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

Brigitte Hochmuth[1*], Stéphane Moyen[2], Felix Schröter[3], and Nikolai Stähler[2]

[1]University of Vienna, CEPR
[2]Deutsche Bundesbank, Frankfurt, Germany
[3]Institute for Advanced Studies (IHS), Vienna

November 2024

Abstract

This paper establishes a connection between labor market reforms and an increase in the reforming country's net foreign asset position through a precautionary savings channel. We use data from the German Socioeconomic Panel to document significant changes in the savings behavior of the most affected groups in response to the reform. We then construct a heterogeneous agent model of a small open economy with labor market frictions to assess the current account effects of the major German unemployment benefit reform (Hartz IV). Our findings show that the reduction in the generosity of the unemployment insurance scheme leads to a significant increase in precautionary savings. As a result, since not all of these additional savings can be absorbed domestically, the net foreign asset position and the current account rise. In the first five years following its implementation, the reform contributed, on average, 13 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.

JEL classification: E21, E24, F16, F41.
Keywords: Heterogeneous Agents, Unemployment Benefit Reform, Current Account Imbalances, Precautionary Savings

[†] We thank Christian Bayer, Corina Boar, Benjamin Born, Jeanne Commault, Alejandro Cuñat, Sergio de Ferra, Christian Haefke, Philip Jung, Keith Kuester, Alexander Ludwig, Ralph Lütticke, Ioana Marinescu, Christian Merkl, Kurt Mitman, Morten Ravn, Timo Sauerbier, Ayşegül Şahin, Ctirad Slavik, and Rune Vejlin for their valuable comments. We also received valuable feedback during seminars and presentations at the University of Kiel, University of Konstanz, T2m (2022), and the Austrian Economic Association (2022). The views expressed in this paper are those of the authors and do not necessarily reflect the views of the Deutsche Bundesbank or its staff. Brigitte Hochmuth gratefully acknowledges funding from the German Research Foundation (DFG) under grant number ME-3887/5-1.
[*] Corresponding author. Email: brigitte.hochmuth@univie.ac.at

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 heterogeneous agents and incomplete insurance. The model includes a detailed unemployment benefit system and realistic wealth inequality to capture the international effects of labor market reforms.[3] Our analysis establishes a link between the reduction in the generosity of unemployment benefits and the build-up of net foreign assets through consumers' precautionary savings motives. We then quantify the importance of *the precautionary savings channel* by exploiting the example of a major unemployment benefit reform in Germany (Hartz IV-reform).

Using data from the German Socioeconomic Panel, we provide empirical evidence that the group of workers most affected by the Hartz IV reform increased their savings rate significantly after the reform. By targeting the estimated aggregate savings rate increase in our model, we quantify the reform's contribution to Germany's current account surplus and net foreign asset position.

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)",[4] 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 investment (see Figure 12 in the appendix). These developments have attracted worldwide attention.[5] The German 'Hartz IV reform' has been repeatedly blamed for contributing to the observed current account surpluses.[6] While existing macroeconomic studies have quantified the domestic effects of these reforms,[7] their potential international consequences have received less attention in the literature.

[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.

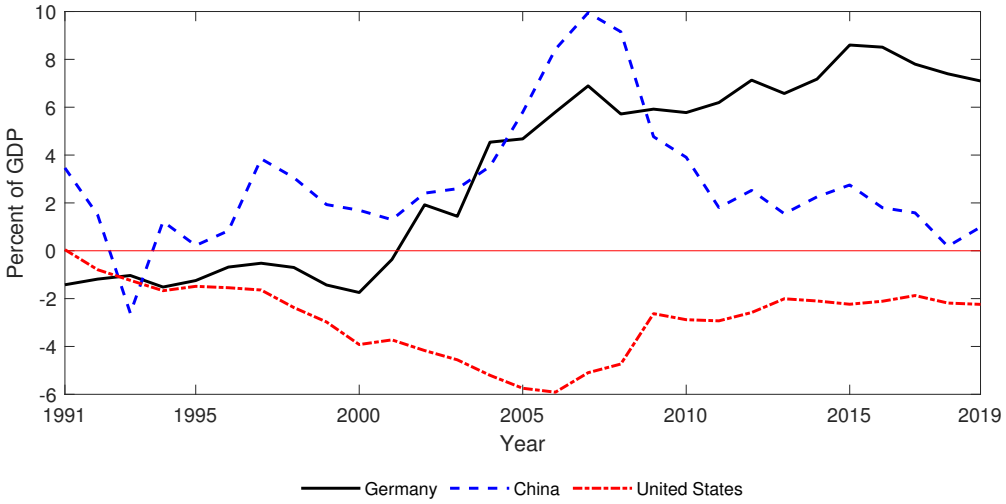
[4] See Hunnekes, Konradt, Schularick, Trebesch, and Wingenbach (forthcoming), who show that despite its vast capital exports, Germany performs poorly in terms of investment returns on its exported capital.

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

[6] For example, in October 2014, Paul Krugman said: "As they [the Germans] see it, their economy was in the doldrums at the end of the 1990s; they then cut labor costs, gaining a huge competitive advantage, and began running gigantic trade surpluses."

[7] See Krause and Uhlig (2012), Krebs and Scheffel (2013), Launov and Wälde (2013), Hochmuth, Kohlbrecher, Merkl, and Gartner (2021), and Hartung, Jung, and Kuhn (2018).

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).

In our model, risk-averse agents aim to smooth consumption over their lifetime. When unemployment benefits are reduced, income risk during unemployment increases. 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. Our model features a precautionary savings channel that is absent in the canonical small open economy representative agent models (in the spirit of Obstfeld and Rogoff, 1995). These traditional models, which rely on perfect consumption insurance, typically emphasize two opposing channels in response to reduced unemployment benefits: a *competitiveness channel*, where lower wages boost exports, and a *demand channel*, where increased employment drives up aggregate consumption.[8] Absent the precautionary savings motive, the demand channel dominates, leading to a fall in the reforming country's current account. Accounting for precautionary savings leads to *qualitatively different dynamics* of the current account.

Our small open economy model captures consumer heterogeneity in terms of 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 structure of the German system, with provisions for both short-term and long-term unemployed workers. Workers enter the labor force as low-skilled and accumulate skills over time, while a labor union negotiates wages with firms for both low-skilled and high-skilled workers.

By simulating the German Hartz IV reform within our model, we provide a novel quantification of how labor market deregulation can lead to a significant build-up of net foreign assets, challenging the predictions of traditional models. The reform consisted of two key steps: (i) a reduction in the replacement rate for long-term unemployment benefit recipients and (ii) a shortening of the

[8] 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).

entitlement period for short-term unemployment benefits.[9] The model is calibrated to the pre-reform period, aligning with German wealth inequality and targeting the empirically observed increase in the private savings rate of the most affected workers, as estimated from the German Socioeconomic Panel (GSOEP).

Our findings demonstrate that the Hartz IV reforms were a major factor, contributing significantly to the increase in Germany's net foreign asset position and offering new insights into the relationship between domestic policy and international economic dynamics. In the short run, the labor market reform drove up the German current account, explaining around 13% of its changes, around 25% of real exchange rate fluctuations, and more than 40% of the decline in unemployment within the first five years. By comparing our model to a complete insurance framework, we highlight the crucial role of precautionary savings and consumer heterogeneity. Additionally, our welfare analysis contrasts the small open economy with a closed-economy model, showing that while the open economy experiences overall welfare losses, the aggregate effects in the closed economy are positive.

Consumer heterogeneity plays an important role in evaluating the macroeconomic consequences of the reform. We compare the outcomes of the incomplete insurance model and the complete insurance model in explaining key macroeconomic responses following the reform. The complete insurance model shows *qualitatively* different impacts on the net foreign asset position due to the absence of a precautionary savings channel. In the incomplete insurance model, asset-poor consumers, relying heavily on labor income, are particularly vulnerable to earnings risk. As a result, they significantly cut consumption to increase their savings. We further document the importance of capturing consumer heterogeneity when evaluating the redistributive and welfare consequences of labor market reforms. In response to the reform, consumers increase their savings. Consequently, they hold a higher level of wealth in the post-reform steady state, contributing to a reduction in overall wealth inequality across the economy.

Welfare effects vary significantly across different groups. During the transition to the post-reform equilibrium, nearly all groups except high-skilled employed workers experienced, on average, welfare losses. Asset-poor households are hit hardest, due to their high marginal propensity to consume and heavy reliance on labor income. Under complete insurance, the reform results in welfare gains due to improved labor market conditions and perfect consumption smoothing.

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 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 con-

[9] 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.

sumer 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) contribute by empirically assessing the precautionary saving channel through variations in unemployment insurance across U.S. states and over time, finding small and statistically non-significant effects that align with a present-biased model.[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 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.

[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 effects in our paper differ from those in Fernandes and Rigato (2024) primarily because the Hartz IV reform represented a permanent structural change. In contrast, their analysis focuses on temporary, countercyclical unemployment insurance extensions. Furthermore, 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.— which heightened the incentive for precautionary savings upon reform implementation.

[13] Recent work by Bayer, Kriwoluzky, Müller, and Seyrich (2023) 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.

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. 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., 2018). These papers all evaluate the reform effects in a closed economy setting.
The rest of the paper is structured as follows. The next section provides stylized facts on the German savings glut. 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 first present empirical evidence on the influence of the Hartz IV labor market reform on the savings behavior of German households, 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 increase the efficiency of labor market services, activate the unemployed, and boost labor demand by deregulating labor markets. Appendix A.2 provides further institutional details on the Hartz reforms. The Hartz IV reform, in particular, was a significant overhaul of the country's social security system. It merged a three-pillar unemployment benefit system into a two-pillar system by combining unemployment assistance and social welfare benefits into a single system called "Unemployment Benefits II" (Arbeitslosengeld II).
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 on 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 13 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). 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. In addition. Figure 15 in Appendix B.1.2 illustrates a trend reversal in savings rates across different educational groups, with low-educated workers initially increasing their savings rates strongly post-reform. We further show that business cycle effects do not drive this trend reversal.[14]

Even though this descriptive evidence does not allow for statements on the underlying reasons for the increase in the private savings rate, it suggests that the precautionary savings motive triggered by the reform is potentially important.[15,]

Figure 2: Private Savings Rate of Employed Workers, 1994-2014

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.

Fixed-Effects Regression: In our subsequent analysis, we investigate how the savings behavior 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. (2018), which highlights 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%.

We estimate the following household-level fixed effects model:

[14] We purge the private savings rate from business cycle effects by regressing the savings rate on a constant and German GDP growth. For details, see Figure 14 in Appendix B.

[15] Unfortunately, the SOEP 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.

$$\begin{aligned} \textit{Savings Rate}_{it} =& \beta_0 + \beta_1 \textit{Most Affected}_{it} + \beta_2 \textit{Hartz-Dummy}_t \\ &+ \beta_3(\textit{Most Affected}_{it} \times \textit{Hartz-Dummy}_t) + \mathbf{X}_{it}\gamma + \mathbf{Z}_t\delta + \mu_i + \epsilon_{it}, \end{aligned} \tag{2.1}$$

where Savings Rate$_{it}$ denotes the savings rate of household i at time t. The intercept is represented by β_0, Most Affected$_{it}$ is a time-varying indicator equal to 1 if household i is classified as most affected by the Hartz reforms at time t, and Hartz-Dummy$_t$ equals 1 during the post-reform period. The interaction term (Most-Affected$_{it}$ × Hartz-Dummy$_t$) captures the differential effects of the reform on the most affected households. $\mathbf{X}_{it}$ is a vector of household-level control variables, and $\mathbf{Z}_t$ represents a vector of macroeconomic controls such as GDP growth or the unemployment rate. μ_i captures household-specific fixed effects.

Table 1 illustrates the results of the household-level fixed-effects estimations. The "Hartz Dummy" denotes a shift variable that takes 1 from 2005 onward. The interaction between "Most Affected" in column (1) and "Hartz Dummy" demonstrates that among the most affected groups, the implementation of the Hartz reforms has led to a significant increase in saving rates. In addition, column (2) depicts how the different groups adapted their savings behavior. In the regressions, we further control for marital status, region (East/West Germany), the number of children in the household, employment level, and ISCO-08 Occupation.[16] The saving rate increased by 0.6 percentage points (Model 1) after the Hartz IV reform. Thus, a considerable share of the increase in the private savings rate depicted in Figure 2 can be attributed to the reform. Furthermore, the interaction term of the reform dummy with the most affected group is significant and positive. They increased their savings rate by an additional 0.9 pp. Column 2 shows that the stronger the decline in the entitlement cut, the stronger the increase in the savings rate. As a robustness check, we estimate the effect solely for the sub-group of civil servants in Germany, who face minimal unemployment risk. Our analysis shows no significant impact on their private savings rate following the reform (see Figure 16 in Appendix B).

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 onwards, 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.

Quantitative Effects: Table 2 summarizes the quantitative effects of the Hartz IV labor market reform on German savings rates. The reform increased the aggregate savings rate by 0.8 percentage points, reflecting the weighted increase across households.[17] From 2005 to 2009, the cumulative

[16] Note that the reference category is Group 0: no change in entitlement duration, which is the case for workers younger than 45 and employment duration less than 28 months.

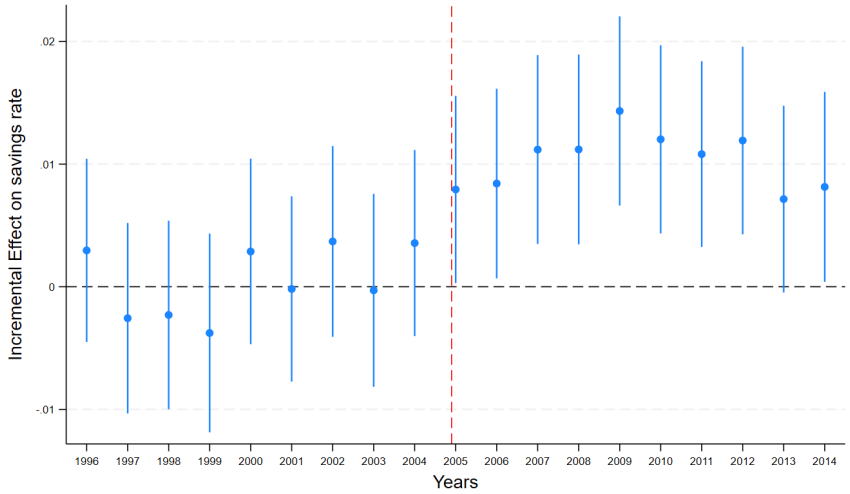
[17] To calculate the overall increase in the savings rate, we use the predicted savings rates for both most affected and non-affected households before and after the reform. We then calculate the overall increase by averaging the changes in predicted savings rates for both groups, weighted by the proportion of households in each group during the relevant periods.

Table 1: Reform Effect on Saving Rates of Most Affected Groups

	(1)	(2)
Dependent Variable: Saving rate		
Hartz IV-Dummy	0.006***	0.004***
	(0.001)	(0.002)
Most affected # Hartz IV-Dummy	0.009***	
	(0.002)	
Group 1 # Hartz IV - Dummy		0.004***
		(0.002)
Group 2 # Hartz IV - Dummy		0.008***
		(0.002)
Group 3 # Hartz IV - Dummy		0.011***
		(0.002)
Controls	Yes	Yes
HH - Fixed Effects	Yes	Yes
Observations	131,625	131,625
R-squared (within)	0.0084	0.0087
Number of hid	24,964	24,964

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. (2018). "Hartz Dummy" is a shift dummy that takes the value 1 from 2005 onward. The annual sample ranges from 1994 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. We include the following macroeconomic controls: a linear trend, unemployment rate, GDP growth, interest rate, and the fiscal balance. Standard Errors are clustered at the household level.*p<0.1; **p<0.05; ***p<0.01

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.

increase in savings due to the reform was 60.66 billion euros, which represents approximately

2.17% of real GDP in 2014. Cumulating the effect until 2014 amounts to 4.53 % of real GDP in 2014.

Table 2: Quantitative Reform Effects based on Microeconomic Estimation

Quantitative Effect	
Aggregate Incremental Effect on Savings Rate (Target)	0.8 pp
Absolute Effect (cum.) in EUR. (2005-2009) in Bn. EUR	60.66
Absolute Effect (cum.) in EUR. (2005-2014) in Bn. EUR	126.85
Cumulated Effect (2005-2009) in % of Real GDP (of 2014)	2.2%
Cumulated Effect (2005-2014) in % of Real GDP (of 2014)	4.5%

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

Further Empirical Evidence: A comparison of current account movements across European countries reveals 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 nature; see Figure 17 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, showed similar current account trends following the Euro's introduction but, unlike Germany, did not implement labor market reforms and, therefore, did not maintain persistent surpluses.
Furthermore, we perform time series regressions in which we control for macroeconomic variables such as the real effective exchange rate, government debt, interest rates, etc., and find a statistically significant positive impact of the Hartz IV reform on Germany's current account as detailed in Table 12 of Appendix B.3.

3 The Model

In this section, we develop a small open economy model incorporating worker heterogeneity and a frictional labor market. Our model builds on the framework by Krusell et al. (2010), with extensions to capture specific aspects of labor markets and worker skill differentiation. The international dimension of our small open economy follows Gali and Monacelli (2005). The model uniquely combines (i) incomplete insurance markets, (ii) a frictional labor market with detailed unemployment benefits and skill heterogeneity, and (iii) a small open economy framework that includes the accumulation of net foreign assets. This integration allows us to analyze the international macroeconomic implications of labor market policies with consumer heterogeneity.
Time is discrete, and there is a continuum of infinitely-lived consumers of measure one, following the standard Aiyagari (1994) structure. Consumers discount the future with a skill-specific factor β^j and derive utility from consumption.[18] Consumers can be employed (E), short-term

[18] Introducing a skill-specific discount factor β^j allows us to generate a higher dispersion of wealth while saving on an additional dimension of heterogeneity.

unemployed (S), or long-term unemployed (L). Each consumer inelastically supplies one unit of labor.

The labor market features a Diamond-Mortensen-Pissarides (DMP) structure (Pissarides, 2000), where firms post vacancies and worker-firm matches are formed randomly via a Cobb-Douglas matching function. Wages are determined through Nash bargaining between firms and a labor union. Workers accumulate skills during employment and face skill deterioration if they become unemployed (Ljungqvist and Sargent, 2007; Krause and Uhlig, 2012; Hartung et al., 2018). Employed workers can either be low-skilled with skill level z^L or high-skilled with skill z^H, with $z^L < z^H$. Workers transitioning from unemployment to employment start as low-skilled and acquire skills over time, becoming high-skilled with probability π^E. Skills are lost when employment terminates.[19]

We distinguish between short-term and long-term unemployment. Short-term unemployment benefits depend on the previous skill-specific wage, while long-term unemployment benefits are a fraction of the wage for low-skilled workers. This approach, which parallels employment duration heterogeneity, captures the impact of unemployment duration on benefits and skill levels (Hartung et al., 2018; Krause and Uhlig, 2012).

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.

Asset markets are incomplete, and agents cannot individually insure against income risk from unemployment. Consumers can purchase only one type of asset, a portfolio bundled by an investment fund. This asset includes the capital stock, a claim to firms' average profits paid as dividends, government bonds, and international assets. Portfolio diversification has no intrinsic benefit because only aggregate shocks affect prices.[20] All agents hold the same portfolio composition but differ in their choice of individual asset levels.

The small open economy is part of a currency union and takes the interest rate as given.

3.1 Labor Market Matching

All unemployed workers search on the same labor market. Each period, vacant jobs for workers (V) and unemployed workers (U) are matched randomly via 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

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

[19] 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.

[20] All consumers face the same aggregate risk, and returns are not correlated with individual labor market status, providing no additional gain from portfolio diversification.

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 (see Oswald, 1993 and Moyen and Stähler, 2014). 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.[21] 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 consolidates aggregate assets $\bar{a}_t$ across four types of assets: 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.[22]
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, with physical capital k_t valued at producer prices.[23]
The law of motion for capital defines aggregate investment I_t:[24]

[21] See Appendix C.1 for a formal characterization of the investment funds' maximization problem.
[22] 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 to reflect the new stream of expected future profits.
[23] The ratio $\frac{p_t^H}{P_t}$ is necessary to convert the value of capital from producer prices to CPI terms, ensuring that all components of the total assets $\bar{a}_t$ are consistently measured using the same price index for consistent aggregation.
[24] By including the price ratio, we ensure that all terms in the equations are comparable and correctly reflect the purchasing power of the assets, consistent with their valuation in different segments of the economy (i.e., producer prices versus consumer prices).

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

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 ($b^S > b^L$).

Aggregate State: The aggregate state Z represents the distribution of agents across individual state variables: assets a, employment status e, and skill levels s. The optimization of individual agents results in policy functions $\{c_t, a_{t+1}\}$ over the agent state space $\mathscr{A} \times \mathscr{E} \times \mathscr{S}$, where $\mathscr{A}$, $\mathscr{E}$, and $\mathscr{S}$ are the sets of all possible values for assets, employment status, and skill levels, respectively. The distribution of agents over the state space $Z = \mathscr{A} \times \mathscr{E} \times \mathscr{S}$ is summarized by the measure μ on (Z, Σ_Z), where Σ_Z is the Borel σ-algebra over Z.

Each period, consumers take prices and wages as given and choose consumption and asset holdings.

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

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

subject to

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

where $c_t^{E,L}$ is the consumption of employed workers, τ_t is a lump-sum tax (or transfer), and $\underline{a}$ denotes the borrowing constraint.

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

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

subject to

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

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 $\kappa_t^{S,j} = b^S(1-\tau_t^W)w_t^j$.[25] With exogenous probability π_L, the worker becomes long-term unemployed if not re-employed in the next period. The recursive problem is

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

subject to

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

Long-term Unemployed Consumers: A long-term unemployed consumer receives less generous unemployment benefits $\kappa^L = b^L(1-\tau)w^L$, based on the lower replacement rate b^L and the equilibrium wage of low-skilled workers.[26] They either find a job with probability λ_t^W in the next

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

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

period or remain long-term unemployed. Their problem is:

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

subject to

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

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

$$y_t^j=z^j(\tilde{k}_t^j)^\alpha. \tag{3.13}$$

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 as

$$\Pi_t^j=\frac{p_t^H}{P_t}y_t^j-\frac{p_t^H}{P_t}r\tilde{k}_t^j-w_t^j. \tag{3.14}$$

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:

$$d_t=\Pi_t^LN_t^L+\Pi_t^HN_t^H-\kappa^vV_t, \tag{3.15}$$

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

$$r=\alpha z^j(\tilde{k}_t^j)^{\alpha-1}. \tag{3.16}$$

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

$$J_t^L(Z_t)=\frac{p_t^H(Z_t)}{P_t(Z_t)}z^L(\tilde{k}_t^L)^\alpha-\frac{p_t^H(Z_t)}{P_t(Z_t)}r\tilde{k}_t^L-w_t^L(Z_t) \\ +q\mathbb{E}_t\left[(1-s^L)(1-\pi^E)J_{t+1}^L(Z_{t+1})+(1-s^L)\pi^EJ_{t+1}^H(Z_{t+1})\right], \tag{3.17}$$

which takes into account that with probability π^E the worker may become high-skilled in the next period and where q denote 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

$$J_t^H(Z_t) = \frac{p_t^H(Z_t)}{P_t(Z_t)} z^H (\tilde{k}_t^H)^\alpha - \frac{p_t^H(Z_t)}{P_t(Z_t)} r \tilde{k}_t^H - w_t^H(Z_t) + q\mathbb{E}_t\left[(1-s^H)J_{t+1}^H(Z_{t+1})\right]. \tag{3.18}$$

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

$$\frac{\kappa^v}{\lambda_t^f} = q(1-s^L)\mathbb{E}_t\left[J_{t+1}^L(Z_{t+1})\right]. \tag{3.19}$$

3.5 Wage Determination

Wage determination is modeled through a Nash bargaining process between firms and atomistic labor unions representing the average worker within each skill group. This approach is both 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.

The union's objective is to maximize the employment surplus over unemployment for the average worker, reflecting a collective concern for members' welfare and aiming to secure outcomes broadly representative of workers' interests. This approach incorporates the average consumption and asset levels of its members into the wage bargaining process.[27]

The marginal value of working for a low-skilled worker is given by:

$$\begin{aligned} \mathscr{W}_t^{E,L}(Z_t) = U(\bar{c}_t^{E,L}) + \beta^L \mathbb{E}_t \Big[& (1-s^L)(1-\pi^E)\mathscr{W}_{t+1}^{E,L}(Z_{t+1}) \\ & + (1-s^L)\pi^E \mathscr{W}_{t+1}^{E,H}(Z_{t+1}) + s^L \mathscr{W}_{t+1}^{S,L}(Z_{t+1}) \Big], \end{aligned} \tag{3.20}$$

where $U(\bar{c}_t^{E,L}(Z_t))$ represents the utility derived from the average consumption of a low-skilled

[27] Modeling unions as representing the utility of an average worker is a common assumption in heterogeneous agent models, see, for example Auclert, Rognlie, and Straub, 2018. 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.

worker. For a high-skilled worker, the marginal value is similarly defined by:

$$\mathcal{W}_t^{E,H}(Z_t) = U(\bar{c}_t^{E,H}) + \beta^H \mathbb{E}_t\left[(1-s^H)\mathcal{W}_{t+1}^{E,H}(Z_{t+1}) + s^H \mathcal{W}_{t+1}^{S,H}(Z_{t+1})\right]. \tag{3.21}$$

For short-term unemployed workers with skill level $j \in \{L,H\}$, the marginal value of being unemployed is:

$$\begin{aligned}\mathcal{W}_t^{S,j}(Z_t) = U(\bar{c}_t^{S,j}) + \beta^j \mathbb{E}_t\Big[&\lambda_t^w(Z_t)\mathcal{W}_{t+1}^{E,L}(Z_{t+1}) \\ &+ (1-\lambda_t^w(Z_t))(1-\pi_L)\mathcal{W}_{t+1}^{S,j}(Z_{t+1}) \\ &+ (1-\lambda_t^w(Z_t))\pi_L \mathcal{W}_{t+1}^{L}(Z_{t+1})\Big].\end{aligned} \tag{3.22}$$

The marginal value of being long-term unemployed is:

$$\mathcal{W}_t^{L}(Z_t) = U(\bar{c}_t^{L}) + \beta^L \mathbb{E}_t\left[\lambda_t^w(Z_t)\mathcal{W}_{t+1}^{E,L}(Z_{t+1}) + (1-\lambda_t^w(Z_t))\mathcal{W}_{t+1}^{L}(Z_{t+1})\right]. \tag{3.23}$$

The union's objective is to maximize the total surplus from employment over unemployment for its members, represented by:

$$\tilde{\mathcal{W}}^j{}_t(Z_t) = \mathcal{W}_t^{E,j}(Z_t) - \left(\mathcal{W}_t^{S,j}(Z_t)\frac{U_t^S}{U_t^S+U_t^L} + \mathcal{W}_t^{L}(Z_t)\frac{U_t^L}{U_t^S+U_t^L}\right). \tag{3.24}$$

This formulation considers the possibility that unemployed members can be either short-term or long-term unemployed.
The firm's surplus from hiring an additional worker of skill level j is denoted by J_t^j (see Equations 3.17 and 3.18). The wage is determined by solving the following Nash bargaining problem:

$$w_t^j(Z_t) = \max_{w_t^j} [\tilde{\mathcal{W}}^j{}_t(Z_t)]^{\zeta} [J_t^j(Z_t)]^{1-\zeta}. \tag{3.25}$$

The resulting wage-sharing rule is given by:

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

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 labor-income tax τ and by issuing new government bonds b_t:

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

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.

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 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:

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

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

3.9 Equilibrium

Given the exogenous interest rate r, the equilibrium of the small open economy is characterized by a sequence of prices $\left\{w^L_t, w^H_t, P_t, p^H_t, p^F_t\right\}$ and allocations $\left\{Y_t, C_t, C_{H,t}, C^*_{H,t}, C_{F,t}, k_{t+1}, NFA_{t+1}, b_{t+1}, d_t, N_t, U_t, U^S_t, U^L_t, V_t\right\}$, and the distribution of employment, skills, and assets Z such that the following statements hold:

1. High- and low-skilled employed consumers, short-term unemployed and long-term unemployed consumers optimize given prices.

2. Firms optimize taking factor prices and the aggregate price level as given.

3. The job-finding rate λ^w_t and the job-filling rate λ^f_t are functions of the market tightness θ_t and follow the matching function (3.1). The job-creation condition is satisfied and determines the vacancy-filling rate λ^f_t. Given the job-finding rate, λ^w_t, employment evolves according to the employment law of motion (3.6).

4. The numbers of short-term unemployed and long-term unemployed consumers evolve according to 3.7 and 3.8.

5. The wages by skill groups are a solution to the Nash bargaining game (3.25).

6. Given the wages by skill groups, the labor income tax, and the share of consumers by skill group and employment state, the government budget constraint (3.27) holds and the lump-sum tax rate follows the tax rule (3.28).

7. Asset markets clear and the investment funds' constraint (3.10) holds.

8. 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 $\beta^L = \beta - \Delta$).[28] 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 2.2% based on the 2002 wave of the German Socioeconomic Panel (GSOEP). This results in a Gini coefficient of 0.70, close to the GSOEP's value of 0.73. Consequently, we set the discount factor to $\beta = 0.981$ with $\Delta = 0.005$, 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.[29] Regarding the technology parameters, we follow Bayer et al. (2023) 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.[30] 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. (2018), 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).

[28] This is a standard feature in the literature to obtain realistic levels of marginal propensities to consume, see Carroll, Slacalek, Tokuoka, and White (2017) and Auclert et al. (2021).

[29] We define a high-skilled worker as an individual with more than 12 years of education and a low-skilled worker as having up to 12 years of education.

[30] Note that in a standard DMP setting, our calibration would adhere to the Hosios (1990) condition. However, incomplete insurance and union bargaining lead to constrained inefficiency even if we were to set the bargaining power equal to the matching elasticity. Dávila, Hong, Krusell, and Ríos-Rull (2012) demonstrate that uninsurable idiosyncratic shocks result in either over- or under-accumulation of capital, causing constrained inefficiency. For further discussion, see Krusell et al. (2010).

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 20 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).[31] Lastly, consistent with Germany's long-term debt-to-output ratio of 60%, we set $\omega_b = 0.6$.

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	0.005	Wealth share of bottom 50% (2.2%)
	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. (2023)
	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 short-term unemployed	b^S	0.670	Institutional value
	Replacement rate for long-term unemployed	b^L	0.570	Institutional value
	Probability to switch to LTU benefit recipient	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. (2018)
	Separation Rate, Low-Skilled Workers	s^L	4.14%	Hartung et al. (2018)
	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%		2.2%	GSOEP
Net interest rate	r	1.50%	Historical average for Germany (2001–2004)
Aggregate private savings rate increase (5-year avg.)		0.8 pp	See Section 2

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

[31] We provide robustness checks regarding the values of these two parameters in Section 5.3.

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 0.8 percentage points within the first five years.

In the initial steady state, all prices, the real exchange rate, and the terms of trade are normalized to one (see Table 4). The net foreign asset (NFA) position is set to zero pre-reform, ensuring a zero steady-state current account, defined as $CA_t = NFA_t - NFA_{t-1}$. We target a low-skilled worker share of 68% and the wealth share of the bottom 50%, based on the German Socioeconomic Panel. The shock size of the replacement rate reduction is calibrated to achieve a 0.8 percentage point increase in the aggregate private savings rate within five years (see the next subsection).

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.[32] Figure 4 schematically plots how we incorporate these changes into our model.

In our model simulation, we replicate the first reform step (cut in replacement rate for long-term unemployed workers) by reducing the replacement rate b^L by 28 percent. We set the decline in the replacement rate to match the aggregate increase in the private savings rate amounting to 0.8 percentage points (see Section 2) in our setting.

The precise magnitude of the economy-wide reduction in the replacement rate due to the Hartz IV reform remains debated (see Hochmuth et al., 2021 for a detailed discussion). However, our model's implementation of a 28% reduction lies within the range of plausible estimates.[33] Our model calibration remains consistent with empirical evidence by adjusting the shock size to align with the observed savings rate increase.

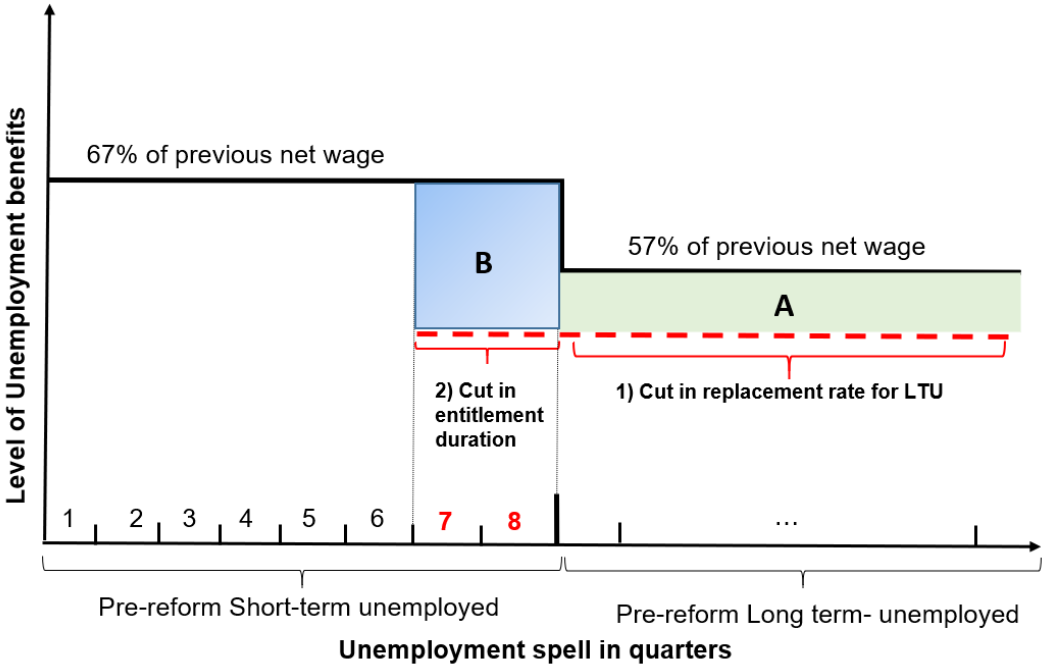
We model the cut in entitlement duration by increasing the probability of transitioning from short-term to long-term unemployment benefits (π^L) from 1/8 to 1/6, a 33.33% increase. Consequently, the maximum duration of short-term unemployment benefits decreases from 8 to 6 quarters, aligning with the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

[32] 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.

[33] For instance, Launov and Wälde (2013) assumed a 7% decline, yielding a 0.1 percentage point drop in unemployment, while Krebs and Scheffel (2013) and Krause and Uhlig (2012) assumed declines of 20% and up to 67%, leading to larger effects.

Figure 4: Reform Implementation (schematic plot)



fect 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 present the steady-state results. Second, we describe the dynamics of our model economy along the transition path. We further calculate the reform's contribution to German (international) macroeconomic time series, and provide robustness checks.

5.1 Steady State Comparison

Table 5 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 46 percentage points.

Table 5: Long-run Reform Effects: Percent Deviation from Initial Steady State

Prices		% deviations from steady state
	Wage, Low-skilled	-0.02
	Wage, High-skilled	0.08
	Price of home good	0.19
	CPI	0.13
	Real Exchange Rate	-0.19
Labor Market		
	Market Tightness	13.95
	Vacancies	7.56
	Unemployment	-5.61
	Job-finding rate	6.75
	Job-filling rate	-6.32
	Low-skilled Short-term unemployed	-11.51
	High-skilled Short-term unemployed	-11.51
	Long-term unemployed	8.32
	Employment	0.76
Aggregates		
	Consumption	1.67
	Aggregate Assets	6.11
	Output	0.76
	Investment	0.76
	Exports	-0.50
	Imports	2.04
	Net foreign assets/Y	45.57

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.

5.2 Transitional Dynamics

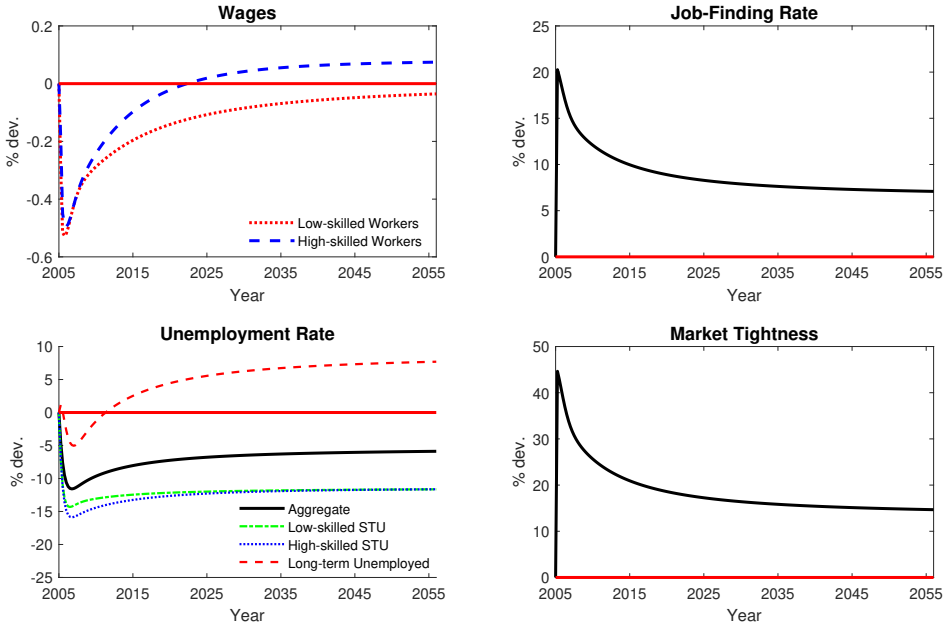
This subsection discusses the transitional dynamics after the Hartz IV reform in Germany. The effects are presented in percent deviations (percentage points if indicated) from the initial steady state at the beginning of 2005 (before the reform).

Labor Market: Figure 5 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 have worsened due to the reduced fall-back utility. Gradually, wages recover over time and are higher for high-skilled workers in the post-reform equilibrium.[34] 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 post-reform, as discussed by Spermann (2015).

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

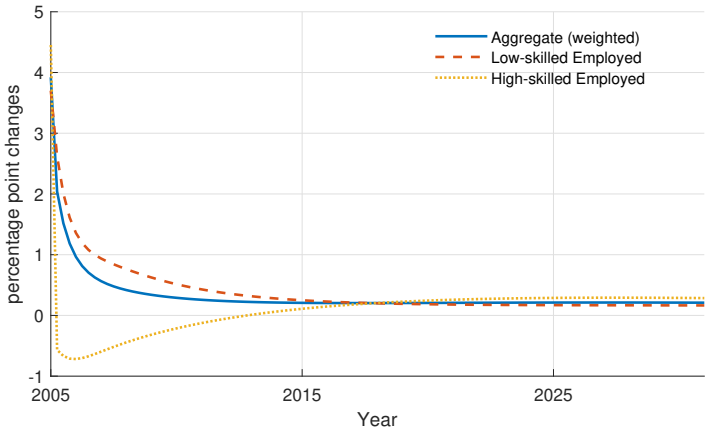
[34] Reassuringly, our short-run wage effect is quantitatively in line with causal microeconomic evidence of Price (2018), who rules out sizeable adverse wage effects caused by the Hartz IV reform.

Figure 5: Reform Effects on Labor Market Outcomes



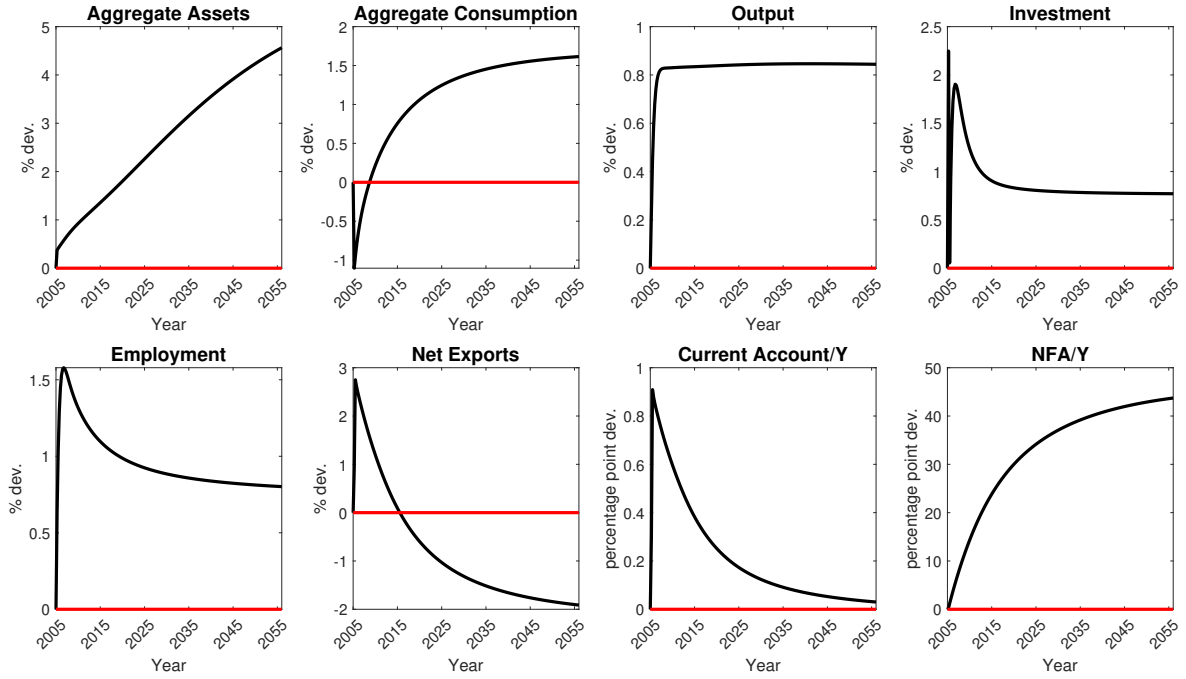
Notes: Model responses of labor market variables in percent deviations from the pre-reform steady state.

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.

Figure 7: Aggregate Reform Effects



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

0.8 percentage points in the first five years after the reform, which is our target and matches the empirical estimate presented in Table 2.

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 levels of self-insurance, as they are more likely to be near borrowing constraints, further amplifying their savings response.

In contrast, high-skilled workers see an initial decline in their savings rate. Improved labor market conditions reduce their need for precautionary savings, and their pre-reform wealth levels provide greater self-insurance, muting their overall response.

Aggregate Outcomes: Figure 7 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 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 enhance the incentive to accumulate precautionary savings. The latter effect dominates, leading to a significant increase in consumer 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,

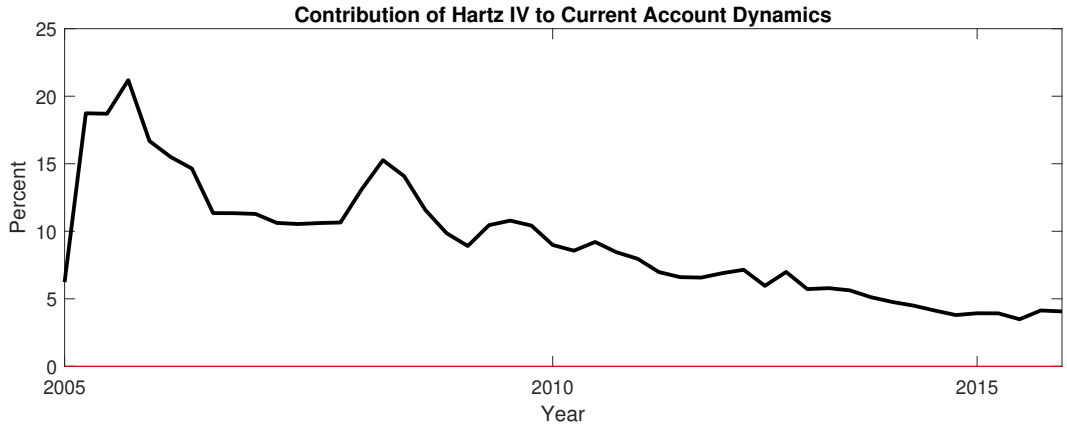
the reforming country's net foreign asset position and current account increase.
Lower wage income and the higher savings effort cause households to reduce their consumption temporarily. However, due to improved labor market conditions and rising wages, the initial dip in aggregate consumption is followed 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.[35]
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 post-reform, government bonds, and expenditures decrease as labor tax revenues rise and expenditures for unemployment benefits decline due to improved labor market conditions and reduced benefit generosity (see Figure 18 in Appendix C.3). These lower expenditures and debt levels also impact the current account through increased national savings.
The model's predictions align with empirical 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 19 and 20). 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 13 in Appendix A).

5.3 Contribution to Macroeconomic Aggregates & Robustness

This section 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.[36]
Figure 8 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 21% shortly after implementation and contributing to 13% 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 6 presents the reform's contributions to key macroeconomic indicators over five and ten years. In the baseline results (column one), the reform explains more than 40% of the unemployment decline by 2010 (five years post-reform), about 13% of Germany's current account surplus,

[35] Introducing investment adjustment costs would further enhance the impact on the current account by limiting the initial surge in investment, leading to a more pronounced increase in net foreign assets and a stronger current account response. We abstain from introducing such costs in our model to maintain a focus on the primary mechanisms of the reform (via savings) and to keep the model as straightforward and transparent as possible.
[36] This approach differs from standard DSGE variance decomposition, which accounts for all dynamics of the observed variables using multiple shocks.

Figure 8: 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.

Table 6: Reform Contribution to Empirical Time Series over 5 and 10 years with Robustness Checks

	Baseline		Anticipation		$\rho^{\tau} = 0.85$		$\chi^{b} = 0.03$	
	5 years	10 years	5 years	10 years	5 years	10 years	5 years	10 years
Unemployment	43.68	22.62	44.85	23.41	36.82	18.84	44.47	22.85
Current Account/GDP	13.04	10.25	10.99	9.30	8.75	6.75	12.75	9.76
Net Foreign Assets/GDP	49.71	63.89	37.68	54.00	33.35	42.60	48.88	62.04
Real Exchange Rate	24.53	13.78	22.39	12.85	17.68	9.98	24.16	13.50
Savings Rate	25.56	13.67	26.97	14.39	23.65	13.10	25.20	13.64

Notes: The unemployment effect is evaluated as of 2010. The "Baseline" column represents our standard model calibration. The "Anticipation" scenario assumes agents anticipated the reform four periods in advance, with contributions including this anticipation period. In the $\rho^{\tau} = 0.85$ scenario, the fiscal rule's persistence parameter is set to 0.85, adjusting the shock size to 24% to maintain the target increase in the aggregate savings rate. In the $\chi^{b} = 0.03$ scenario, the weight on government debt in the fiscal rule is 0.03, with the shock size increased to 28.5%.

50% of the net foreign asset increase, and 26% of real effective exchange rate changes.

Additionally, Table 6 compares the baseline scenario to several robustness checks: (i) allowing for anticipatory effects, (ii) adjusting the fiscal rule persistence to $\rho^{\tau} = 0.85$, and (iii) modifying the weight on government debt to $\chi^{b} = 0.03$.

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 ($\rho^{\tau} = 0.85$) reduces the short-run contributions 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 20), 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.

Another concern might be that the Hartz IV reform was part of a broader reform package, in-

cluding 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. 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.[37]

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.[38] 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.

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.[39]

Table 7 compares the performance of the heterogeneous agent (HA) and complete insurance (representative agent, RA) models in explaining key 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 9 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 key distinction arises from the absence of

[37] Detailed results on the effects of increased matching efficiency are available upon request.

[38] 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.

[39] 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.

Table 7: 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	43.68	22.62	23.69	15.12
Current Account/GDP	13.04	10.25	-4.11	-1.70
Net Foreign Assets/GDP	49.71	63.89	-22.89	-18.57
Real Exchange Rate	24.53	13.78	0.94	-0.38
Savings Rate	25.56	13.67	1.26	0.69

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.

a precautionary savings motive in the complete insurance model. In the HA setting, consumption declines in the short run as agents accumulate savings, reflecting a consumption-savings trade-off. In the RA model, savings decrease slightly following the reform due to improved labor market conditions (higher employment), 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.[40]

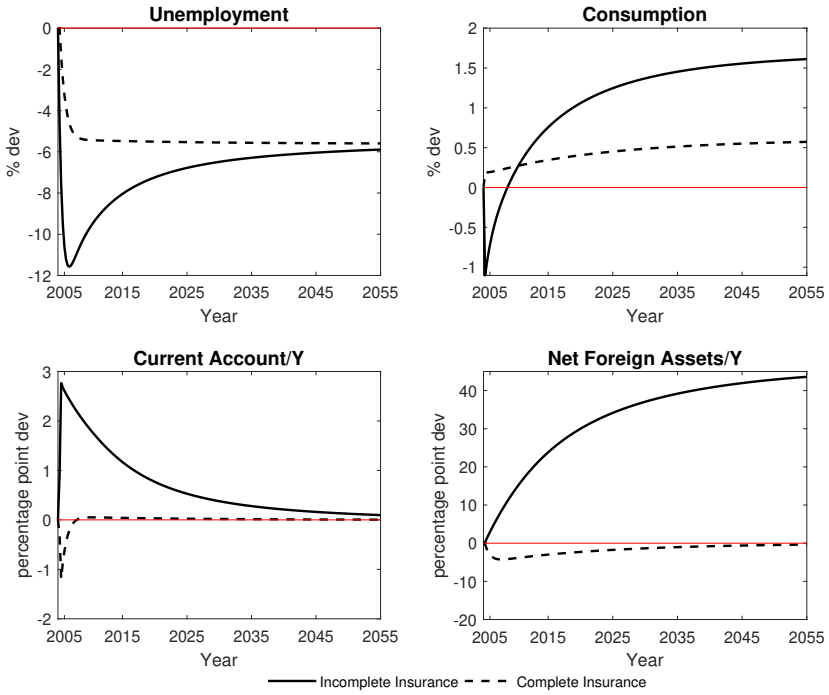
6.2 Redistributive Effects

Table 8 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.

The patterns for consumption inequality, measured by the coefficient of variation, show heterogeneity in the reform's effects. 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 reflects the compression in consumption levels following the reform, as their benefits decrease significantly. For high-skilled workers, improved labor market conditions and increased savings lead to greater dispersion in consumption levels, resulting in higher consumption variability.

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

Figure 9: 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.

Table 8: Change in Inequality by Employment Status and Skill Level

	Pre-Reform	Post-Reform	Percentage Change
Gini Coefficient			
Low-skilled Employed	0.80	0.74	-8.23
High-skilled Employed	0.40	0.40	-2.11
Low-skilled STU	0.77	0.72	-7.10
High-skilled STU	0.41	0.40	-2.17
Long-term Unemployed	0.82	0.79	-3.50
Coefficient of Variation for Consumption			
Low-skilled Employed	2.75	2.65	-3.75
High-skilled Employed	1.03	1.05	1.85
Low-skilled STU	2.43	2.25	-7.33
High-skilled STU	1.06	1.07	1.63
Long-term Unemployed	9.23	4.11	-55.53

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.

7 Welfare Analysis

This section explores the welfare implications of reduced unemployment benefits across several dimensions. First, we examine the welfare effects during the transition to the post-reform steady state. Next, we compare the stationary welfare effects, contrasting them with outcomes in a model with complete insurance. We then decompose the welfare effects into partial equilibrium, matching, and price effects as discussed by Mukoyama (2013). Finally, we assess the differences within a closed-economy framework.

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.[41]

7.1 Benchmark: Transitional vs. Steady State Effects

Table 9 illustrates the welfare effects of the labor market reform in terms of consumption equivalents by wealth quintiles, employment state, and skill group. The last column displays the welfare effects in the model with complete insurance.

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. Comparing welfare outcomes in the heterogeneous agent model to a representative agent model highlights the role of consumer heterogeneity (see Table 9). Under complete insurance, welfare effects are positive, as the representative agent benefits from improved job-finding rates without facing consumption drops (see Figure 9).

[41] 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.

Table 9: Welfare Effects: The Labor Market Reform in a Small Open Economy

	Incomplete Insurance							Complete Insurance
	Wealth Quintiles							
	1	2	3	4	5	Average	Whole Economy	Whole Economy
Effects along Transition								
Low-skilled Employed	-0.28	-0.23	-0.21	-0.01	0.39	-0.07		
High-skilled Employed	0.46	0.49	0.48	0.45	0.40	0.45		
ST Unemployed, low skilled	-1.08	-0.92	-0.78	-0.35	0.37	-0.55	-0.04	0.37
ST Unemployed, high skilled	0.19	0.55	0.64	0.67	0.65	0.54		
LT Unemployed	-4.26	-4.08	-3.37	-1.33	0.02	-2.61		
Steady State Effects								
Low-skilled Employed	-0.31	-0.27	-0.25	-0.08	0.30	-0.12		
High-skilled Employed	0.52	0.54	0.52	0.49	0.44	0.50		
ST Unemployed, low skilled	-1.55	-1.41	-1.26	-0.80	0.11	-0.98	-0.11	0.60
ST Unemployed, high skilled	-0.17	0.22	0.34	0.40	0.42	0.25		
LT Unemployed	-4.75	-4.59	-3.96	-1.86	-0.27	-3.09		

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 effects for the complete insurance case represent consumption equivalents in the representative agent framework discussed in Subsection 6.1.

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 price effect.[42] Figures 10 (for employed consumers) and 11 (for unemployed consumers) illustrate the results.

The *partial equilibrium effect*, represented by the blue dashed line in Figures 10 (for employed consumers) and 11 (for unemployed consumers), isolates the impact of changes in unemployment benefits and taxes.[43] 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.

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.

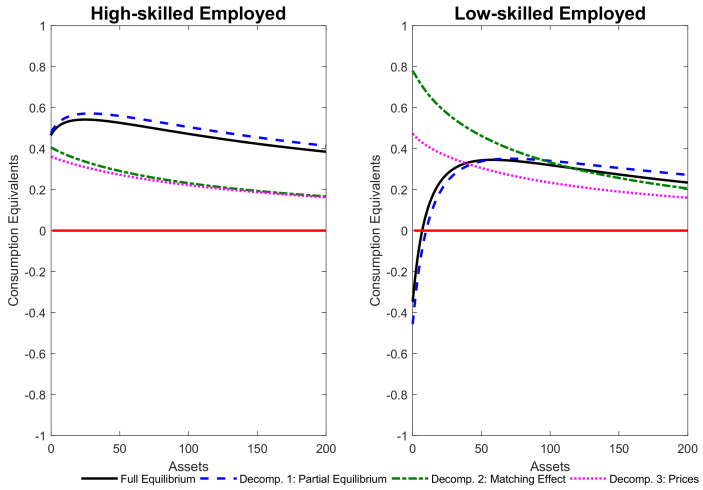
The *price effect*, shown by the magenta line, results from changes in wages and relative goods

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

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

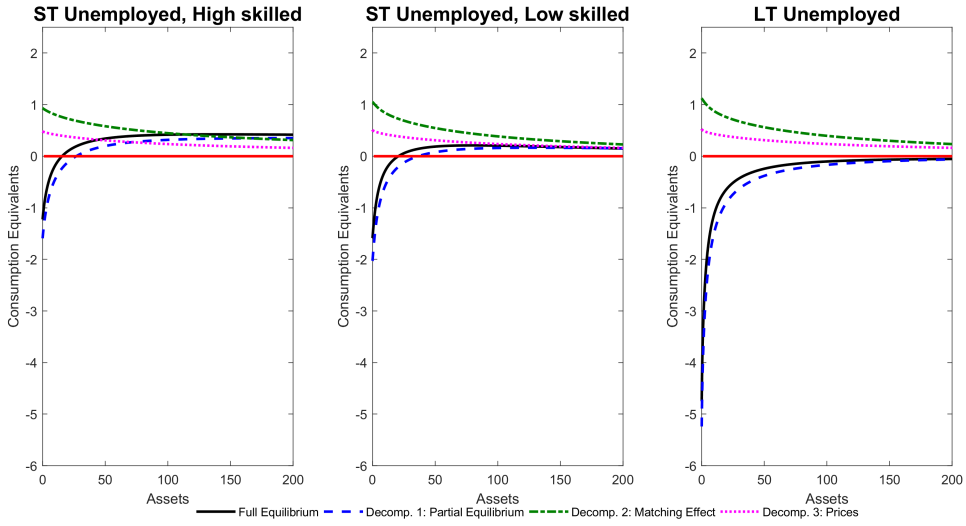
prices. A modest increase in wages for high-skilled workers and the decline in the real exchange rate lead to an overall rise in welfare, with the effect being most significant among asset-poor workers who rely heavily on labor income.

Figure 10: 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 11: 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).

7.3 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. Table 10 compares consumption equivalents along the transition path to the post-reform equilibrium and in the steady state.[44]

In both frameworks, the reduction in long-term unemployment benefits leads to increased demand for assets due to the precautionary savings motive. 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 22 in Appendix C.6). 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 welfare effects differ between the small open and closed economies. In the closed economy, the temporary rise in the interest rate and stronger labor market responses (see Figure 22) lead to slightly greater welfare gains and less severe welfare losses.

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.

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 markets 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, 13 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 key macroeconomic dynamics post-reform.

[44] Appendix C.6 illustrates the corresponding dynamic effects and welfare decompositions in steady state for the small-open vs. closed economy.

Table 10: 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	-0.28	-0.23	-0.21	-0.01	0.39	-0.07	
High-skilled Employed	0.46	0.49	0.48	0.45	0.40	0.45	
ST Unemployed, low skilled	-1.08	-0.92	-0.78	-0.35	0.37	-0.55	-0.04
ST Unemployed, high skilled	0.19	0.55	0.64	0.67	0.65	0.54	
LT Unemployed	-4.26	-4.08	-3.37	-1.33	0.02	-2.61	
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	-0.31	-0.27	-0.25	-0.08	0.30	-0.12	
High-skilled Employed	0.52	0.54	0.52	0.49	0.44	0.50	
ST Unemployed, low skilled	-1.55	-1.41	-1.26	-0.80	0.11	-0.98	-0.11
ST Unemployed, high skilled	-0.17	0.22	0.34	0.40	0.42	0.25	
LT Unemployed	-4.75	-4.59	-3.96	-1.86	-0.27	-3.09	
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.

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. We leave this for future research.

References

AGGARWAL, R., A. AUCLERT, M. ROGNLIE, AND L. STRAUB (2023): "Excess Savings and Twin Deficits: The Transmission of Fiscal Stimulus in Open Economies," *NBER Macroeconomics Annual*, 37, 325 – 412.

AIYAGARI, S. R. (1994): "Uninsured Idiosyncratic Risk and Aggregate Saving," *The Quarterly Journal of Economics*, 109, 659–684.

ANDOLFATTO, D. (1996): "Business Cycles and Labor-Market Search," *American Economic Review*, 86, 112–132.

AUCLERT, A., M. ROGNLIE, M. SOUCHIER, AND L. STRAUB (2021): "Exchange Rates and Monetary Policy with Heterogeneous Agents: Sizing up the Real Income Channel," Working Paper 28872, National Bureau of Economic Research.

AUCLERT, A., M. ROGNLIE, AND L. STRAUB (2018): "The Intertemporal Keynesian Cross," Working Paper 25020, National Bureau of Economic Research.

BAYER, C., A. KRIWOLUZKY, G. MÜLLER, AND F. SEYRICH (2023): "A HANK2 Model of Monetary Unions," CEPR Discussion Paper 18258, CEPR.

BAYER, C., R. LUETTICKE, L. PHAM-DAO, AND V. TJADEN (2019): "Precautionary Savings, Illiquid Assets, and the Aggregate Consequences of Shocks to Household Income Risk," *Econometrica*, 87, 255–290.

BEHRINGER, J. AND T. VAN TREECK (2018): "Income Distribution and the Current Account," *Journal of International Economics*, 114, 238–254.

BERGER, H. AND V. NITSCH (2010): "The Euro's Effect on Trade Imbalances," IMF Working Paper WP/10/226, International Monetary Fund.

BERTOLA, G. AND A. LO PRETE (2015): "Reforms, Finance, and Current Accounts," *Review of International Economics*, 23, 469–488.

BURDETT, K., C. CARRILLO-TUDELA, AND M. COLES (2020): "The Cost of Job Loss," *Review of Economic Studies*, 87, 1757–1798.

CABALLERO, R. J., E. FARHI, AND P.-O. GOURINCHAS (2008): "An Equilibrium Model of Global Imbalances and Low Interest Rates," *American Economic Review*, 98, 358–93.

CACCIATORE, M., R. DUVAL, G. FIORI, AND F. GHIRONI (2016): "Market Reforms in the Time of Imbalance," *Journal of Economic Dynamics and Control*, 72, 69–93.

CARROLL, C., J. SLACALEK, K. TOKUOKA, AND M. N. WHITE (2017): "The Distribution of Wealth and the Marginal Propensity to Consume," *Quantitative Economics*, 8, 977–1020.

CARROLL, C. D. AND O. JEANNE (2009): "A Tractable Model of Precautionary Reserves, Net Foreign Assets, or Sovereign Wealth Funds," Working Paper 15228, National Bureau of Economic Research.

CHALLE, E., J. MATHERON, X. RAGOT, AND J. F. RUBIO-RAMIREZ (2017): "Precautionary Saving and Aggregate Demand," *Quantitative Economics*, 8, 435–478.

CHALLE, E. AND X. RAGOT (2016): "Precautionary Saving Over the Business Cycle," *The Economic Journal*, 126, 135–164.

CHRISTOFFEL, K., K. KUESTER, AND T. LINZERT (2009): "The Role of Labor Markets for Euro Area Monetary Policy," *European Economic Review*, 53, 908–936.

DE FERRA, S., K. MITMAN, AND F. ROMEI (2020): "Household heterogeneity and the transmission of foreign shocks," *Journal of International Economics*, 124, 103303.

DE FERRA, S., K. MITMAN, AND F. ROMEI (2021): "Why Does Capital Flow from Equal to Unequal Countries?" Tech. Rep. DP15647, CEPR Discussion Paper No. 15647, Paris & London.

DÁVILA, J., J. H. HONG, P. KRUSELL, AND J.-V. RÍOS-RULL (2012): "Constrained Efficiency in the Neoclassical Growth Model With Uninsurable Idiosyncratic Shocks," *Econometrica*, 80, 2431–2467.

ELGUTH, P. AND S. KOHAUT (2005): "Tarifbindung und betriebliche Interessenvertretung. Aktuelle

Ergebnisse aus dem IAB-Betriebspanel," *WSI-Mitteilungen*, 58, 398–403.

FEENSTRA, R. C., P. LUCK, M. OBSTFELD, AND K. N. RUSS (2018): "In Search of the Armington Elasticity," *The Review of Economics and Statistics*, 100, 135–150.

FERNANDES, A. AND R. RIGATO (2024): "Precautionary Savings and Stabilization Policy in a Present-Biased Economy," Tech. rep., Harvard University and European Central Bank, working Paper.

GADATSCH, N., N. STÄHLER, AND B. WEIGERT (2016): "German Labor Market and Fiscal Reforms 1999–2008: Can they be blamed for Intra-Euro Area Imbalances?" *Journal of Macroeconomics*, 50, 307–324.

GALI, J. AND T. MONACELLI (2005): "Monetary Policy and Exchange Rate Volatility in a Small Open Economy," *The Review of Economic Studies*, 72, 707–734.

GOEBEL, J., M. M. GRABKA, S. LIEBIG, M. KROH, D. RICHTER, C. SCHRÖDER, AND J. SCHUPP (2018): "The German Socio-Economic Panel (SOEP)," *Jahrbücher für Nationalökonomie und Statistik, Journal of Economics and Statistics*, 238.

GUO, X., P. OTTONELLO, AND D. J. PEREZ (2020): "Monetary Policy and Redistribution in Open Economies," NBER Working Papers 28213, National Bureau of Economic Research, Inc.

HARTUNG, B., P. JUNG, AND M. KUHN (2018): "What Hides behind the German Labor Market Miracle? Unemployment Insurance Reforms and Labor Market Dynamics," IZA Discussion Paper 12001, IZA.

HEATHCOTE, J. AND F. PERRI (2018): "Wealth and Volatility," *The Review of Economic Studies*, 85, 2173–2213.

HOCHMUTH, B., B. KOHLBRECHER, C. MERKL, AND H. GARTNER (2021): "Hartz IV and the Decline of German Unemployment: A Macroeconomic Evaluation," *Journal of Economic Dynamics and Control*, 127, 104114.

HOCHMUTH, B., C. MERKL, AND H. STÜBER (2024): "Incomplete insurance and open-economy spillovers of labor market reforms," FAU Discussion Papers in Economics 03/2024, Friedrich-Alexander University Erlangen-Nuremberg, Institute for Economics.

HOFFMANN, M., M. U. KRAUSE, AND P. TILLMANN (2019): "International Capital Flows, External Assets and Output Volatility," *Journal of International Economics*, 117, 242–255.

HOSIOS, A. (1990): "On The Efficiency of Matching and Related Models of Search and Unemployment," *Review of Economic Studies*, 57, 279–298.

HUNNEKES, F., M. KONRADT, M. SCHULARICK, C. TREBESCH, AND J. WINGENBACH (forthcoming): "Exportweltmeister: Germany's Foreign Investment Returns in International Comparison," *Journal of International Economics*.

HUNT, B. AND A. REBUCCI (2005): "The US Dollar and the Trade Deficit: What Accounts for the Late 1990s?" *International Finance*, 8, 399–434.

INTERNATIONAL MONETARY FUND (2020): "External Sector Report: Global Imbalances and the COVID-19 Crisis." .

JACOBI, L. AND J. KLUVE (2006): "Before and After the Hartz Reforms: The Performance of Active Labour Market Policy in Germany," Tech. rep., IZA Discussion Paper No. 2100.

JAROSCH, G. (2023): "Searching for Job Security and the Consequences of Job Loss," *Econometrica*, 91, 903–942.

JAUMOTTE, M. F. AND P. SODSRIWIBOON (2010): "Current Account Imbalances in the Southern Euro Area," IMF Working Papers 2010/139, International Monetary Fund.

KENNEDY, M. AND T. SLOK (2005): "Are Structural Reforms the Answer to Global Current Account Imbalances?" *OECD Economic Studies*, 2005, 47–73.

KIRSANOVA, T. AND S. WREN-LEWIS (2012): "Optimal Fiscal Feedback on Debt in an Economy with Nominal Rigidities," *The Economic Journal*, 122, 238–264.

KOLLMANN, R., M. RATTO, W. ROEGER, J. IN 'T VELD, AND L. VOGEL (2015): "What drives the German Current Account? And how does it affect other EU Member States?" *Economic Policy*, 30,

47–93.

KRAUSE, M. AND H. UHLIG (2012): "Transitions in the German Labor Market: Structure and Crisis," *Journal of Monetary Economics*, 59, 64–79.

KREBS, T. AND M. SCHEFFEL (2013): "Macroeconomic Evaluation of Labor Market Reform in Germany," *IMF Economic Review*, 61, 664–701.

KRUEGER, D., K. MITMAN, AND F. PERRI (2016a): "Macroeconomics and Household Heterogeneity," in *Handbook of Macroeconomics*, ed. by J. B. Taylor and H. Uhlig, Elsevier, vol. 2 of *Handbook of Macroeconomics*, 843–921.

——— (2016b): "On the Distribution of the Welfare Losses of Large Recessions," Staff Report 532, Federal Reserve Bank of Minneapolis.

KRUSELL, P., T. MUKOYAMA, AND A. ŞAHIN (2010): "Labour-Market Matching with Precautionary Savings and Aggregate Fluctuations," *The Review of Economic Studies*, 77, 1477–1507.

LAUNOV, A. AND K. WÄLDE (2013): "Estimating Incentive and Welfare Effects of Nonstationary Unemployment Benefits." *International Economic Review*, 54, 1159–1198.

LJUNGQVIST, L. AND T. J. SARGENT (2007): "Understanding European unemployment with matching and search-island models," *Journal of Monetary Economics*, 54, 2139–2179.

MCKAY, A. (2017): "Time-Varying Idiosyncratic Risk and Aggregate Consumption Dynamics," *Journal of Monetary Economics*, 88, 1–14.

MCKAY, A., E. NAKAMURA, AND J. STEINSSON (2017): "The Discounted Euler Equation: A Note," *Economica*, 84, 820–831.

MCKAY, A. AND R. REIS (2016): "The Role of Automatic Stabilizers in the U.S. Business Cycle," *Econometrica*, 84, 141–194.

MENDOZA, E., V. QUADRINI, AND J. RIOS-RULL (2009): "Financial Integration, Financial Development, and Global Imbalances," *Journal of Political Economy*, 117, 371–416.

MERZ, M. (1995): "Search in the Labor Market and the Real Business Cycle," *Journal of Monetary Economics*, 36, 269–300.

MOYEN, S. AND N. STÄHLER (2014): "Unemployment Insurance And The Business Cycle: Should Benefit Entitlement Duration React To The Cycle?" *Macroeconomic Dynamics*, 18, 497–525.

MUKOYAMA, T. (2013): "Understanding the Welfare Effects of Unemployment Insurance Policy in General Equilibrium," *Journal of Macroeconomics*, 38, 347–368.

NAKAJIMA, M. (2012): "A Quantitative Analysis of Unemployment Benefit Extensions," *Journal of Monetary Economics*, 59, 686–702.

OBSTFELD, M. AND K. ROGOFF (1995): "The Intertemporal Approach to the Current Account," in *Handbook of International Economics*, ed. by G. M. Grossman and K. Rogoff, Elsevier, vol. 3, chap. 34, 1731–1799, 1 ed.

OSKOLKOV, A. (2021): "Exchange Rate Policy and Heterogeneity in Small Open Economies," *ERN: Other Macroeconomics: Consumption*.

OSWALD, A. J. (1993): "Efficient Contracts are on the Labour Demand Curve : Theory and facts," *Labour Economics*, 1, 85–113.

PISSARIDES, C. A. (2000): *Equilibrium Unemployment Theory, 2nd Edition*, vol. 1 of *MIT Press Books*, The MIT Press.

PRICE, B. (2018): "The Duration and Wage Effects of Long-Term Unemployment Benefits: Evidence from Germany's Hartz IV Reform," UC Davis, mimeo.

RAVN, M. O. AND V. STERK (2017): "Job Uncertainty and Deep Recessions," *Journal of Monetary Economics*, 90, 125–141.

RUPPERT, K. AND N. STÄHLER (2020): "Household Savings, Capital Investments and Public Policies: What Drives the German Current Account?" Discussion Papers 41/2020, Deutsche Bundesbank.

SCHMITT-GROHE, S. AND M. URIBE (2003): "Closing Small Open Economy Models," *Journal of International Economics*, 61, 163–185.

——— (2007): "Optimal Simple and Implementable Monetary and Fiscal Rules," *Journal of Monetary Economics*, 54, 1702–1725.

SPERMANN, A. (2015): "How to fight long-term unemployment: lessons from Germany," *IZA Journal of Labor Policy*, 4, 15.

STEIN, U. (2009): "Zur Entwicklung der Sparquoten der Privaten Haushalte: eine Auswertung von Haushaltsdaten des SOEP," SOEP-papers on Multidisciplinary Panel Data Research 249, DIW Berlin, The German Socio-Economic Panel (SOEP).

THE ECONOMIST (2017a): "The Good and Bad in Germany's Economic Model are Strongly Linked," July 8th 2017.

——— (2017b): "Why Germany's Current-Account Surplus is Bad for the World Economy," July 8th 2017.

THE GUARDIAN (2017): "The German Economy is Unbalanced – but Trump has the Wrong Answer," May, 12th 2017.

ZHOU, H. (2022): "Open Economy, Redistribution, and the Aggregate Impact of External Shocks," Tech. rep., Princeton University, available at SSRN.

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 12 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 imbalances 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 imbalances have been subject to worldwide criticism (see, for example, Eichengreen's comment in The Guardian, 2017, and The Economist, 2017b).

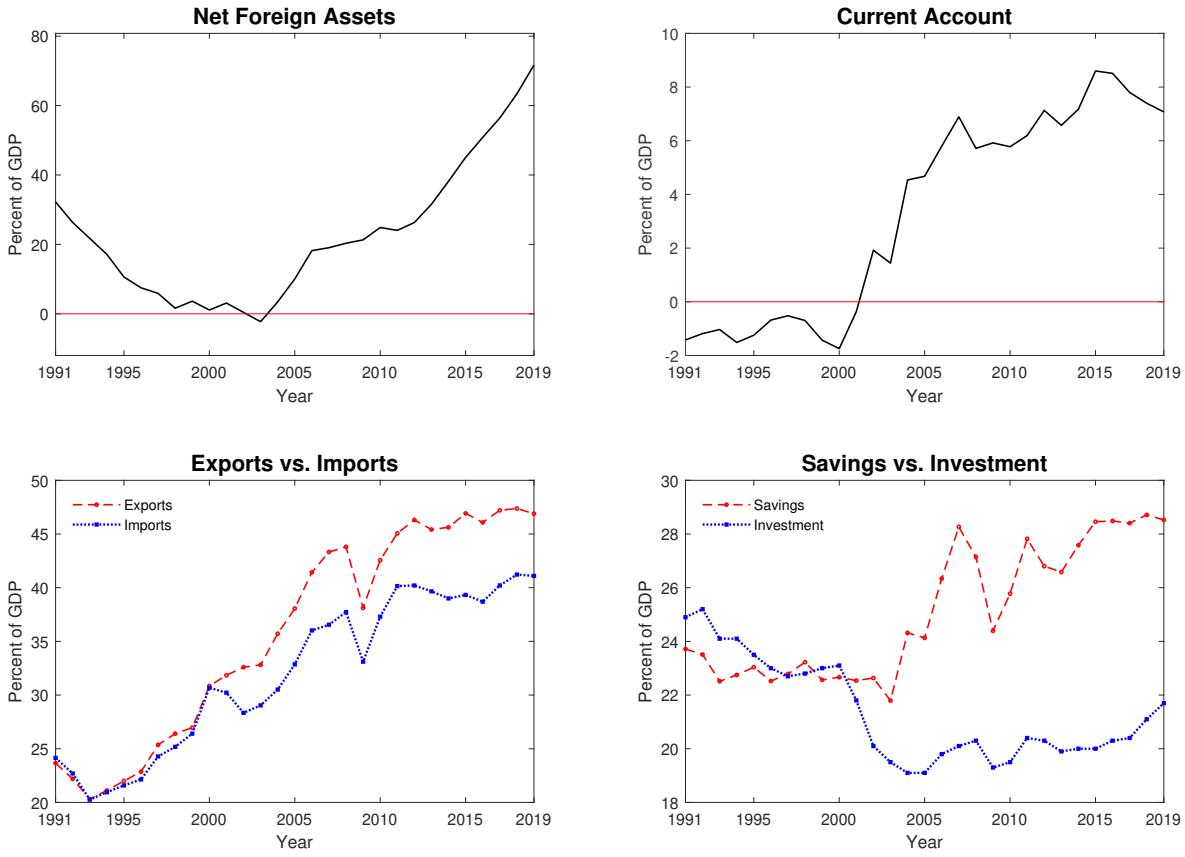
Figure 13 illustrates the components of the German current account as a percentage of GDP from 1991 to 2019. It breaks down the current account into contributions from financial corporations (in blue), the government (in red), private households (in yellow), and non-financial corporations (in purple). 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 exhibit smaller or negative contributions.

A.2 The Hartz Reforms

Germany's bad 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 11 provides an overview of the key changes of the corresponding reforms.

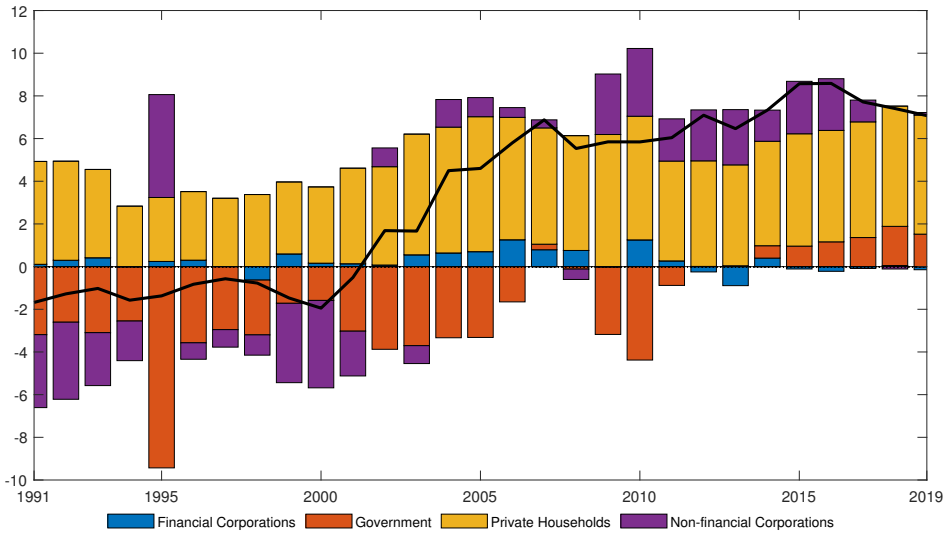
In 2005, the farest-reaching and most discussed Hartz IV reform was implemented to reduce workers' reservation wages and increase labor supply. Before Hartz IV, short-term unemployed workers were entitled to unemployment benefits of 60 percent of their net previous salary (*"Ar-*

Figure 12: 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: German National Statistical Office (2021) and Bundesbank (2021).

Figure 13: Components of the German Current Account



Notes: Values are in percent of GDP. Data source: The World Bank Data (2021).

beitslosengeld"). Short-term unemployment benefits expired after three years on average. Unemployed workers were then considered long-term unemployed and received a less generous unemployment benefit (*"Arbeitslosenhilfe"*) amounting to 53 percent of their previously earned net wage. The replacement rates for unemployed workers with children were 67 and 57 percent, respectively. 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 the purely means-tested *"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 11: Overview of the Hartz Reforms

Hartz Reform	**Implementation Date**	**Key Changes**
Hartz I	2003	Facilitated temporary employment and introduced training vouchers.
Hartz II	2003	Introduced new marginal employment types and start-up subsidies.
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 strict eligibility and 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) has 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, IAB PASS data shows that only 12 percent of households receiving short-term unemployment benefits (ALG I) have savings exceeding 10,000 Euros. Approximately 10 percent of long-term unemployment benefits (ALG II) applicants had to deplete their savings to meet eligibility requirements, with 60 percent qualifying for assistance after three months. This suggests that the eligibility criteria do not significantly distort the savings incentives for most households.

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 1994 to 2014. The SOEP is a comprehensive longitudinal survey that includes approximately 11,000 private households, with data collection starting in 1984. 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 Removing Business Cycle Effects

To determine whether the observed trend reversal in the private savings rate of employed workers, as shown in Figure 2, is influenced by business cycle fluctuations, we regressed the private savings rate on a constant and German GDP growth. The residual from this regression—representing the savings rate adjusted for business cycle effects—is presented in Figure 14. The residuals indicate a similar trend reversal around 2005, coinciding with the implementation of the reform. This suggests that the increase in the private savings rate among employed workers is not attributable to business cycle factors but instead points to underlying structural changes.

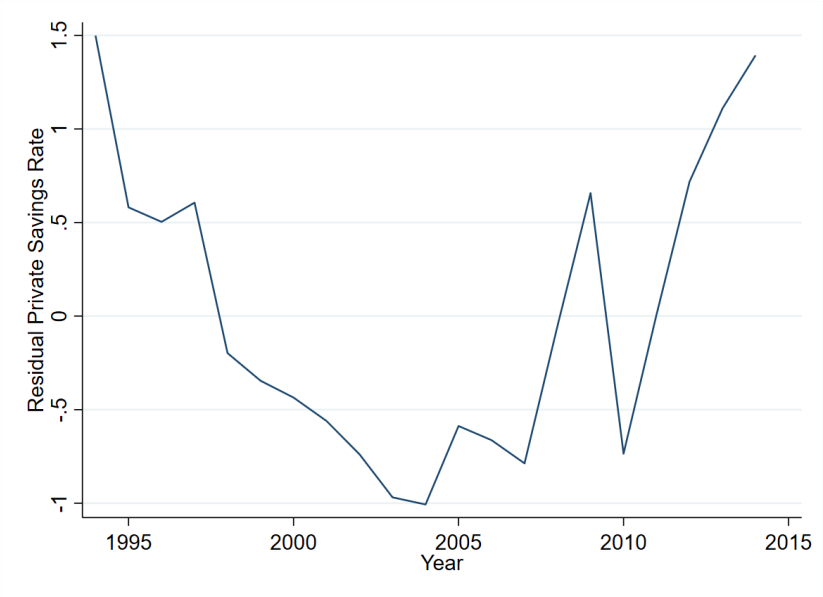
B.1.2 Saving Rates by Educational Groups

Figure 15 highlights the variation in saving rates across different educational groups. Before the reform, highly educated workers (defined as those with more than 13 years of education) exhibited a savings rate over 24 percent higher than that of low-educated workers. Around 2005, a trend reversal in the savings rate is observed for both groups. In the first three years following the reform, low-educated workers increased their savings rate by nearly two percentage points. However, this gain diminished during the Great Recession, indicating a greater sensitivity to business cycle fluctuations. In contrast, the savings rate for highly educated workers rose more gradually initially, with a significant acceleration around 2010.

B.1.3 Effect on Saving Rates: No Unemployment Risk

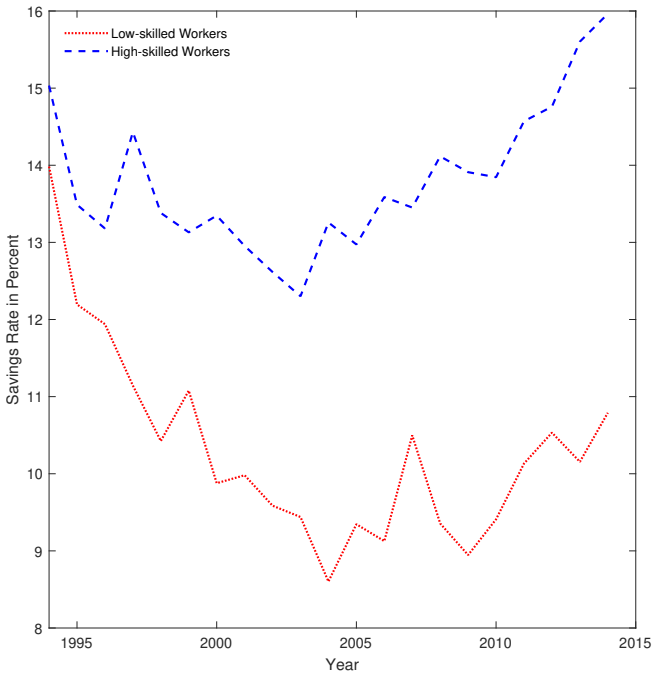
To further validate our micro-level estimations of the incremental effects on savings rates among workers most affected by the reform, we also examine the savings behavior of civil servants. In Germany, civil servants face minimal unemployment risk, as their employment contracts can

Figure 14: Controlling for Business Cycle Effects: Residual Private Savings Rate



Source: German Socioeconomic Panel and Destatis, 1994-2014. The residual private savings rate for employed workers is the private savings rate adjusted for business cycle effects, as measured by GDP growth.

Figure 15: Private Savings Rates by Educational Group, 1994-2014



Notes: The private savings rate for employed workers is calculated using household-level survey data from the German Socioeconomic Panel (SOEP). Low-educated workers are defined as those with up to 13 years of education, while highly-educated workers have more than 13 years of education. Workers with less than 10 years of education are excluded from the analysis due to their negligible savings rates.

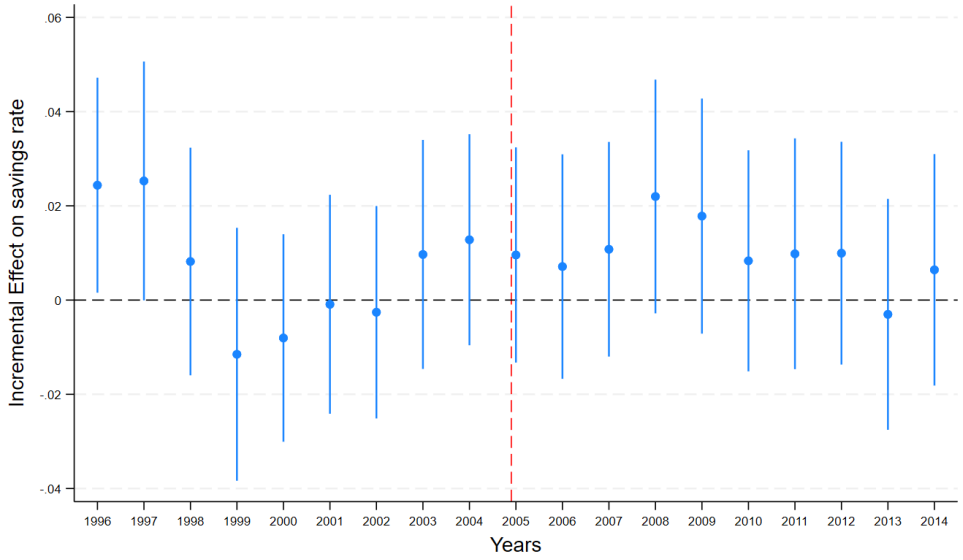
only be terminated under exceptional circumstances.[45] Therefore, we would not expect any sig-

[45] 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.

nificant change in the savings behavior of civil servants within the same age and employment duration group following the labor market reform.

As shown in Figure 16, there is no notable change in the savings rates of civil servants after 2005. This stability in savings behavior supports the robustness of our findings, suggesting that the observed changes in savings rates among the broader workforce are driven by the reform and its associated unemployment risk rather than other factors.

Figure 16: 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.

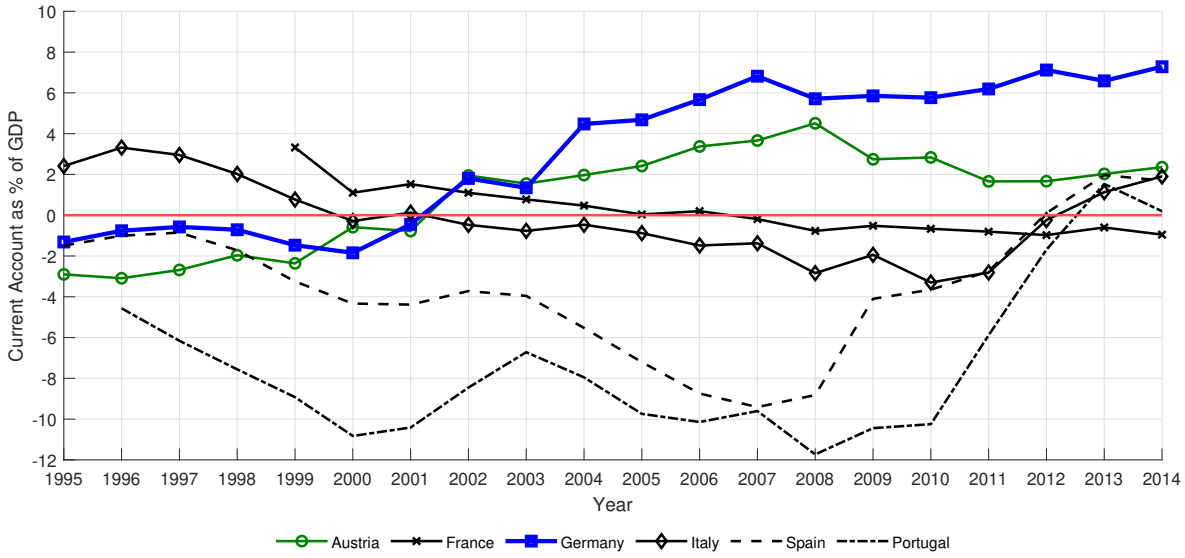
B.2 Cross-Country Evidence: Current Account Movements in European Countries

Figure 17 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, shared 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.

Other major Eurozone economies exhibited diverse current account trends. Southern European countries such as Spain, Italy, and Portugal consistently faced deficits, reflecting structural imbalances that persisted even after Germany's reforms. France's balance remained relatively sta-

Figure 17: 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).

ble, 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, in contrast to Germany's rising savings and surpluses.

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

In this section, we analyze the impact of the German Hartz IV reform on the current account-to-GDP ratio using a comprehensive time series model. Table 12 presents the results of this analysis, with models incorporating various macroeconomic variables 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 models also account for potential persistence in the current account by including a lag of the dependent variable.

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 result is consistent even when varying the time frame and 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, revealing 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 12: 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				0.86
				(0.990)
Dummy 2005-09				**2.807** **
				(1.219)
Dummy 2010-14				1.681
				(1.093)
Constant	-49.627***	0.632***	-59.038***	-53.869***
	(11.713)	(0.064)	(16.263)	(11.036)
Observations	84	84	63	84
$R\hat{2}$	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 Funds' 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, to maximize the present value of future returns. The problem is formulated as:

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

This is subject to the law of motion for capital:

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

where r^k is the return on capital, r_G is the return on government bonds, r_{NFA} is the return on net foreign assets, and r is 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 new equity purchased in period t. The pricing kernel is denoted as $m_{0,t}$.

First-Order Conditions (FOCs)

The first-order conditions for each asset class are:

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

No-Arbitrage Condition We assume no arbitrage, so all assets must yield the same rate of return (all are riskless). Note that there is no aggregate risk. The following relationship holds:

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

Thus, the equity price can be expressed as:

$$p_t = \frac{d_{t+1} + p_{t+1}}{1 + r - \delta}.$$

Asset Market Clearing Condition

The asset market clearing condition ensures that the aggregate supply of assets in the economy matches the demand. The condition is given by:

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

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:

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

Next, we plug in for the equity price p_t

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

Rearrange slightly and see that p_t cancels out.

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

Now, we plug in the condition for firm profits:

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

Cancel labor income, but labor tax revenue remains:

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

Let's use the definition for aggregate output, $Y_t = z_t F(\tilde{k}_t) N_t$ and rearrange:

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

Rewriting gives:

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

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

$$\frac{p_t^H}{P_t} Y_t = C_t + \underbrace{NFA_{t+1} - (1 + r - \delta) NFA_t}_{NX_t} + \underbrace{\frac{p_{H,t+1}}{P_{t+1}} k_{t+1} - \frac{p_t^H}{P_t} (1 - \delta) k_t}_{\frac{p_t^H}{P_t} I_t} - \frac{p_t^H}{P_t} r k_t \tag{C.10}$$
$$+ \underbrace{b_{t+1} - (1 + r - \delta) b_t - \tau_t^w w_t N_t - \tau_t - \kappa_t^{BS,H} U_t^{S,H} - \kappa_t^{BS,L} U_t^{S,L} - \kappa_t^{BL} U_t^L}_{\text{GV BC}} + \frac{p_t^H}{P_t} r k_t + \kappa^v V_t$$

Thus,

$$\frac{p_t^H}{P_t} Y_t = C_t + \frac{p_t^H}{P_t} I_t + NX_t + \kappa^v V_t \tag{C.11}$$

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

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

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

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

Let's factor out the price ratio:

$$\frac{p_t^H}{P_t} Y_t = \frac{p_t^H}{P_t}(c_{H,t} + c_{H,t}^* + I_t) + \kappa^v V_t \tag{C.14}$$

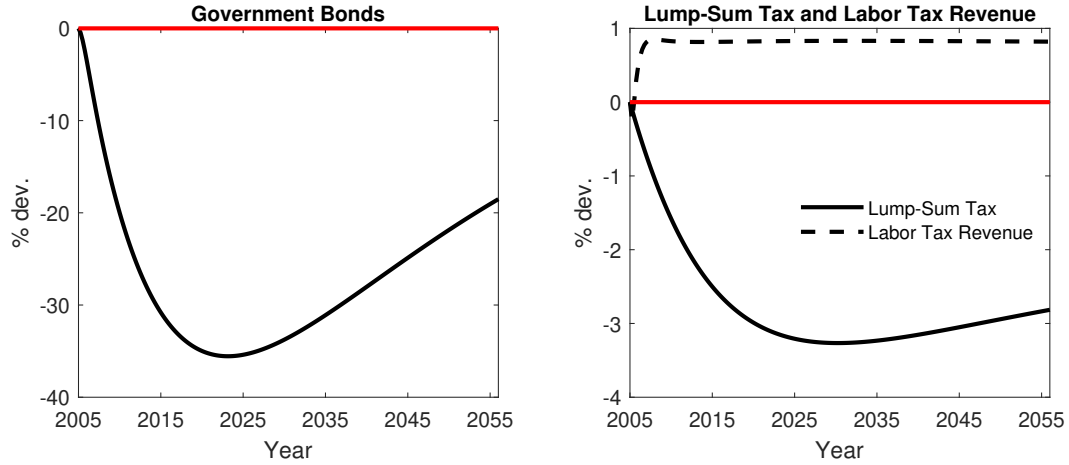
Finally, we multiply by the inverse of the price ratio and get

$$Y_t = c_{H,t} + c_{H,t}^* + I_t + \frac{P_t}{p_t^H}\kappa^v V_t \tag{C.15}$$

C.3 The Government Sector

Figure 18 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.

Figure 18: Model Responses: The Government Sector



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

The model's predictions are consistent with empirical data. Figure 19 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.

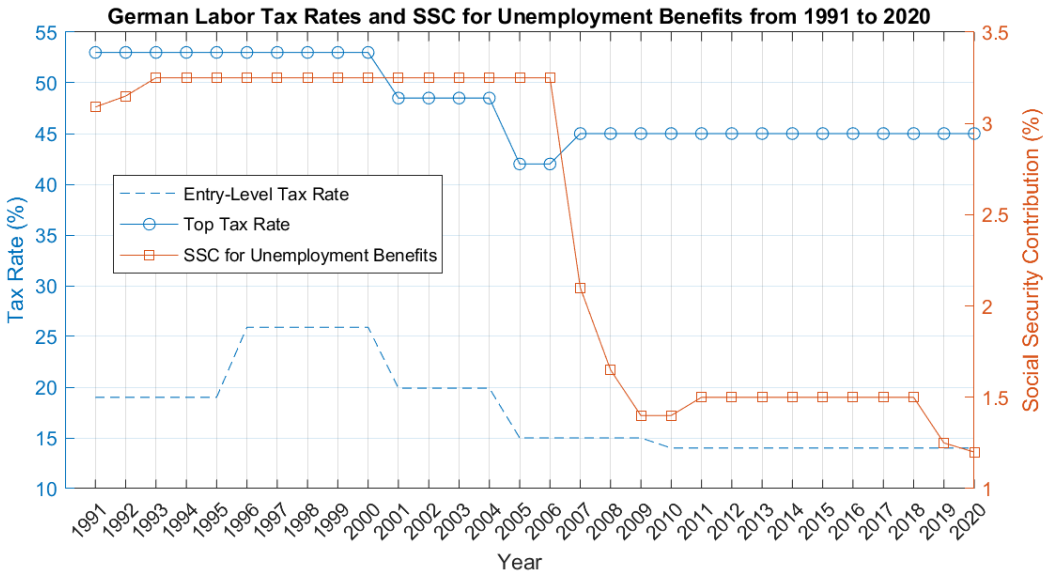
Figure 20 further supports the model's predictions, showing the evolution of German labor tax rates and social security contributions (SSC) for unemployment benefits from 1991 to 2020. The data indicate a significant decrease in the top tax rate and SSC after 2005, reducing the financial burden on workers.

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 5.2.

Figure 19: 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 20: 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.

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.

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. 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. We set $\psi = 0.00074$ for

the simulation, following Schmitt-Grohe and Uribe (2003).[46]

Wage Setting The marginal values in the Nash bargaining game (equation 3.25) differ between the heterogeneous agent and representative agent versions. In the heterogeneous agent model, we include the utility of average consumption for each worker type. In the representative agent model, however, consumption levels are identical across workers. As a result, wages and unemployment benefits replace worker-specific consumption levels in determining the bargaining outcomes.

The marginal values of working for a low-skilled consumer is

$$\mathscr{W}_t^{E,L} = U(w_t^{E,L}) + \beta\, E_t\left[(1-s^L)(1-\pi^E)\mathscr{W}_{t+1}^{E,L} + (1-s^L)\pi^E\mathscr{W}_{t+1}^{E,H} + s^L\mathscr{W}_{t+1}^{S,L}\right], \tag{C.16}$$

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

$$\mathscr{W}_t^{E,H} = U(w_t^{E,H}) + \beta\, E_t\left[(1-s^H)\mathscr{W}_{t+1}^{E,H} + s^H\mathscr{W}_{t+1}^{S,H}\right]. \tag{C.17}$$

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

$$\mathscr{W}_t^{S,j} = U(\kappa_t^{S,j}) + \beta\, E_t\left[\lambda_t^w\mathscr{W}_{t+1}^{E,L} + (1-\lambda_t^w)(1-\pi_L)\mathscr{W}_{t+1}^{S,j} + (1-\lambda_t^w)\pi_L\mathscr{W}_{t+1}^{L}\right]. \tag{C.18}$$

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

$$\mathscr{W}_t^{L} = U(\kappa_t^{L}) + \beta\, E_t\left[\lambda_t^w\mathscr{W}_{t+1}^{E,L} + (1-\lambda_t^w)\mathscr{W}_{t+1}^{L}\right]. \tag{C.19}$$

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.

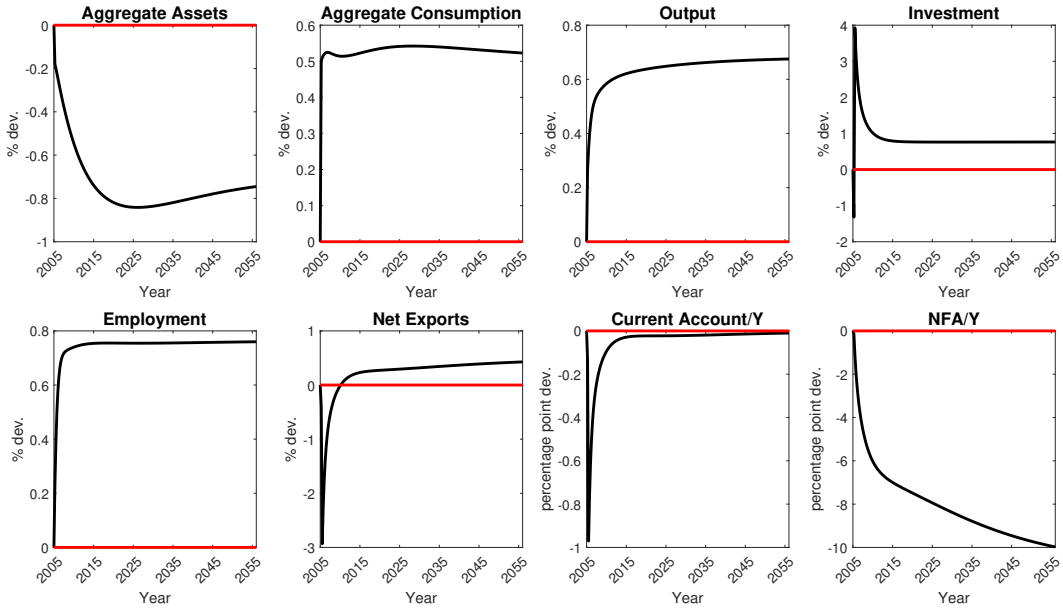
[46] Note that this prevents long-run effects on the NFA position by construction.

C.5 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 section examines the effects of tThe 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 7.4 percent, which generates the same steady state decline in unemployment. Figure 21 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. This is because any simultaneous expansionary impacts of other reforms, like Hartz III, would likely have dampened the overall increase in savings. As 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 21: 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 7.4 percent increase in matching efficiency.

Table 13: Long-run Effects of Hartz IV vs. Hartz III

	Hartz IV Reform	Hartz III Reform
Prices		
Wage, Low-skilled	-0.02	-0.02
Wage, High-skilled	0.08	-0.03
Price of home good	0.19	-0.24
CPI	0.13	-0.16
Real Exchange Rate	-0.19	0.24
Labor Market		
Market Tightness	13.95	-1.19
Vacancies	7.56	-6.74
Unemployment	-5.61	-5.61
Job-finding rate	6.75	6.76
Job-filling rate	-6.32	8.05
Low-skilled Short-term unemployed	-11.51	-3.25
High-skilled Short-term unemployed	-11.51	-3.25
Long-term unemployed	8.32	-11.18
Employment	0.76	0.77
Aggregates		
Consumption	1.67	0.50
Aggregate Assets	6.11	-0.74
Output	0.76	0.77
Investment	0.76	0.77
Exports	-0.50	0.65
Imports	2.04	0.03
Net foreign assets/Y	45.57	-11.07

Notes: Hartz IV reform refers to our baseline reform. The Hartz III reform corresponds to an increase in matching efficiency by 7.4 percent (without changes in the replacement rate or entitlement duration); effects are in % dev. from steady state.

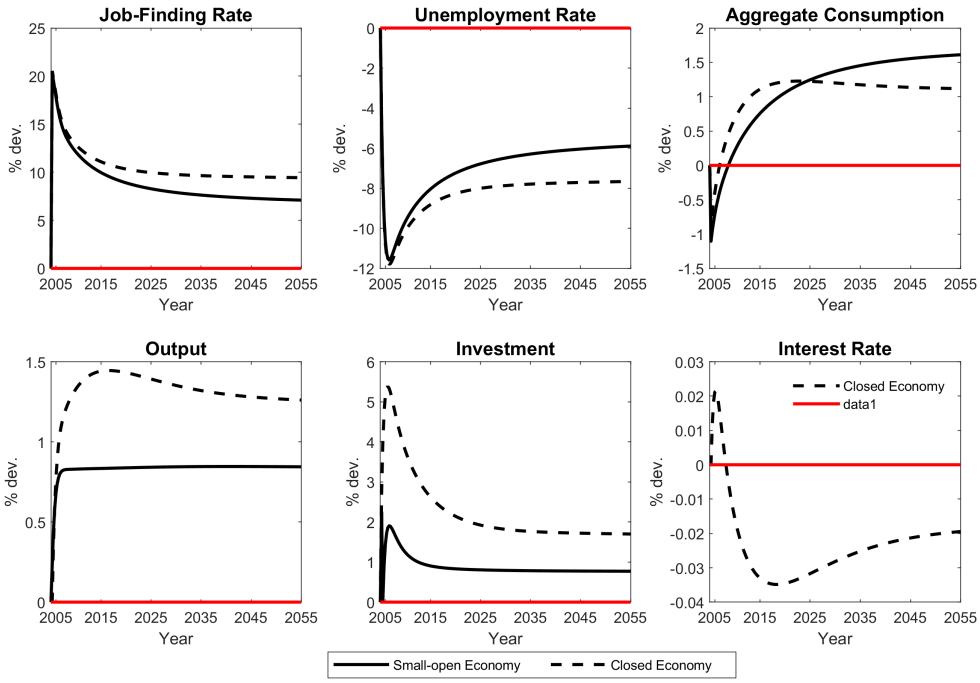
C.6 Small open vs. Closed Economy

Figure 22 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 smaller 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 greater capital formation, leading to a more pronounced increase in investment and a higher rise in output than in the small open economy.

Figures 23 compares 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) across different asset levels. In the closed economy, the new steady-state features a lower endogenous interest rate, which affects the returns on savings. As a result, for both high-skilled and low-skilled workers, welfare decreases more sharply in the closed economy as asset holdings increase. This is because the lower interest rate diminishes the benefits of accumulating assets. The lower returns on savings in the closed economy thus exacerbate welfare losses, particularly for workers with higher asset holdings.

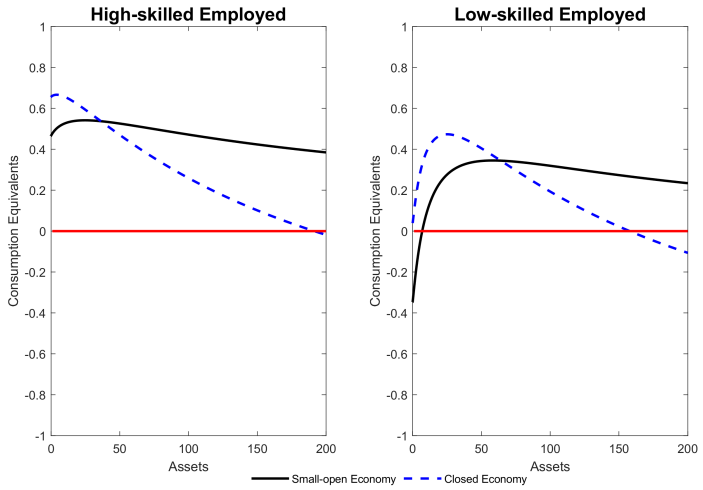
Figures 24 illustrates the differences in welfare effects for unemployed worker. The welfare effects are more similar between the two frameworks compared to employed workers because the unemployed generally have lower asset holdings. Consequently, the differences in welfare impacts between the small open and closed economies are less pronounced.

Figure 22: Comparison to the Closed Economy Framework



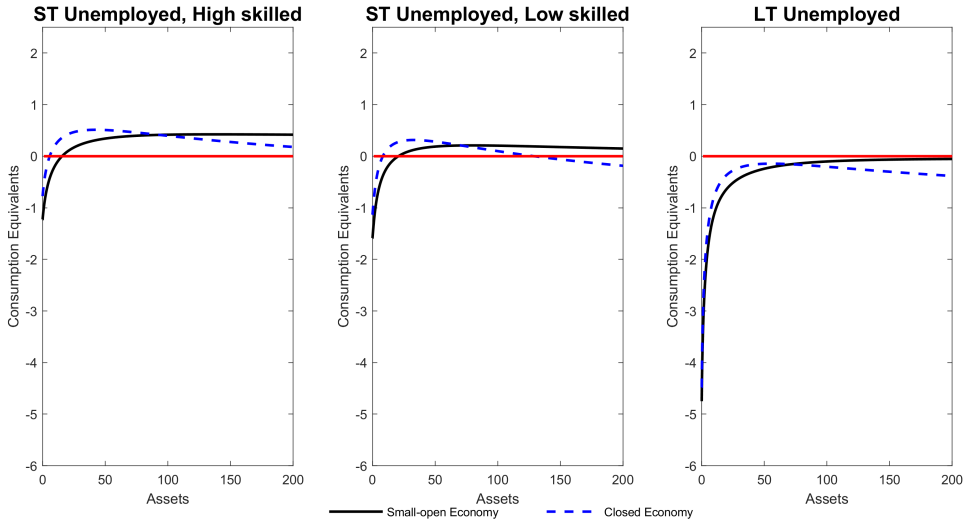
Notes: Responses to the labor market reform in the small open economy (solid line) and the closed economy (dashed line).

Figure 23: 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 24: 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.