumers rely heavily on labor income and have a high marginal propensity to consume, making them especially vulnerable to the reduction in unemployment benefits. To self-insure, they are forced to reduce current consumption, leading to a substantial decline in their welfare. In contrast, high-skilled and asset-rich individuals can more easily smooth consumption and mitigate the negative effects of the reform, with some even experiencing modest welfare gains in the long run. Under complete insurance, the reform leads to uniform welfare gains, as improved labor market conditions allow agents to benefit from higher job-finding rates without experiencing consumption losses. Additionally, comparing the small open economy with a closed-economy setting reveals significant differences: while the small open economy experiences aggregate welfare losses due to stronger precautionary savings behavior and a slower consumption recovery, the closed economy benefits from a temporary rise in the interest rate and stronger labor market responses, leading to net positive welfare effects.

Related Literature: This paper is connected to multiple areas of the literature. First, it relates to studies discussing the link between labor market reforms and current account disparities. Kollmann, Ratto, Roeger, in 't Veld, and Vogel (2015) find that the Hartz reforms were one of the main drivers of the German current account surplus. They abstract from modeling a frictional labor market and instead interpret shocks to leisure as changes in the generosity of unemployment benefits. This is confirmed by Ruppert and Stähler (2020) in a three-region life-cycle model with

[9] Behringer and van Treeck (2018) show that decreases in the share of wages in national income lead to an increase in the current account, which also seems to be the case for wage-dampening labor market deregulations (see Bertola and Lo Prete, 2015).

labor market frictions but stands in contrast to Gadatsch, Stähler, and Weigert (2016). Cacciatore et al. (2016) study the effects of labor market deregulations in general and find quantitatively small effects on the current account. These studies feature perfect insurance; thus, there is no precautionary savings motive. We contribute to this strand of the literature by allowing for consumer heterogeneity and a precautionary savings motive.[10]

Empirical studies on the impact of labor market reforms on the current account include Kennedy and Slok (2005) and Bertola and Lo Prete (2015). Kennedy and Slok (2005) show that labor market deregulation initially reduces prices and wages, improving the trade balance, but eventually reverses the current account due to increased foreign capital inflows driven by higher domestic profitability. Bertola and Lo Prete (2015) find that labor market deregulations generally improve a country's current account, emphasizing the role of precautionary savings, though their focus is on financial market imperfections and human capital investment. Our work complements Bertola and Lo Prete (2015) by quantifying the effects of specific deregulations and highlighting the role of idiosyncratic consumption risk.

Second, our work relates to the literature that addresses uninsurable labor market risk with precautionary savings, such as Challe and Ragot, 2016, Challe, Matheron, Ragot, and Rubio-Ramirez, 2017, Krusell et al., 2010, Heathcote and Perri, 2018, as well as McKay and Reis, 2016, McKay, 2017, McKay, Nakamura, and Steinsson, 2017, and Ravn and Sterk, 2017.[11] Fernandes and Rigato (2024) empirically assess the precautionary saving channel using variations in unemployment insurance across U.S. states and over time, finding small and statistically non-significant effects consistent with a present-biased model. The effects in our paper differ from those in Fernandes and Rigato (2024) because the Hartz IV reform was a permanent structural change, whereas their analysis examines temporary, countercyclical unemployment insurance extensions, and because Germany's higher pre-reform replacement rates made the benefit reduction more pronounced.[12] These papers are based on a closed-economy framework and, therefore, are silent on the effects in an international dimension.

Third, we contribute to the recent emerging literature that analyzes the effects of (mostly foreign) shocks in heterogeneous-agent open-economy models. de Ferra, Mitman, and Romei (2020) highlight the importance of household portfolio composition in the transmission of foreign shocks, while Auclert, Rognlie, Souchier, and Straub (2021) and Oskolkov (2021) explore how heterogeneous households respond to exchange rate depreciations and external monetary shocks, respectively. Guo, Ottonello, and Perez (2020) and Zhou (2022) further investigate the role of financial integration and redistribution in shaping the distributional impacts of these shocks. Additionally, Aggarwal, Auclert, Rognlie, and Straub (2023) analyze the effects of deficit-financed fiscal transfers, showing how they lead to excess savings and persistent current account

[10] Hochmuth, Merkl, and Stüber (2024) extend this discussion by examining how reduced unemployment benefits in one country can generate significant long-run consumption spillovers to non-reforming countries under incomplete insurance.

[11] Further related are Krueger, Mitman, and Perri (2016a) and Krueger et al. (2016b) who focus on the role of unemployment insurance systems in analyzing welfare and consumption effects in heterogeneous agent models. Bayer, Luetticke, Pham-Dao, and Tjaden (2019) study the effects of income uncertainty on households' precautionary savings.

[12] The initial replacement rate before Hartz IV was significantly higher in Germany — approximately 67 percent of previous net earnings, compared to 40 percent in the U.S.

deficits.[13] While these studies focus on the distributional effects of both foreign and domestic shocks, our work specifically examines the current account implications of a permanent domestic policy reform in the absence of nominal rigidities.

Fourth, we contribute to the literature on current account disparities in quantitative macroeconomic models. Mendoza, Quadrini, and Rios-Rull (2009) study the role of financial market developments and financial integration across countries in explaining global imbalances. Caballero, Farhi, and Gourinchas (2008) explain these disparities through heterogeneity in a country's ability to generate financial assets for global savers, and Hunt and Rebucci (2005) analyze the role of accelerating productivity growth. Broer (2014) highlights how rising income risk can endogenously relax borrowing constraints, leading to reductions in aggregate foreign assets even in the presence of precautionary savings motives. de Ferra, Mitman, and Romei (2021) identify a negative relationship between a country's income inequality and its current account balance, which they rationalize in a model with endogenously incomplete financial markets. Further related are Hoffmann, Krause, and Tillmann (2019), who show that higher uncertainty in income streams increases precautionary savings and leads to a higher long-run external asset position. Carroll and Jeanne (2009) introduce a tractable framework of net foreign assets, where the level of domestic wealth is determined by precautionary savings in the presence of idiosyncratic shocks.

Finally, our paper is related to studies evaluating the effects of the Hartz IV reform on German unemployment from a macroeconomic perspective (see e.g. Krebs and Scheffel, 2013, Krause and Uhlig, 2012, Launov and Wälde, 2013, Hochmuth et al., 2021, Hartung et al., 2024). These papers all evaluate the reform effects in a closed economy setting.

The rest of the paper is structured as follows. The next section presents empirical evidence on how the reform affected German savings rates. Section 3 derives an open-economy heterogeneous agent model with search and matching frictions. We explain the calibration in Section 4. Section 5 shows our results. We discuss the effects of consumer heterogeneity in Section 6 and analyze welfare effects in Section 7. Section 8 concludes.

2 Empirical Evidence

In this section, we present descriptive evidence and household-level fixed effects regression results on the impact of the Hartz IV labor market reform on German households' savings behavior, using data from the German Socioeconomic Panel (GSOEP).

Institutional Background: In response to rising unemployment and low economic growth rates in the late 1990s and early 2000s (when Germany was referred to as the "sick man of Europe"), the Hartz reforms were implemented gradually from 2003 to 2005. These reforms aimed to reduce unemployment, increase non-standard employment, enhance the efficiency of the labor market, and increase the incentives to work by reducing the generosity of unemployment benefits. Appendix A.2 provides further institutional details on the Hartz reforms. The Hartz IV

[13] Recent work by Bayer, Kriwoluzky, Müller, and Seyrich (2024) shows that in a Heterogeneous Agent New Keynesian (HANK) model of a two-country monetary union, business cycle shocks primarily redistribute across countries rather than within the union-wide wealth distribution.

reform, introduced in 2005, marked a major overhaul of Germany's social security system. Before the reform, unemployment support consisted of three tiers: (i) short-term unemployment benefits (up to 67% of previous net earnings for a maximum of 32 months), (ii) long-term benefits (up to 57% of previous net earnings, potentially until retirement), and (iii) social assistance for those ineligible for unemployment benefits. Hartz IV consolidated long-term unemployment benefits and social assistance into a single program, "Unemployment Benefits II" (Arbeitslosengeld II), which provided a flat-rate benefit independent of prior earnings, set at 345 euros for a single household, with possible top-ups for housing, heating, and additional living expenses. In a second reform step in 2006, the entitlement period for short-term unemployment benefits was reduced, with the extent of the reduction being age-dependent. Long-term unemployment benefits in Germany are subject to means testing. However, the asset limits are generally not restrictive enough to distort the savings decisions of most households significantly. Data from the Deutsche Bundesbank and the Institute for Employment Research (IAB) show that only a small percentage of households exceed these thresholds, indicating that the majority are not adversely impacted when qualifying for benefits. A detailed discussion of the role of asset limits in influencing savings behavior is provided in Appendix A.2.

Descriptives: As private households constitute the largest component of the German current account (see Figure 14 in Appendix A), shifts in their savings behavior can have significant implications for the overall current account balance. Figure 2 depicts the savings rate for employed household heads based on microeconomic data from the German Socioeconomic Panel (GSOEP).[14] Before the reform, the private savings rate showed a declining trend. By 2005, when the unemployment benefit reform (Hartz IV) was implemented, we observe a reversal of this trend and an increase in the private savings rate.[15]

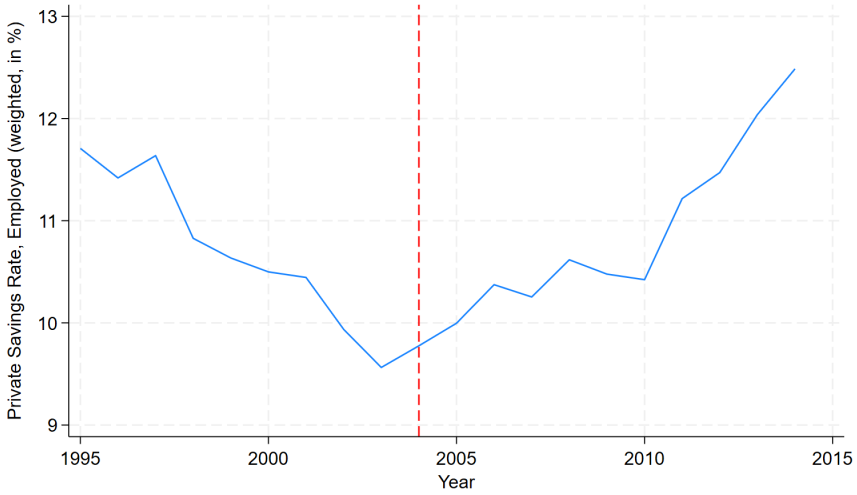
Fixed-Effects Regression: In our subsequent analysis, we examine how the aggregate savings rate and the savings rates of the most affected groups changed in response to the reform. To identify the most affected groups, we build on the classification provided by Hartung et al. (2024), which distinguishes variations in the reduction of maximum benefit duration based on age and prior employment duration. The most substantial decrease in entitlement duration was observed among workers aged 45 to 55 with over three years of previous employment. Furthermore, we refine our analysis by dividing affected workers into more detailed subgroups: "Group 1" encompasses those who faced an entitlement cut of up to 20%, Group 2 experienced a cut ranging from 21% to 40%, and Group 3 underwent a reduction exceeding 41%.[16]
To assess the effect on the aggregate savings rate, we estimate the following household-level fixed effects model:

[14] The GSOEP data does not provide information on the amount of precautionary savings (e.g. due to labor market risk) for this period. For details on the SOEP and the savings rate calculation, see Appendix B.

[15] Figure 15 in Appendix B.1.1 illustrates a trend reversal in savings rates across different educational groups, with low-educated workers initially increasing their savings rates strongly post-reform.

[16] Groups 1–3 are not strict subgroups of the most affected workers but rather cover a broader range of individuals who experienced varying degrees of entitlement reductions.

Figure 2: Private Savings Rate of Employed Workers, 1995-2014



Notes: We calculate the private savings rate for employed workers based on household-level survey data of the German Socioeconomic Panel (SOEP). The calculation follows Stein (2009); for details, see Appendix B. The dashed vertical line denotes the year 2004 (right before the implementation of the reform).

For the aggregate effect of the reform on the savings rate:

$$SavingsRate_{it} = \beta_0 + \beta_1 HartzDummy_t + \mathbf{X}_{it}\gamma + \mathbf{Z}_t\delta + \mu_i + \epsilon_{it}, \tag{2.1}$$

where $SavingsRate_{it}$ is the savings rate of household i at time t, and $HartzDummy_t$ equals 1 for the post-reform period (2005 onward). $\mathbf{X}_{it}$ includes household-level controls, and $\mathbf{Z}_t$ contains macroeconomic controls (i.e., a linear time trend, unemployment rate, GDP growth, interest rate, debt-to-GDP ratio, and terms of trade). μ_i denotes household fixed effects.
To capture the incremental effects on the most affected groups, we use:

$$SavingsRate_{it} = \beta_0 + \beta_1 MostAffected_{it} + \beta_2(MostAffected_{it} \times HartzDummy_t) + \mathbf{X}_{it}\gamma + \lambda_t + \mu_i + \epsilon_{it}, \tag{2.2}$$

where $MostAffected_{it}$ is a time-varying indicator for households most affected by the Hartz reforms. The interaction term $(MostAffected_{it} \times HartzDummy_t)$ measures differential effects on these households. Here, time-fixed effects (λ_t) replace macro controls. We also estimate (2.2) for different groups based on the severity of entitlement cuts.
Table 1 presents the results of household-level fixed-effects estimations. Column (1) shows a statistically significant one-percentage-point increase in the aggregate savings rate post-reform, suggesting that a substantial portion of the private savings rate increase in Figure 2 can be attributed to the reform. Columns (2) and (3) refine the analysis by estimating the incremental effects on the most affected groups. These specifications replace macroeconomic control variables with time-fixed effects to account for common year-specific shocks affecting all households.[17] In column (2), the interaction between "Most Affected" and the "Hartz Dummy" indicates a significant rise in savings rates among the most impacted groups. Column (3) further shows that

[17] As a result, the Hartz-shift dummy drops out.

larger entitlement cuts correspond to stronger increases in savings rates.[18] In the regressions, we control for potential time-varying household-level characteristics, i.e. marital status, region (East/West Germany), the number of children in the household, employment level, and ISCO-08 Occupation.

Table 1: Reform Effect on Saving Rates: Aggregate and Most Affected Groups

	(1)	(2)	(3)
Dependent Variable: Saving rate			
Hartz-Dummy	0.010***		
	(0.001)		
Most affected		-0.009***	
		(0.001)	
Most affected # Hartz IV-Dummy		0.008***	
		(0.002)	
Group 1			0.007***
			(0.002)
Group 2			-0.004**
			(0.002)
Group 3			-0.005***
			(0.002)
Group 1 # Hartz IV - Dummy			0.004***
			(0.001)
Group 2 # Hartz IV - Dummy			0.008***
			(0.002)
Group 3 # Hartz IV - Dummy			0.010***
HH-level Controls	Yes	Yes	Yes
Macro Controls	Yes	No	No
HH Fixed Effects	Yes	Yes	Yes
Time Fixed Effects	No	Yes	Yes
Observations	125,701	125,701	125,587
R^2	0.5911	0.5770	0.5771

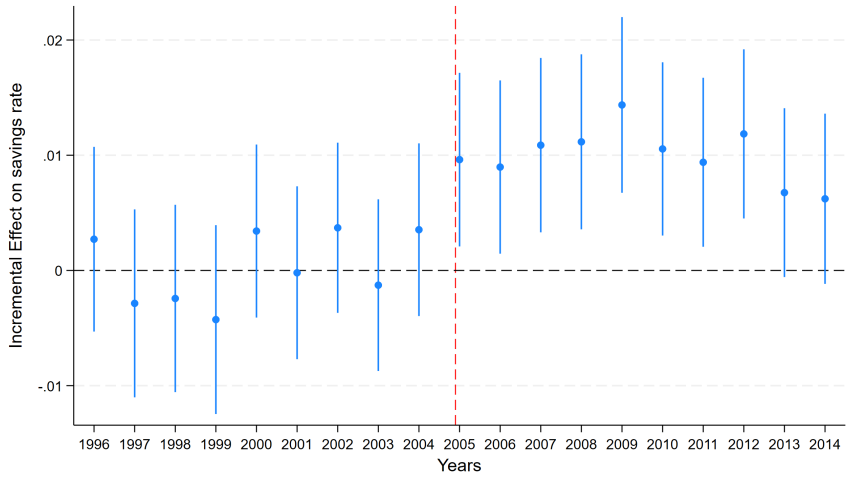
Note: "Most affected" denotes workers with an employment spell of min. 36 months and between the age of 45 and 55. "Group 1" denotes workers that experienced an entitlement cut of up to 20%, "Group 2" denotes workers with an entitlement cut between 21% and 40%, and "Group 3" consists of workers with an entitlement cut of more than 41%. The entitlement cut varies by employment duration and age, see Hartung et al. (2024). "Hartz Dummy" is a shift dummy that takes the value 1 from 2005 onward. The annual sample ranges from 1995 to 2014. All Regressions include the following household-level controls: Marriage Status, Region (East/West Germany), ISCO-08 Occupations, Number of children, and employment level. Specification (1) includes the following macroeconomic controls: a linear time trend, unemployment rate, GDP growth, interest rate, debt-to-GDP ratio, and terms of trade. Data Sources: GSOEP, Destatis and Deutsche Bundesbank. Standard Errors are clustered at the household level.*p<0.1; **p<0.05; ***p<0.01

Figure 3 shows the interaction terms of year dummies with the most affected workers, along with 90% confidence bands, capturing the dynamic effects of changes in the savings behavior. Before the reform, the savings rate for this group remained unaffected, with point estimates close to zero. From 2005 onward, however, there was a clear and statistically significant increase in their savings rate, which persisted in subsequent years. This suggests that the Hartz IV reform significantly changed the savings behavior of the most affected workers in the years after the reform. In contrast, there is no evidence that the 2001 pension reform, including the introduction of the "Riester-Rente" (a state-subsidized third pillar of the pension system), significantly affected the savings behavior of these workers in the early 2000s. While the Riester system was introduced

[18] The reference category is Group 0, which includes workers younger than 45 with employment durations under 28 months, who experienced no change in entitlement duration.

to encourage private retirement savings, its uptake remained limited, particularly among low-income individuals (see Geyer, Grabka, and Haan, 2021).

Figure 3: Incremental Effect on Savings Rate of Most Affected Group



Notes: We illustrate the point estimates of the interaction terms of year-dummies with the group of most affected workers together with 90% confidence intervals based on the household-level fixed effects regression with the include the following household-level controls: Marriage Status, Region (East/West Germany), ISCO-08 Occupations, Number of children, and Employment level. The red vertical line illustrates the time of the reform implementation.
Data Source: German Socioeconomic Panel.

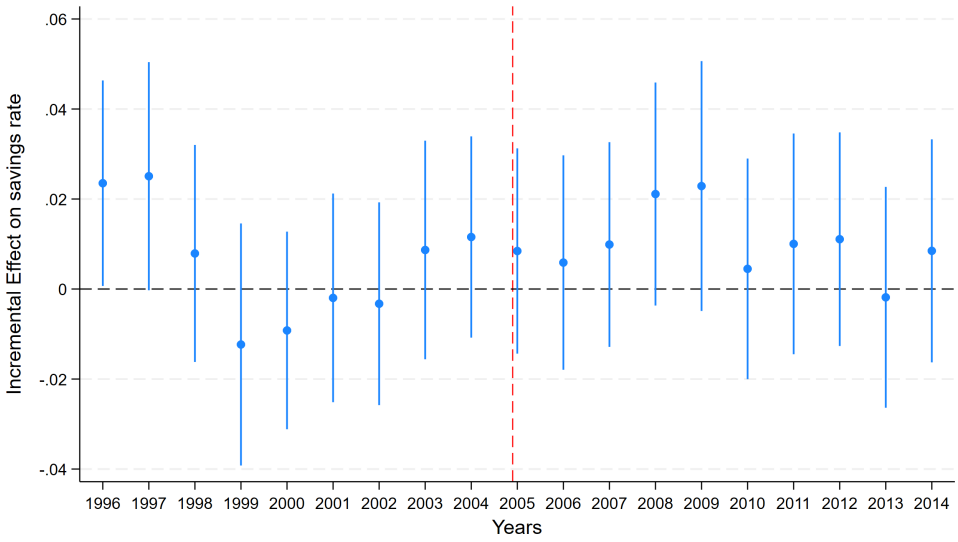
Robustness: Civil Servants To validate our micro-level estimations of the incremental effects on savings rates, we examine the savings behavior of civil servants exhibiting the same characteristics as the group of most affected workers (along the dimensions of age and employment spell). In Germany, civil servants face minimal unemployment risk as their employment contracts can only be terminated under exceptional circumstances.[19] Consequently, we would not expect any significant shift in their savings behavior following the labor market reform. This is confirmed in Figure 4, which shows no notable change in their savings rates after 2005.

Quantitative Effects: Table 2 presents the estimated quantitative effects of the Hartz IV labor market reform on savings rates, based on our household-level estimations. Using the aggregate increase of approximately one percentage point (as illustrated in Table 1), we compute the counterfactual absolute savings of private households in Germany, amounting to a cumulative rise of about 78 billion euros from 2005 to 2009—equivalent to roughly 2.8% of real GDP in 2014. Extending the effect through 2014 results in a total increase of 5.89% of real GDP in that year.

Further Empirical Evidence: A comparison of current account movements across European countries shows that, while many Eurozone economies, particularly those in Southern Europe, experienced persistent deficits, Germany's surplus is notable both for its size and its sustained

[19] In Germany, civil servants can be dismissed for reasons such as serious misconduct, health issues, the abolition of their position, incompetence, violations of loyalty obligations, financial misconduct, and persistent non-performance, although the process is complex and highly regulated.

Figure 4: Incremental Effect on Savings Rates of Most Affected Groups: Civil Servants



Notes: The figure illustrates the point estimates of the interaction terms of year dummies for civil servants with the group of most affected workers (based on age and employment duration) and 90% confidence intervals. These estimates are derived from household-level fixed effects regressions that include controls for marriage status, region (East/West Germany), ISCO-08 occupations, number of children, and employment level. The red vertical line marks the time of the reform implementation. Data Source: German Socioeconomic Panel.

nature; see Figure 16 in Appendix B.2. Since the introduction of the Euro, current account balances within the Eurozone have increasingly diverged. Notably, Austria, which shares several institutional similarities with Germany, exhibited similar current account trends after the Euro's introduction but, unlike Germany, did not implement labor market reforms and did not experience persistent surpluses.

Furthermore, we perform time series regressions controlling for macroeconomic variables such as the real effective exchange rate, government debt, and interest rates. The results, depicted in Table 10 of Appendix B.3, indicate a statistically significant positive impact of the Hartz IV reform on Germany's current account. Additionally, rolling window regressions show that the effect was strongest in the first five years post-reform (2005–2009).

Table 2: Quantitative Reform Effects based on Microeconomic Estimation

Quantitative Effect	
Aggregate Incremental Effect on Savings Rate (Target)	1.0 pp
Cumulated Effect (2005-2009) in % of Real GDP (of 2014)	2.8%
Cumulated Effect (2005-2014) in % of Real GDP (of 2014)	5.89%
Absolute Effect (cum.) in EUR. (2005-2009) in Bn. EUR	78.22
Absolute Effect (cum.) in EUR. (2005-2014) in Bn. EUR	164.74

Notes: Quantitative Effects of the incremental increase in household-level savings rate based on the household-level panel regression (see main text for details). Cumulated effects are calculated by computing the increase in private households' savings (based on national accounts). Data Sources: German Socioeconomic Panel (GSOEP) and Destatis (National Accounts).

3 The Model

In this section, we develop a small open economy model with worker heterogeneity, a frictional labor market, and incomplete asset markets. Time is discrete, and the economy consists of a continuum of infinitely-lived consumers who discount the future with a skill-specific factor β^j and derive utility from consumption.[20] The economy operates within a currency union and treats the constant interest rate as exogenously given.

Consumers can be employed (E), short-term unemployed (S), or long-term unemployed (L), supplying one unit of labor inelastically. Employed workers are either low-skilled (z^L) or high-skilled (z^H), with transitions governed by skill acquisition (probability π^E) and skill depreciation upon job loss. Workers accumulate skills while employed and experience skill deterioration during unemployment.[21] We distinguish between short- and long-term unemployment, with benefits linked to past wages: short-term benefits depend on the previous skill-specific wage, while long-term benefits are a fraction of the low-skilled wage.[22]

Several components of our model follow standard approaches from the literature. The heterogeneous agent structure with idiosyncratic risk and precautionary savings follows the incomplete markets framework of Aiyagari (1994). The labor market features a Diamond-Mortensen-Pissarides (DMP) structure (Pissarides, 2000), in which firms post vacancies and worker-firm matches are formed via a Cobb-Douglas matching function. On the international side, our model builds on the small open economy structure of Gali and Monacelli (2005), in which the domestic economy interacts with the rest of the world through trade and financial flows.

Our framework departs from these benchmark models in several ways. First, unlike Gali and Monacelli (2005), we do not assume perfect risk sharing. Instead, consumers face idiosyncratic, uninsurable employment risk and accumulate precautionary savings, which shape net foreign asset accumulation and trade balance dynamics.[23]

Second, we introduce a labor market with skill heterogeneity and unemployment duration. While Krusell et al. (2010) incorporate search frictions, we extend their framework by including ex-ante skill differentiation and a detailed unemployment benefit system. Workers accumulate skills while employed and experience skill deterioration during unemployment (Ljungqvist and Sargent, 2007; Krause and Uhlig, 2012; Hartung et al., 2024).

Asset markets are incomplete and agents cannot trade state-contingent securities that allow them to fully insure against all income risk. However, consumers can self-insure by purchasing one type of asset, a portfolio bundled by an investment fund. This asset includes the capital stock, a claim to firms' profits paid as dividends, government bonds, and international assets. Portfolio diversification has no intrinsic benefit since only aggregate shocks affect prices.[24] All

[20] A skill-specific discount factor β^j increases wealth dispersion while reducing the need for additional heterogeneity.

[21] Our assumption of skill depreciation during unemployment aligns with empirical evidence from German data, as shown in estimated models by Jarosch (2023) and Burdett, Carrillo-Tudela, and Coles (2020), which highlight significant human capital erosion during prolonged unemployment.

[22] This approach, which parallels employment duration heterogeneity, captures the impact of unemployment duration on benefits and skill levels (Hartung et al., 2024; Krause and Uhlig, 2012).

[23] Further differences from Gali and Monacelli (2005) are that we abstract from nominal rigidities and explicitly incorporate capital accumulation in our framework.

[24] With no aggregate risk and returns uncorrelated with individual labor market status, diversification provides no additional gain.

agents hold the same portfolio composition but choose different asset levels.
There is a positive measure of firms, each hiring one worker and operating in a competitive product market. Firms use capital and labor as inputs, and profits are paid out as dividends d in every period.

3.1 Labor Market Matching

All unemployed workers search on the same labor market. Each period, vacant jobs for workers (V_t) and unemployed workers (U_t) are matched randomly, and the number of matches per period can be described by a Cobb-Douglas matching function:

$$M_t = \chi V_t^{1-\eta} U_t^{\eta}, \tag{3.1}$$

where χ denotes the matching efficiency and η the matching elasticity. A match is always formed between a firm and a low-skilled worker. The probability that a vacancy is filled in the current period is

$$\lambda_t^f(\theta_t) = \frac{M_t(V_t, U_t)}{V_t} = \chi \theta_t^{-\eta}, \tag{3.2}$$

where $\theta_t = V_t/U_t$ is the ratio of vacancies to unemployed workers and defines labor market tightness. The probability that an unemployed worker finds a job in the current period is

$$\lambda_t^w(\theta_t) = \frac{M_t(V_t, U_t)}{U_t} = \chi \theta_t^{1-\eta}. \tag{3.3}$$

Low-skilled workers can become high-skilled with probability π^E, reflecting skill upgrading during employment. Job destruction is exogenous, occurring with a constant probability that differs by skill level ($s^L > s^H$), where s^L denotes the separation rate for low-skilled workers and s^H is the separation rate for a high-skilled worker.
The law of motion for low-skilled employment N_t^L is given by last period's low-skilled employed workers who did not become high-skilled and new matches:

$$N_{t+1}^L = (1-s^L)(1-\pi^E)N_t^L + M_t. \tag{3.4}$$

The next period's pool of high-skilled workers N_t^H consists of high-skilled workers who were not separated from their jobs and low-skilled workers who became high-skilled:

$$N_{t+1}^H = (1-s^L)\pi^E N_t^L + (1-s^H)N_t^H. \tag{3.5}$$

The aggregate law of motion for employment is given by

$$N_{t+1} = (1-s^L)N_t^L + (1-s^H)N_t^H + M_t. \tag{3.6}$$

The aggregate unemployment rate is given by all workers who are currently not in employment $U_t = 1 - N_t$. If a match gets destroyed, the worker becomes short-term unemployed. In the next period, the worker either finds a job again with probability λ_t^w, enters the pool of long-term

unemployment benefit recipients with constant probability π^L, or remains short-term unemployed.[25] Once a worker has entered the pool of long-term unemployment benefit recipients, she either finds a job or remains long-term unemployed. The corresponding law of motions of short-term unemployment benefit recipients with skill level $j \in (L,H)$ during their previous employment spell is given by

$$U_{t+1}^{S,j} = (1-\pi^L)(1-\lambda_t^W)U_t^{S,j} + s^j N_t^j, \tag{3.7}$$

where π_L denotes the exogenous probability to switch from short-term into long-term unemployment. Long-term unemployment benefits are independent of the previous skill level. The law of motion for long-term unemployment benefit recipients is:

$$U_{t+1}^{L} = \pi^L(1-\lambda_t^W)U_t^{S} + (1-\lambda_t^W)U_t^{L}, \tag{3.8}$$

where $U_t^S = U_t^{S,L} + U_t^{S,H}$. It follows that $U_t = U_t^S + U_t^L$.

3.2 Investment Fund and Asset Structure

A consumer is subject to idiosyncratic uninsurable employment risk but has access to assets, which an investment fund bundles. The investment fund collects and aggregates deposits from consumers at no cost.[26] We denote aggregate assets $\bar{a}$, which are given by integrating over all individuals with asset choices a

$$\bar{a}_t = \int a_t F^M(a) da,$$

where $F^M(a)$ is the mass of all consumers (employed and unemployed) with wealth level a.
The role of the investment fund in our model is restricted to aggregating different asset classes. It aggregates total assets $\bar{a}_t$ across four types: physical capital k_t used in production, government bonds b_t, equity x_t representing claims on firms' profits, and net foreign assets NFA_t. We normalize the total amount of firms' equity to one. Following Krusell et al. (2010), we denote the value of a firm by p_t and assume that consumers can only hold claims on aggregate profits rather than profits to individual firms. Consequently, the equity price p_t is determined by the following relationship:

$$p_t = \frac{d_{t+1} + p_{t+1}}{1 + r - \delta}, \tag{3.9}$$

where r denotes the return on capital, and δ represents the depreciation rate. This expression follows from the no-arbitrage condition, which ensures that the returns on capital and equity are equivalent.[27]

[25] See Oswald, 1993 and Moyen and Stähler, 2014.
[26] See Appendix C.1 for a formal characterization of the investment funds' maximization problem.
[27] As highlighted by Mukoyama (2013), equation 3.9 holds at any point where the future path of the aggregate state is known to the consumer. However, when shocks or reforms are implemented, the value of p_0 must be reassessed

The investment fund operates under the following constraint, which ensures the total assets $\bar{a}_t$ are allocated without exceeding available resources:

$$\bar{a}_t = \frac{p_t^H}{P_t} k_t + NFA_t + b_t + p_{t-1}. \tag{3.10}$$

All assets in this equation are expressed in real terms.[28]
The law of motion for capital defines aggregate investment I_t:

$$\frac{p_t^H}{P_t} I_t = \frac{p_{t+1}^H}{P_{t+1}} k_{t+1} - (1-\delta)\frac{p_t^H}{P_t} k_t. \tag{3.11}$$

3.3 Consumers

All consumers have CRRA preferences over consumption:

$$U = \mathbb{E}_0 \sum_{t=0}^{\infty} \beta^{j,t} U(c_t) \quad \text{with} \quad U(c_t) = \frac{c_t^{1-\sigma}}{1-\sigma}, \tag{3.12}$$

where c_t is a CES aggregate of home and foreign consumption goods. The future is discounted with the skill-specific discount rate $\beta^{j,t}$. Agents consume goods produced at home and abroad in the small open economy. The CES aggregated consumption bundle in the home country, with preference parameter for domestic goods γ and elasticity of substitution η^C, is given by

$$c_t = \left(\gamma^{\frac{1}{\eta^C}} c_{H,t}^{\frac{\eta^C-1}{\eta^C}} + (1-\gamma)^{\frac{1}{\eta^C}} c_{F,t}^{\frac{\eta^C-1}{\eta^C}} \right)^{\frac{\eta^C}{\eta^C-1}},$$

where $c_{H,t}$ denotes home goods consumed domestically and $c_{F,t}$ denotes goods produced in the rest of the currency union and consumed at home.
Employed consumers receive after-tax labor income $(1-\tau_t^W)w_t$, where w_t denotes the real wage (to be defined later). Unemployed agents receive unemployment benefits $\kappa_t^{B,j}$, which depend on the previous net wage level and the replacement rate b^j that varies by unemployment duration $j \in \{S, L\}$, with short-term unemployment benefits being more generous ($b^S > b^L$). Each period, consumers take prices and wages as given and choose consumption and asset holdings.

Aggregate State: The aggregate state Z_t represents the distribution of agents over individual states—assets a, employment status e, and skill levels s. Z_t is a probability measure on the state space $\mathscr{A} \times \mathscr{E} \times \mathscr{S}$, defined over the Borel σ-algebra $\Sigma_Z = \mathscr{B}(\mathscr{A}) \otimes \mathscr{P}(\mathscr{E}) \otimes \mathscr{P}(\mathscr{S})$. The evolution of Z_t is deterministic and follows the law of motion:

$$Z_{t+1} = \Gamma(Z_t),$$

to reflect the new stream of expected future profits.

[28] Note that physical capital k_t is converted from producer prices to CPI terms, which ensures that all components of the total assets $\bar{a}_t$ are measured in consistent units.

where Γ is a deterministic transition function derived from agents' optimal policies and the individual transition probabilities.

Low-skilled Employed Consumers: The recursive formulation of the low-skilled employed consumer's problem is

$$V_t^{E,L}(a_t, Z_t) = \max_{\{c_t^{E,L}, a_{t+1}\}} \Big\{ U(c_t^{E,L}) + \beta^L \Big[(1-s^L)(1-\pi^E) V_{t+1}^{E,L}(a_{t+1}, Z_{t+1}) + (1-s^L)\pi^E V_{t+1}^{E,H}(a_{t+1}, Z_{t+1}) + s^L V_{t+1}^{S,L}(a_{t+1}, Z_{t+1}) \Big] \Big\}, \tag{3.13}$$

subject to

$$\begin{aligned} c_t^{E,L} + a_{t+1} &= (1+r-\delta)a_t + (1-\tau^W) w_t^L(Z_t) - \tau_t(Z_t), \\ a_{t+1} &\geq \underline{a}. \end{aligned}$$

where $U(\cdot)$ denotes the increasing and concave utility function. Let the decision rule for a_{t+1} for low-skilled employed workers be $a_{t+1} = \varphi_t^{E,L}(a)$. The consumption of employed workers is denoted $c_t^{E,L}$, $(1+r-\delta)$ represents the interest rate net of depreciation δ on assets a_t, τ^W denotes a labor-income tax on the wage of low-skilled workers, w_t^L, τ_t is a lump-sum tax (or transfer), and $\underline{a}$ represents the borrowing constraint.

High-skilled Employed Consumers: The recursive formulation of the high-skilled employed consumer's problem is

$$V_t^{E,H}(a_t, Z_t) = \max_{\{c_t^{E,H}, a_{t+1}\}} \Big\{ U(c_t^{E,H}) + \beta^H \Big[(1-s^H) V_{t+1}^{E,H}(a_{t+1}, Z_{t+1}) + s^H V_{t+1}^{S,H}(a_{t+1}, Z_{t+1}) \Big] \Big\}, \tag{3.14}$$

subject to

$$\begin{aligned} c_t^{E,H} + a_{t+1} &= (1+r-\delta)a_t + (1-\tau^W) w_t^H(Z_t) - \tau_t(Z_t), \\ a_{t+1} &\geq \underline{a}. \end{aligned}$$

where the decision rule for a_{t+1} for high-skilled employed workers be $a_{t+1} = \varphi_t^{E,H}(a)$.

Short-term Unemployed Consumers: A short-term unemployed consumer of skill group $j \in \{L, H\}$ receives unemployment benefits $\kappa_t^{S,j}$ based on the short-term replacement rate b^S and the previous skill-specific wage w_t^j, such that $\kappa_t^{S,j} = b^S(1-\tau^W)w_t^j$.[29] With exogenous probability π_L, the worker becomes long-term unemployed if not re-employed in the next period. The

[29] In equilibrium, $w_t^H > w_t^L$, so $\kappa_t^{S,H} > \kappa_t^{S,L}$.

recursive problem is

$$V_t^{S,j}(a_t,Z_t)=\max_{\{c_t^{S,j},a_{t+1}\}}\Bigg\{U(c_t^{S,j})+\beta^j\Big[\lambda_t^W(Z_t)V_{t+1}^{E,L}(a_{t+1},Z_{t+1}) \\ +(1-\lambda_t^W(Z_t))\Big[(1-\pi_L)V_{t+1}^{S,j}(a_{t+1},Z_{t+1})+\pi_L V_{t+1}^{L}(a_{t+1},Z_{t+1})\Big]\Big]\Bigg\}, \quad (3.15)$$

subject to

$$c_t^{S,j}+a_{t+1}=(1+r-\delta)a_t+\kappa_t^{S,j}(Z_t)-\tau_t(Z_t),$$
$$a_{t+1}\geq\underline{a}.$$

Let the decision rule for a_{t+1} for short-term unemployed workers be $a_{t+1}=\varphi_t^{S,j}(a)$.

Long-term Unemployed Consumers: A long-term unemployed consumer receives less generous unemployment benefits $\kappa_t^L=b^L(1-\tau^W)w_t^L$, based on the lower replacement rate b^L and the equilibrium wage of low-skilled workers.[30] They either find a job with probability λ_t^W in the next period or remain long-term unemployed. Their problem is:

$$V_t^L(a_t,Z_t)=\max_{\{c_t^L,a_{t+1}\}}\Bigg\{U(c_t)+\beta^L\Big[\lambda_t^W(Z_t)V_{t+1}^{E,L}(a_{t+1},Z_{t+1}) \\ +(1-\lambda_t^W(Z_t))V_{t+1}^{L}(a_{t+1},Z_{t+1})\Big]\Bigg\}, \quad (3.16)$$

subject to

$$c_t^L+a_{t+1}=(1+r-\delta)a_t+\kappa_t^L(Z_t)-\tau_t(Z_t),$$
$$a_{t+1}\geq\underline{a},$$

where $a_{t+1}=\varphi_t^L(a)$ denotes the decision rule for long-term unemployed workers.

3.4 Firms

Firms produce output with two inputs: capital and labor. They hire workers on a frictional labor market and rent capital. A matched worker-firm pair produces output according to

$$y_t^j=z^j(\tilde{k}_t^j)^\alpha. \quad (3.17)$$

where z^j is a skill-specific total factor productivity parameter, $\tilde{k}_t^j$ is the amount of capital per worker and defined as the ratio of aggregate capital per employed worker $\tilde{k}_t^j=\frac{k_t^j}{N_t^j}$. The aggregate output is then given by $Y_t=y_t^LN_t^L+y_t^HN_t^H$. The real per-period firm profit for a worker is defined

[30] We assume that low-skilled workers dominate the pool of long-term unemployment benefit recipients.

as

$$\Pi_t^j = \frac{p_t^H}{P_t} y_t^j - \frac{p_t^H}{P_t} r \tilde{k}_t^j - w_t^j. \tag{3.18}$$

The dividends paid out are given by aggregate profits (per-worker firm profits Π_t^j times the number of employed workers N_t^j for low-skilled and high-skilled worker-firm pairs respectively) minus vacancy posting costs:

$$d_t = \Pi_t^L N_t^L + \Pi_t^H N_t^H - \kappa^v V_t, \tag{3.19}$$

where κ^v denotes real vacancy posting costs. Firms maximize the present value of the discounted stream of dividends. Thus, the marginal product of capital is given by

$$r = \alpha z^j (\tilde{k}_t^j)^{\alpha-1}. \tag{3.20}$$

Note that the real return to capital r is fixed on the international market in the setting of a small open economy.
The marginal value of an additional low-skilled worker to the firm is

$$\begin{aligned} J_t^L(Z_t) = & \frac{p_t^H(Z_t)}{P_t(Z_t)} z^L (\tilde{k}_t^L)^\alpha - \frac{p_t^H(Z_t)}{P_t(Z_t)} r \tilde{k}_t^L - w_t^L(Z_t) \\ & + q\left[(1-s^L)(1-\pi^E) J_{t+1}^L(Z_{t+1}) + (1-s^L)\pi^E J_{t+1}^H(Z_{t+1}) + s^L \mathcal{V}_{t+1}^{V,L}(Z_{t+1})\right], \end{aligned} \tag{3.21}$$

which takes into account that with probability π^E the worker may become high-skilled in the next period. Additionally, with probability s^L, the match is destroyed, in which case the firm receives the continuation value of a vacant position, $\mathcal{V}_{t+1}^{V,L}$. The term q represents the inverse of the gross real interest rate, $q = \frac{1}{1+r-\delta}$. The marginal value of a high-skilled worker to the firm is

$$\begin{aligned} J_t^H(Z_t) = & \frac{p_t^H(Z_t)}{P_t(Z_t)} z^H (\tilde{k}_t^H)^\alpha - \frac{p_t^H(Z_t)}{P_t(Z_t)} r \tilde{k}_t^H - w_t^H(Z_t) \\ & + q\left[(1-s^H) J_{t+1}^H(Z_{t+1}) + s^H \mathcal{V}_{t+1}^{V,H}(Z_{t+1})\right]. \end{aligned} \tag{3.22}$$

The value of a vacancy, $\mathcal{V}_t^{V,j}$, is

$$\mathcal{V}_t^{V,j}(Z_t) = -\kappa^V + q\left[(1-\lambda_t^f)\mathcal{V}_{t+1}^{V,j}(Z_{t+1}) + \lambda_t^F J_{t+1}^j(Z_{t+1})\right], \tag{3.23}$$

where in equilibrium, firms will post vacancies until $\mathcal{V}_t^{V,j} = 0$ holds.

The job-creation condition assuming free market entry is given by

$$\frac{\kappa^v}{\lambda_t^f} = q(1-s^L)\left[J_{t+1}^L(Z_{t+1})\right]. \tag{3.24}$$

3.5 Wage Determination

We assume that the surplus generated by a match between workers and firms is shared according to a surplus-sharing rule that ensures equal gains for both parties. Atomistic labor unions, representing the average worker, negotiate wages with firms.

This approach is empirically grounded and offers tractability for our analysis. Empirically, it reflects the significant role of sectoral agreements in the German labor market during the period of the reform. Before the reform, collective bargaining was the predominant wage-setting mechanism in Germany. According to the IAB Establishment Panel, 68% of employees in western Germany were covered by collective agreements in 2004, with sectoral agreements playing the largest role, while company-level agreements covered only 2% of establishments and 7% of employees (Elguth and Kohaut, 2005). Technically, modeling wage determination through unions that bargain on behalf of the average worker simplifies the complex dynamics that arise in search-and-matching frameworks with heterogeneous agents and asset accumulation, especially when calculating dynamic transition paths.[31]

The union's objective is to maximize the surplus of employment over unemployment for the average worker, reflecting a central motive for members' welfare and aiming to secure outcomes representative of workers' interests.[32] This approach accounts for the average consumption and asset levels of its members in the wage bargaining process.[33]

The value of an employed worker in skill group j is given by the value function $V^{E,j}(a_t, Z_t)$. For the average worker in this group, we evaluate the function at the group-specific mean asset level, denoted by $\tilde{a}_t$, and define this as:

$$\mathscr{W}_t^{E,j}(Z_t) = V^{E,j}(\tilde{a}_t, Z_t).$$

Similarly, the values of short-term unemployed and long-term unemployed workers in skill group j are given by the corresponding value functions, $V^{S,j}(a_t, Z_t)$ and $V^{L}(a_t, Z_t)$, respectively. Evaluating these functions at the average values of the individual states, we define the corresponding values as:

$$\mathscr{W}_t^{S,j}(Z_t) = V^{S,j}(\tilde{a}_t, Z_t), \quad \mathscr{W}_t^{L}(Z_t) = V^{L}(\tilde{a}_t, Z_t).$$

The fallback position of a union member in union j is the payoff during unemployment, which can be short-term or long-term unemployment (weighted by the corresponding share).

We assume that the union's surplus is given by its average members' difference between the values of being employed and the fallback position of unemployment.[34]

[31] Bilateral bargaining between workers and firms leads to a wage schedule that rises with wealth. Solving the model thus involves determining this endogenous wage schedule, adding another layer of complexity as it represents an infinite-dimensional object.

[32] Using the median worker instead would amplify the net foreign asset effects due to lower initial assets and higher savings. Consequently, modeling the average worker provides a more conservative approach.

[33] Modeling wage determination through a labor union is a standard approach in heterogeneous agent models (see Auclert, Rognlie, and Straub, 2024; de Ferra et al., 2020; Bayer et al., 2024 who abstract from search and matching frictions.

[34] Note that this setup is not efficient as long-term unemployed would have a lower reservation wage.

$$\tilde{\mathcal{W}}^j{}_t(Z_t) = \mathcal{W}_t^{E,j}(Z_t) - \left(\mathcal{W}_t^{S,j}(Z_t) \frac{U_t^S}{U_t^S + U_t^L} + \mathcal{W}_t^L(Z_t) \frac{U_t^L}{U_t^S + U_t^L} \right). \tag{3.25}$$

The firm's surplus is given by the marginal value of one additional worker to a firm, $J_t^j(Z_t)$, see equations 3.21 and 3.22.

Bargaining Solution

To solve for the bargained wage, we assume Egalitarian bargaining (see Kalai, 1977), which in our context ensures equal gains for both parties upon reaching an agreement.[35] The wage is implicitly characterized by the following surplus-sharing rule:

$$\tilde{\mathcal{W}}^j{}_t(Z_t) = \frac{\zeta}{(1-\zeta)} J_t^j(Z_t). \tag{3.26}$$

By adopting Egalitarian bargaining, our model remains tractable, eliminates the endogenous wealth-wage feedback loop that would arise under Nash bargaining (see Bardóczy, 2017 for a discussion), and ensures a stable wage structure. This makes it particularly suitable for environments with precautionary savings and risk-averse workers.[36] Moreover, controlled experiments indicate that real-world bargaining behavior frequently aligns more closely with the Egalitarian solution than with the Nash solution (see Bruce and Clark, 2012).

3.6 Fiscal Authority

The fiscal authority finances unemployment benefits for short and long-term unemployed workers as well as interest payments on outstanding government debt with a lump sum tax τ, a labor-income tax τ^W, and by issuing new government bonds b_t:

$$\kappa_t^{S,L} U_t^{S,L} + \kappa_t^{S,H} U_t^{S,H} + \kappa_t^L U_t^L + (1 + r - \delta) b_{t-1} = \tau^W (w_t^L N_t^L + w_t^H N_t^H) + \tau_t + b_t. \tag{3.27}$$

To ensure stationarity of government debt (see Schmitt-Grohe and Uribe, 2007), the lump-sum tax follows the following tax rule:

$$\frac{\tau_t}{\bar{\tau}} = \rho^\tau \frac{\tau_{t-1}}{\bar{\tau}} + \chi^b \frac{b_{t-1}}{\omega^B Y_{t-1}}, \tag{3.28}$$

where $\bar{\tau}$ denotes the steady-state level of the lump-sum tax, ρ^τ is a smoothing parameter, and χ^b determines the elasticity of the tax rate to deviations of government debt from the long-run debt ratio, where ω^B denotes the percent of government debt.

[35] Egalitarian bargaining satisfies the axioms Pareto-optimality, symmetry, and strong monotonicity. However, as opposed to the Nash bargaining solution, the solution is not scaled by the wage's marginal utility and, therefore, is not scale invariant (see l'Haridon, Malherbet, and Pérez-Duarte, 2013 for a discussion).

[36] As shown in l'Haridon et al. (2013), in a model without precautionary savings, Nash and Egalitarian bargaining yield equivalent outcomes when workers are risk-neutral. However, under risk aversion, this equivalence breaks, though the quantitative differences remain small.

3.7 Rest of the Currency Zone

The small open economy is linked to the rest of the currency zone by trade in consumption goods and international assets. We define the real exchange rate rer_t as the ratio of import prices to export prices, $\text{rer}_t = p_t^H / p_t^F$ and the terms of trade, tot_t, as the inverse $\text{tot}_t = p_t^F / p_t^H$. The consumer price index is given by

$$P_t = \left[\gamma (p_t^H)^{-\eta^C/(1-\eta^C)} + (1-\gamma)(p_t^F)^{-\eta^C/(1-\eta^C)}\right]^{-(1-\eta^C)/\eta^C}. \tag{3.29}$$

The demand for consumption goods of the rest of the currency union produced in home c_H^* is a function of the terms of trade:

$$c_{H,t}^* = \text{tot}_t^{-\theta_F} X \tag{3.30}$$

where θ_F denotes the demand elasticity of the foreign population for changes in the relative price between goods produced at home and abroad and X is an exogenous demand shifter capturing the size of the foreign market (see de Ferra et al., 2020). Demand for home and foreign consumption goods can be expressed as

$$c_{H,t} = \left(\frac{\gamma}{(1-\gamma)}\right) \text{rer}_t^{\frac{1}{1-\eta^C}} c_{F,t}. \tag{3.31}$$

Asset market clearing implies that total assets in the home economy, $\bar{a}_t$, have to equal government debt plus net foreign assets, capital, and equities. Hence, the loanable funds constraint defined in Equation 3.10 must hold. A country's net foreign asset position is defined as last period's assets plus current net exports, NX_t,

$$\text{NFA}_{t+1} = (1 + r - \delta)\text{NFA}_t + NX_t, \tag{3.32}$$

where the difference between exports and imports gives net exports:

$$NX_t = EX_t - IM_t = \frac{p_t^H}{P_t} c_{H,t}^* - \frac{p_t^F}{P_t} c_{F,t}. \tag{3.33}$$

The current account is given by the change in the net foreign asset position, $\text{CA}_t = \text{NFA}_t - \text{NFA}_{t-1}$.

3.8 Market Clearing

Total resources in the domestic economy equal aggregate domestic consumption, investment, and resource costs arising from vacancy posting. Hence, domestic good market clearing implies:

$$Y_t = c_{H,t} + c_{H,t}^* + I_t + \frac{P_t}{p_t^H} \kappa^v V_t. \tag{3.34}$$

Appendix C.2 contains a detailed derivation of the resource constraint.

3.9 Equilibrium

Given the exogenous interest rate r, the recursive competitive equilibrium of the small open economy consists of prices $\{w_t^L, w_t^H, P_t, p_t^H, p_t^F\}$, value functions $\{V_t^{E,L}(a_t, Z_t), V_t^{E,H}(a_t, Z_t), V_t^{S,L}(a_t, Z_t), V_t^{S,H}(a_t, Z_t), V_t^L(a_t, Z_t), J_t^L(Z_t), J_t^H(Z_t), \mathcal{V}_t^{V,j}\}$, consumers' decision rules for asset holdings $\{\varphi_t^{E,j}(a), \varphi_t^{S,j}(a), \varphi_t^L(a)\}$, a law of motion for the distribution Z_t, and aggregate allocations, such that:

1. Consumers solve their optimization problems given by Equations (3.13) to (3.16), subject to their budget constraints.
2. Firms optimize, taking prices and the aggregate state Z_t as given. The number of vacancies V_t is determined by the free-entry condition, implying that the value of posting a vacancy satisfies $\mathcal{V}_t^{V,j} = 0$.
3. The law of motion for the distribution Z_t is consistent with individual decision rules.
4. The job-finding rate λ_t^w and the job-filling rate λ_t^f depend on market tightness θ_t via the matching function:
$$\lambda_t^w = \lambda^w(\theta_t), \quad \lambda_t^f = \lambda^f(\theta_t), \quad \theta_t = \frac{V_t}{U_t}.$$
Employment evolves according to the law of motion (3.6).
5. The numbers of short-term unemployed and long-term unemployed follow (3.7) and (3.8).
6. Wages are determined by the surplus splitting rule in Equation (3.26).
7. The government budget constraint (3.27) holds, and the lump-sum tax rate is determined by the tax rule (3.28).
8. Asset markets clear, all assets yield the same risk-free return in equilibrium (no-arbitrage) and the asset market clearing condition (3.10) is satisfied.
9. The aggregate resource constraint (3.34) is satisfied.

4 Calibration and Reform Implementation

In this section, we first describe the calibration of our model and then discuss the implementation of the German labor market reform.

4.1 Calibration

We calibrate the model to a quarterly frequency. Table 3 presents our baseline parameter choices, while Table 4 lists our calibration targets. We assume permanent discount factor heterogeneity with $\beta \pm \Delta$ to obtain a realistic level of wealth inequality, where high-skilled workers are more

patient (with a discount factor $\beta^H = \beta + \Delta$) and low-skilled workers are less patient (with a discount factor $\beta^L = \beta - \Delta$).[37] We set the discount factor β to obtain a net interest rate of 1.5% and calibrate Δ to match the share of wealth held by the bottom 50% of the German wealth distribution, which is 2.05% based on the 2002 wave of the German Socioeconomic Panel, resulting in a model-implied Gini coefficient of 0.71. Consequently, we set the discount factor to $\beta = 0.981$ with $\Delta = 0.006$, resulting in a firm discount factor of $q = 0.985$. We set the parameter of relative risk aversion, σ, to 2, which is a standard value in the literature.

We normalize the total factor productivity of low-skilled workers, z^L, to one and set the productivity of high-skilled workers, z^H, to 1.559. This value reflects the difference in average wages between high- and low-skilled workers based on data from the German Socio-Economic Panel (GSOEP), serving as a proxy for productivity differences.[38] Regarding the technology parameters, we follow Bayer et al. (2024) and set the share of capital in production, α, to 0.32, and assume that capital depreciates at a quarterly rate of 2.5 percent.

Regarding the labor market, we set the bargaining power of the union, ζ, to 0.5 and the elasticity of matches with respect to unemployment to 0.5, both are standard values in the literature.We set the replacement rate for short-term unemployed, b^S, to 0.67, and for long-term unemployed, b^L, to 0.57, corresponding to the legal values (for individuals with children) before the reform. The probability of transitioning to long-term unemployment benefits is 0.125, resulting in an expected duration of short-term unemployment benefits of 8 quarters, as was typical before the reform. The probability of becoming a high-skilled worker is set to target a low-skilled worker share of 68%, consistent with GSOEP data, resulting in a probability π^E of 1/230. Separation rates for high-skilled and low-skilled workers are set according to Hartung et al. (2024), with 0.89% for high-skilled workers and 4.14% for low-skilled workers based on IAB data. We target a steady-state unemployment rate of 12%, reflecting the prevailing unemployment rate at the time of the reform, and a job-filing rate λ_f of 0.7, according to empirical evidence for the Euro area as reported in Christoffel, Kuester, and Linzert (2009). These targets endogenously determine the matching efficiency χ and vacancy posting costs κ^V in the steady state.

Regarding the open economy parameters, we set the home bias γ to the standard value of 0.66 and the elasticity of substitution between home and foreign goods η^C to 0.74. Following Feenstra, Luck, Obstfeld, and Russ (2018), we set the elasticity of foreign demand with respect to the terms of trade to 3 (see also de Ferra et al., 2020).

For the policy parameters, we set the autocorrelation of the lump sum tax rate to 0.95, reflecting the delayed reduction in German social security contributions for unemployment benefits after the reform (see Figure 19 in the Appendix). To ensure stationarity of government debt, we set the response to deviations in government debt from its target at $\chi^b = 0.02$ (see Kirsanova and Wren-Lewis, 2012).[39] Lastly, consistent with Germany's long-term debt-to-output ratio of 60%, we set $\omega_b = 0.6$.

In the initial steady state, we normalize all prices, the real exchange rate, and the terms of trade

[37] This is a standard feature in the literature to obtain a realistic distribution of wealth, see Carroll, Slacalek, Tokuoka, and White (2017) and Auclert et al. (2021).

[38] We use years of education as a proxy for skills, classifying individuals with more than 12 years of education as high-skilled workers and those with 12 years or fewer as low-skilled workers.

[39] We provide robustness checks regarding the values of these two parameters in Section 5.2.

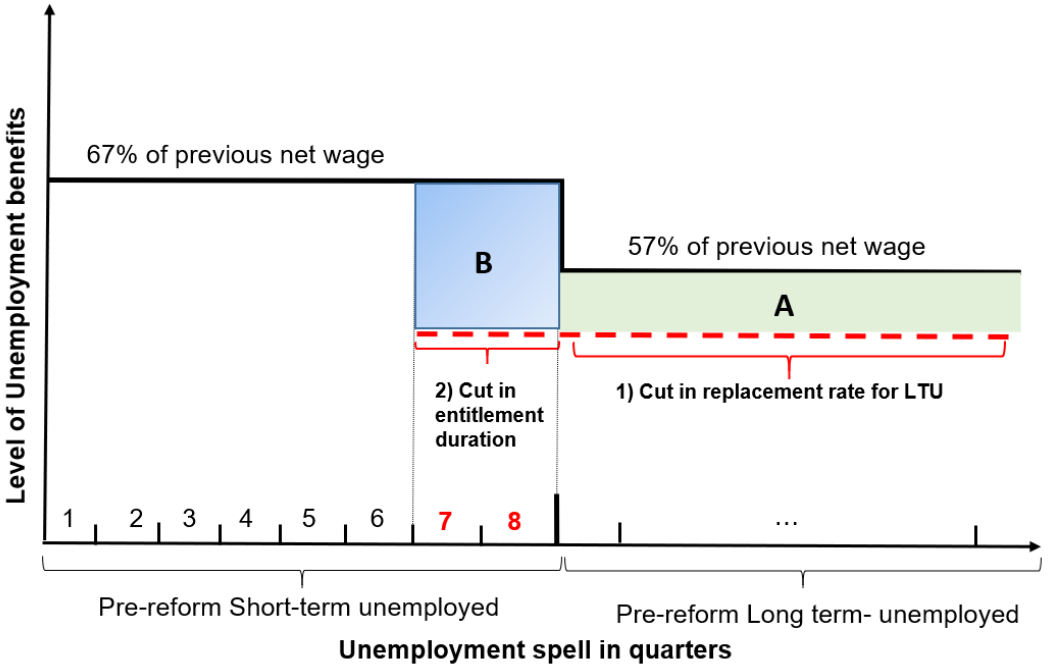
Table 3: Calibration and Targets

Parameters		**Symbol**	**Value**	**Source/Target**
Preferences				
	Discount factor	β	0.981	Net interest rate of 1.5%
	Discount factor spread	Δ	0.006	Wealth share of bottom 50% (2.05%)
	Risk aversion	σ	2.000	Standard Value
Technology				
	Total Factor Productivity, Low Skilled	z^L	1.000	Normalization
	Total Factor Productivity, High Skilled	z^H	1.559	Relative mean wages of high-vs. low-skilled (GSOEP)
	Capital share	α	0.320	Bayer et al. (2024)
	Capital depreciation rate	δ	0.025	Standard value
Labor Market				
	Workers' bargaining power	ζ	0.500	Standard Value
	Matching elasticity	η	0.500	Standard Value
	Replacement rate for STU	b^S	0.670	Institutional value
	Replacement rate for LTU	b^L	0.570	Institutional value
	Probability to switch to LTU	π^{LTU}	0.125	Institutional value
	Probability to become high skilled	π^E	1/230	Share of low-skilled worker (GSOEP)
	Separation Rate, High-Skilled Workers	s^H	0.89%	Hartung et al. (2024)
	Separation Rate, Low-Skilled Workers	s^L	4.14%	Hartung et al. (2024)
	Matching efficiency	χ	0.399	Job-filling rate of 0.7 (Christoffel et al., 2009)
	Vacancy posting costs	κ^V	0.228	Unemployment rate of 12%
Open Economy				
	Home Bias	γ	0.660	Standard value
	E. o. S btw. home and foreign goods	η^C	0.744	Standard value
	Elasticity of foreign demand to rer	θ^F	3.000	Feenstra et al. (2018)
Policy				
	Smoothing parameter of fiscal rule	ρ^τ	0.950	Gradual adjustment of German SSC after reform
	Tax rate elasticity to debt deviations	χ^b	0.020	Kirsanova and Wren-Lewis (2012)
	Long-run government debt-output ratio	ω_b	0.600	German Institutional Target

Table 4: Targets

	Symbol	**Value**	**Source/Target**
Targets			
Price of home goods	p_H	1	Normalization
Price of foreign goods	p_F	1	Normalization
Consumer Price Index (CPI)	P	1	Normalization
Real Exchange Rate	rer	1	Normalization
Terms of Trade	tot	1	Normalization
Net Foreign Assets/Y		0.00%	Normalization
Unemployment rate	U	12.0%	Value end of 2004
Job-filling rate	λ_f	0.7	Euro area evidence (see Christoffel et al., 2009)
Share of low-skilled workers		68.00%	GSOEP
Wealth Share of Bottom 50%		2.05%	GSOEP
Net interest rate	r	1.50%	Historical average for Germany (2001–2004)
Aggregate private savings rate increase		1.0 pp	See Section 2

Figure 5: Reform Implementation (schematic plot)



to one, and assume that inflation is zero (see Table 4). Additionally, we assume that the net foreign asset (NFA) position is zero in the pre-reform steady state. The current account is defined as $CA_t = NFA_t - NFA_{t-1}$ and is, therefore, also zero in steady state. We further target the share of low-skilled workers of 68% and the wealth share of the bottom 50% based on the German Socioeconomic Panel. Importantly, we set the shock size of the replacement rate reduction to match our dynamic target of an increase in the aggregate private savings rate of one percentage point within the first ten years (consistent with our empirical estimation in Section 2 and as discussed in more detail below).

4.2 Reform Implementation

The Hartz IV reform was undertaken in two steps. First, in 2005, the replacement rate for long-term unemployment benefits was reduced, fixed, and independent of prior earnings. One year later, from 2006 onward, the entitlement duration for receiving short-term unemployment benefits was reduced (see Appendix A for details). On average, the entitlement duration was cut by six months.[40] Figure 5 schematically plots how we incorporate these changes into our model. The precise economy-wide reduction in the replacement rate due to the Hartz IV reform remains debated. Launov and Wälde (2013) estimated a 7% decline, leading to a 0.1 percentage point drop in unemployment, while Krebs and Scheffel (2013) and Krause and Uhlig (2012) assumed reductions of 20% and up to 6%, implying larger effects (see Hochmuth et al., 2021 for

[40] The entitlement cut varied by age group and was strongest for elderly workers. For them, the entitlement duration was reduced from a maximum of 32 months to a maximum of 18 months.

a detailed discussion). We set the reduction in the replacement rate to match the empirically estimated post-reform increase in private savings rates. This is done by simulating a panel of 50,000 individuals in our model and applying the same regression as in the GSOEP data. Based on this approach, we set the reduction in b^L to 26%, a value within the plausible range and close to the average reported by OECD (2019). The simulation spans 40 quarters (10 years) before and after the reform, aligning with the time horizon of the shift dummy in Table 1. Using the same macroeconomic controls—time trend, real exchange rate, unemployment, GDP, and government debt—we ensure a consistent estimation of the partial effect on aggregate savings while accounting for general equilibrium effects. Since the reduction in the replacement rate is chosen to match the observed savings response, we obtain the same coefficient on the Hartz dummy by construction (see Table 11 in Appendix D.1).

Furthermore, we model the cut in entitlement duration by increasing the probability of transitioning from short-term to long-term unemployment benefits (π^L) from 1/8 to 1/6, a 33.33% increase. Consequently, the maximum duration of short-term unemployment benefits decreases from 8 to 6 quarters, aligning with the observed reduction for an average worker.

Regarding the simulation design, we assume the economy was in its initial steady state before the policy change in 2005, with no future shocks occurring afterward. As a robustness check, we account for anticipatory effects starting one year before the reform's implementation. We solve for the transition paths between the pre-reform and post-reform steady states under perfect foresight.

5 Aggregate Effects of Labor Market Reform

In this section, we discuss the aggregate results of our model simulation before we investigate the role of heterogeneity in more detail in the next section. First, we describe the dynamics of our model economy along the transition path. We then calculate the reform's contribution to German (international) macroeconomic time series and provide robustness checks.

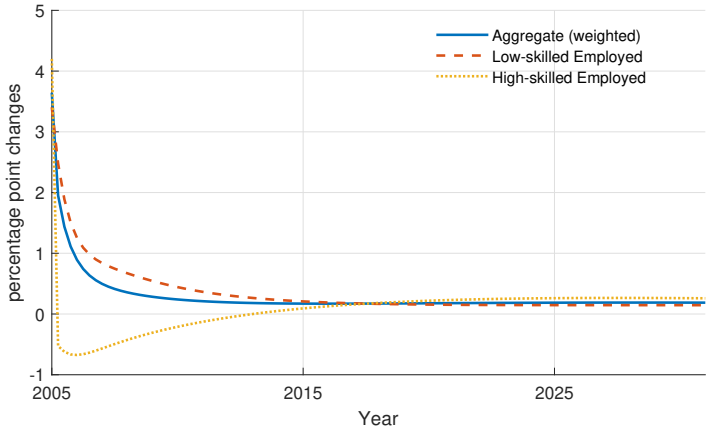
5.1 Transitional Dynamics

This subsection discusses the transitional dynamics after the Hartz IV reform in Germany. We provide a comparison of pre- vs. post-reform steady states in Appendix D.2.

Saving Rates: Figure 6 presents the model-based responses of savings rates on aggregate and for low-skilled and high-skilled workers separately. On aggregate, the savings rate increases by 0.8 percentage points in the first five years after the reform.

The savings rate for low-skilled workers increases sharply before gradually declining to a new steady state. Several factors drive this stronger response among low-skilled workers. First, they face a higher (exogenous) job separation rate and are, therefore, more likely to fall into unemployment in response to the reform, which increases their need for precautionary savings. Second, a larger share of their income comes from labor earnings, making them more sensitive to changes in labor market conditions. Importantly, in steady state, low-skilled workers tend to have lower

Figure 6: Effect on Saving Rates



Notes: Model responses of saving rates of all workers (weighted with their corresponding shares), low-skilled employed, and high-skilled employed workers in percent deviations from the pre-reform steady state.

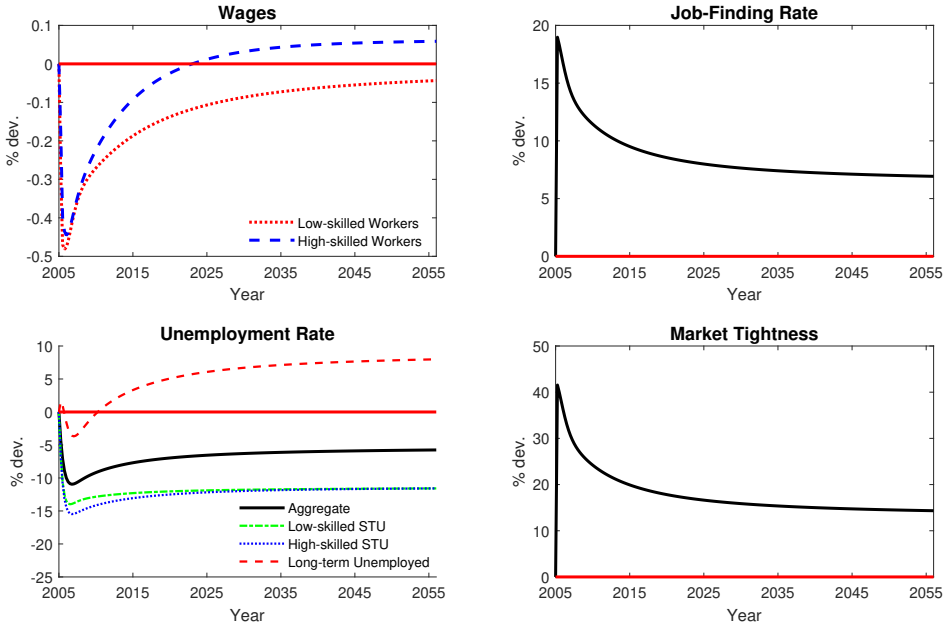
levels of self-insurance, as they are more likely to be near the borrowing constraint. This amplifies their savings response, as they want to increase their asset holdings. The stronger response of low-skilled workers aligns well with the more pronounced reaction of the most affected workers in our empirical analysis (see Table 1), though the former serves only as a rough proxy for this group. In contrast, high-skilled workers initially experience a decline in their savings rate. This is due to improved labor market conditions, which reduce their need for precautionary savings. Additionally, their pre-reform wealth levels provide greater self-insurance, thereby muting their overall response.

Labor Market: Figure 7 shows the reform effects on various labor market outcomes. The reduction in the generosity of the unemployment benefit scheme leads to an initial decline in wages as workers' bargaining positions worsen due to the reduced fall-back utility. Gradually, wages recover over time and are higher for high-skilled workers in the post-reform equilibrium.[41] Lower wages increase the marginal value of a worker to firms. As a result, they post more vacancies and the job-finding rate increases. Aggregate unemployment decreases by more than 10% in the short run. However, in the short run, the reduction is less pronounced for long-term unemployed workers, as the reform accelerates their transition into long-term unemployment. This dynamic partially offsets the increased job-finding rate, leading to a modest increase in unemployment among the long-term unemployed in the medium and long run. This trend aligns with the rather stagnant number of long-term unemployed individuals in Germany after the implementation of the reform, as discussed by Spermann (2015).

Aggregate Outcomes: Figure 8 illustrates the effects of the reform on aggregate variables. For households, the labor market effects induced by the reform lead to two opposing forces regarding precautionary savings: On the one hand, an improved labor market situation reduces the

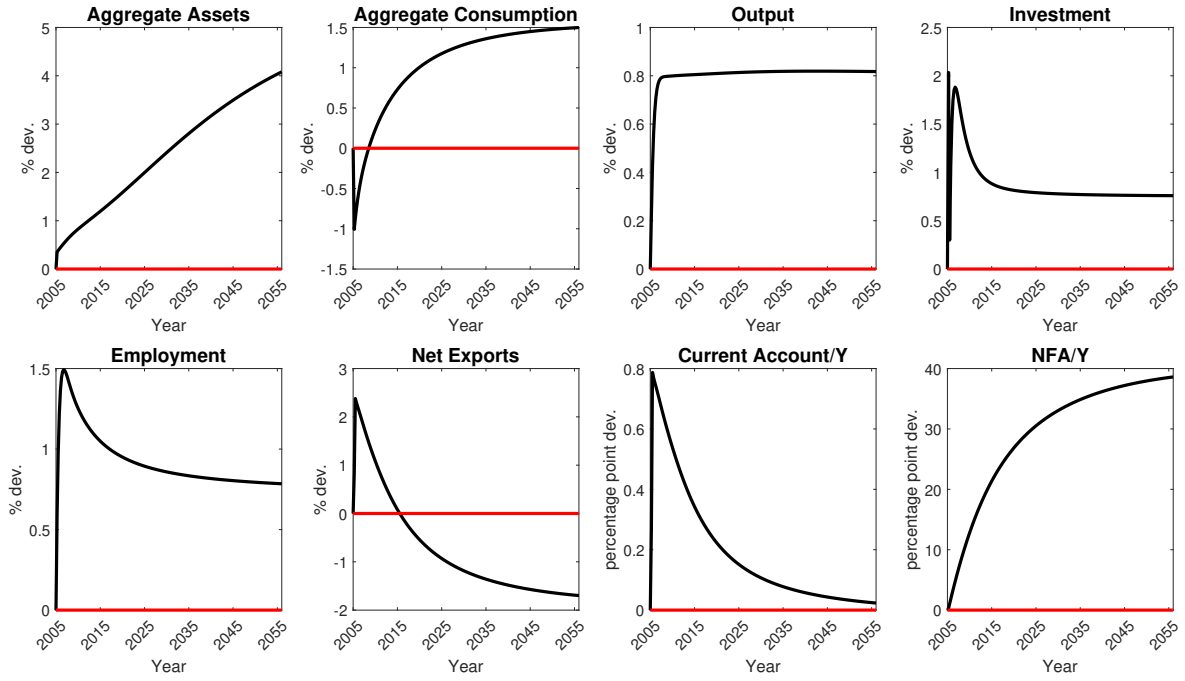
[41] Reassuringly, our short-run wage effect is quantitatively in line with causal microeconomic evidence of Price (2018), who rules out sizeable adverse wage effects caused by the Hartz IV reform.

Figure 7: Reform Effects on Labor Market Outcomes



Notes: Model responses of labor market variables in percent deviations from the pre-reform steady state.

Figure 8: Aggregate Reform Effects



Notes: Model responses of aggregate variables in percent deviations (percentage point deviations where indicated) from the pre-reform steady state.

incentive to save because the likelihood of transitioning from unemployment to employment increases. On the other hand, higher income losses in the event of unemployment increase the incentive to accumulate precautionary savings. We observe that the latter effect clearly dominates, leading to a significant increase in consumers' asset holdings in the domestic economy. Agents invest in international bonds because the necessary assets are not fully provided domestically, being limited by the availability of domestic government bonds, firm profits, and domestic capital—consequently, the reforming country's net foreign asset position and current account increase.

Lower wage income and increased precautionary savings create a consumption-savings tradeoff, causing households to temporarily reduce their consumption However, due to improved labor market conditions and rising wages in the medium run, the initial dip in aggregate consumption is followed by a continuous rise, stabilizing at approximately 1.5% above the pre-reform steady state. Output and investment increase due to higher employment and an expanding capital stock. The initial response of investment plays a crucial role in moderating the impact on the current account. The rise in investment absorbs some of the surplus in savings that would otherwise have been directed toward foreign assets, thereby dampening the increase in the current account.[42]

Furthermore, as prices for domestic goods fall in the short run, indicating higher competitiveness, the real exchange rate depreciates. This relative price adjustment leads to higher net exports in the short run. This, combined with the increased demand for assets, contributes to the build-up of the net foreign asset position and an improvement in the current account.

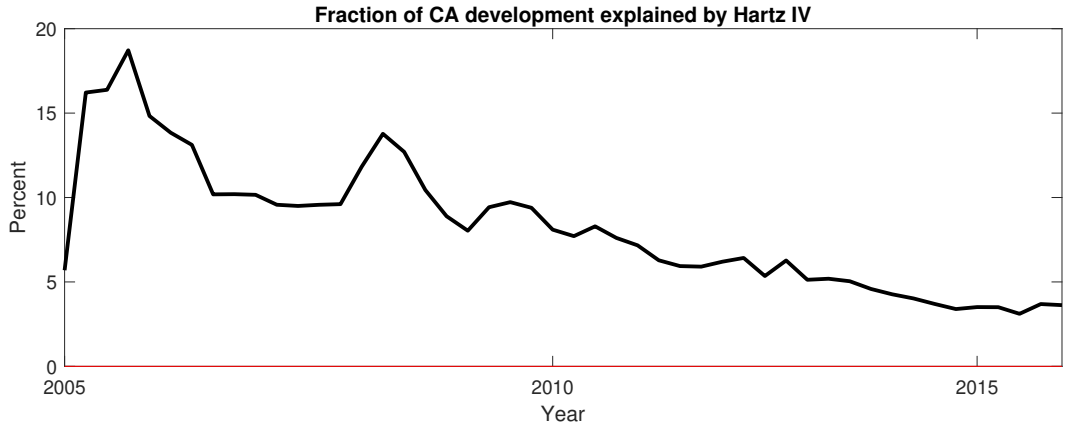
Government Sector: The model predicts that in response to the reform, government bonds and expenditures decline as rising labor tax revenues and lower unemployment benefits reduce the fiscal burden (see Figure 17 in Appendix C.3). This reduction in government expenditures and debt issuance leads to an increase in national savings, which in turn contributes to the rise in the current account balance. Specifically, with lower public borrowing requirements, fewer domestic savings are absorbed by government debt, allowing more to flow into foreign assets, thereby strengthening the current account.

This model-based prediction aligns with the data. After 2005, Germany experienced a significant reduction in its government deficit, alongside lower labor tax rates and social security contributions (see Appendix C.3, Figures 18 and 19). Furthermore, the model's prediction of increased national savings and its positive impact on the current account is reflected in the shift in the government's contribution to Germany's current account dynamics starting in 2005, except for the period following the Great Recession (see Figure 14 in Appendix A).

Because of this interplay between the government sector and the current account, the fiscal rule plays a crucial role in shaping the overall response. In the next subsection, we perform robustness exercises regarding the fiscal rule's parameters.

[42] By not introducing investment adjustment costs, our model provides a conservative estimate of the current account response. Incorporating such costs would further amplify the impact by limiting the initial surge in investment, leading to a more pronounced increase in net foreign assets and a stronger current account adjustment. We abstain from including these costs to keep the model focused on the primary mechanisms of the reform (via savings) and to maintain clarity.

Figure 9: Contribution of the Hartz IV Reform to Germany's Current Account Position (in % of GDP)



Notes: Quarterly effects on the CA/Output ratio based on our model simulations as a share of Germany's quarterly CA/GDP developments from 2005 to 2019. Data Sources: Deutsche Bundesbank and Destatis.

5.2 Contribution to Macroeconomic Aggregates & Robustness

This subsection assesses the impact of the Hartz IV reform on key macroeconomic aggregates and performs several robustness checks. By modeling the Hartz IV reform as the only shock, we can isolate and analyze its effects on these variables as they transition to the new steady state.[43] Figure 9 illustrates the contribution of the Hartz IV reform to Germany's current account position, expressed as a percentage of GDP, from 2005 to 2019. The graph shows that the reform had a significant initial impact, peaking at around 19% shortly after implementation and contributing to 12% in the first five years after the reform. Over time, the contribution gradually decreases, fluctuating between 5% and 10%, before stabilizing at a lower level towards the end of the period. Table 5 presents the reform's contributions to key macroeconomic indicators over five and ten years. In the baseline (column one), the reform explains more than 40% of the unemployment decline by 2010 (five years post-reform), about 12% of Germany's current account surplus, 44% of the net foreign asset increase, and 22% of real effective exchange rate changes.

Additionally, Table 5 compares the baseline scenario to several robustness checks: (i) allowing for anticipatory effects, (ii) adjusting the fiscal rule persistence to $\rho^{\tau} = 0.9$, and (iii) modifying the weight on government debt to $\chi^{b} = 0.03$. To isolate the effects of parameter changes and assess their sensitivity under the same initial conditions, we keep the shock size constant across scenarios.[44]

The "Hartz IV Law" was passed on December 24, 2003, and enacted on January 1, 2005, suggesting that German households could have anticipated the reform about one year in advance. In this anticipation scenario, agents adjust their savings behavior as soon as they become aware of the upcoming reform. This early adjustment smooths consumption-savings decisions, slightly reducing the estimated impact of the reform in the five years following its implementation.

Lowering the persistence parameter in the fiscal rule ($\rho^{\tau} = 0.9$) reduces the short-run contri-

[43] This approach differs from standard DSGE variance decomposition, which accounts for all dynamics of the observed variables using multiple shocks.

[44] As a result, we do not necessarily match the empirical target of a one percentage point increase in the aggregate private savings rate, as we do in our baseline using a regression on a simulated panel.

Table 5: Reform Contribution to Empirical Time Series over 5 and 10 years with Robustness Checks

	Baseline		Anticipation		$\rho^{\tau} = 0.9$		$\chi^{b} = 0.03$	
	5 years	10 years	5 years	10 years	5 years	10 years	5 years	10 years
Unemployment	41.51	21.62	40.85	21.49	40.46	20.72	41.66	21.54
Current Account/GDP	11.66	9.18	8.98	7.72	10.03	7.69	11.13	8.53
Net Foreign Assets/GDP	44.25	57.11	30.04	44.18	38.38	48.79	42.46	54.14
Real Exchange Rate	22.31	12.57	19.05	11.01	19.88	11.20	21.54	12.09
Savings Rate	23.62	12.54	23.26	12.30	24.59	13.55	22.81	12.24

Notes: The "Baseline" column represents our standard model calibration. Unemployment effects represent the share of the unemployment rate explained by the model five (ten) years after the reform. The "Anticipation" scenario assumes agents anticipated the reform four periods in advance, with contributions including this anticipation period. In the $\rho^{\tau} = 0.9$ scenario, the fiscal rule's persistence parameter is set to 0.9. In the $\chi^{b} = 0.03$ scenario, the weight on government debt in the fiscal rule is 0.03.

butions to current account dynamics. However, empirically, the adjustment of social security contributions was observed to take place two years post-reform (see Appendix C.3, Figure 19), making a higher persistence parameter more consistent with observed behavior. Finally, setting $\chi^{b} = 0.03$ yields results similar to the baseline, indicating that a higher elasticity with respect to debt deviations does not significantly alter the overall dynamics of the model.

Further Considerations Another concern might be that the Hartz IV reform was part of a broader reform package, including Hartz III, which aimed to improve the federal employment agency (see Appendix A for details). However, simulating the Hartz III reform, represented by an increase in matching efficiency, improves labor market outcomes without a corresponding rise in precautionary savings (see Appendix D.3 for the results). Instead, the expansionary effects on consumption and output lead to lower aggregate savings and a decline in the net foreign asset position, indicating that while Hartz III effectively reduced unemployment, it dampened Germany's international financial position.

6 The Role of Heterogeneity

This section assesses how well the Heterogeneous Agent (HA) model explains key empirical macroeconomic facts following the Hartz IV reforms, compared to a complete insurance model.[45] Consumer heterogeneity plays a critical role in analyzing labor market reforms for two main reasons: i) the precautionary savings motive that arises under incomplete insurance and ii) differences in agents' asset holdings, which lead to varying marginal propensities to consume (MPCs). These differences have aggregate implications, particularly when a significant share of consumers exhibit high MPCs, as noted by Krueger et al. (2016b). We specifically examine how both models account for dynamics in labor markets, savings, and external balances, and we also explore the redistributive effects arising from these reforms.

[45] In our analysis, we use the terms "complete insurance" and "representative agent framework" interchangeably because, in our setting, the representative agent is assumed to be fully insured against idiosyncratic shocks.

Table 6: Comparison of the Complete and Incomplete Insurance Models 5 and 10 Years Post-Reform

	Incomplete Insurance		Complete Insurance	
	5 years	10 years	5 years	10 years
Unemployment	41.51	21.62	23.32	14.88
Current Account/GDP	11.66	9.18	-4.05	-1.67
Net Foreign Assets/GDP	44.25	57.11	-22.52	-18.28
Real Exchange Rate	22.31	12.57	0.93	-0.37
Savings Rate	23.62	12.54	1.24	0.68

Notes: Effects are computed as the average fraction of annual contributions to observed dynamics in the model relative to the data. Unemployment effects represent the share of the unemployment rate explained by the model five (ten) years after the reform.

6.1 Comparison to the Complete-Insurance Framework

We simulate the reform using a version of our model with a representative agent model featuring full insurance against idiosyncratic unemployment risk. In this framework, consumption, and savings decisions are independent of employment status, following Andolfatto (1996) and Merz (1995). Appendix C.4 details the household's problem in this case. As with the baseline heterogeneous agent model, we simulate the complete insurance model non-linearly under perfect foresight.[46]

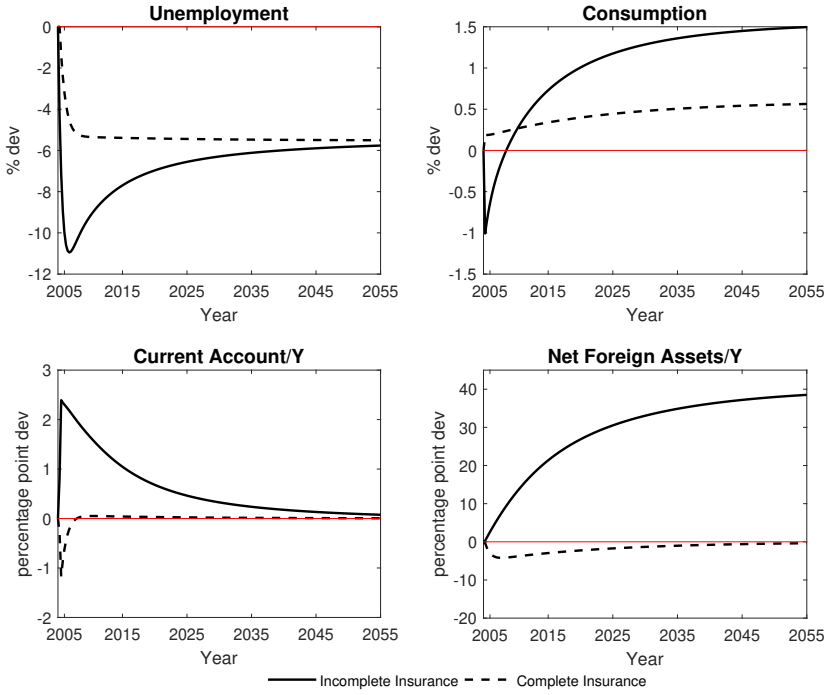
Table 6 compares the performance of the heterogeneous agent (HA) and complete insurance (representative agent, RA) models in explaining (international) macroeconomic variables five and ten years after the reform. The HA model better captures post-reform dynamics, particularly for the savings rate, net foreign assets (NFA/GDP), and the real exchange rate (REER). These results suggest the HA model explains a larger fraction of observed adjustments in household savings and external balances. By contrast, the RA model generates *qualitatively* different outcomes for the current account and net foreign assets and contributes *quantitatively* less to observed external balance and exchange rate changes.

Figure 10 contrasts the simulation results from our heterogeneous agent model (solid line) with the complete insurance case (dashed line), showing qualitatively different responses for the current account and the net foreign asset position. The main difference can be explained by the absence of a precautionary savings motive in the complete insurance model. In the HA setting, consumption declines in the short run as agents start accumulating savings, reflecting a consumption-savings trade-off. In the complete insurance model, consumption increases immediately and savings decrease slightly following the reform due to improved labor market conditions (higher job-finding rate and employment). As a result, domestic demand effects dominate, leading to a fall in the current account balance and the net foreign asset position. Consequently, when households are perfectly insured against unemployment-related consumption risk, a reduction in the replacement rate and a cut in entitlement duration result in an opposite effect on the reforming country's net foreign asset position.[47]

[46] To ensure stationarity in the complete-insurance framework, we adopt a debt-elastic interest rate following Schmitt-Grohe and Uribe (2003); see Appendix C.4 for details.

[47] The size of the shock is calibrated to produce the same steady-state effect on unemployment as in the incomplete

Figure 10: Comparison to the Complete Insurance Framework



Notes: Model responses in the baseline heterogeneous agent (HA) model (solid line) and the complete insurance (RA) model (dashed line). The shock size is calibrated to achieve the same steady-state effect on unemployment as in the HA model.

6.2 Redistributive Effects

Table 7 illustrates the effects of the Hartz IV labor market reform on wealth and consumption inequality in Germany. The Gini coefficient for wealth declines across all employment and skill groups, reflecting a reduction in wealth inequality. This is primarily driven by an increase in savings and asset accumulation among low-skilled workers, who move further from the borrowing constraint due to the reform. This pattern aligns with the observed decline in Germany's wealth Gini starting in 2008, as documented by Albers, Bartels, and Schularick (2022).

Consumption inequality, measured by the coefficient of variation, shows heterogeneous responses to the reform. For high-skilled employed and short-term unemployed (STU) workers, consumption variability increases slightly, while it decreases for low-skilled workers and long-term unemployed individuals. The strong reduction in consumption variability for long-term unemployed workers is driven by the compression in consumption levels as all long-term unemployed workers are directly affected by the reform and face a decline in their consumption levels. In contrast, for high-skilled workers, improved labor market conditions and higher savings lead to greater dispersion in consumption levels, and thereby higher consumption variability.

Our findings on the reform's redistributive effects and the resulting increase in the country's net foreign asset position align with de Ferra et al. (2021), who show that capital flows from more equal to less equal countries in advanced economies. Following the Hartz IV reform, greater

insurance baseline. This approach is necessary because the savings rate decreases in the short run due to the absence of a precautionary savings motive, making it unsuitable as a dynamic target.

Table 7: Change in Inequality by Employment Status and Skill Level

	Pre-Reform	Post-Reform	Percentage Change
Gini Coefficient			
Low-skilled Employed	0.81	0.75	-7.45
High-skilled Employed	0.41	0.40	-1.87
Low-skilled STU	0.78	0.73	-6.39
High-skilled STU	0.41	0.41	-1.93
Long-term Unemployed	0.82	0.80	-3.03
Coefficient of Variation for Consumption			
Low-skilled Employed	2.86	2.72	-4.58
High-skilled Employed	1.02	1.04	1.65
Low-skilled STU	2.55	2.27	-10.87
High-skilled STU	1.05	1.07	1.44
Long-term Unemployed	9.73	4.57	-53.06

Notes: The table displays within-group Gini coefficients and coefficients of variation for consumption in the pre-reform steady state, the post-reform steady state, and the percentage change between steady states by employment and skill group. "STU" refers to short-term unemployed workers.

equality in the economy leads to capital outflows.

7 Welfare Analysis

This section examines the welfare implications of reduced unemployment benefits across several dimensions. We begin by analyzing the welfare effects during the transition to the post-reform steady state, followed by a comparison of stationary welfare outcomes. The analysis also contrasts the results with those from a model incorporating complete insurance and evaluates the differences within a closed-economy framework. Lastly, we decompose the welfare effects into partial equilibrium, matching, and price effects, following the approach of Mukoyama (2013).
We quantify the relative welfare consequences of the German unemployment benefit reform for consumers in all skill groups and employment states along the wealth distribution. For this purpose, we calculate welfare effects in terms of consumption equivalents (CE) after the reform. We calculate the CE for employment state i as

$$CE^i(a;Z) = \left(\frac{V^{i,R}(a;Z)}{V^{i,0}(a;Z)} \right)^{\frac{1}{1-\sigma}} - 1,$$

where $V^{i,R}(a;Z)$ denotes the value function after implementing the reform and $V^{i,0}(a;Z)$ is the initial value function in steady state.[48]

[48] To calculate the effects along the transition path, we follow Bayer et al. (2019) and compute the value functions $V^{i,R}(a;Z)$ by iterating backward given the equilibrium paths of the wage, prices, labor income tax, and the job-finding rate. We calculate consumption equivalents based on the value function $V^{i,R}(a;Z)$ one period after the shock implementation.

7.1 Transitional vs. Steady State Effects

Table 8 illustrates the welfare effects of the labor market reform in terms of consumption equivalents by wealth quintiles, employment state, and skill group.

The reform generates welfare losses for most low-skilled workers, particularly those with lower asset holdings, during the transition. These workers rely heavily on labor income, have high marginal propensities to consume, and face declining wages, making them more vulnerable. In contrast, asset-rich individuals benefit from their ability to smooth consumption, mitigating the impact of the reform. The largest welfare losses are experienced by low-skilled workers, as well as short-term and long-term unemployed individuals.

In steady state, these welfare losses become even more pronounced for low-skilled and long-term unemployed workers. Their income declines, and they are directly affected by the reduction in consumption insurance (see the discussion in the next subsection). Additionally, wages for low-skilled workers decrease further, while wages for high-skilled workers increase slightly in the post-reform steady state.

While the overall welfare effects of the reform are modest, the distribution of gains and losses varies significantly across the population. In contrast, under complete insurance, there is no consumption-savings trade-off, as consumption immediately increases due to positive labor market effects (as depicted in Figure 10). Consequently, welfare effects are uniformly positive, amounting to 0.36 during the transition and 0.59 in steady-state comparisons. This again highlights that abstracting from precautionary savings leads to *qualitatively* different effects.

Comparison to the Closed Economy Next, we compare the welfare effects of the reform in a small open economy to those in a closed economy setting, which lacks access to international bonds and features an endogenous interest rate.[49] A key distinction between the two settings is that aggregate savings rise more sharply in the open economy because consumers can buy international bonds, while domestic asset supply adjusts more slowly (see Figure 21 in Appendix D.4). In the closed economy, this excess demand for assets results in a temporary increase in the interest rate. Over the long run, the closed economy experiences an increase in aggregate asset supply and capital stock, which ultimately reduces the interest rate in the new steady state. This more muted response in savings also leads to a quicker recovery in aggregate consumption. These differences across frameworks are reflected in the welfare effects. During the transition, the temporary rise in the interest rate and stronger labor market responses (see Figure 21) lead to slightly greater welfare gains and less severe welfare losses in the closed economy. In steady state, the average welfare effect remains negative in the small open economy but turns positive in the closed economy, driven by a stronger increase in the job-finding rate in the latter.

7.2 Decomposing the Welfare Effects

To gain a clearer understanding of the welfare impacts, we decompose the steady-state welfare effects into three key components: the partial equilibrium effect, the matching effect, and the

[49] Appendix D.4 illustrates the corresponding dynamic effects and welfare decompositions in steady state for the small-open vs. closed economy.

Table 8: Welfare Effects by Wealth Quintiles in the Small-open vs. Closed Economy

	Wealth Quintiles						
	1	2	3	4	5	AVG	Economy
Transitional Effects							
Small-open Economy							
Low-skilled Employed	-0.25	-0.21	-0.18	-0.03	0.37	-0.06	
High-skilled Employed	0.45	0.48	0.47	0.44	0.39	0.45	
ST Unemployed, low skilled	-1.00	-0.86	-0.73	-0.35	0.35	-0.52	-0.03
ST Unemployed, high skilled	0.21	0.55	0.64	0.67	0.65	0.55	
LT Unemployed	-3.92	-3.78	-3.19	-1.32	0.02	-2.45	
Closed Economy							
Low-skilled Employed	0.00	0.05	0.07	0.22	0.52	0.18	
High-skilled Employed	0.61	0.55	0.44	0.31	0.10	0.40	
ST Unemployed, low skilled	-0.87	-0.73	-0.58	-0.19	0.52	-0.37	0.10
ST Unemployed, high skilled	0.52	0.84	0.85	0.76	0.57	0.71	
LT Unemployed	-4.28	-4.17	-3.58	-1.43	0.10	-2.68	
Steady State Effects							
Small-open Economy							
Low-skilled Employed	-0.25	-0.22	-0.20	-0.07	0.30	-0.08	
High-skilled Employed	0.51	0.52	0.51	0.48	0.42	0.49	
ST Unemployed, low skilled	-1.39	-1.27	-1.15	-0.74	0.12	-0.88	-0.08
ST Unemployed, high skilled	-0.11	0.26	0.37	0.42	0.44	0.28	
LT Unemployed	-4.33	-4.21	-3.67	-1.79	-0.24	-2.85	
Closed Economy							
Low-skilled Employed	0.07	0.09	0.11	0.21	0.38	0.18	
High-skilled Employed	0.65	0.57	0.47	0.34	0.15	0.44	
ST Unemployed, low skilled	-1.11	-1.00	-0.88	-0.50	0.23	-0.65	0.08
ST Unemployed, high skilled	0.20	0.48	0.50	0.45	0.31	0.39	
LT Unemployed	-4.48	-4.39	-3.87	-1.83	-0.21	-2.96	

Notes: Effects are measured in terms of consumption equivalents. Transition effects refer to consumption equivalents in the first period after the shock implementation. Steady-state effects compare consumption equivalents between pre-reform and post-reform equilibria. The last column displays the welfare effects of our complete insurance model.

price effect.[50] Figures 11 (for employed consumers) and 12 (for unemployed consumers) illustrate the results.

The *partial equilibrium effect*, represented by the blue dashed line in Figures 11 (for employed consumers) and 12 (for unemployed consumers), isolates the impact of changes in unemployment benefits and taxes.[51] When the reform is implemented, both the replacement rate for long-term unemployment benefits and the lump-sum tax are reduced. The overall effect is negative for all unemployed consumers due to reduced consumption insurance, which particularly impacts asset-poor, long-term unemployed individuals. However, for employed consumers—especially those who are high-skilled and asset-rich—the reduced tax burden acts as an implicit transfer, mitigating the negative effects and resulting in positive welfare gains for them.

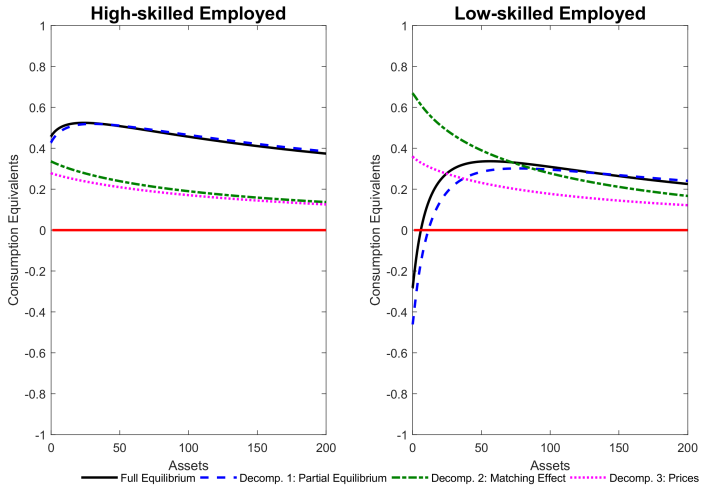
[50] This decomposition follows the methodology of Mukoyama (2013), while potential non-linear interactions are not addressed here.

[51] In this analysis, the transition probability between short- and long-term unemployment remains constant.

The *matching effect*, depicted by the green dotted line, arises from changes in the job-finding rate. For this analysis, we compute the welfare effects assuming that consumers experience only the transition path of the job-finding rate as modeled in our baseline simulation, while other variables remain fixed at their pre-reform steady-state levels. As the reform increases the job-finding rate, welfare improves for all consumers, with the effect being particularly strong for those who are currently unemployed. Asset-poor consumers, who are more dependent on labor income, benefit the most from this improvement.

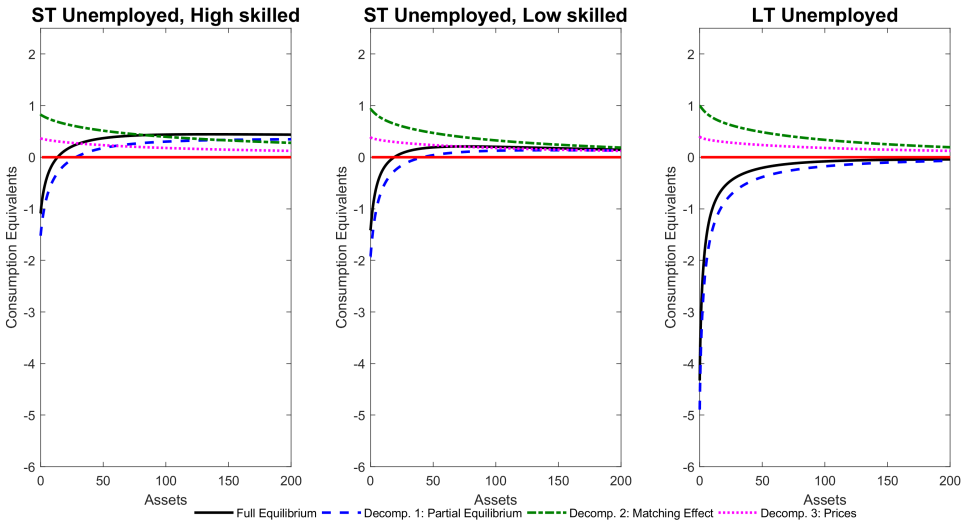
The *price effect*, shown by the magenta line, results from changes in wages and relative goods prices. In the new steady state, the average wage increases slightly while stronger domestic demand reduces import prices, making foreign goods more affordable. This disproportionately benefits asset-poor workers by raising their real purchasing power, as wages make up a larger share of their total income, and they spend a higher fraction of their income on consumption.

Figure 11: Welfare Decomposition for Employed Consumers: Stationary Effects



Notes: Responses to the labor market reform in the small open economy (solid line), the partial equilibrium model (only changes in benefits, illustrated by the blue dashed line), the matching effect (effects via changes in the job-finding rate, illustrated by the green dotted line), and the price effect (effects via wage and goods price reactions, illustrated by the magenta dotted line).

Figure 12: Welfare Decomposition for Unemployed Consumers: Stationary Effects



Notes: Responses to the labor market reform in the small open economy (solid line), the partial equilibrium model (only changes in benefits and the lump-sum tax, illustrated by the blue dashed line), the matching effect (effects via changes in the job-finding rate, illustrated by the green dotted line), and the price effect (effects via wage and goods price reactions, illustrated by the magenta dotted line).

8 Concluding Remarks

This paper investigates the role of precautionary savings and consumer heterogeneity in evaluating the open-economy effects of labor market reforms. We establish a link between the reduction in the generosity of unemployment benefits and the reforming country's net foreign asset position via a precautionary savings channel. While the effects of labor market reforms are well explored in closed-economy incomplete market models, their consequences in a globalized world have gained little attention in the academic literature. We fill this gap by building a small open-economy heterogeneous agent model with labor market frictions.

We apply our framework to simulate the far-reaching unemployment benefit reform in Germany (Hartz IV) and find that the reduction in the generosity of the unemployment insurance scheme increases precautionary savings significantly. Because not all of these additional savings can be absorbed domestically, the net foreign asset position and the current account increase. Our empirical analysis further supports this finding, showing that the most affected groups significantly increased their savings rates after the reforms. We find that the reform contributed, on average, 12 percent to the German current account dynamics in the first five years. Comparing our baseline incomplete insurance model to a setting with a representative agent and complete insurance, we find that accounting for the precautionary savings channel is qualitatively and quantitatively important to capture (international) macroeconomic dynamics in the aftermath of the reform. Thus, we document that allowing for precautionary savings is crucial when evaluating labor market reforms in open economies—an insight that extends beyond the specific case of Germany examined in this study

We analyze how the structural reform affects consumers across the wealth distribution and find that welfare gains and losses are unevenly distributed. During the transition, low-skilled, asset-

poor workers face significant welfare losses due to declining wages and foregone consumption. Asset-rich individuals, however, benefit from increased job-finding rates and their ability to smooth consumption.

Several open questions remain for future research. Possible extensions include incorporating a portfolio-choice problem and an incentive to hold foreign assets due to higher returns or a lower correlation with the domestic business cycle. Also, while precautionary savings serve as one form of self-insurance, other factors, such as fewer quits and targeting safer jobs in general, can act as additional margins of individual insurance. We leave this for future research.

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A Background

This section briefly outlines the background of Germany's current account and net foreign asset position. We also summarize the main points of the cluster of labor market reforms, the so-called Hartz reforms, that were implemented in Germany between 2003 and 2005.

A.1 The German Current Account and Net Foreign Asset Position

Figure 13 shows the German net foreign asset position (NFA), current account (CA), as well as exports (EX) and imports (IM), and savings and investment from 1991 onwards. Between 1991 and the early 2000s, a decade that was characterized by high unemployment rates and low GDP growth, Germany has repeatedly been called 'the sick man of Europe' (see, for example, The Economist, 2017a). Even though Germany had current account surpluses before the German Reunification of around 4 percent of GDP, in the time between 1991 and 2000, there were no surpluses worth mentioning. However, starting in 2001, the German economy experienced a complete reversal: International competitiveness rose, and exports started to persistently exceed imports. In addition, savings and investment diverged. By the (simplified) identity of the current account, $CA = EX - IM = S - I$, this implies large current account surpluses and an increasing net foreign asset position. Germany's NFA position reached a level of 51 percent of GDP in 2016 and, therefore, makes the country a big net lender. These figures have been subject to worldwide criticism (see, for example, Eichengreen's comment in The Guardian, 2017, and The Economist, 2017b).

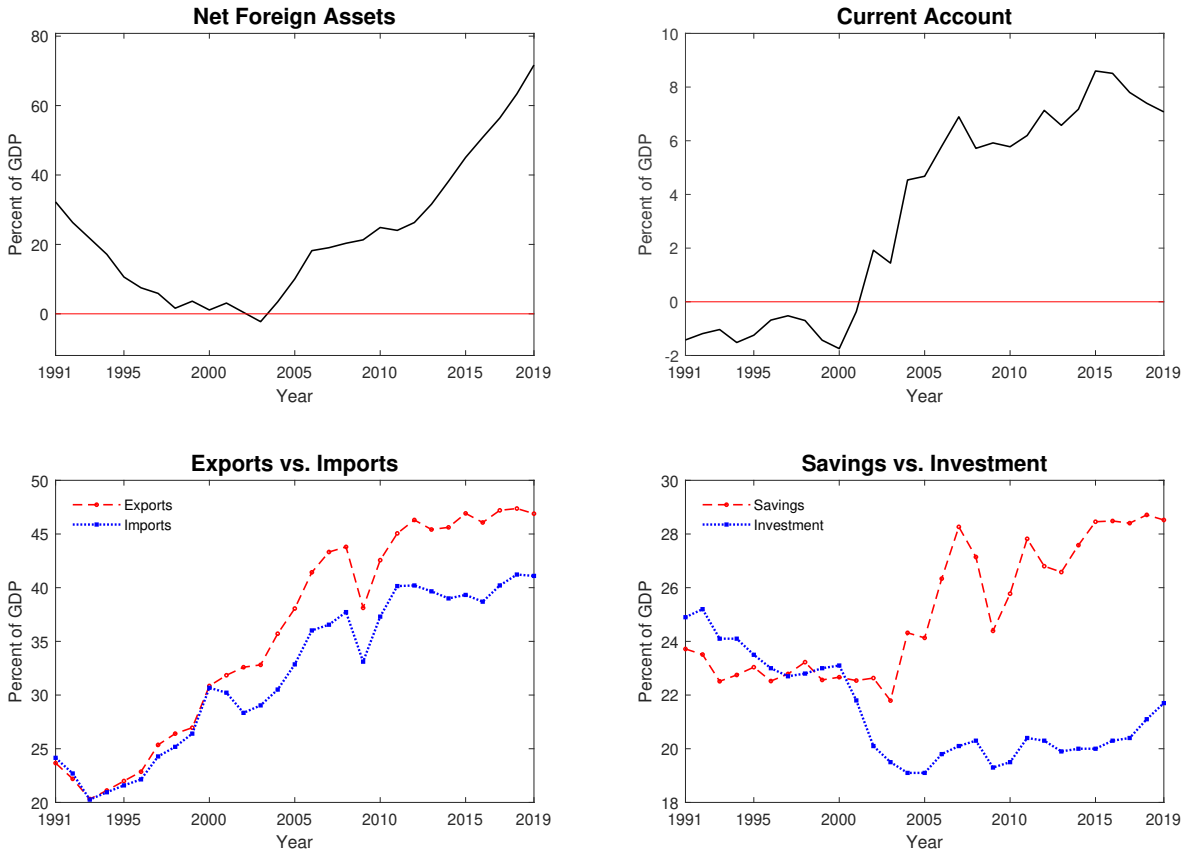
Figure 14 illustrates the components of the German current account as a percentage of GDP from 1991 to 2019. It breaks down the current account into contributions from financial corporations (in blue), the government (in red), private households (in yellow), and non-financial corporations (in purple). Over the period, the figure shows a significant shift in the contributions of these sectors. Notably, after the early 2000s, private households and non-financial corporations increasingly contributed to Germany's current account surplus, while the government and financial corporations exhibited smaller or negative contributions.

A.2 The Hartz Reforms

Germany's weak economic performance around the 2000s motivated a comprehensive reform package. The centerpiece of the reform agenda was a set of extensive labor market reforms, commonly known as the "Hartz reforms" (for a detailed description of the Hartz reforms, see Jacobi and Kluve, 2006). Their objectives were to improve job matching efficiency and incentives to take up employment (Hartz I), promote the transition to self-employment and introduce more flexible arrangements for minor employment relationships (Hartz II), further support the matching process between firms and workers through a reorganization of the Federal Labor Agency (Hartz III). Table 9 provides an overview of the key changes of the corresponding reforms.

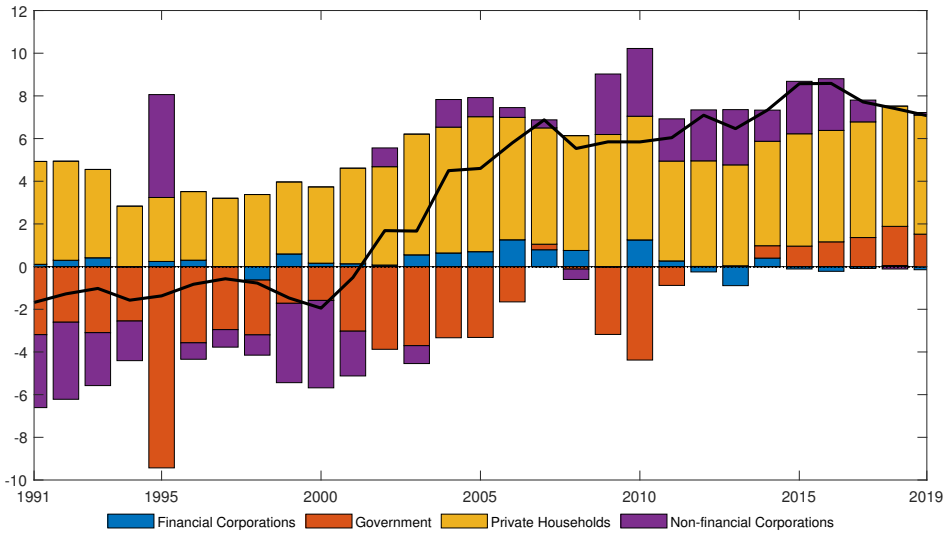
In 2005, the farest-reaching and most discussed Hartz IV reform was implemented. Before Hartz IV, short-term unemployed workers were entitled to unemployment benefits of up to 67 percent of their net previous salary (*"Arbeitslosengeld"*). Short-term unemployment benefits expired af-

Figure 13: Net Foreign Assets, Current Account, Exports and Imports, and National Savings and Investment for Germany, 1991-2019



Notes: Values are in percent of GDP. Savings refer to gross national savings and are defined as disposable income minus consumption and net transfers. Exports and Imports refer to both goods and services. Data sources: Destatis (2021) and Bundesbank (2021).

Figure 14: Components of the German Current Account



Notes: Values are in percent of GDP. Data sources: Destatis (2024).

ter three years on average. Unemployed workers were then considered long-term unemployed and received a less generous unemployment benefit (*"Arbeitslosenhilfe"*) amounting to 57 percent of their previously earned net wage.[52] Persons who were not eligible for unemployment benefits received means-tested social assistance (*"Sozialhilfe"*; in 2004, the standard rate for a single household was around 300 euros, not including one-time benefits).

The Hartz IV reform had two components: First, social assistance and long-term unemployment benefits were merged into *"Arbeitslosengeld II" (ALG II)*. Hence, from 2005 onwards, long-term unemployment benefits were independent of previous earnings. Second, the maximum entitlement duration of short-term unemployment benefit receipt was reduced. The severity of the entitlement cut differed by age. Before the reform, the maximum duration was 12 months for workers younger than 45 years and ranged up to 32 months for workers who were older than 56 years. In 2006, when the reform came into action, the maximum duration of entitlement to unemployment benefit receipt was 12 months for workers below 55 and 18 months for older workers. In 2008, the maximum duration for older workers was softened again to a maximum entitlement duration of 24 months.

Table 9: Overview of the Hartz Reforms

Hartz Reform	**Implementation Year**	**Key Changes**
Hartz I	2003	Facilitated temporary employment and introduced training vouchers.
Hartz II	2003	Introduced new marginal employment types (e.g., Mini-jobs and Midi-jobs) and start-up subsidies ("Ich-AG").
Hartz III	2004	Restructured the Federal Employment Agency.
Hartz IV	2005 & 2006	Merged unemployment and social assistance into a lower, means-tested benefit (ALG II) after a shortened duration of higher unemployment benefits (ALG I), with sanctioning measures. The reduction in entitlement duration was implemented in 2006.

Asset Limits Long-term unemployment benefits in Germany are subject to means testing, with asset limits that vary by age. The maximum limit is approximately 10,000 Euros per adult and 3,100 Euros per child, with an additional cap of 48,750 Euros for retirement assets. According to the Panel of Household Finance provided by the Deutsche Bundesbank (wave 1 for 2010/2011), the second quintile (20-40% of the net wealth distribution) owns a median net wealth of 11,660 Euros per household. Therefore, these asset limits are not binding for a significant fraction of German households.

Furthermore, data from the IAB Panel Labour Market and Social Security (PASS) — a panel survey of approximately 10,000 households, starting in 2007, with a particular focus on long-term unemployed individuals and ALG II recipients — shows that only 12 percent of households receiving short-term unemployment benefits (ALG I) have savings exceeding 10,000 euros. Additionally, around 10 percent of applicants for long-term unemployment benefits (ALG II) had to deplete their savings to meet eligibility requirements, while 60 percent qualified for assistance

[52] This replacement rate refers to unemployed workers with children.

after three months. This suggests that, for most households, the eligibility criteria do not create strong distortions in savings incentives.

B Empirical Evidence on Savings and Wealth

B.1 Micro Evidence on Private Savings of Full-time Employed

We analyze the private savings rate of full-time employed household heads using data from the German Socioeconomic Panel (SOEP) spanning the years 1995 to 2014. The SOEP is a comprehensive longitudinal survey that includes approximately 11,000 private households, with data collection starting in 1984 in West Germany and including East Germany since 1990. Further details on the SOEP dataset can be found in Goebel, Grabka, Liebig, Kroh, Richter, Schröder, and Schupp (2018).

To construct the private savings rate presented in Figure 2, we adhere to the methodology outlined by Stein (2009). Initially, we exclude all observations that do not correspond to household heads. We then calculate the annual total of weighted monthly savings (variable *hlc0120*) and divide this by the annual total of weighted monthly household net income (variable *hlc0005_h*) to derive the private savings rate. To ensure that our savings rates are representative of the broader population, we apply cross-sectional household weights (variable *hhref*).

B.1.1 Saving Rates by Educational Groups

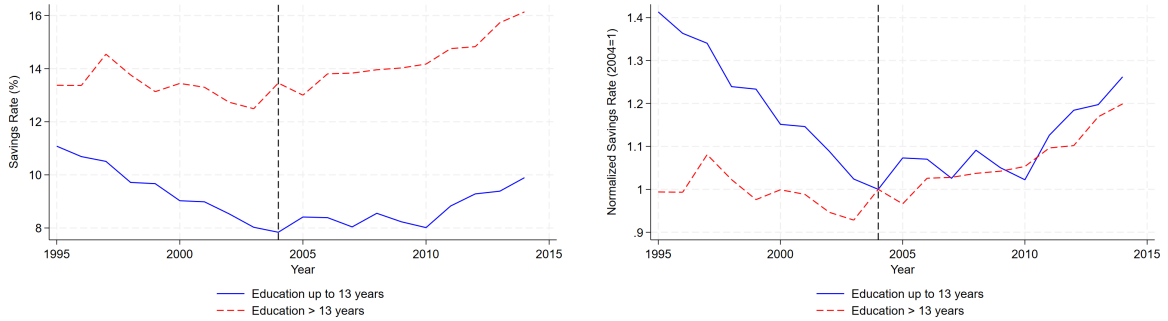
Figure 15 illustrates the evolution of private savings rates by education group from 1995 to 2014. Panel (a) presents savings rates in levels, showing that individuals with more than 13 years of education consistently saved at a higher rate than those with fewer years of education. Panel (b) normalizes savings rates to 2004 (2004=1), the year before the reform was implemented (indicated by the vertical dashed line), highlighting differences in savings behavior after the reform. The savings rate of low-educated workers initially increased but declined during the Great Recession, indicating greater sensitivity to business cycle fluctuations. In contrast, the savings rate of highly educated workers rose more gradually before accelerating after 2010.

B.2 Cross-Country Evidence: Current Account Movements in European Countries

Figure 16 shows the annual current account-to-GDP ratios for Germany, Austria, Italy, Spain, Portugal, and France from 1995 to 2014. Germany's current account surplus, depicted in blue, began rising significantly in the early 2000s, before the major labor market reforms. This early trend suggests that factors such as the adoption of the Euro and the convergence of interest rates across the Eurozone (see, e.g., Berger and Nitsch, 2010) likely played a role. Post-reform, however, the surplus grew even more sharply.

Austria, represented by the dark green line, shares some institutional similarities with Germany but did not implement comparable labor market reforms. Although Austria's current account improved around the introduction of the Euro in 2000, the surpluses were smaller and less persistent than Germany's afterward.

Figure 15: Private Savings Rates by Educational Group, 1995-2014

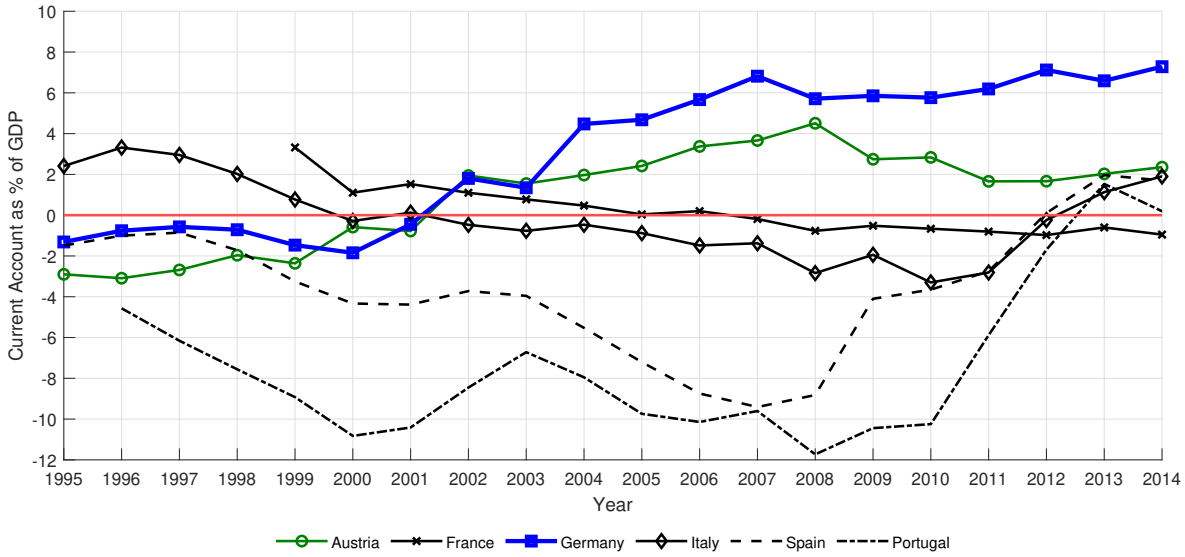


(a) Savings Rate in Levels

(b) Normalized Savings Rate (2004=1)

Notes: The left panel (a) shows the private savings rate by education group in levels from 1995 to 2014. The right panel (b) presents the normalized savings rate, with values indexed to 2004 (2004=1). The solid blue line represents individuals with up to 13 years of education, while the dashed red line represents those with more than 13 years of education. The vertical black dashed line marks the year 2004 (right before the reform was implemented).

Figure 16: Current Account-to-GDP Ratio for Selected European Countries, 1995-2014



Notes: The figure displays the current account-to-GDP ratio for Germany, Austria, France, Italy, Portugal, and Spain from 1995 to 2014. The blue (green) line represents Germany (Austria). Data Source: OECD (2023)

Other major Eurozone economies exhibited diverse current account trends. Southern European countries such as Spain, Italy, and Portugal consistently faced deficits that persisted even after Germany's reforms. France's balance remained relatively stable, hovering around zero.

Germany's sustained current account surpluses stand out during this period. As Jaumotte and Sodsriwiboon (2010) noted, Southern European nations have run deficits since the Euro's introduction, largely due to declining private savings. This stands in contrast to Germany's increase in savings and surpluses.

B.3 Time Series Evidence of the Hartz IV Reform on the Current Account

In this subsection, we analyze the impact of the German Hartz IV reform on the current account-to-GDP ratio using an AR(1) time series model. Table 10 presents the results of this analysis, with models incorporating various macroeconomic variables (beyond one lag of the dependent variable) to control for factors that could influence the current account. These include the interest rate, CPI-based real effective exchange rate (REER), export price index, export growth, terms of trade, and lagged government debt.

The Hartz IV reform is represented by a dummy variable that takes the value of 1 starting in 2005. The reform shows a statistically significant positive effect on the current account-to-GDP ratio. This is consistent when varying the set of controls. In our baseline specification (Model 1), the reform is associated with a 1.75 percentage point increase in the current account-to-GDP ratio, a finding that remains robust across alternative model specifications.

Finally, Model 4 examines the effects of the reform over rolling 5-year windows, showing that the strongest and most significant effect occurs in the first five years post-reform (2005-2009), where the reform leads to an increase of 2.81 percentage points.

These findings suggest that the Hartz IV reform substantially improved Germany's current account-to-GDP ratio, which other macroeconomic factors in the model cannot explain.

Table 10: Effects of the German Labor Market Reform on the Current Account

Dependent Variable: CA/GDP	Model 1 Dummy: 2005-14	Model 2 Dummy: 2005-14	Model 3 Dummy: 2005-14	Model 4 5-year windows
Interest rate	-0.455***	-0.215	-0.445**	-0.471***
	(0.116)	(0.141)	(0.189)	(0.139)
GDP Growth	-0.008	-0.039	0.009	-0.006
	(0.070)	(0.074)	(0.105)	(0.066)
REER (CPI-based)	0.141***		0.235**	0.138***
	(0.052)		(0.095)	(0.051)
Export price index	0.417***	0.450***	0.515***	0.463***
	(0.088)	(0.098)	(0.174)	(0.082)
Export growth	0.096***	0.099***	0.100**	0.092***
	(0.033)	(0.033)	(0.046)	(0.032)
Hartz IV - Dummy	**1.748*** **	**1.690*** **	**1.865*** **	
	(0.353)	**(0.327)**	**(0.454)**	
Terms of Trade		0.210**		
		(0.087)		
Lag (log Government Debt,1)			-2.286	
			(4.392)	
Dummy 2000-04				0.867
				(0.990)
Dummy 2005-09				**2.807** **
				(1.219)
Dummy 2010-14				1.681
				(1.093)
Lagged CA/GDP	0.889***	0.893***	0.809***	0.811***
	(0.053)	(0.049)	(0.099)	(0.118)
Constant	-49.627***	0.632***	-59.038***	-53.869***
	(11.713)	(0.064)	(16.263)	(11.036)
Observations	84	84	63	84
R^2	0.983	0.982	0.972	0.967
Wald chi2	1164.70	914.84	342.75	760.34
Prob > chi2	0.00	0.00	0.00	0.00
AIC	180.93	183.69	151.20	180.95
BIC	202.80	205.56	172.63	207.69

Note: "Hartz IV Dummy" is a shift dummy that takes the value 1 from 2005 onward. The quarterly sample ranges from 1994/Q1 to 2014/Q1. Due to data availability, the sample for Model 3, including Government debt, ranges from 1999/Q1 to 2014/Q4. Model 4 contains 5-year windows. Standard Errors are clustered at the household level.*p<0.1; **p<0.05; ***p<0.01.

C Model Appendix

C.1 The Investment Fund's Problem

The investment fund aggregates multiple assets, including physical capital k_t, government bonds b_t, equity $x_t p_t$, and net foreign assets NFA_t. It operates under the following constraint (asset market clearing condition), ensuring that the aggregate supply of assets in the economy matches the demand.

$$\bar{a}_t = \frac{p_t^H}{P_t} k_t + NFA_t + b_t + x_{t-1} p_{t-1}$$

The fund's objective is to maximize the present value of future real returns:[53]

$$\max_{\bar{a}_{t+1}, \frac{p_{t+1}^H}{P_{t+1}} k_{t+1}, NFA_{t+1}, b_{t+1}, x_t} E_0 \sum_{t=0}^{\infty} m_{0,t} \Bigg(\frac{p_t^H}{P_t} r^k k_t + r_G b_t + r_{NFA} NFA_t - r \bar{a}_t + (d_t + p_t) x_{t-1} - \frac{p_t^H}{P_t} I_t - b_{t+1} - NFA_{t+1} - x_t p_t + \bar{a}_{t+1} \Bigg), \quad \text{(C.1)}$$

where r^k denotes the return on capital, r_G the return on government bonds, r_{NFA} the return on net foreign assets, and r the return on aggregate assets. Dividends and equity price gains from shares held are denoted by $x_{t-1}(d_t + p_t)$, while $x_t p_t$ represents the value of newly purchased equity in period t. The pricing kernel is denoted by $m_{0,t}$.
Subject to the law of motion for Capital

$$\frac{p_t^H}{P_t} I_t = \frac{p_{t+1}^H}{P_{t+1}} k_{t+1} - (1-\delta) \frac{p_t^H}{P_t} k_t$$

First-Order Conditions (FOCs) The first-order conditions for each asset class are:

$$\begin{aligned}
\bar{a}_t &: \frac{m_{0,t}}{m_{0,t+1}} = r \\
\frac{p_t^H}{P_t} k_t &: \frac{m_{0,t}}{m_{0,t+1}} = (1 + r^k - \delta) \\
b_t &: \frac{m_{0,t}}{m_{0,t+1}} = r_G \\
NFA_t &: \frac{m_{0,t}}{m_{0,t+1}} = r_{NFA} \\
x_t &: \frac{m_{0,t}}{m_{0,t+1}} p_t = d_{t+1} + p_{t+1}
\end{aligned}$$

No-Arbitrage Condition Without aggregate uncertainty, all assets yield the same risk-free return in equilibrium, implying:

$$\frac{m_{0,t}}{m_{0,t+1}} = 1 + r^k - \delta = r_G = r_{NFA} = r.$$

[53] The fund maximizes with respect to the real value of its capital stock, $\frac{p_t^H}{P_t} k_t$, to measure capital priced in production goods in consumer good prices, ensuring consistency across assets.

This ensures that the fund is indifferent between different asset classes.

C.2 Derivation of the Resource Constraint

We start with the aggregate budget constraint of all households:

$$C_t + a_{t+1} = (1-\tau_t^w) w_t N_t + \kappa_t^{BS,H} U_t^{S,H} + \kappa_t^{BS,L} U_t^{S,L} + \kappa_t^{BL} U_t^L - \tau_t + (1+r-\delta) a_t \tag{C.2}$$

Let's plug in the asset market clearing condition:

$$\overbrace{C_t + NFA_{t+1} + \frac{p_{t+1}^H}{P_{t+1}} k_{t+1} + b_{t+1} + p_t}^{\bar{a}_{t+1}} = (1-\tau_t^w) w_t N_t + \kappa_t^{BS,H} U_t^{S,H} + \kappa_t^{BS,L} U_t^{S,L} + \kappa_t^{BL} U_t^L \tag{C.3}$$
$$-\tau_t + (1+r-\delta) \overbrace{(NFA_t + \frac{p_t^H}{P_t} k_t + b_t + p_{t-1})}^{\bar{a}_t}$$

Next, we plug in for the equity price p_t

$$C_t + NFA_{t+1} + \frac{p_{t+1}^H}{P_{t+1}} k_{t+1} + b_{t+1} + p_t = (1-\tau_t^w) w_t N_t + \kappa_t^{BS,H} U_t^{S,H} + \kappa_t^{BS,L} U_t^{S,L} + \kappa_t^{BL} U_t^L \tag{C.4}$$
$$-\tau_t + (1+r-\delta)(NFA_t + \frac{p_t^H}{P_t} k_t + b_t + \overbrace{\frac{d_t + p_t}{1+r-\delta}}^{p_t})$$

Rearrange slightly and see that p_t cancels out.

$$C_t + NFA_{t+1} + \frac{p_{t+1}^H}{P_{t+1}} k_{t+1} + b_{t+1} = (1-\tau_t^w) w_t N_t + \kappa_t^{BS,H} U_t^{S,H} + \kappa_t^{BS,L} U_t^{S,L} + \kappa_t^{BL} U_t^L \tag{C.5}$$
$$-\tau_t + (1+r-\delta)(NFA_t + \frac{p_t^H}{P_t} k_t + b_t) + d_t$$

Now, we plug in the condition for firm profits:

$$C_t + NFA_{t+1} + \frac{p_{t+1}^H}{P_{t+1}} k_{t+1} + b_{t+1} = (1-\tau_t^w) w_t N_t + \kappa_t^{BS,H} U_t^{S,H} + \kappa_t^{BS,L} U_t^{S,L} + \kappa_t^{BL} U_t^L \tag{C.6}$$
$$-\tau_t + (1+r-\delta)(NFA_t + \frac{p_t^H}{P_t} k_t + b_t) + \overbrace{\frac{p_t^H}{P_t} z_t F(\tilde{k}_t) N_t - \frac{p_t^H}{P_t} r k_t - w_t N_t - \kappa^{\upsilon} V_t}^{d_t}$$

We can cancel out labor income, but labor tax revenue remains. We use the definition for aggregate output, $Y_t = z_t F(\tilde{k}_t) N_t$ and rearrange:

$$\frac{p_t^H}{P_t} Y_t = C_t + NFA_{t+1} + \frac{p_{t+1}^H}{P_{t+1}} k_{t+1} + b_{t+1} - \tau_t^w w_t N_t - \tau_t - \kappa_t^{BS,H} U_t^{S,H} - \kappa_t^{BS,L} U_t^{S,L} - \kappa_t^{BL} U_t^L \tag{C.7}$$
$$+ \frac{p_t^H}{P_t} r k_t + \kappa^{\upsilon} V_t - (1+r-\delta)(NFA_t + \frac{p_t^H}{P_t} k_t + b_t)$$

Rewriting gives:

$$\frac{p_t^H}{P_t} Y_t = C_t + NFA_{t+1} - (1+r-\delta)NFA_t + \frac{p_{t+1}^H}{P_{t+1}} k_{t+1} - \frac{p_t^H}{P_t}(1+r-\delta)k_t \tag{C.8}$$
$$+ b_{t+1} - (1+r-\delta)b_t - \tau_t^w w_t N_t - \tau_t - \kappa_t^{BS,H} U_t^{S,H} - \kappa_t^{BS,L} U_t^{S,L} - \kappa_t^{BL} U_t^L + \frac{p_t^H}{P_t} r k_t + \kappa^\upsilon V_t$$

Now, we see that $\frac{p_t^H}{P_t} r k_t$ cancels out. We use the definition of investment, the government budget constraint, and the law of motion for net foreign assets, which allows us to plug in net exports:

$$\frac{p_t^H}{P_t} Y_t = C_t + \underbrace{NFA_{t+1} - (1+r-\delta)NFA_t}_{NX_t} + \underbrace{\frac{p_{t+1}^H}{P_{t+1}} k_{t+1} - \frac{p_t^H}{P_t}(1-\delta)k_t}_{\frac{p_t^H}{P_t} I_t} - \frac{p_t^H}{P_t} r k_t \tag{C.9}$$
$$+ \underbrace{b_{t+1} - (1+r-\delta)b_t - \tau_t^w w_t N_t - \tau_t - \kappa_t^{BS,H} U_t^{S,H} - \kappa_t^{BS,L} U_t^{S,L} - \kappa_t^{BL} U_t^L}_{\text{GBC}} + \frac{p_t^H}{P_t} r k_t + \kappa^\upsilon V_t$$

Thus,

$$\frac{p_t^H}{P_t} Y_t = C_t + \frac{p_t^H}{P_t} I_t + NX_t + \kappa^\upsilon V_t \tag{C.10}$$

We can now use the definitions for consumption as well as net exports:

$$\frac{p_t^H}{P_t} Y_t = \frac{p_t^H}{P_t} c_{H,t} + \frac{p_t^F}{P_t} c_{F,t} + \frac{p_t^H}{P_t} c_{H,t}^* - \frac{p_t^F}{P_t} c_{F,t} + \frac{p_t^H}{P_t} I_t + \kappa^\upsilon V_t \tag{C.11}$$

Note that imports of consumption goods cancel out. This gives:

$$\frac{p_t^H}{P_t} Y_t = \frac{p_t^H}{P_t} c_{H,t} + \frac{p_t^H}{P_t} c_{H,t}^* + \frac{p_t^H}{P_t} I_t + \kappa^\upsilon V_t \tag{C.12}$$

Finally, we rearrange and multiply by the inverse of the price ratio and get

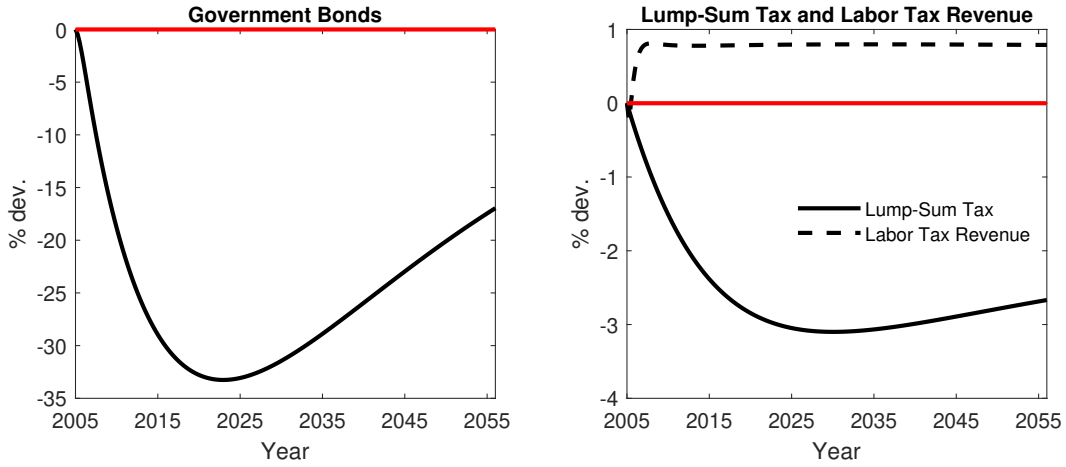
$$Y_t = c_{H,t} + c_{H,t}^* + I_t + \frac{P_t}{p_t^H} \kappa^\upsilon V_t. \tag{C.13}$$

C.3 The Government Sector

Figure 17 shows the model's responses in the government sector post-reform. The left panel illustrates a substantial decline in government bonds and expenditures, while the right panel depicts a decrease in labor tax revenue and lump-sum tax, reflecting the improved fiscal position due to increased employment and reduced unemployment benefits.

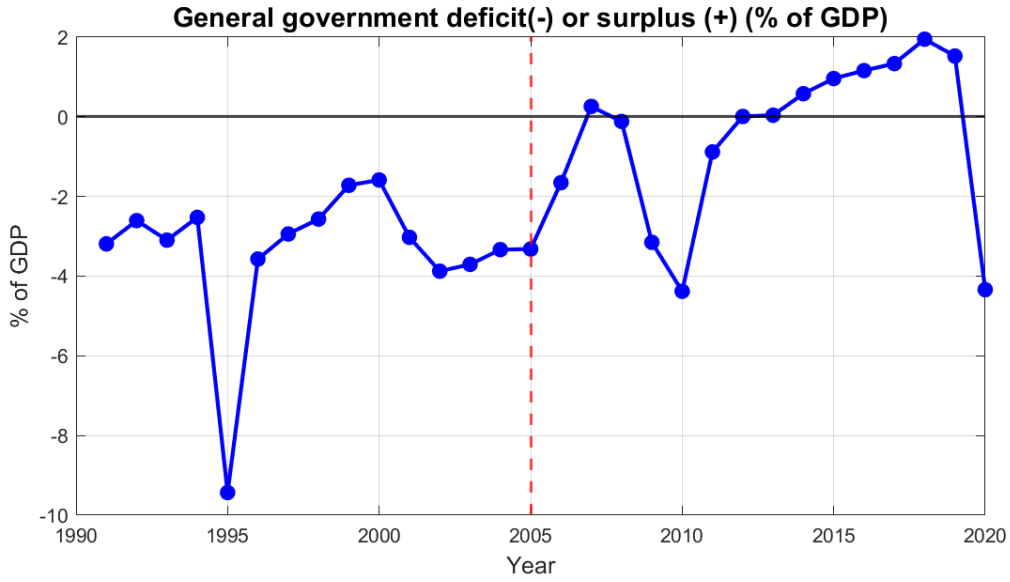
The model's predictions are consistent with empirical data. Figure 18 shows the general government deficit or surplus as a percentage of GDP from the early 1990s through 2020. Following the Hartz IV reforms in 2005, indicated by the vertical line, there was a clear reduction in the deficit, eventually leading to a surplus in subsequent years.

Figure 17: Model Responses: The Government Sector



Notes: Model responses in percent deviations from the pre-reform steady state.

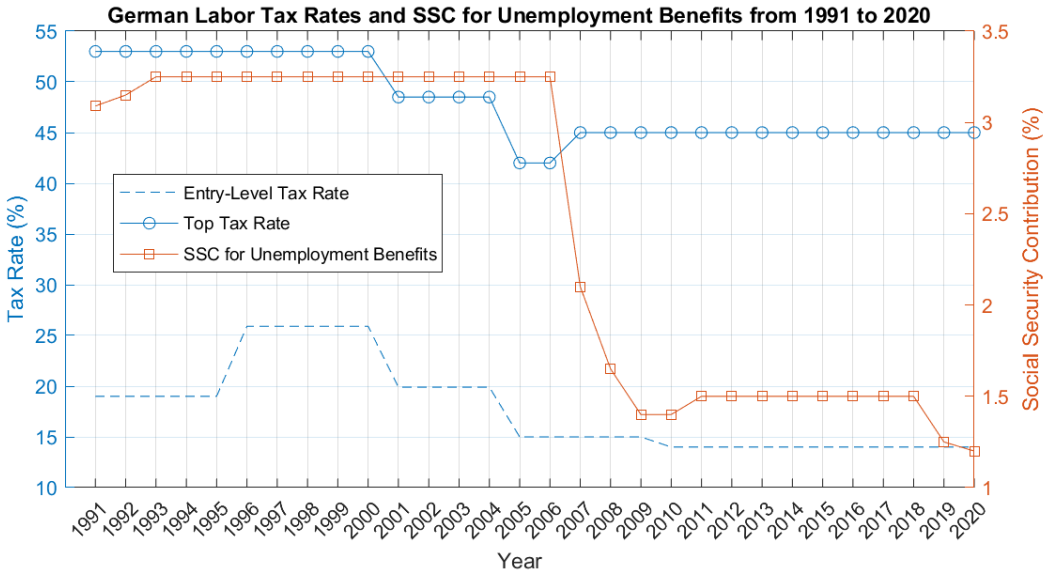
Figure 18: General Government Deficit(-) or Surplus(+) (% of GDP)



Notes: General government deficit(-) or surplus (+) (ESA 2010) as a percentage of GDP. Data Source: Bundesbank 2024 (BBK01.BK9190).

Figure 19 further supports the model's predictions, showing the evolution of German labor tax rates and social security contributions (SSC) for unemployment benefits from 1991 to 2020. The data indicate a significant decrease in the top tax rate and SSC after 2005 (starting in 2007), reducing the financial burden on workers.

Figure 19: German Labor Tax Rates and SSC for Unemployment Benefits (1991-2020)



Notes: Evolution of the entry-level tax rate, top tax rate, and social security contributions (SSC) for unemployment benefits in Germany from 1991 to 2020. The left vertical axis represents the tax rates in percentage terms, while the right vertical axis shows the percentage of SSC for unemployment benefits. Data Source: German Federal Ministry of Finance and Federal Ministry of Labour and Social Affairs.

Thus, the empirical evidence on the government deficit, tax rates, and social security contributions aligns with the model's predictions of a decline in government debt, as discussed in Section 5.1.

C.4 The Representative Agent Version

The Representative Agent's Problem In the representative agent version of our model, all consumers are fully insured against idiosyncratic risk. The consumption function follows the same CES aggregation as in the baseline:

$$c_t = \left(\gamma^{\frac{1}{\eta^C}} c_{H,t}^{\frac{\eta^C-1}{\eta^C}} + (1-\gamma)^{\frac{1}{\eta^C}} c_{F,t}^{\frac{\eta^C-1}{\eta^C}} \right)^{\frac{\eta^C}{\eta^C-1}},$$

The representative agent's maximization problem is:

$$V_t = \max_{\{c_t, a_{t+1}\}} U(c_t) + \beta E_t[V_{t+1}].$$

subject to the budget constraint:

$$\begin{aligned} c_t + a_{t+1} =& (1-\tau_t^W) w_t^L N_t^L + (1-\tau_t^W) w_t^H N_t^H + \kappa_t^{S,L} U_t^{S,L} + \kappa_t^{S,H} U_t^{S,H} + \kappa_t^L U_t^L - \tau_t \\ &+ (1+r-\delta) \mathrm{e}^{-\psi(NFA_{t-1} - \overline{NFA})} a_t, \end{aligned}$$

where c_t is aggregate consumption, and a_{t+1} is asset holdings for the next period. w_t^L and w_t^H represent wages for low- and high-skilled workers, with N_t^L and N_t^H denoting the respective numbers of employed workers. Short-term unemployed workers in skill groups L and H receive benefits $\kappa_t^{S,L}$ and $\kappa_t^{S,H}$, while long-term unemployed workers receive κ_t^L. Taxes are levied at a lump-sum rate τ_t, and net foreign assets evolve based on a debt-elastic interest rate adjustment, with NFA_t reflecting the country's foreign asset position. Note that to ensure stationarity of net foreign assets, we follow Schmitt-Grohe and Uribe (2003) and assume a debt-elastic interest rate on international bonds, where the interest rate increases with the country's net foreign asset position. This adjustment prevents non-stationarity in the net foreign asset dynamics and is not required in our benchmark model. We set $\psi = 0.00074$ for the simulation, following Schmitt-Grohe and Uribe (2003).[54]

The first-order conditions for the representative agent's optimization problem are:

$$\begin{aligned} c_t : \lambda_t &= c_t^{-\sigma} \\ a_{t+1} : \lambda_t &= \beta \lambda_{t+1} (1+r-\delta) \mathrm{e}^{-\psi(NFA_{t-1} - \overline{NFA})} \end{aligned}$$

Rearranging the condition for asset holdings gives the Euler equation for optimal intertemporal consumption:

$$\lambda_t = \beta \lambda_{t+1} \cdot (1+r-\delta) \cdot \mathrm{e}^{-\psi(NFA_t - \overline{NFA})}$$

where λ_t represents the marginal utility of consumption, $\overline{NFA}$ is the steady-state level of net foreign assets, and ψ is the adjustment cost parameter.

Wage Setting In the heterogeneous agent model, the utility function includes the average consumption of each worker type. In contrast, the representative agent model assumes perfect consumption pooling, leading to identical consumption levels across all workers. Consequently, wages and unemployment benefits directly enter the utility function, replacing worker-specific consumption levels in the bargaining process.

The value of working for a low-skilled consumer is

$$\mathscr{W}_t^{E,L} = U(w_t^{E,L}) + \beta E_t \left[(1-s^L)(1-\pi^E) \mathscr{W}_{t+1}^{E,L} + (1-s^L) \pi^E \mathscr{W}_{t+1}^{E,H} + s^L \mathscr{W}_{t+1}^{S,L} \right], \tag{C.14}$$

[54] This prevents long-run effects on the NFA position by construction.

and for a high-skilled consumer, the utility of working is given by

$$\mathcal{W}_t^{E,H} = U(w_t^{E,H}) + \beta\, E_t\left[(1-s^H)\mathcal{W}_{t+1}^{E,H} + s^H \mathcal{W}_{t+1}^{S,H}\right]. \tag{C.15}$$

For short-term unemployed consumers with skill level $j \in (L,H)$, the value of being short-term unemployed is

$$\mathcal{W}_t^{S,j} = U(\kappa_t^{S,j}) + \beta\, E_t\left[\lambda_t^w \mathcal{W}_{t+1}^{E,L} + (1-\lambda_t^w)(1-\pi_L)\mathcal{W}_{t+1}^{S,j} + (1-\lambda_t^w)\pi_L \mathcal{W}_{t+1}^{L}\right]. \tag{C.16}$$

And the value of being long-term unemployed is given by

$$\mathcal{W}_t^{L} = U(\kappa_t^{L}) + \beta\, E_t\left[\lambda_t^w \mathcal{W}_{t+1}^{E,L} + (1-\lambda_t^w)\mathcal{W}_{t+1}^{L}\right]. \tag{C.17}$$

Note that the union's surplus and the wage-sharing rule remain identical to our benchmark incomplete markets model.

Net Foreign Asset Dynamics The dynamics of net foreign assets are governed by the following equation:

$$NFA_t = (1 + r - \delta) \cdot \mathrm{e}^{-\psi(NFA_{t-1} - \overline{NFA})} NFA_{t-1} + NX_t$$

where NX_t represents net exports, and the debt-elastic interest rate mechanism ensures stationarity of the net foreign asset position.
The rest of the representative agent version is identical to the heterogeneous agent model.

D Further Model Results

D.1 Regression Results from Empirical and Simulated Data

Table 11 presents the regression results of our empirical model alongside those based on simulated panel data from the model. The decline in the replacement rate for long-term unemployed workers is chosen to match the observed increase in savings rates post-Hartz IV reform, ensuring that we obtain the same coefficient by construction (our target). Additionally, the qualitative effects of most control variables remain consistent. Since the interest rate is constant in our model, it is not included as an independent variable in the regression. To avoid losing an observation when computing growth rates, we use GDP in levels in the model-based regression.

Table 11: Regression Results from Empirical and Simulated Data: Aggregate Reform Effects

	GSOEP Savings Rate	Model Savings Rate
Hartz-Dummy	**0.010*****	**0.010*****
	(0.001)	(0.001)
Time Trend	-0.002***	-0.000***
	(0.000)	(0.000)
Unemployment_rate	-0.004***	-5.196***
	(0.000)	(0.705)
debt_gdp_ratio	-0.001***	-0.130***
	(0.000)	(0.021)
Terms of Trade	-0.001***	-0.854***
	(0.000)	(0.301)
Interest rate	-0.009***	
	(0.001)	
GDP growth	0.001***	
	(0.000)	
GDP		-3.009***
		(0.388)
Constant	0.442***	10.637***
	(0.025)	(1.460)
Observations	125701	4000000
HH Fixed Effects	Yes	Yes

Notes: All regressions include individual fixed effects. Household-level control variables in the empirical model include marital status, region, occupation, number of children, and employment level. Standard errors are reported in parentheses. * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$.

D.2 Steady State Comparison

Table 12 displays the percentage changes between the initial (pre-reform) steady state and the steady state following the complete reform package. Wages for low-skilled workers decrease slightly, which is contrasted by a slight increase in wages for high-skilled workers, driven by the rise in market tightness. Additionally, the prices of domestically produced goods and the consumer price index (CPI) experience a slight increase, reflecting the positive long-run demand effects.

The reform positively impacts the labor market by significantly increasing market tightness and the job-finding rate while reducing unemployment in the post-reform steady state. The number of short-term unemployment benefit recipients declines considerably. In contrast, the number of long-term recipients increases due to faster transitions from short-term to long-term benefits following the reduced entitlement duration.

Regarding aggregate variables, we observe higher consumption levels, aggregate assets, and output in the post-reform steady state. The reduction in unemployment benefits triggers consumers' precautionary savings motive, increasing asset holdings. This results in a higher aggregate capital stock and an increase in investment in the long run. The rise in domestic consumption leads to higher imports, while exports decrease slightly in the post-reform steady state. The net foreign asset position (as a percentage of output) increases significantly by approximately 40 percentage points.

Table 12: Long-run Reform Effects: Percent Deviation from Initial Steady State

Prices		% deviations from steady state
	Wage, Low-skilled	-0.03
	Wage, High-skilled	0.06
	Price of home good	0.15
	CPI	0.10
	Real Exchange Rate	-0.15
Labor Market		
	Market Tightness	13.74
	Vacancies	7.45
	Unemployment	-5.53
	Job-finding rate	6.65
	Job-filling rate	-6.24
	Low-skilled Short-term unemployed	-11.48
	High-skilled Short-term unemployed	-11.48
	Long-term unemployed	8.50
	Employment	0.75
Aggregates		
	Consumption	1.53
	Aggregate Assets	5.43
	Output	0.75
	Investment	0.75
	Exports	-0.39
	Imports	1.82
	Net foreign assets/Y	39.58

Notes: Long-run reform effects in percent deviations (percentage points if otherwise indicated) from the pre-reform steady state compared to the post-reform steady state in our baseline scenario.

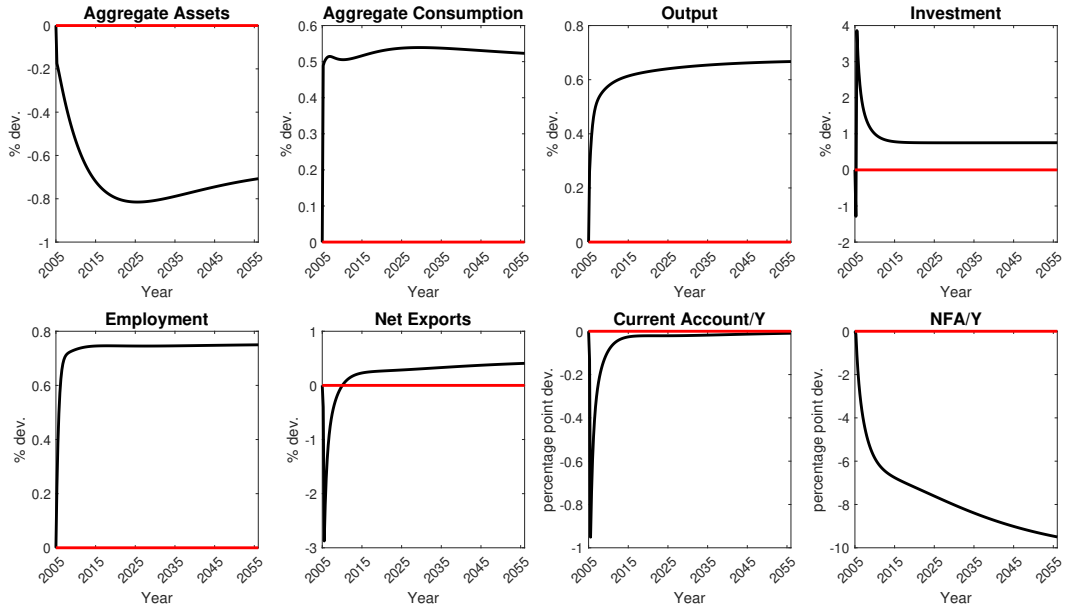
D.3 Increase in Matching Efficiency: The Hartz III Reform

As discussed in Appendix A, the Hartz IV reform was part of a broader agenda to restructure the German labor market. This subsection examines the effects of the Hartz III reform, which was implemented in 2004 and aimed at restructuring the Federal Employment Agency to improve job matching and placement services. We implement the German Hartz III reform by increasing the job-matching efficiency parameter (κ^e) by 7.3 percent, which generates the same steady state decline in unemployment. Figure 20 illustrates the dynamic effects of increasing the matching

efficiency along the transition to the new steady state. An increase in matching efficiency leads to positive labor market effects, including higher consumption and output, but they do not trigger a precautionary savings response as consumers' consumption risk in case of unemployment remains unaffected by a change in the matching efficiency. On the contrary, the expansionary impact of improved job-matching efficiency reduces aggregate assets, leading to a decline in the current account-to-output ratio and net foreign assets. Table 13 presents the corresponding steady-state effects of the increased matching efficiency

It is important to note that our empirical estimation of the effect of Hartz IV on savings presented in Section 2 provides a conservative, lower-bound estimate of the reform's effects as any simultaneous expansionary impacts of other reforms, like Hartz III, would likely have dampened the overall increase in savings. Because Hartz III improved labor market conditions and reduced unemployment, households faced less unemployment risk, reducing their need for precautionary savings. Consequently, Hartz III potentially dampened the current account effects by contributing to lower unemployment without inducing precautionary savings.

Figure 20: Simulation Results of an Increase in Matching Efficiency (Hartz III Reform)



Notes: Model responses of aggregate variables in percent deviations (percentage point deviations where indicated) from the pre-reform steady state to a 7.3 percent increase in matching efficiency.

D.4 Small open vs. Closed Economy

Figure 21 compares the impulse responses to a labor market reform between a small open economy (solid line) and a closed economy (dashed line). While the labor market impacts are similar across both settings, the closed economy experiences a reduced increase in aggregate assets due to the declining interest rate and the restriction of asset supply to domestic assets. This dampened consumption-savings trade-off results in a smaller initial decline in consumption and a quicker recovery, though it stabilizes at a slightly lower steady-state level compared to the small open economy. However, the lower interest rate in the closed economy stimulates capital for-

Table 13: Long-run Reform Effects of Hartz IV and Hartz III (Increase in Matching Efficiency): Percent Deviation from Initial Steady State

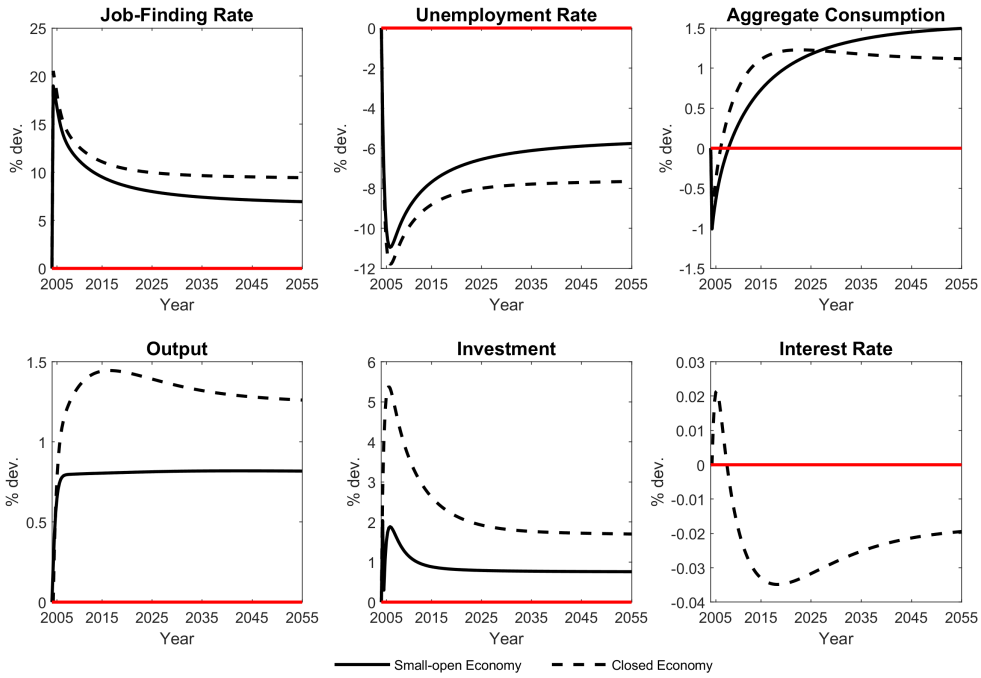
	Hartz IV Reform	Hartz II Reform
Prices		
Wage, Low-skilled	-0.03	-0.01
Wage, High-skilled	0.06	-0.03
Price of home good	0.15	-0.24
CPI	0.10	-0.16
Real Exchange Rate	-0.15	0.24
Labor Market		
Market Tightness	13.74	-1.19
Vacancies	7.45	-6.66
Unemployment	-5.53	-5.54
Job-finding rate	6.65	6.66
Job-filling rate	-6.24	7.94
Low-skilled Short-term unemployed	-11.48	-3.21
High-skilled Short-term unemployed	-11.48	-3.21
Long-term unemployed	8.50	-11.03
Employment	0.75	0.75
Aggregates		
Consumption	1.53	0.50
Aggregate Assets	5.43	-0.68
Output	0.75	0.75
Investment	0.75	0.75
Exports	-0.39	0.63
Imports	1.82	0.05
Net foreign assets/Y	39.58	-10.50

Notes: Hartz IV reform refers to our baseline reform. The Hartz III reform corresponds to an increase in matching efficiency by 7.3 percent (without changes in the replacement rate or entitlement duration); effects are in % dev. from steady state.

mation, leading to a more pronounced increase in investment and a higher rise in output than in the small open economy.

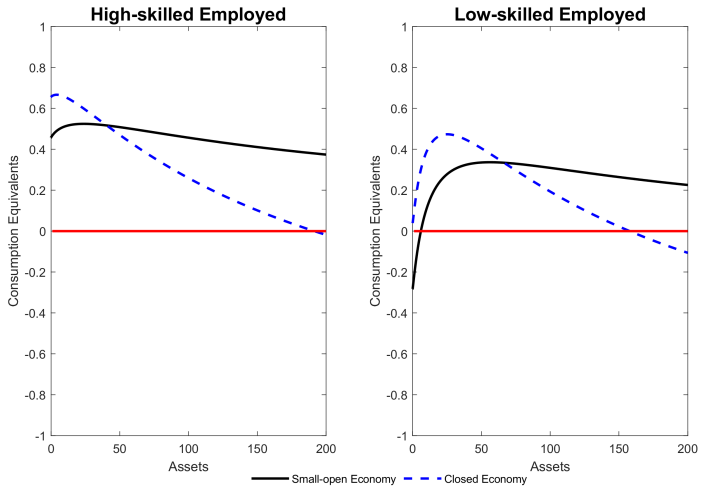
Figures 22 and 23 compare the welfare effects of the labor market reform between a small open economy (solid black line) and a closed economy (dashed blue line) for high-skilled and low-skilled employed workers, measured in consumption equivalents (CE) along the wealth distribution. In the closed economy, the positive labor market effect is stronger, benefiting asset-poor consumers more than in the small open economy. Additionally, the new steady state features a lower endogenous interest rate, reducing returns on savings. As a result, welfare declines for consumers with very high asset holdings—although the mass of agents at these wealth levels is negligible. Given the high mass of agents with low asset holdings, overall welfare effects are more positive in the closed economy.

Figure 21: Comparison to the Closed Economy Framework



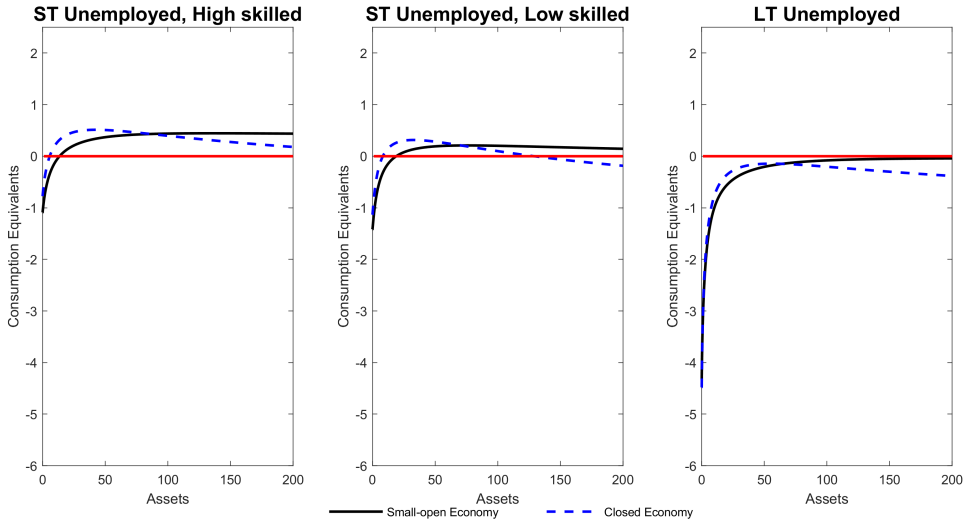
Notes: Responses to the labor market reform in the small open economy (solid line) and the closed economy (dashed line).

Figure 22: Welfare Effects in the Small Open vs. Closed Economy. Employed Workers (Steady State Comparison)



Notes: Consumption Equivalents (CE) of the welfare effects of the full labor market reform in the small open economy (solid black line) and the closed economy (dashed blue line) for employed workers by skill group.

Figure 23: Welfare Effects in the Small Open vs. Closed Economy. Unemployed Workers (Steady State Comparison)



Notes: Consumption Equivalents (CE) of the welfare effects of the full labor market reform in the small open economy (solid black line) and the closed economy (dashed blue line) for unemployed workers by skill group.