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

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Abstract

This paper establishes a link between labor market reforms and an increase in the reforming country's net foreign asset position via a precautionary savings channel. Using a heterogeneous agent model of a small open economy with labor market frictions, we evaluate the current account effects of a major German unemployment benefit reform. We show that accounting for precautionary savings is qualitatively and quantitatively important for current account dynamics. Furthermore, welfare gains and losses are distributed unequally among agents. Compared to a closed economy, the reform is more detrimental in the short run and more beneficial in the long run.

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1 Introduction

How do economies respond to structural labor market reforms? What is the role of precautionary savings due to incomplete insurance? So far, these questions have only been studied in heterogeneous agent models of closed economies.[1] These models are silent on the potential international effects of reducing unemployment benefits. Other studies aim at evaluating labor market reforms in open economies using the standard representative agent framework.[2] In these models, the incentive to accumulate precautionary savings is missing due to perfect consumption insurance.

In this paper, we study these questions in a small open economy heterogeneous agent model with incomplete insurance that features a detailed unemployment benefit system and realistic wealth inequality.[3] We use our framework first to establish a link between the reduction in the generosity of unemployment benefits and the built-up of net foreign assets via consumers' precautionary savings motive. 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). Our results highlight the importance of the precautionary savings effect in the evaluation of structural reforms.

In our model, risk-averse agents want to smooth consumption over their lifetime. A reduction in the generosity of unemployment benefits (UB) increases income risk in case of unemployment. If asset markets are incomplete, consumers self-insure against this risk by accumulating assets. In an open economy, consumers have access to international asset markets and buy international bonds. This leads to an increase in the reforming country's net foreign asset position. This precautionary savings channel is absent in the canonical small open economy representative agent model (in the spirit of Obstfeld and Rogoff, 1995). These models feature two opposing channels on the current account in response to a reduction in UB: (i) a *competitiveness channel* and (ii) a *demand channel*. Those arise because less generous unemployment benefits deteriorate workers' bargaining position and wages fall. Lower wages make the production of domestic goods cheaper and boost exports in the home country (competitiveness channel).[4] In addition, as the job-finding rate increases, employment and aggregate consumption rise (demand channel). Absent the precautionary savings motive, the demand channel dominates and leads to a fall in the reforming country's current account. Accounting for precautionary savings leads to *qualitatively different dynamics* of the current account.

Our contribution is threefold. First, we propose a heterogeneous agent small open economy model with labor market frictions. Doing so, we add to the emerging literature on heterogeneous agent frameworks in small open economies (see de Ferra, Mitman, and Romei, 2020, Auclert,

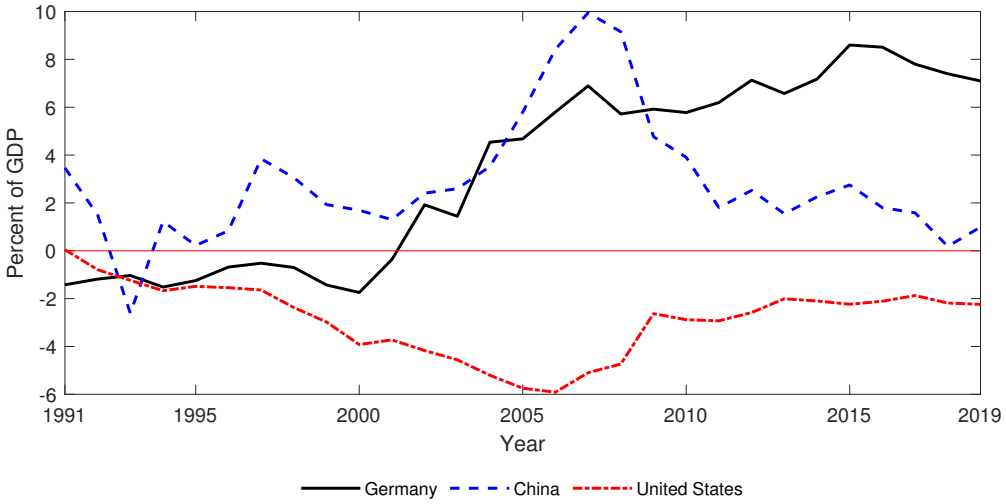
[1] The role of precautionary savings due to incomplete insurance against the risk of becoming unemployed has been stressed by Krusell, Mukoyama, and Şahin (2010), Krueger, Mitman, and Perri (2016b), Krause and Uhlig (2012), Krebs and Scheffel (2013), Launov and Wälde (2013), and Nakajima (2012) among 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". Featuring full consumer heterogeneity in a small open economy, the current version fundamentally differs from the earlier version.

[4] 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).

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).

Rognlie, Souchier, and Straub, 2021, Guo, Ottonello, and Perez, 2020). Second, we demonstrate that the existing literature underestimates the contribution of structural labor market reforms to global imbalances. Third, we document the welfare effects of a labor market reform in a small open economy and contrast it to (i) a representative agent model, (ii) a closed economy framework, and (iii) provide a detailed decomposition of welfare effects. Overall, our paper highlights important differences in studying labor market reforms when capturing consumer heterogeneity in an open-economy setting.

Germany is the ideal case study for our quantitative exercise. The country was running the world's largest current account surpluses for ten years until 2019. In contrast to China, where the current account surplus started decreasing in 2008, Germany's surpluses built up persistently since the early 2000s (see Figure 1). This implies an increase of the net foreign asset position and a divergence of aggregate savings and investment (see Figure 14 in the appendix). This development has been subject to worldwide criticism.[5] The German "Hartz IV-reform" was blamed repeatedly for having contributed to the observed macroeconomic imbalances.[6] Existing macroeconomic studies have quantified the domestic reform effects.[7] So far, the potential international effects have gained little attention in the literature.

In our small open economy model, consumers differ in their asset holdings, employment status, and skills. The labor market is characterized by matching frictions in line with Pissarides (2000) and features a two-tier unemployment benefit system with short-term and long-term unemployed workers. Upon entering the labor force, workers are low-skilled and accumulate skills on the job. A labor union bargains with firms over wages for low-skilled and high-skilled workers.

[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 (2022).

We simulate the German Hartz IV reform to quantify the effect of a labor market deregulation on the reforming country's built-up of net foreign assets. The reform consisted of two steps: (i) a cut in the replacement rate for long-term unemployment benefit recipients and (ii) a reduction in the entitlement period for short-term unemployment benefits.[8] The model is calibrated to the pre-reform period. We match German wealth inequality and the relative wealth levels by skill groups, which we derive from the German Socioeconomic Panel (GSOEP).

Our quantitative exercise shows that the reform contributed significantly to the increase in Germany's net foreign asset position. In the short run, the labor market reform pushed up the German current account considerably and accounted for around 22% of current account developments in the first five years after the reform. We illustrate the importance of the precautionary savings motive and consumer heterogeneity by comparing our model to a complete-insurance framework.[9] Under complete insurance, the precautionary savings channel is absent and the reform has hardly any effect on the current account. In addition, we provide a detailed welfare analysis of the reform and contrast the welfare effects of our small open economy to a closed-economy model. Along the transition to the post-reform equilibrium, we find that consumers suffer stronger welfare losses in the open economy. Once the new equilibrium is reached, welfare effects are more beneficial in the open economy setting.

Consumer heterogeneity plays an important role in evaluating the macroeconomic consequences of the reform. As there is a sizable mass of consumers with low wealth, the response of aggregate consumption differs substantially from the response in the representative agent case (see Krueger, Mitman, and Perri, 2016a). Asset-poor consumers are less well insured against the earnings risk by the time the reform is implemented. They strongly reduce consumption to build up additional savings. Thus, the sign and magnitude of the aggregate consumption reaction depend on the underlying wealth distribution and labor market status of consumers. 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, all consumers save more. As a result, they hold a higher level of wealth in the post-reform steady state, which reduces wealth inequality in the economy altogether.

Furthermore, welfare gains and losses are distributed unequally among agents. We find that along the transition to the post-reform equilibrium, all but high-skilled employed consumers suffer from the reform due to the reduction in consumption induced by higher savings and lower gross wages (given that the fall-back utility has declined). However, asset-poor households suffer disproportionately more. They have a high marginal propensity to consume and depend strongly on labor income. The welfare effects in a closed economy are different. There, the reform triggers a short-lived increase in the interest rate. In the new steady state, however, higher aggregate savings increase capital supply and lead to a lower post-reform interest rate. The short-run increase in the interest rate causes higher returns on assets and leads to positive (instead of negative) welfare effects along the transition for most employed consumers. Also, evaluating

[8] 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.

[9] Note that we use the terms consumer heterogeneity and worker heterogeneity interchangeably throughout the paper.

the reform effects in a framework with a representative agent yields completely different results: Due to perfect consumption insurance and higher aggregate employment, there are only welfare gains because of improved labor market conditions.

This paper is connected to multiple areas of the literature. First, it relates to studies discussing the link between labor market reforms and global imbalances. 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, no precautionary savings motive. We contribute to this strand of the literature by allowing for consumer heterogeneity and a precautionary savings motive.

Empirical contributions, which focus on the general effect of labor market reforms on the current account are Kennedy and Slok (2005) and Bertola and Lo Prete (2015). Kennedy and Slok (2005) provide empirical reduced-form evidence that deregulation on the labor market leads to an immediate fall in prices and wages and, therefore, an increase in the trade balance. In the long run, however, they argue that the capital balance adjusts because the increased profitability of domestic capital leads to an influx of foreign capital, which reverses the current account. Using OECD country-level panel data, Bertola and Lo Prete (2015) find empirical evidence that labor market deregulations tend to increase a country's current account position. They also stress the precautionary savings channel, however, their focus lies on financial market imperfections and the role of human capital investment. As we quantify the effects of a specific deregulation and stress the role of idiosyncratic consumption risk, we see our work complementary to Bertola and Lo Prete (2015).

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.[10] 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 et al. (2020) study the distributional effects of a sudden current account reversal and highlight the importance of households' portfolio composition for the transmission of foreign shocks. Auclert et al. (2021) show that a real income channel can cause contractionary effects of exchange rate depreciations due to higher import prices if households are heterogeneous. Furthermore, Guo et al. (2020) study the distributional effects of monetary policy if households differ in their financial integration. These studies

[10] Further related are Krueger et al. (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.

focus on the effects of temporary foreign shock in New Keynesian frameworks, whereas we study the current account effects of a permanent domestic policy reform absent nominal rigidities.
Fourth, we add to the literature on global imbalances 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 global imbalances with 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. Further related are Hoffmann, Krause, and Tillmann (2019), who show that higher uncertainty in income streams increases precautionary savings and causes 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., 2022). 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).
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 the year 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. We further show that this trend reversal is not driven by business cycle effects.[11]
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.[12,13]

[11] 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 15 in Appendix B.
[12] 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 calculation of the savings rate, see Appendix B.
[13] Long-term unemployment benefits are subject to means testing. The asset limit is age-dependent with a maximum of approximately 10.000 Euros *per adult* and 3.100 Euros per child. In addition, there is a safe limit for retirement assets of maximum 48.750 Euros. According to the Panel of Household Finance provided by the Deutsche Bundesbank (wave 1 for the years 2010/2011), the second quintile (20-40% of the net wealth distribution) has a median net wealth of 11.660 Euros *per household*. Thus, for a large fraction of German households asset limits are not binding.

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.

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. (2022), which highlights variations in the reduction of maximum benefit duration based on age and prior employment duration. Notably, the most substantial reduction in entitlement duration was observed among workers aged 45 to 55 with over three years of previous employment. Notably, the most substantial reduction 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%.

Table 1 illustrates the results of the household-level fixed-effects estimations. The "Hartz Dummy" denotes a shift variable that takes the value 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, log of household net income, annual hours worked, and ISCO-08 Occupation.[14] Overall, the saving rate increased by 1.2 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.

Table 2 summarizes the quantitative effects of the Hartz IV labor market reform on German sav-

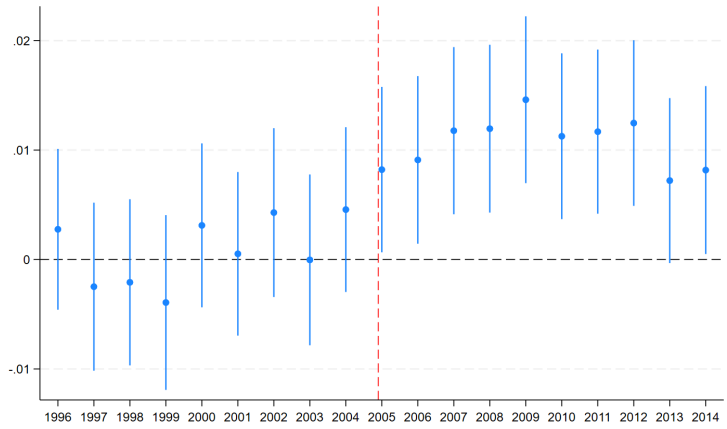
[14] Note that the reference category is Group 0: no change in entitlement duration, which is the case for workers younger than 45 and employment duration less than 28 months.

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

	(1)	(2)
Dependent Variable: Saving rate		
Hartz IV-Dummy	0.012***	0.009***
	(0.002)	(0.002)
Most affected # Hartz IV-Dummy	0.009***	
	(0.002)	
Group 1 # Hartz IV - Dummy		0.006***
		(0.002)
Group 2 # Hartz IV - Dummy		0.009***
		(0.002)
Group 3 # Hartz IV - Dummy		0.013***
		(0.002)
Controls	Yes	Yes
HH - Fixed Effects	Yes	Yes
Observations	134,544	134,544
R-squared	0.035	0.045
Number of hid	26,296	26,296

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. (2022). "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, log of household net income, and annual hours worked. We further include the following macroeconomic controls: a linear trend, unemployment rate, GDP growth, interest rate, terms of trade, exports/GDP ratio, the export price index, the debt/GDP ratio, 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, log of household net income, and annual hours worked. The red vertical line illustrates the time of the reform implementation.
Data Source: German Socioeconomic Panel.

ing rates. The reform increased the savings rate by 1.2 percentage points, the increase for the most affected group amounts to around 2.16 percentage points. This translates into an increase in real aggregate savings by 13.58 % (calculated as the cumulated increase in savings from 2005 to 2014 as a share of aggregate savings in the year 2014) and amounts to around 1.6 percent of German GDP (in 2014). This points towards a quantitative meaningful effect at the aggregate level.

Table 2: Quantitative Reform Effects based on Microeconomic Estimation

Quantitative Effect	
Estimated Hartz IV effect on savings rate	1.21 pp
Overall effect for "Most affected" (overall)	2.16 pp
Cum. Effect (05-14) in % of Real Aggregate Savings (in 2014)	13.58%

Notes: Quantitative Effects of the incremental increase of the household-level savings rate for the most affected groups based on a household-level panel regression. Data Sources: German Socioeconomic Panel (GSOEP) and Eurostat (National Accounts).

3 The Model

In this section, we develop a small open economy model with worker heterogeneity and a frictional labor market.

Time is discrete. There is a continuum of infinitely lived consumers of measure one. A consumer discounts the future with her skill-specific factor β^j and derives utility from consumption.[15] Consumers can either be employed (E), short-term unemployed (S) or long-term unemployed (L). Each consumer inelastically supplies one unit of labor to the labor market.

The labor market has a Diamond-Mortensen-Pissarides structure (see Pissarides, 2000). Firms post vacancies and worker-firm matches are formed randomly via a Cobb-Douglas matching function. Wages are determined via Nash bargaining between the firm and a labor union. Workers accumulate skills during their employment spell and face skill deterioration in case of job loss (see Ljungqvist and Sargent, 2007, Krause and Uhlig, 2012, and Hartung et al., 2022 for a similar modeling approach in terms of skill heterogeneity). 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 who leave the pool of unemployed and find a job are initially low-skilled. They acquire skills over their employment spell and become high-skilled with probability π^E. These skills are lost when employment relationships are severed. The level of short-term unemployment benefits depends on the previous skill-specific wage, long-term unemployment benefits are a fraction of the wage for low-skilled workers.[16]

There is a positive measure of firms. Every firm hires one worker and operates in a competitive product market. The firm uses capital and labor as production inputs. The firm's capital stock

[15] 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.

[16] This approach is identical to employment duration heterogeneity because both skill and the level of unemployment benefits depend on employment duration (see also Hartung et al., 2022 and Krause and Uhlig, 2012). As stressed in Hartung et al. (2022), the assumption of a perfect correlation between skill groups and benefit levels reduces the state space.

depreciates at a rate δ. Firms' profits are paid out as dividends d in every period.
Asset markets are incomplete. Agents cannot buy insurance against individual income risk associated with unemployment. There is only one type of asset, which is bundled by an investment fund and sold to consumers. The asset is a portfolio of the capital stock, a claim to firms' (average) profits paid as dividends, government bonds, and international assets. There is no intrinsic benefit in diversifying the portfolio because only aggregate shocks cause prices to fluctuate.[17] All agents hold the same portfolio composition while they differ in the total value of their investment. Consumers face a borrowing constraint. 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 which is specified as

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

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

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

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

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

With probability π^E, a low-skilled worker has acquired the necessary skills to become a high-skilled worker. We assume that job destruction is exogenous, occurs with constant probability, and differs by skill-level with $s^L > s^H$, 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:

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

Next period's pool of high-skilled employed workers N_t^H is given by this period's high-skilled workers who did not get separated from their match and low-skilled workers who become high-

[17] All consumers face the same aggregate risk and returns are not correlated with the individual labor market status. There is no (additional) gain from portfolio diversification.

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 employed $U_t = 1 - N_t$. 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 are bundled by an investment fund. The investment fund collects and aggregates deposits from consumers at no cost. 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 fund allocates aggregate assets $\bar{a}_t$ across a number of asset classes: physical capital k_t government bonds b_t, claims to the firm's profit x_t, and international assets, NFA_t. We normalize the total amount of firms' equity to one. We follow Krusell et al. (2010) and denote the value of a firm p_t. As a result, the equity price p_t is given by

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

where r denotes the return to capital and δ is the depreciation rate. One unit of capital results in $1+r-\delta$ unit of return in the next period. Let q denote the inverse of the gross real interest rate:

$$q = \frac{1}{1+r-\delta}. \tag{3.10}$$

We define the consumer's individual assets a

$$a_t \equiv (1+r-\delta)(k_t + b_t + NFA_t) + (p_t + d_t)x_t, \tag{3.11}$$

and aggregate investment I is defined as:

$$I_t = k_t - (1-\delta)k_{t-1}. \tag{3.12}$$

The investment fund operates subject to the loanable funds constraint

$$\frac{1}{1+r-\delta}\bar{a}_{t+1} = k_t + NFA_t + b_t + p_t. \tag{3.13}$$

3.3 Consumers

All consumers have CRRA preferences over consumption

$$U = E_0 \sum_{t=0}^{\infty} \beta^{j,t} U(C_t) \quad \text{with} \quad U(C_t) = \frac{C_t^{1-\sigma}}{1-\sigma}, \tag{3.14}$$

where C_t is a CES aggregate of home and foreign consumption goods. The future is discounted with the skill-specific discount rate $\beta^{j,t}$. In the small open economy, agents consume goods produced at home and abroad. 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 $(1-\tau_t)w_t$ with w_t denoting 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 differs by unemployment duration $j \in (S, L)$ with short-term unemployment benefits being more generous ($b^S > b^L$). Each period, a consumer decides how much to consume and save. The consumers' individual state variable is a. The aggregate state Z is given by the joint distribution of assets, employment level, and skill level.

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 con-

sumer's problem is

$$V^{E,L}(a,Z)=\max_{\{C,a'\}}\left\{U(C)+\beta^L\left[(1-s^L)(1-\pi^E)V^{E,L}(a',Z')+(1-s^L)\pi^E V^{E,H}(a',Z')+s^L V^{S,L}(a',Z')\right]\right\}$$

subject to

$$PC+qa'=a+(1-\tau)w^L \quad \text{and} \quad a'\geq \underline{a},$$

where P denotes the aggregate price level, C is the consumption of employed workers and $\underline{a}$ denotes the borrowing constraint.

High-skilled Employed Consumers: The recursive formulation of the high-skilled employed consumer's problem ($i=E,H$) can be written

$$V^{E,H}(a,Z)=\max_{\{C,a'\}}\left\{U(C)+\beta^H\left[(1-s^H)V^{E,H}(a',Z')+s^H V^{S,H}(a',Z')\right]\right\}$$

subject to

$$PC+qa'=a+(1-\tau)w^H \quad \text{and} \quad a'\geq \underline{a}.$$

Short-term Unemployed Consumer: A short-term unemployed consumer ($i=S$) of skill group $j\in(L,H)$ receives unemployment benefits $\kappa^{S,j}$ which depend the replacement rate for short-term unemployed b^S and on the previous skill-specific wage w^j. Thus $\kappa^{S,j}=b^S(1-\tau)w^j$.[18] With exogenous probability π_L she becomes long-term unemployed if she does not find a job in the next period. Her recursive problem is

$$V^{S,j}(a,Z)=\max_{\{C,a'\}}\left\{U(C)+\beta^j\left[\lambda^W V^{E,L}(a',Z')+(1-\lambda^W)\left((1-\pi_L)V^{S,j}(a',Z')+\pi_L V^L(a',Z')\right)\right]\right\},$$

subject to

$$PC+qa'=a+\kappa^{S,j} \quad \text{and} \quad a'\geq \underline{a}.$$

Long-term Unemployed Consumer: A long-term unemployed consumer ($i=L$) receives less generous unemployment benefits $\kappa^L=b^L(1-\tau)w^L$ which depend on the lower replacement rate b^L and the equilibrium wage of low-skilled workers.[19] They either find a job with probability λ_w in the next period or remain long-term unemployed. Their problem is:

$$V^L(a,Z)=\max_{\{C,a'\}}\left\{U(C)+\beta^L\left[\lambda^W V^{E,L}(a',Z')+(1-\lambda^W)V^L(a',Z')\right]\right\},$$

subject to

$$PC+qa'=a+\kappa^L \quad \text{and} \quad a'\geq \underline{a}.$$

[18] In equilibrium, it holds that $w^H>w^L$, thus $\kappa^{S,H}>\kappa^{S,L}$.

[19] We assume that the pool of long-term unemployment benefit recipients is dominated by low-skilled workers.

3.4 Firms

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

$$y_t^j = z^j(\tilde{k}_t^j)^\alpha. \tag{3.15}$$

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 $Y_t = y_t^L N_t^L + y_t^H N_t^H$. The real per-period firm profit for a worker is defined as

$$\Pi_t^j = \frac{p_t^H}{P_t} y_t^j - r\,\tilde{k}_t^j - w_t^j. \tag{3.16}$$

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

$$d_t = \Pi_t^L N_t^L + \Pi_t^H N_t^H - \kappa^\upsilon V_t, \tag{3.17}$$

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

$$r = \frac{p_t^H}{P_t}\alpha z^j(\tilde{k}_t^j)^{\alpha-1}. \tag{3.18}$$

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

$$J_t^L = \frac{p_t^H}{P_t} z^L(\tilde{k}_t^L)^\alpha - r\,\tilde{k}_t^L - w_t^L + q\,E_t\left[(1-s^L)(1-\pi^E)J_{t+1}^L + (1-s^L)\pi^E J_{t+1}^H\right], \tag{3.19}$$

which takes into account that with probability π^E the worker may become high-skilled in the next period. The marginal value of a high-skilled worker to the firm is

$$J_t^H = \frac{p_t^H}{P_t} z^H(\tilde{k}_t^H)^\alpha - r\,\tilde{k}_t^H - w_t^H + q\,E_t\left[(1-s^H)J_{t+1}^H\right]. \tag{3.20}$$

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

$$\frac{\kappa^\upsilon}{\lambda_t^f} = q(1-s^L)\,E_t\left[J_{t+1}^L\right]. \tag{3.21}$$

3.5 Wage Determination

By the time of the reform implementation, collective bargaining was the most widely used wage-setting mechanism in Germany. According to the IAB Establishment Panel (a representative

sample of German establishments), 68% of employees in Western Germany were covered by a collective bargaining agreement in the year 2004 (see Elguth and Kohaut, 2005).[20]
Given the importance of collective bargaining for Germany, the wage is determined via a Nash bargaining game between a firm and a labor union. The union aims to maximize the surplus from employment over unemployment of its members (see Moyen and Stähler, 2014 and Oswald, 1993). It represents workers of all employment statuses and has bargaining power ζ.
The marginal values of working for a low-skilled consumer is

$$\mathcal{W}_t^{E,L} = w_t^L + \beta^L E_t\left[(1-s^L)(1-\pi^E)\mathcal{W}_{t+1}^{E,L} + (1-s^L)\pi^E \mathcal{W}_{t+1}^{E,H} + s^L \mathcal{W}_{t+1}^{S,L}\right], \tag{3.22}$$

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

$$\mathcal{W}_t^{E,H} = w_t^H + \beta^H E_t\left[(1-s^H)\mathcal{W}_{t+1}^{E,H} + s^H \mathcal{W}_{t+1}^{S,H}\right]. \tag{3.23}$$

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

$$\mathcal{W}_t^{S,j} = \kappa_t^{S,j} + \beta^j E_t\left[\lambda_t^w \mathcal{W}_{t+1}^{E,L} + (1-\lambda_t^w)(1-\pi_L)\mathcal{W}_{t+1}^{S,j} + (1-\lambda_t^w)\pi_L \mathcal{W}_{t+1}^{L}\right]. \tag{3.24}$$

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

$$\mathcal{W}_t^{L} = \kappa_t^{L} + \beta^L E_t\left[\lambda_t^w \mathcal{W}_{t+1}^{E,L} + (1-\lambda_t^w)\mathcal{W}_{t+1}^{L}\right]. \tag{3.25}$$

The union maximizes the surplus from employment over unemployment of its members, which is given by

$$\tilde{\mathcal{W}}^j{}_t = \mathcal{W}_t^{E,j} - \left(\mathcal{W}_t^{S,j}\frac{U^{S,j}}{U^{S,j}+U^L} + \mathcal{W}_t^{L}\frac{U^{L}}{U^{S,j}+U^L}\right) \tag{3.26}$$

and takes into account that the unemployed members can either be short-term unemployed or long-term unemployed. The firm's surplus of hiring one additional worker is given by J_t^j (Equations 3.19 and 3.20). Therefore, the wage is derived from solving

$$w_t^j = \max_{w_t^j} [\tilde{\mathcal{W}}^j{}_t]^{\zeta} [J_t^j]^{1-\zeta}. \tag{3.27}$$

The wage sharing rule is given by $\tilde{\mathcal{W}}^j{}_t = \frac{\zeta}{(1-\zeta)} J_t^j$.

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

[20] Note that sectoral agreements play the most important role. Only 2% of establishments and 7% of the workforce are covered by a company-level collective agreement.

by issuing new government bonds b_t:

$$\kappa_t^{S,L} U_t^{S,L} + \kappa_t^{S,H} U_t^{S,H} + \kappa_t^{L} U_t^{L} + b_{t-1} \frac{P_{t-1}}{P_t} = \tau_t (w_t^L N_t^L + w_t^H N_t^H) + q\, b_t. \tag{3.28}$$

To ensures stationarity of government debt (see Schmitt-Grohe and Uribe, 2007), the labor income tax follows the following labor tax rule:

$$\frac{\tau_t}{\bar{\tau}} = \rho^{\tau} \frac{\tau_{t-1}}{\bar{\tau}} + \chi^{b} \frac{b_{t-1}}{\omega^{B} Y_{t-1}}, \tag{3.29}$$

where $\bar{\tau}$ denotes the steady-state level of the labor income tax, ρ^{τ} is a smoothing parameter and χ^{b} determines the elasticity of the labor income 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, $\text{RER}_t = p_{F,t}/p_{H,t}$ and the terms of trade as the inverse $\text{ToT}_t = p_{H,t}/p_{F,t}$. The consumer price index is given by

$$P_t = \left[\gamma p_{H,t}^{-\eta^C/(1-\eta^C)} + (1-\gamma) p_{F,t}^{-\eta^C/(1-\eta^C)} \right]^{-(1-\eta^C)/\eta^C}. \tag{3.30}$$

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:

$$C_{H,t}^* = \text{ToT}_t^{-\theta_F} X \tag{3.31}$$

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

$$C_{H,t} = \left(\frac{\gamma}{(1-\gamma)} \right) \text{RER}_t^{\frac{1}{1-\eta^C}} C_{F,t}. \tag{3.32}$$

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 3.13 must hold. A country's net foreign asset position is defined as last period's assets plus current net exports, NX_t,

$$q\text{NFA}_{t+1} = \text{NFA}_t \frac{P_t}{P_{t+1}} + NX_t, \tag{3.33}$$

where net exports are given by the difference of exports and imports:

$$NX_t = EX_t - IM_t = \frac{p_t^H}{P_t} C_{H,t}^* - \frac{p_t^F}{P_t} C_{F,t}. \tag{3.34}$$

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

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.

$$Y_t = C_t^H + C_{H,t}^* + I_t + \kappa^v V_t. \tag{3.35}$$

3.9 Equilibrium

Given the exogenous interest rate r, the equilibrium of the small open economy is characterized by a sequence of prices $\left\{w_t^L, w_t^H, P_t, p_t^H, p_t^F\right\}$ and allocations $\left\{Y_t, C_t, C_{H,t}, C_{H,t}^*, C_{F,t}, k_{t+1}, NFA_{t+1}, b_{t+1}, d_t, N_t, U_t, U_t^S, U_t^L, V_t\right\}$, 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 and the job-filling rate λ^f are functions of the market tightness θ and follow the matching function (3.1). The job-creation condition is satisfied and determines the vacancy-filling rate λ^f. Given the job-finding rate, λ^w, 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 (3.27).
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 (3.28) holds and the labor tax rate follows the tax rule (3.29).
7. Asset markets clear and the loanable funds constraint (3.13) holds.
8. The aggregate resource constraint (3.35) 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 quarterly frequency. Table 3 shows our baseline parameter choice. We assume permanent discount factor heterogeneity with $\beta \pm \Delta$ to obtain a realistic level of wealth inequality, where we assume that high-skilled workers are more patient (face discount factor $\beta^H = \beta + \Delta$) and low-skilled workers are impatient (discounting the future with $\beta^L = \beta - \Delta$).[21] We set the discount factor β and Δ to match the Gini coefficient of German wealth inequality (based on the German Socioeconomic Panel), which amounts to 0.57[22] (see Figure 19 in the appendix for a comparison of Lorenz curves between the model and the data). As a result, we set the discount factor to $\beta = 0.9855$ with $\Delta = 0.001$. Doing so, the share of wealth hold by the bottom 60 percent of the population amounts to 18.5 percent in our model, which is only slightly above the value of 15.4% in the data. The risk aversion parameter σ_c takes the standard value of 1.5.[23] We further set the preference parameter for domestic goods γ to 0.35 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 to the terms of trade to 3.

Regarding the technology parameters, the share of capital in production α is 0.25, and we assume that capital depreciates at a quarterly rate of 2.5 percent. We normalize the total factor productivity of low-skilled workers, z^L to one and set the productivity of high-skilled workers z^H such that the steady-state difference in average wealth levels of low versus high-skilled workers matches the difference in median wealth by skill groups in the data. According to the German Socioeconomic Panel (GSOEP), the median wealth level of high-skilled workers is approximately 74% higher, which corresponds to a productivity of high-skilled workers, z^H, of 1.3.

Regarding the labor market, we set the bargaining power of the union and the elasticity of matches with respect to unemployment to 0.5, which are standard values.[24] We set the replacement rate for short-term unemployed, b^S to 0.67, and the replacement rate for long-term unemployed, b^L, to 0.57, which corresponds to the legal values (for individuals with children) before the reform. The probability to switch to a long-term unemployment benefit recipient is 0.125, which results in an expected switching probability after 8 quarters. This corresponds to the average length of staying in short-term unemployment before the reform implementation. We set the probability to become a high-skilled worker such that we target a share of low-skilled workers of 68%, which corresponds to the value found in the GSOEP and results in a probability π^E of $1/228$.

In accordance with IAB administrative data, we target a quarterly market tightness of 0.28. This value corresponds to the average market tightness in Germany between 1992 and 2004 (before the reform). Furthermore, we target an unemployment rate of 9.0 percent which corresponds

[21] 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).

[22] The value of 0.57 corresponds to the GSOEP wave of 2002, the only year with available wealth data prior to the reform.

[23] As the parameter of relative risk aversion may influence the degree of precautionary savings, we perform a robustness analysis regarding σ_c.

[24] Note that this calibration follows the Hosios efficiency condition. Due to incomplete insurance and bargaining via a labor union in our setting, this does not imply constrained efficiency. Dávila, Hong, Krusell, and Ríos-Rull (2012) show that uninsurable idiosyncratic shocks cause over-or under-accumulation of capital which leads to constrained inefficiency. See also Krusell et al. (2010) for a discussion.

Table 3: Calibration and Targets

Parameters		**Symbol**	**Value**
Preferences			
	Discount factor	β	0.9855
	Discount factor spread	Δ	0.001
	Risk aversion	σ	1.500
	Preference for domestic goods	γ	0.350
	Elasticity of substitution between home and foreign goods	η^C	0.744
	Elasticity of foreign demand to the real exchange rate	θ^F	3.000
Technology			
	Total Factor Productivity, Low Skilled	z^L	1.000
	Total Factor Productivity, High Skilled	z^H	1.300
	Capital share	α	0.250
	Capital depreciation rate	δ	0.025
Labor Market			
	Matching elasticity	η	0.500
	Workers' bargaining power	ζ	0.500
	Replacement rate for short-term unemployed	b^S	0.670
	Replacement rate for long-term unemployed	b^L	0.570
	Probability to switch to LTU benefit recipient	π^{LTU}	0.125
	Probability to become high skilled	π^E	1/228
Policy			
	Smoothing parameter of fiscal rule	ρ^{tau}	0.800
	Elasticity of tax rate response to debt deviations	χ^b	0.020
	Percent of government debt (SS)	ω_b	0.650
Targets			
	Unemployment rate	U	9.0%
	Market Tightness (SS)	θ	28.0%
	Separation Rate, High-Skilled Workers (SS)	s^H	0.89%
	Separation Rate, Low-Skilled Workers (SS)	s^H	4.14%
	Share of low-skilled workers		68.00%

to the average registered unemployment rate for Germany between 1992 and 2004. We set the separation rates for low-skilled and high-skilled according to the values calculated in Hartung et al. (2022), which results in a separation rate for high-skilled workers of 0.89 percent, and a separation rate for low-skilled workers of 4.14 percent. We further target the share of low-skilled workers (i.e. workers with less than 13 years of education) based on the GSOEP of 68%. These targets pin down the quarterly job-finding rate, the job-filling rate, the matching efficiency, and vacancy posting costs.

The autocorrelation of the labor tax rate amounts to 0.8. Setting its response to deviations in government debt from target (65% of GDP) to $\chi^b = 0.02$ ensures stationarity in government debt (see Kirsanova and Wren-Lewis, 2012).[25]

In the initial steady state, inflation is assumed to be zero. The current account is defined as $CA_t = NFA_t - NFA_{t-1}\frac{P_{t-1}}{P_t}$ and is, therefore, zero in steady state.

4.2 Reform Implementation

As discussed in detail in Appendix A, the Hartz IV reform was undertaken in two steps. First, in 2005, the replacement rate for long-term unemployment benefits was reduced, fixed, and hence independent of prior earnings. One year later, from 2006 onward, the entitlement duration for receiving short-term unemployment benefits was reduced. On average, the entitlement duration was roughly cut by six months.[26] 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 20 percent. The magnitude of the decline in the replacement rate is based on the change in the average net replacement rate for single households based on the OECD Tax-Benefit model (see Krebs and Scheffel, 2013 for a similar approach). Note that the discussion on how much the overall (economy-wide) replacement rate declined due to Hartz IV is still ongoing (see Hochmuth et al., 2021 for a detailed discussion). We choose reduction in the replacement rate in-between plausible estimates following the approach by Krebs and Scheffel (2013). Given the disagreement in the literature, we provide robustness checks concerning the decline in the replacement rate.

We implement the cut in entitlement duration by assuming that the probability to switch from short-term unemployment benefit recipient to long-term unemployment benefit recipient (π^L increases from 1/8 to 1/6, which corresponds to an increase of 33 percent). Hence, conditional on being short-term unemployed, the probability to stay in short-term unemployment is reduced from 8 to 6 quarters. This corresponds to the reduction for an average worker.

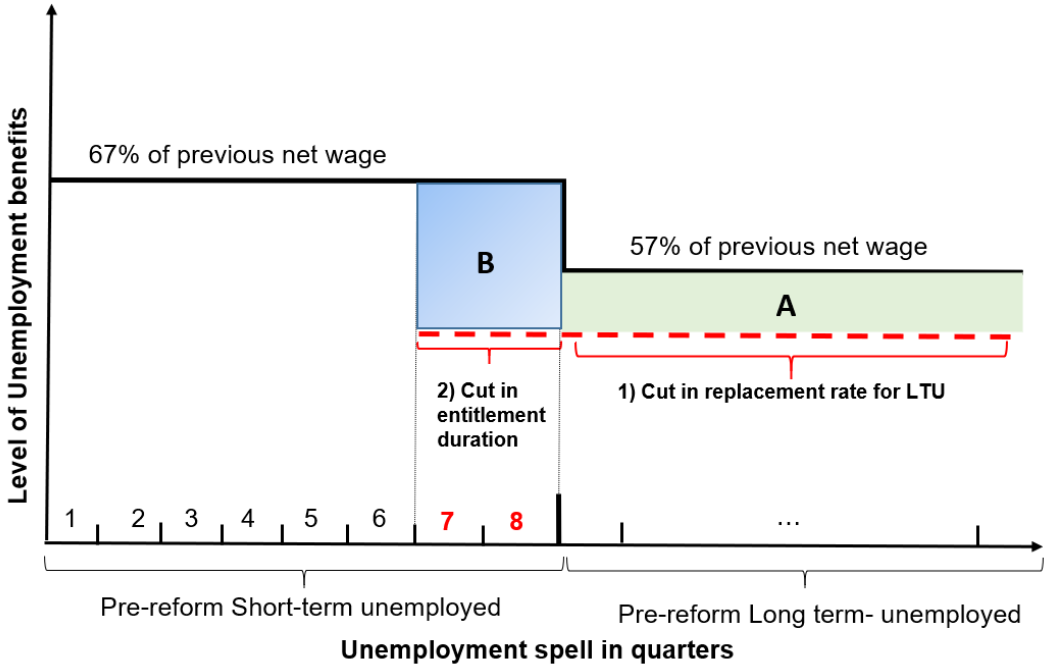
Regarding the simulation design, we assume that, at the time of the initial policy change in 2005, the economy is in its initial steady-state and that there are no future shocks in the economy after the policy change. We solve our model with the methodology proposed by Winberry (2018) and perform the simulation under perfect foresight.[27]

[25] See Section 5.4 for a sensitivity analysis regarding the parameter χ^b.

[26] 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.

[27] The solution method approximates the infinite distribution of heterogeneous agents with a flexible parametric

Figure 4: Reform Implementation (schematic plot)



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 the increase in the German current account position, provide a sensitivity analysis, and a decomposition into the driving channels.

5.1 Steady State Comparison

Table 4 illustrates the percentage changes from the initial (pre-reform) steady-state compared to the steady-state after the entire reform package. We observe a modest decline in wages, which is stronger for low-skilled workers.[28] Furthermore, prices of domestically produced goods as well as the consumer price index (CPI) increase due to stronger domestic demand in the long run. As a result, the real exchange rate depreciates.

The reform triggers positive effects on the labor market with an increase in the job-finding rate and lower unemployment in the post-reform steady state. The number of short-term unemployment benefit recipients declines considerably, whereas the number of long-term unemployment benefit recipients increases as the entitlement cut makes transitioning into the pool of long-term

family. The parameters of the parametric family then enter the model as endogenous state variables (see Winberry, 2018 for details).

[28] Note that the steady-state wage effect is smaller compared to the effect along the transition because of a counteracting effect via the increase in market tightness.

unemployment benefit recipients more likely.

Regarding aggregate variables, we observe a higher level of consumption and output in the post-reform steady state. The reduction in the generosity of long-term unemployment benefits induced agents to increase their asset holdings considerably (more than 12%). This leads to a higher aggregate capital stock and an increase in investment in the long run. The increase in domestic consumption leads to a rise in imports, whereas exports are lower in the post-reform steady state due to higher prices of the domestic good. Due to lower unemployment benefits and the higher employment level, the labor tax decreases. Most importantly, the reforming country's net foreign asset position (in percent of output) increases by approximately 105 percent.

Table 4: Long-run Reform Effects: Percent Deviation from Initial Steady State

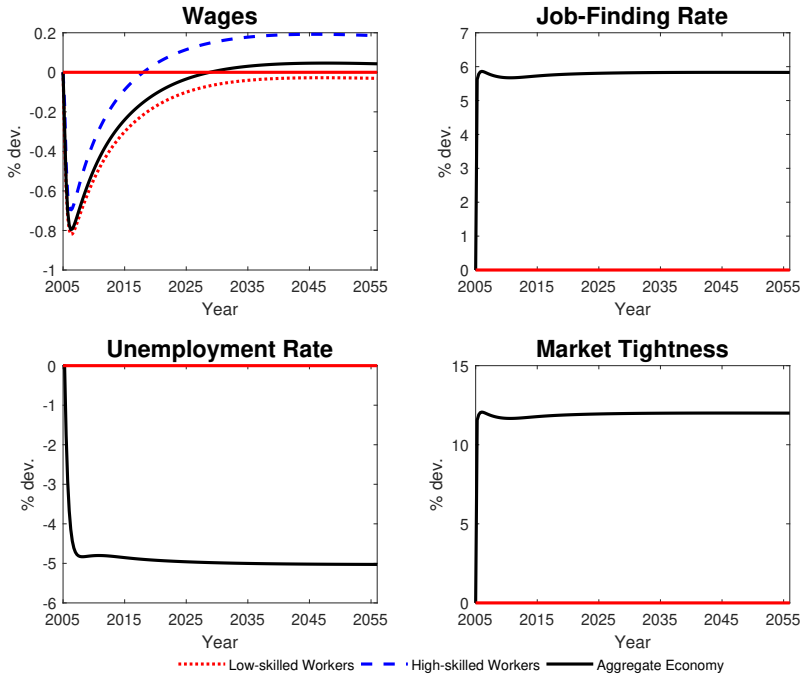
Prices	% dev. from initial steady state
Wage, Low-skilled	-0.129
Wage, High-skilled	-0.233
Price of home good	0.432
CPI	0.318
Real Exchange Rate	-0.406
Labor Market	
Market Tightness	11.830
Vacancies	6.269
Unemployment	-4.972
Job-finding rate	5.749
Job-filling rate	-5.437
Low-skilled Short-term unemployed	-9.412
High-skilled Short-term unemployed	-9.412
Long-term unemployed	11.223
Employment	0.492
Aggregates	
Consumption	2.491
Aggregate Assets	12.285
Output	0.886
Investment	2.105
Labor tax	-8.403
Dividends	2.474
Capital	2.105
Exports	-0.833
Imports	2.974
Net foreign assets	104.891

Notes: Long-run reform effects in percent deviations from the pre-reform steady state compared to the post-reform steady state.

5.2 Transitional Dynamics

Figures 5 and 6 illustrate 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).

Figure 5: Reform Effects on Labor Market Outcomes



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

The reduction in the generosity of the unemployment benefit scheme leads to a decrease in wages as workers' bargaining position has worsened due to the reduced fall-back utility.[29] Reassuringly, our short-run wage effect is quantitatively in line with causal microeconomic evidence of Price (2018), who rules out negative wage effects of more than -1.6 percent caused by the Hartz IV reform.[30] Lower wages increase the marginal value of a worker to firms. As a result, they post more vacancies. This augments the job-finding rate and reduces the unemployment rate. On aggregate, unemployment falls by around 5 percent (see Table 4). Due to the increase in the job-finding rate and the cut in the entitlement duration, the number of short-term unemployment benefit recipients declines by more than 9 percent.

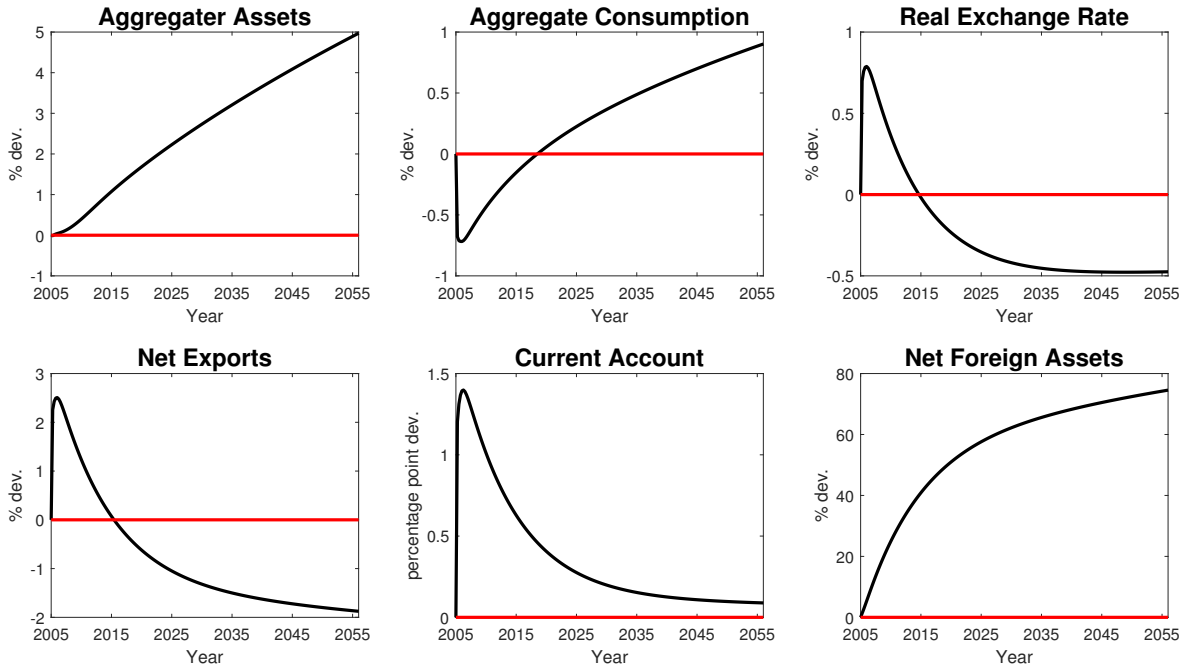
The effect on aggregate variables are illustrated in Figure 6.[31] For households, the labor market effects induced by the reform lead to two opposing effects regarding precautionary savings: On the one hand, an improved labor market situation reduces the incentive to save because transitioning from unemployment to employment has become more likely. On the other hand, higher income losses in case of unemployment increase the incentive to accumulate precautionary savings. The latter effect dominates and consumers in the domestic economy increase their asset holdings considerably. Because the necessary assets are not fully provided domestically (being restricted by domestic government bonds, firm profits, and domestic capital), agents buy international bonds. Thus, the reforming country's net foreign asset position as well as the current

[29] In the medium-run, wages increase slightly, but return to a lower post-reform steady-state level.

[30] A realistic magnitude of the change in wages is important as the wage reaction is an important driver for the strength of the precautionary savings motive.

[31] Figure 18 in Appendix C depicts the long-run model responses (also for additional aggregate variables).

Figure 6: Aggregate Reform Effects



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

account increase. Note that in the short run we observe a decrease in capital and aggregate investment because of a temporary capital-labor substitution effect caused by declining wages and a constant interest rate. This makes hiring new workers for a firm more attractive relative to investing in capital goods. In the long run, however, the Cobb-Douglas production complementarity leads to an increase in capital and investment by more than 2 percent (see Figure 18 in the appendix).

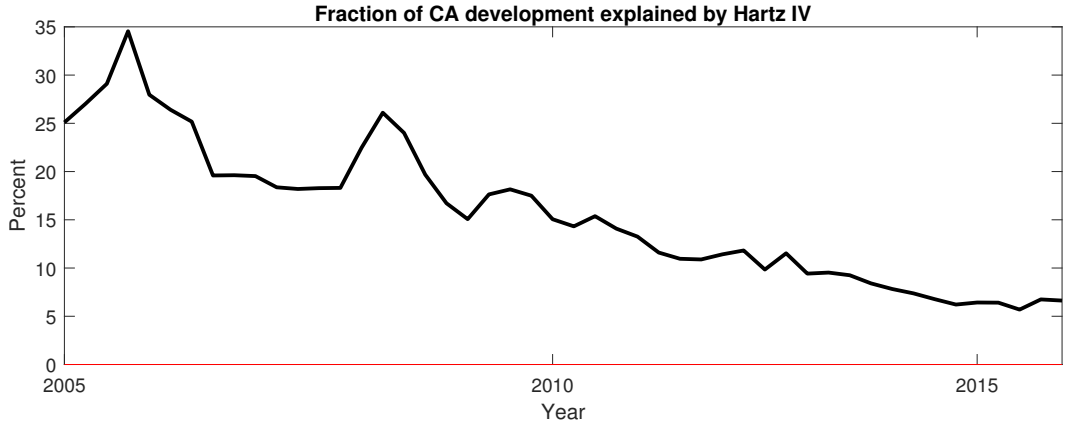
Lower wage income and the higher savings effort make households consume less for a while. This depresses the demand for imports of foreign goods. As prices for domestic goods fall representing higher competitiveness in the short run, the real exchange rate increases. This relative price reaction fosters exports. Overall, the reactions of imports and exports lead to higher net exports in the short run. As aggregate consumption picks up in the medium and long run, the price for domestic goods increases, which leads to a long-run decline in the real exchange rate and lower steady-state net exports.

5.3 The Impact on Current Account Dynamics

How much did the labor market reform contribute to the German current account dynamics and the level of the current account position? To answer this question, we calculate the increase of the current account (relative to aggregate output) in the model economy as a share of the increase of the actual German current account position (in % of GDP) in the data.[32] Figure 7 shows the reform contributed to the surge in the current account in a quantitative important

[32] In 2005, the German net foreign asset position relative to GDP was 13.4 percent and climbed to around 72 percent in 2019 (see Figure 1 for the current account and 14 for the net foreign asset position around that time.

Figure 7: 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 in the data for the years 2005 to 2019. Data Sources: Deutsche Bundesbank and Destatis.

way, explaining around 30 percent in the first year. Since then, the reform's share is decreasing with an average contribution of around 22 percent in the first five years after the reform and a contribution of around 16 percent between 2005 and 2019. We perform a sensitivity analysis regarding the reform contribution in the next subsection.

5.4 Sensitivity Analysis

Next, we assess the quantitative sensitivity with respect to the parameter of relative risk aversion, the magnitude of the decline in the replacement rate for long-term unemployment benefit recipients (i.e. the shock size), and the elasticity of the tax rate to debt deviations (i.e. the fiscal rule).[33]

The parameter of relative risk aversion is potentially important in determining the strength of agents' precautionary savings motive. To assess the robustness of our results with respect to this parameter, we vary σ between 1.3 and 1.7. Table 5 shows that our quantitative results are hardly affected by these variations as the average reform contributions between 2005 and 2019 vary between 14.6 percent and 15.8 percent. Note, that the response of unemployment is hardly affected by variations in σ.

Second, as discussed in Section 4.2, existing literature has not yet reached an agreement on the actual decline in the replacement rate for long-term unemployed (see Hochmuth et al., 2021 for a discussion). For this reason, we perform a robustness analysis regarding the decline of the replacement rate.[34] Compared to our baseline scenario, in which we consider a decline of 20%, we consider a very modest decline of 10% and a stronger decline of 30%.[35] Table 5 shows that the contribution of Hartz IV to the German net foreign asset position is sensitive to the chosen

[33] The corresponding model responses and contributions to the current account dynamics are illustrated in Appendix D.

[34] For this exercise, we keep the cut in the entitlement period from 1/8 to 1/6 (as in our baseline simulation) and only vary the cut in the replacement rate.

[35] Figure 22 in the appendix depicts the corresponding model responses and shows that unemployment declines between 3 percentage points (low shock size) and over 7 percentage points (high shock size).

shock size. The average contribution varies between 8.5% and around 23%.
Third, the elasticity of the labor income tax to deviations of government debt from its targeted debt level determines how much debt is issued by the government. If the government issues less debt (lower χ_b) and agents' asset demand is given, consumers buy more international bonds and, thus, drive up the current account. To quantify the sensitivity of our results to specifications of the fiscal rule, we vary χ_b between 0.01 and 0.05, which results in a range of the average reform contribution to the current account dynamics ranging from 14% to 19.3%.

Table 5: Sensitivity: The Reform's Contribution to Current Account Dynamics

		Max. Contribution	**Average 2005-2010**	**Average 2005-2019**
Baseline	($\sigma = 1.5$, cut in rr=20%, $\chi = 0.02$)	34.5%	21.6%	15.7%
Risk Aversion	$\sigma = 1.3$	32.1%	20.1%	14.6%
	$\sigma = 1.7$	35.0%	21.9%	15.8%
Shock Size	cut in rr=10%	18.3%	11.7%	8.5%
	cut in rr=30%	51.2%	31.8%	22.9%
Fiscal Rule	$\chi = 0.05$	30.8%	19.3%	14.0%
	$\chi = 0.01$	42.8%	26.7%	19.3%

Notes: The numbers refer to quarterly effects on the CA/Output ratio based on our model simulations (including different shock sizes, different parameters of risk aversion, and different elasticities of the fiscal rule) as percent of Germany's quarterly CA/GDP developments in the data for the years 2005 to 2019. Data Sources: Deutsche Bundesbank and Destatis.

5.5 Which Channel Matters Most?

Table 6 allows us to assess the importance of different channels influencing the short-run current account dynamics and long-run net foreign asset levels. We shut off one channel at a time and evaluate the reform's contribution to current account developments absent the corresponding channel. We consider the quantitative importance of three effects: First, we analyze the labor market channel fixing wages and market tightness at their pre-reform values.[36] Second, we shut off the competitiveness channel by keeping good prices and the real exchange rate fixed, and third, we eliminate the precautionary savings channel by assuming complete insurance in a standard representative agent version, see section 6.1 for details.
Labor Market Channel: In our baseline, workers' bargaining position has worsened, and they are willing to accept lower wages. This increases the match surplus for firms and they increase hiring. Thus, market tightness and employment increase. Excluding the labor market channel by holding wages and market tightness constant leads to lower current account effects in the short-run because unemployment benefits depend on last period's wages which remain at pre-reform levels and, thus, dampen the precautionary savings motive. However, due to the missing positive labor market developments, the long-run effects on the net foreign asset position are higher compared to the baseline.
Competitiveness Channel: Table 6 shows that shutting off the effects triggered by the decrease in goods prices and the resulting short-run increase in the real exchange rate leads to considerably lower effects on current account dynamics. Without the competitiveness effect, the average

[36] The labor market channel influences aggregate demand and gives rise to demand effects.

reform contribution would only be around one-fourth compared to our baseline. Given the increase in the real exchange rate in the first couple of years after the reform implementation, this effect is especially important for short-run dynamics. The long-run increase in the net foreign asset position would be strongly dampened absent the competitiveness effect and would amount to only around half of the increase.

Precautionary Savings Channel: Anticipating the next section in which we investigate this channel in detail, Table 6 shows that in a model without consumer heterogeneity the average reform contribution is negative. The reason is that the positive labor market effect outweighs the competitiveness channel in the short run. In the medium run, the competitiveness effect dominates but is quantitatively not important (with a maximum contribution of 0.67%). In addition, there is no long-run effect on the net foreign asset position.

These counterfactual simulations show that, first and foremost, allowing for a precautionary savings channel is essential – not only quantitatively, but also qualitatively. Second, the boost in competitiveness explains a large fraction of the short-run current account dynamics. Third, the positive labor market reactions dampen the long-run increase in net foreign assets by approximately 15 percent.

Table 6: Counterfactual Model Simulations with One Channel Successively Shut Off

	Contribution to Current Account Dynamics %			**Δ Net Foreign Assets**
	Maximum	Average 2005-2010	Average 2005-2019	Steady-State Effect
Baseline	34.54	21.65	15.65	104.89
No Labor Market Channel	26.15	16.00	11.55	121.27
No Competitiveness Channel	8.97	5.55	4.05	48.02
No Precautionary Savings Channel	0.67	-0.49	-0.17	0.00

Notes: Quarterly effects in percent on the CA/Output ratio based on counterfactual model simulations as a share of Germany's quarterly CA/GDP developments in the data for the years 2005 to 2019. *'No Labor Market Channel'* refers to a scenario where wages and the market tightness is fixed. *'No Competitiveness Channel'* is a scenario with fixed good prices and a constant real exchange rate. refers to a scenario where wages and the market tightness is fixed. *'No Precautionary Savings Channel'* refers to a reform simulation in a model with complete insurance.

6 The Role of Heterogeneity

Why is it important to consider consumer heterogeneity when studying labor market reforms? The two most important reasons are i) the presence of a precautionary savings motive under incomplete insurance and ii) agents' different marginal propensities to consume (MPCs) along the asset distribution. In this section, we contrast the implications of our heterogeneous agent model to a representative agent model and analyze redistributive effects.

6.1 Comparison to the Complete-Insurance Framework

Our quantitative exercise shows that the reform triggers a considerable consumption risk effect, which outweighs the positive labor market developments. Hence, in expectations, the uninsurable earnings risk causes higher uncertainty regarding consumption. Agents want to insure themselves against this risk and save. We illustrate the importance of consumers' precautionary

savings motive by simulating the reform in a version of our model with complete asset markets and full insurance against the idiosyncratic risk of becoming unemployed. Thus, their consumption and savings decisions are independent of their employment status (as in Andolfatto, 1996 and Merz, 1995).[37] As a result, the Euler condition boils down to the conventional one:

$$\lambda_t = \beta \lambda_{t+1} \cdot R^{-\psi(NFA_t - \overline{NFA})},$$

where λ_t denotes the marginal utility of savings, $\overline{NFA}$ denotes the steady-state level of net foreign assets and ψ is an adjustment cost parameter. To ensure stationarity of net foreign assets, we follow Schmitt-Grohe and Uribe (2003) and assume a risk premium on international bonds that increases with the country's net foreign asset position.[38]

As mentioned above, the relevance of incomplete asset markets in studying the effects on a country's net foreign asset position is not only qualitatively important but also quantitatively. Figure 8 contrasts the simulation results from our heterogeneous agent model (solid line) with the complete insurance case (dashed line) depicting qualitatively different responses for the current account and the net foreign asset position. Although the reaction on the labor market is quite similar in both settings, the incentive to hold precautionary savings is absent in the model with full worker insurance. As a result, the aggregate consumption responses differ strongly in the two frameworks. Under full worker heterogeneity consumption declines in the short run because agents start to accumulate savings. This consumption-savings trade-off is absent in the complete insurance version and causes consumption to immediately increase to a higher steady-state level. In the full insurance model savings even decrease slightly in response to the reform due to the positive labor market reaction (higher employment). The decline in savings leads to a hardly visible and short-lived fall in the current account balance and the net foreign asset position. Thus, as long as households are perfectly insured against the consumption risk in case of unemployment, a drop in the replacement rate and a cut in the entitlement duration has almost no (or even the contrary) effect on the reforming country's net foreign asset position.

6.2 Redistributive Effects

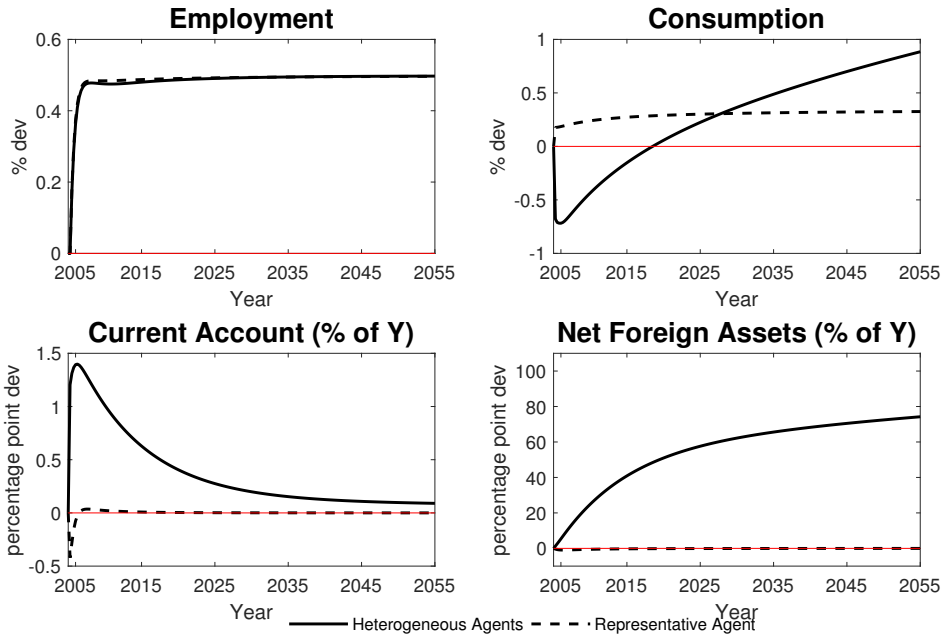
How did the unemployment benefit reform change the wealth distribution of consumers in the economy? To answer this question, we calculate the change of the Gini coefficient and the coefficient of variation (CV) for consumption. Table 7 illustrates the corresponding values for the wealth distributions before and after the reform within consumer groups. Overall, inequality decreases due to the reform, both in terms of the Gini coefficient as well as in terms of the coefficient of variation for consumption. The reduction in inequality is strongest for the within-group distribution of low-skilled (un-)employed workers and long-term unemployed.

Figure 9 depicts the asset distribution by high- and low-skilled employed consumers in the pre-reform steady-state (solid, black line) and in the post-reform steady-state (dashed, blue line). A higher fraction of low-skilled employed consumers are close to/at the borrowing constraint

[37] See Appendix C.3 for the household's problem in the full-insurance case. As in our baseline heterogeneous agent model, we simulate the full insurance model in a non-linear fashion under perfect foresight.

[38] We further require to impose an exogenous level of net foreign assets, which we set to zero in the initial steady state.

Figure 8: Comparison to the Complete Insurance Framework



Notes: Model responses in our baseline small open economy heterogeneous agent model (solid line) and in model with full consumption insurance (dashed line).

Figure 9: Shift in Stationary Asset Distribution of Employed Consumers by Skill Level

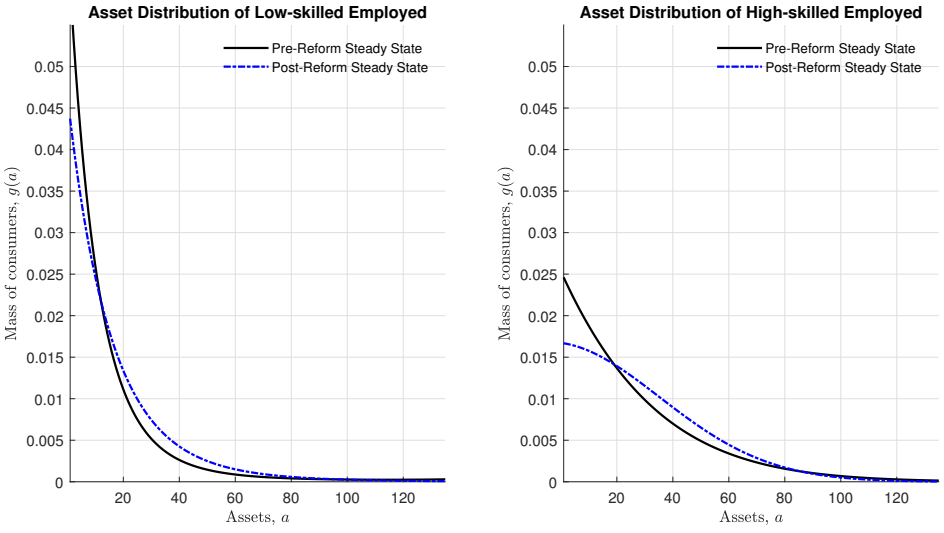


Table 7: Change in Inequality by Employment Status and Skill Level

	Pre-Reform	Post-Reform	Percentage Change
Gini Coefficient			
Low-skilled Employed	0.568	0.510	-10.132
High-skilled Employed	0.470	0.415	-11.720
Low-skilled STU	0.573	0.515	-10.156
High-skilled STU	0.472	0.416	-11.831
Long-term Unemployed	0.581	0.526	-9.444
Coefficient of Variation for Consumption			
Low-skilled Employed	2.201	1.840	-16.412
High-skilled Employed	1.285	1.134	-11.738
Low-skilled STU	2.264	1.881	-16.929
High-skilled STU	1.300	1.142	-12.163
Long-term Unemployed	2.309	1.934	-16.244

Notes: The table display the 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".

and hold a significantly lower amount of assets. As mentioned above, we target the difference in mean asset holdings for low-and high-skilled employed consumers to the difference in net wealth by skill group based on microeconomic GSOEP survey data. We observe a shift of the asset distribution of all worker groups to the right in response to the reform. As a result, initial asset-poor agents hold more wealth and move away from the borrowing constraint.[39] The analysis of the redistributive effects focuses solely on a comparison of stationary wealth levels before vs. after the reform. However, as discussed above, along the transition to the post-reform steady-state, agents had to adapt their consumption-savings behavior and suffer heterogeneous welfare losses in the short and medium run. We analyze these welfare effects in the next section.

7 Welfare Analysis

Consumer heterogeneity plays an important role when analyzing the welfare effects of the reform. In this section, we investigate the welfare effects of a reduction in the generosity of unemployment benefits along several dimensions. First, we analyze the welfare effects *along the transition* to the post-reform steady state. Second, we compare the *stationary* welfare effects (i.e. comparing only steady states) and contrast the effects to the welfare effects in a model with complete insurance. Third, we provide a decomposition of welfare effects into partial equilibrium, matching, and price effects as studied by Mukoyama (2013). Finally, we investigate the differences to 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. The consumption equivalent is the percentage of an agents' lifetime consumption that is required to make the agent indifferent to implementing the policy change. As a starting point, we target the

[39] Our model's predictions on the redistributive reform effects are consistent with Krueger et al. (2016a).

average German unemployment rate for the pre-reform period from 1995 to 2004 (9 percent in our quantitative exercise). 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.[40]

7.1 Benchmark: Transitional vs. Steady State Effects

Table 8 illustrates the welfare effects of the labor market reform in terms of consumption equivalents by wealth quintiles, employment state, and skill group. The last column displays the welfare effects in the model with complete insurance.

Upon reform implementation – along the transition to the new steady-state – all but high-skilled employed workers suffer welfare losses. Low-skilled employed consumers in the first wealth quintile require 0.211% of lifetime consumption as compensation for the reform, whereas the reform is less detrimental for asset-rich agents in the top two wealth quintiles. The reason is that asset-rich consumers depend less on labor income, which decreases in response to the reform. In addition, they have lower MPCs, and have to give up less consumption to accumulate more wealth. Thus, they suffer less in terms of foregone consumption compared to consumers with low asset holdings because a higher amount of wealth allows them to better smooth consumption. The reform is more detrimental for low-skilled employed consumers, and especially for consumers who are directly affected by the cut in entitlement duration and benefits: unemployed consumers. Low-skilled short-term unemployed and long-term unemployed consumers suffer the strongest consumption losses. The economy-wide consumption equivalent, which takes into account the corresponding shares of consumers in all employment states, amounts to -0.088% of lifetime income.

If we compare the welfare effects between steady states (pre-reform vs. post-reform, i.e. we do not consider the transition paths), welfare effects are less detrimental, but still negative for long-term unemployed and poor low-skilled workers. In the post-reform steady state, the level of consumption and the job-finding rate are higher. This reduces the probability that consumers effectively experience long-term unemployment. As we show in a detailed decomposition of stationary welfare effects in the next subsection, they benefit from improved labor market conditions. In addition, they gain via an implicit transfer effect from unemployed to employed workers, which is caused by a decline in the labor income tax.[41] For the whole economy, these positive effects outweigh the negative effects, which arise due to the loss in consumption insurance as well as the decline in wages and increase in good prices.

[40] 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.

[41] Note that a decline in unemployment benefits and a higher employment level lead to lower government spending and, thus, a lower labor income tax.

Table 8: 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	-0.211	-0.132	-0.090	-0.079	-0.105	-0.121		
High-skilled Employed	0.071	0.074	0.055	0.026	-0.019	0.041		
ST Unemployed, low skilled	-0.415	-0.241	-0.159	-0.129	-0.141	-0.210	-0.088	0.271
ST Unemployed, high skilled	-0.236	-0.078	-0.059	-0.064	-0.079	-0.101		
LT Unemployed	-1.121	-0.643	-0.490	-0.419	-0.363	-0.597		
Steady State Effects								
Low-skilled Employed	-0.020	0.041	0.074	0.078	0.047	0.046		
High-skilled Employed	0.193	0.193	0.174	0.147	0.106	0.162		
ST Unemployed, low skilled	-0.223	-0.075	-0.004	0.019	0.003	-0.051	0.064	0.166
ST Unemployed, high skilled	-0.063	0.074	0.088	0.080	0.063	0.050		
LT Unemployed	-0.930	-0.484	-0.341	-0.276	-0.224	-0.441		

Notes: Effects refer to consumption equivalents. Effects along the transition refer to consumption equivalents in the first period after the shock implementation (see main text for details). Steady-state effects denote consumption equivalents comparing value functions in the pre-reform vs- post-reform equilibrium. Effects for the complete insurance case refer to consumption equivalents in the representative agent framework of Subsection 6.1.

The welfare differences between the transition and the steady-state effects are driven by the amount of foregone consumption due to the consumption-savings trade-off workers face. Relative to their income, low-asset, high MPC consumers suffer most in terms of foregone consumption. In addition, as asset-poor consumers rely strongly on labor income, they are severely affected by the decrease in wages. Thus, along the transition, all agents (except for high-skilled employed workers) suffer considerably due to consumption and wage losses. In the new equilibrium, the job-finding rate, aggregate employment, and aggregate consumption are higher relative to the pre-reform steady state. As a result, the steady-state welfare losses are smaller and turn into welfare gains for many groups.

The importance of taking into account consumer heterogeneity in evaluating labor market reforms is further highlighted if we compare the welfare effects of our heterogeneous agent model to the representative agent case with complete insurance (last column in Table 8). In a setting with complete asset markets, the welfare effects are always positive as all consumers profit from the increase in the job-finding rate but do not have to self-insure against the risk of becoming unemployed. Therefore, they do not face a temporary drop in consumption (see Figure 8 for the comparison to the representative agent framework).

7.2 Decomposing the Welfare Effects

To understand the welfare effects in detail, we decompose the effects into different factors. We single out the *partial equilibrium*, the *matching effect*, and the *price effect*.[42]

[42] See Mukoyama (2013) for a similar decomposition in a closed economy framework. Note that there exist potential non-linear interacting effects, which we do not discuss.

7.2.1 Partial Equilibrium Welfare Effect

We follow Mukoyama (2013) and refer to the isolated effect of a change in the replacement rate of long-term unemployment benefit recipients and taxes as the *partial equilibrium welfare effect*.[43] By the time the reform is implemented, both the replacement rate for long-term unemployment benefit recipients as well as the labor tax decrease immediately.

The partial equilibrium welfare effects are depicted by the dashed, blue line in Figures 10 (employed consumers) and 11 (unemployed consumers). We observe that the partial equilibrium effect is negative for all unemployed consumers as the reform implies a loss in consumption insurance (insurance effect), especially for long-term unemployed workers. Asset-poor consumers suffer the most as their ability to smooth consumption immediately declines. In addition to the insurance effect, there is an implicit transfer effect from unemployed to employed consumers via the decline in the labor income tax. An employed consumer faces a lower tax burden after the reform, which dampens the insurance loss effect for them. As a result, the partial equilibrium welfare effects are positive for high-skilled employed workers and low-skilled employed with high asset holdings.

7.2.2 Matching Effect

Next, we analyze the *matching effect*, which arises in general equilibrium, and isolate the effect that stems from changes in the job-finding rate. For this exercise, we compute the welfare effects when consumers face only the transition path of the job-finding rate as in our baseline simulation. The remaining values are fixed at their pre-reform steady-state levels.

The matching effect by employment status is illustrated by the dotted green line in Figures 10 and 11. The reform leads to an increase in the job-finding rate. As the probability to exit unemployment has risen, welfare improves for all consumers. This effect is stronger for the unemployed, who are currently searching for a new job. The matching effect is higher for the asset-poor consumers as they rely more on labor income. [44]

7.2.3 Price Effect

Finally, we consider another general equilibrium effect, the *price effect*, which arises due to changes in wages for high-skilled and low-skilled workers as well as changes in the relative prices of goods.[45] The price effect is depicted by the magenta line Figures 10 and 11 and shows that the decline in wages and the increase in goods prices is welfare detrimental and highest for asset-poor workers with a large fraction of their earnings consisting of labor income. The price effect decreases with the level of asset holdings.[46]

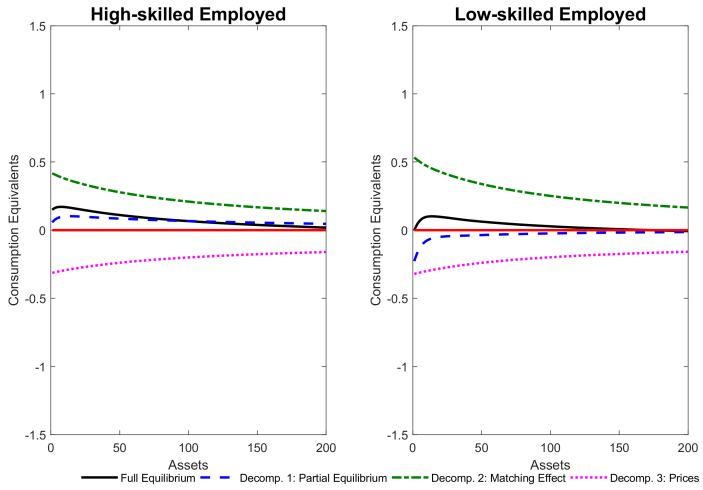
[43] For this exercise, we keep the transition probability between short- and long-term unemployed fixed.

[44] As the job-finding rate increases immediately, the matching effects are also positive along the transition path. Results are available upon request.

[45] As before, we keep the remaining values fixed at their initial steady-state level.

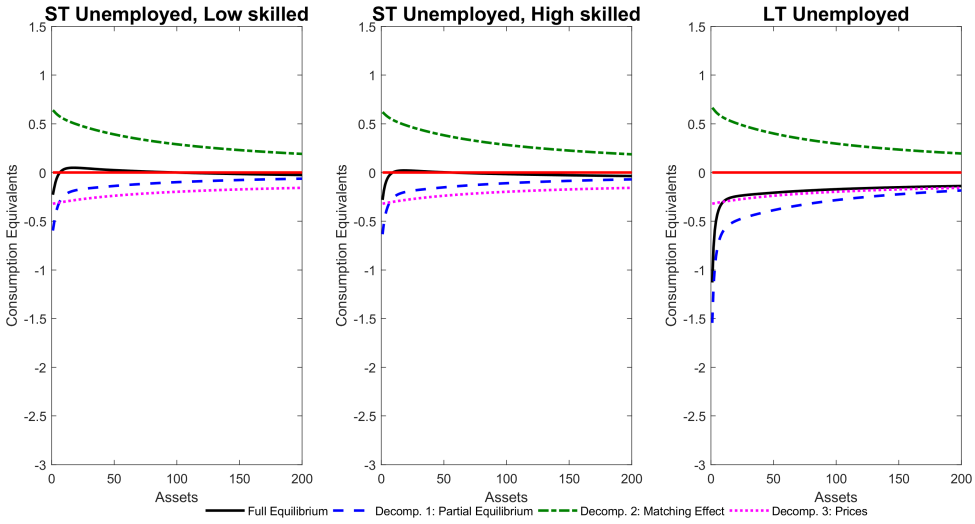
[46] The decline in wages is the most important driving force for the negative price effect, whereas the effect due to increases in goods prices and the CPI are negligible.

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, 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 the small open economy to those in a closed economy setting, with is characterized by lacking access to international bonds, and an endogenous interest rate. Table 9 provides a detailed comparison of consumption equivalents along the transition path to the post-reform equilibrium and in steady-state. Figure 26 in Appendix D compares the impulse response functions.

Table 9: Welfare Effects: The Labor Market Reform in a Closed vs. small open Economy.

	Wealth Quintiles						
	1	**2**	**3**	**4**	**5**	**Average**	**Economy**
Transitional Effects							
Small open Economy							
Low-skilled Employed	-0.211	-0.132	-0.090	-0.079	-0.105	-0.121	
High-skilled Employed	0.071	0.074	0.055	0.026	-0.019	0.041	
ST Unemployed, low skilled	-0.415	-0.241	-0.159	-0.129	-0.141	-0.210	-0.088
ST Unemployed, high skilled	-0.236	-0.078	-0.059	-0.064	-0.079	-0.101	
LT Unemployed	-1.121	-0.643	-0.490	-0.419	-0.363	-0.597	
Closed Economy							
Low-skilled Employed	-0.111	-0.032	0.029	0.072	0.110	0.019	
High-skilled Employed	0.076	0.115	0.134	0.148	0.166	0.129	
ST Unemployed, low skilled	-0.324	-0.145	-0.045	0.013	0.063	-0.082	0.033
ST Unemployed, high skilled	-0.138	0.045	0.100	0.131	0.165	0.064	
LT Unemployed	-1.045	-0.579	-0.402	-0.294	-0.183	-0.484	
Steady State Effects							
Small open Economy							
Low-skilled Employed	-0.020	0.041	0.074	0.078	0.047	0.046	
High-skilled Employed	0.193	0.193	0.174	0.147	0.106	0.162	
ST Unemployed, low skilled	-0.223	-0.075	-0.004	0.019	0.003	-0.051	0.064
ST Unemployed, high skilled	-0.063	0.074	0.088	0.080	0.063	0.050	
LT Unemployed	-0.930	-0.484	-0.341	-0.276	-0.224	-0.441	
Closed Economy							
Low-skilled Employed	-0.342	-0.288	-0.262	-0.285	-0.419	-0.321	
High-skilled Employed	-0.027	-0.006	-0.016	-0.034	-0.067	-0.030	
ST Unemployed, low skilled	-0.547	-0.398	-0.330	-0.332	-0.447	-0.412	-0.331
ST Unemployed, high skilled	-0.380	-0.261	-0.294	-0.372	-0.495	-0.362	
LT Unemployed	-1.265	-0.829	-0.677	-0.628	-0.682	-0.808	

Notes: Effects refer to consumption equivalents. Effects along the transition refer to consumption equivalents in the first period after the shock implementation (see main text for details). Steady-state effects denote consumption equivalents comparing value functions in the pre-reform vs- post-reform equilibrium.

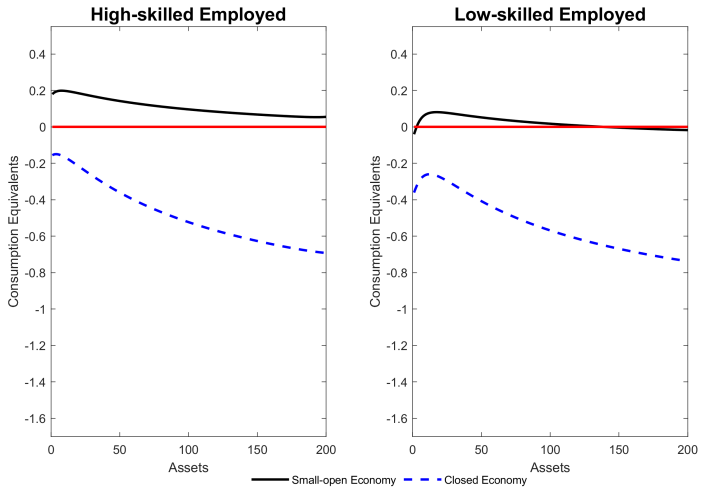
In response to the reduction in long-term unemployment benefits, the demand for assets increases in both frameworks due to the precautionary savings motive. One main difference between the closed-economy and the open-economy setting is that aggregate saving increases stronger in the open economy, because consumers buy international bonds, whereas domestic asset supply is more sluggish in adapting. Hence, there is excess asset demand in the short run. In the closed economy, this results in a temporary increase in the interest rate. In the long run, however, the aggregate asset supply and the capital stock increase to a higher level, which leads to a lower interest rate in the new steady state. The dampened response in savings also causes a quicker recovery of aggregate consumption. These differences across model frameworks are mirrored in the welfare effects.

In the closed economy, the welfare effects along the transition path are less detrimental (see Table 9). The temporary increase in the interest rate benefits especially asset-rich consumers with high asset holdings. Due to the less pronounced increase in aggregate assets, aggregate consumption recovers quicker compared to the small open economy framework (see the responses depicted in Figure 26 in Appendix D). Overall, this leads to positive instead of negative welfare effects along

the transition to the post-reform steady state for the majority of employed workers and most high-skilled short-term unemployed workers.

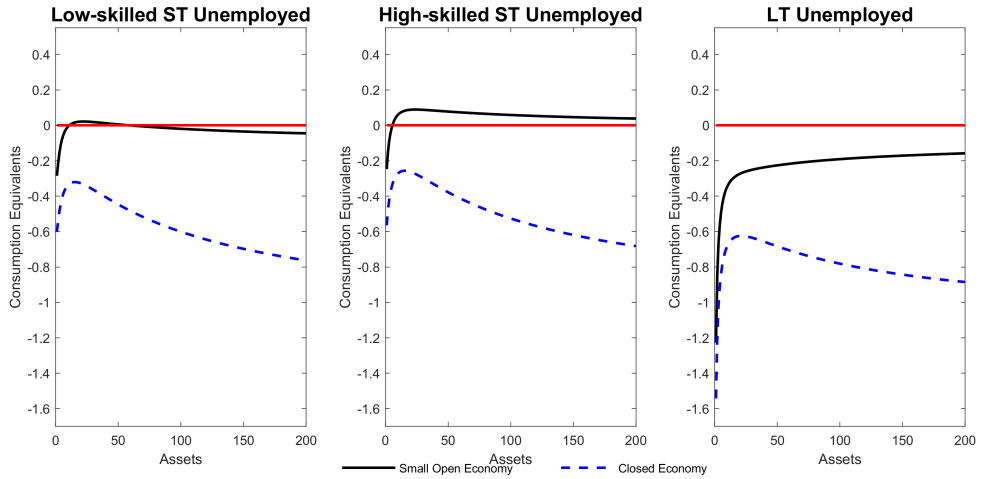
The picture changes if we consider steady-state effects. Table 9 shows that agents of all employment states suffer *more* in terms of foregone consumption in the closed-economy setting compared to the small open economy. The lower interest rate in the new steady state reduces the return on consumers' higher post-reform savings, while the effect on unemployment and the job-finding rate is almost identical. The welfare gap between the frameworks increases with the share of investment income (return on assets) of total income in each employment category. As employed agents hold the largest amount of assets, the difference in welfare effects caused by the interest rate reaction is stronger. As long-term unemployed have only a small share of investment income, the gap between the two frameworks is less pronounced.

Figure 12: 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 13: 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.

8 Concluding Remarks

This paper investigates the role of precautionary savings and consumer heterogeneity when evaluating the open-economy effects of labor market reforms. We establish a link between a 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, its consequences in a globalized world have – so far – gained little attention in the academic literature. We fill this gap and build 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. We find that since its implementation, the reform contributed in the first five years on average 22 percent to the German current account dynamics. Decomposing the magnitude of different channels, we find that the precautionary savings channel is both qualitatively and quantitatively important.

We further analyze how consumers in different segments of the wealth distribution are affected by the structural reform. Our key finding is that welfare gains and losses are distributed unequally among agents. Along the transition to the post-reform equilibrium, poor consumers with a high marginal propensity to consume suffer most in terms of foregone consumption due to the reform. However, once the post-reform equilibrium is reached, the reform is beneficial for rich, employed consumers. In addition, we uncover significant differences in welfare effects in the small open economy setting compared to the closed-economy framework that is driven by access to international bonds and (the lack of) the interest rate reaction.

The welfare decomposition reveals that for most consumers the gain stemming from the match-

ing effect of the reform is outweighed by (i) the partial equilibrium welfare effect of a less generous unemployment benefit system, and (ii) the price effect which is driven by the decline in wages. Consumers benefit from a higher job-finding rate after the reform. However, a less generous unemployment benefits regime decreases insurance and requires agents to build up more precautionary savings.

There are several open questions for future research. 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 would be possible extensions. We leave this for future research.

References

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.

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.

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

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.

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

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.

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.

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 (2022): "Unemploymentinsurancereformsandlabormarket dynamics," Tech. rep., mimeo.

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.

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

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.

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.

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.

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.

WINBERRY, T. (2018): "A Method for Solving and Estimating Heterogeneous Agent Macro Models," *Quantitative Economics*, 9, 1123–1151.

A Background

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

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

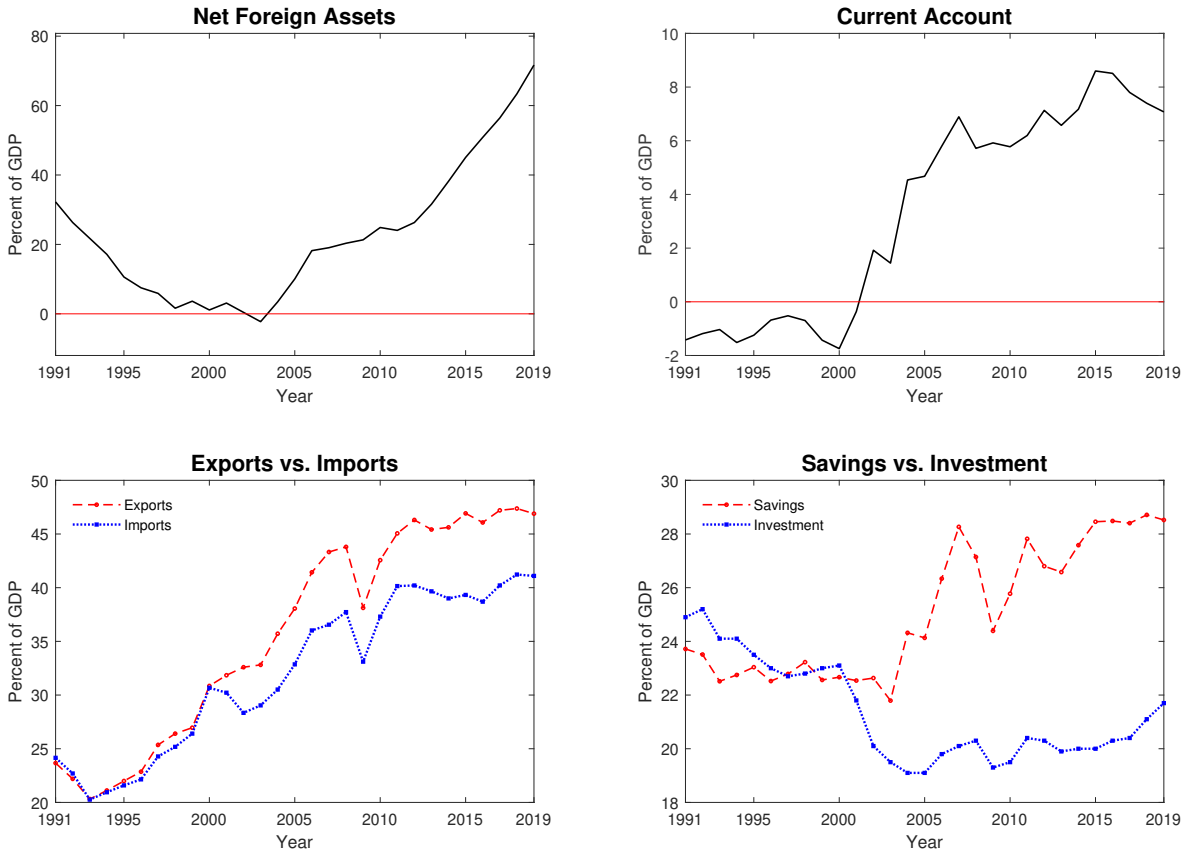
Figure 14 shows the German net foreign asset position (NFA), current account (CA) as well as exports (EX) and imports (IM), and savings and investment from 1991 onwards. Between 1991 and the early 2000s, a decade that was characterized by high unemployment rates and low GDP growth, Germany has repeatedly 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. In fact, 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).

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).

In 2005, the farest-reaching and most discussed Hartz IV reform was implemented with the aim to reduce workers' reservation wages and increase labor supply. Prior to Hartz IV, short-term unemployed workers were entitled to unemployment benefits of 60 percent of their previous net wage (*"Arbeitslosengeld"*). 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. For unemployed workers with children, the replacement rates 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).

Figure 14: 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).

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 entitlement of unemployment benefit receipt was 12 months for workers below the age of 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. Many consider these reforms as important drivers of the increase in German competitiveness and its current account surplus.

B Empirical evidence on Savings and Wealth

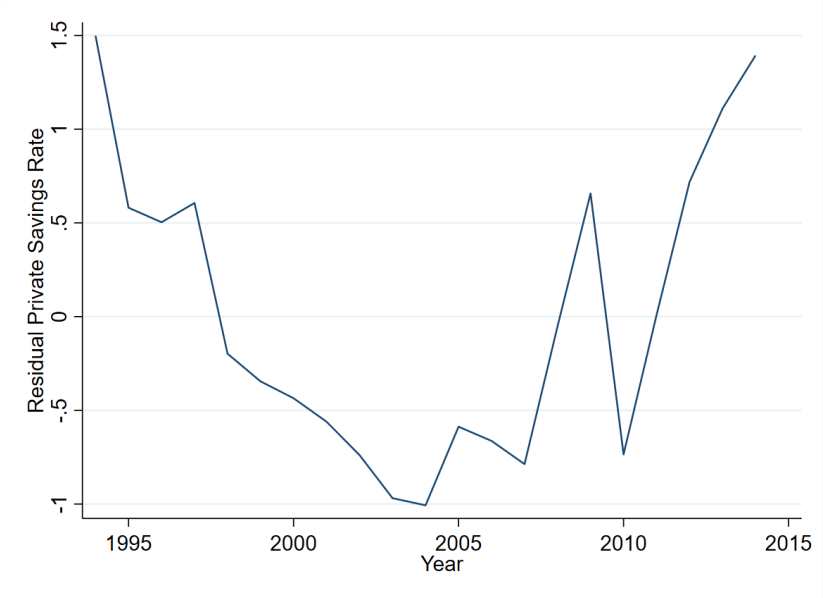
B.1 Private Savings of Full-time Employed

We use survey data from the German Socioeconomic Panel (SOEP) between the years 1994 to 2014 to calculate private savings rate of full-time employed household heads. The SOEP is a longitudinal survey covering around 11,000 private households. It was first conducted in 1984. We use the recently released wave 34 of the SOEP. For more details on the SOEP, see Goebel, Grabka, Liebig, Kroh, Richter, Schröder, and Schupp (2018).

For the construction of the private savings rate depicted in Figure 2, we follow Stein (2009). First, we remove all observations which are not assigned to a household head. We calculate the annual sum of weighted monthly savings (variable *hlc0120*) and divide by the annual sum of weighted monthly household net income (variable *hlc0005_h*) to obtain the private savings rate. To ensure representativeness of the savings rates, we apply cross-sectional household weights (variable *hhref*).

Furthermore, we check whether the trend-reversal in the private savings rate for employed workers depicted in Figure 2 is driven by business cycle effects. For this purpose, we purge the savings rate of business cycle effects by regressing the private savings rate on a constant and German GDP growth. The residual (i.e. the purged savings rate) is illustrated in Figure 15 and shows a similar trend-reversal around the year 2005, when the reform was implemented. Thus, the increased private saving rate for employed worker cannot be explained by business cycle effects, and instead points towards structural reasons.

Figure 15: Controlling for Business Cycle Effects: Residual Private Savings Rate

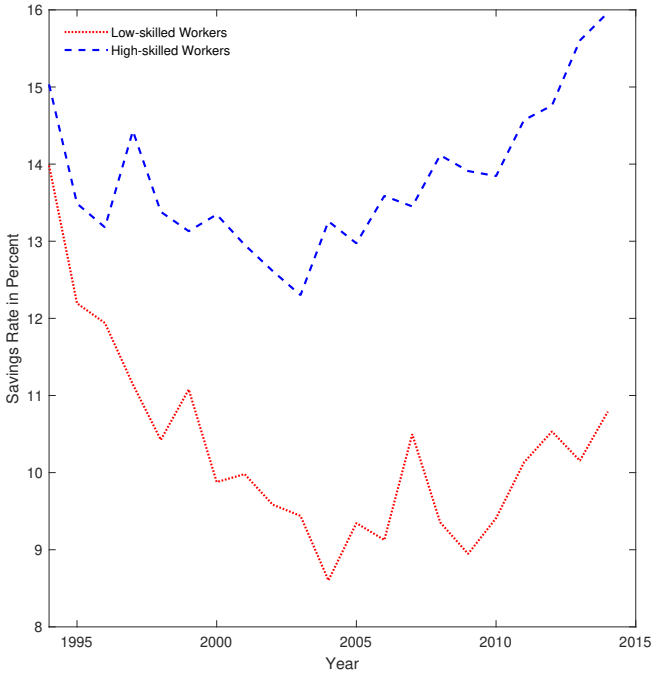


Source: German Socioeconomic Panel and Destatis, 1994-2014, The residual private savings rates for employed workers refers to the private savings rate purged of business cycle effects (measured in terms of GDP growth).

Figure 16 illustrates the heterogeneity in saving rates by skill groups. Prior to the reform, high-skilled workers (i.e. workers with more than 13 years of education) have a more than 24 per-

cent higher savings rate compared to low-skilled workers. Around the year 2005, we observe the trend-reversal of the savings rate for both skill groups. In the first three years after the reform, low-skilled workers increase their savings rate by almost 2 percentage points, which declines again during the Great Recession (suggesting a higher business cycle volatility). For high-skilled workers, the savings rate increases initially at a slower pace and strongly picks up around 2010.

Figure 16: Private Savings Rates by Skill Group, 1994-2014



Notes: We calculate the private savings rate for employed workers based on household-level survey data of the German Socioeconomic Panel (SOEP). We define a low-skilled employed worker as a person with up to 13 years of education, a high-skilled employed worker has more than 13 years of education, and drop workers with less than 10 years of education as their savings are close to zero.

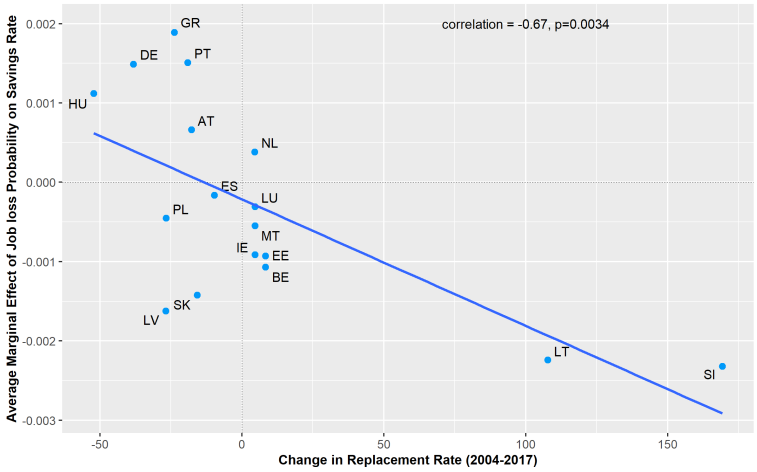
B.2 Cross-Country Evidence

Moreover, we provide additional empirical evidence of the relationship between changes in the replacement rates and the strength of the precautionary savings motive across countries. Based on the *Household Finance and Consumption Survey (HFCS)*, we first construct a measure for the strength of the precautionary savings motive due to job loss. We estimate the effect of an increase in the subjective probability of job loss and the propensity to save for unexpected events across EU countries at the household level i. We estimate the following logit model for k countries:

$$saving\ for\ unexpected\ events_{i,k} = \alpha_{0,k} + \alpha_{1,k} P(job\ loss)_{i,k} + \sum_{j=1}^{J} \beta_{j,k} X_{i,k} + \epsilon_{i,k}, \qquad \text{(B.1)}$$

where $saving\ for\ unexpected\ events_{i,k}$ is a binary variable indicating whether a household saves for unexpected events. The key explanatory variable, $P(job\ loss)_{i,k}$, represents the household head's perceived risk of job loss. X_i summarizes household-level control variables such as gen-

Figure 17: Change in Replacement Rates and Precautionary Savings



Notes: the x-axis depicts the change in the replacement rate between 2004 and 2017 for unemployed after 13 months of unemployment who are single earnings without children and have earned the average wage prior to unemployment, the y-axis shows the estimated country-specific average marginal effect of the subjective job loss probability on the probability to save for unexpected events (i.e. the marginal effect of α_k). The blue line denotes the linear regression line.
Data Sources: Household Finance and Consumption Survey, wave 2017 and OECD.

der, marital status, age, income, liquid assets, household size, and education level.
We focus on the average marginal effect (AME) of the estimated coefficient $\alpha_{1,k}$, which we interpret as a measure of the strength of the precautionary savings motive due to labor income risk in each country k. Figure 17 plots the country-specific AMEs of the subjective probability of job loss on the probability of saving for unexpected events, against the variation in country-level unemployment replacement rates between 2004 and 2017. The negative correlation indicates that households in countries that experienced a reduction in their replacement rates tend to show a stronger precautionary savings motive due to labor market risk.[47] In Figure **??** in Appendix **??** we further show that countries that show a stronger precautionary savings motive experienced increases in their current account.
Moreover, Table 10 in Appendix B.3 illustrates the results of a time series analysis examining the influence of the German Hartz IV reform on the country's current account to GDP ratio. In our preferred model specification, the reform contributed to a notable increase of 1.75 percentage points in the German CA/GDP ratio during the period from 2005 to 2014.g

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

Table 10 presents the impact of the German Hartz IV reform on the German current account to GDP ratio using a quarterly time series model with one lag of the dependent variable. The models (Model 1 to Model 4) vary in specifications, with controls for GDP growth, the interest rate, the CPI-based REER, an export price index, export growth, the terms of trade, and lagged government debt.

[47] Note that if we exclude Slovenia (SI) and Lithuania (LT), the correlation amounts to −0.50.

The Hartz IV reform, represented as a dummy variable, shows a significant and positive effect across all models (with standard errors clustered at the household level), indicating its substantial impact on improving the current account/GDP ratio. In the baseline specification (Model 1), with the Hartz IV dummy from 2005 to 2014, the reform leads to a 1.75 percentage point increase in the ratio, which is consistent in magnitude across other models. Notably, Model 4 uses a shorter time frame for the Hartz IV dummy (2005-2010), offering a slightly different perspective on the reform's impact during that specific period.

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

	Model 1	Model 2	Model 3	Model 4
Dependent Variable: CA/GDP	Dummy: 2005-14	Dummy: 2005-14	Dummy: 2005-14	Dummy: 2005-10
Lag (CA/GDP)	0.889***	0.893***	0.809***	0.870***
	(0.053)	(0.049)	(0.099)	(0.067)
GDP Growth	-0.008	-0.039	0.009	0.008
	(0.070)	(0.074)	(0.105)	(0.070)
Interest rate	-0.455***	-0.215	-0.445**	-0.513***
	(0.116)	(0.141)	(0.189)	(0.121)
REER (CPI-based)	0.141***		0.229**	0.150***
	(0.052)		(0.089)	(0.053)
Export priceindex	0.417***	0.450***	0.515***	0.543***
	(0.088)	(0.098)	(0.174)	(0.096)
Export growth	0.096***	0.099***	0.100**	0.095***
	(0.033)	(0.033)	(0.046)	(0.033)
Hartz IV - Dummy	**1.748*** **	**1.690*** **	**1.865*** **	**1.208*** **
	(0.353)	**(0.327)**	**(0.454)**	**(0.431)**
Terms of Trade		0.210**		
		(0.087)		
Lag (log Government Debt,1)			-2.286	
			(4.392)	
Constant	-49.627***	-67.191***	-141.784**	-141.784**
	(11.713)	(16.150)	(61.572)	(61.572)
Observations	84	84	63	84
$R\hat{2}$	0.983	0.982	0.972	0.983
Wald chi2	1164.70	914.84	342.75	800.36
Prob > chi2	0.00	0.00	0.00	0.00
AIC	180.93	183.69	151.20	182.07
BIC	202.80	205.56	172.63	203.95

Note: "Hartz 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. The Hartz IV-Dummy in Model 4 ranges only from 2005 to 2010. Standard Errors are clustered at the household level.*p<0.1; **p<0.05; ***p<0.01

C Model Appendix

C.1 Derivation of the Current Account Identity

- Asset Market Clearing

$$q_t A_t = \bar{k}_t + p_t + nfa_t \longleftrightarrow A_t = (1 + r - \delta)(\bar{k}_t + p_t + nfa_t) \tag{C.1}$$

- Aggregate Budget Constraint in relative prices

$$\frac{p_t^H}{P_t}c_t^H + \frac{p_t^F}{P_t}c_t^F + q_t A_{t+1} = A_t + w_t N_t$$

Plug in the asset market clearing condition

$$\frac{p_t^H}{P_t}c_t^H + \frac{p_t^F}{P_t}c_t^F + (\bar{k}_{t+1} + p_{t+1} + nfa_{t+1}) = (1+r-\delta)(\bar{k}_t + p_t + nfa_t) + w_t N_t$$

$$\frac{p_t^H}{P_t}c_t^H + \frac{p_t^F}{P_t}c_t^F + (\bar{k}_t + p_t + nfa_t) = (1+r-\delta)(\bar{k}_{t-1} + nfa_{t-1}) + d_t + p_t + w_t N_t$$

$$\frac{p_t^H}{P_t}c_t^H + \frac{p_t^F}{P_t}c_t^F + (\bar{k}_t + nfa_t) = (1+r-\delta)(\bar{k}_{t-1} + nfa_{t-1}) + d_t + w_t N_t$$

- Aggregate Profits and real dividends

$$\int \pi(a;z,S) fe(a,S) da = \frac{p^H}{P} z F(\tilde{k})(1-u) - r\frac{\bar{k}}{(1-u)}(1-u) - w(1-u)$$

$$d = \int \pi(a;z,S) fe(a,S) d - \kappa^v V$$

- Plug in for real dividends:

$$\frac{pH_t}{P_t}cH_t + \frac{pF_t}{P_t}cF_t + (\bar{k}_t + nfa_t) = (1+r-\delta)(\bar{k}_{t-1} + nfa_{t-1}) + \frac{p^H}{P_t}z_t F(\tilde{k}_t)N_t - r\frac{\bar{k}_t}{N}{}_t N_t$$

$$-\kappa^v V - w_t N_t + w_t N_t$$

$$\frac{pH_t}{P_t}cH_t + \frac{pF_t}{P_t}cF_t + (\bar{k}_t + nfa_t) = (1-\delta)(\bar{k}_{t-1}) + (1+r-\delta)nfa_{t-1} + \frac{p^H}{P_t}z_t F(\tilde{k}_t)N_t - \kappa^v V$$

Rearranging gives

$$\underbrace{\frac{p^H}{P_t}z_t F(\tilde{k}_t)N_t}_{Y_t} = \underbrace{\frac{pF_t}{P_t}cF_t + \frac{pH_t}{P_t}cH_t}_{C_t} + I_t + \underbrace{nfa_t - (1+r-\delta)nfa_{t-1}}_{-TD_t} + \kappa^v V_t$$

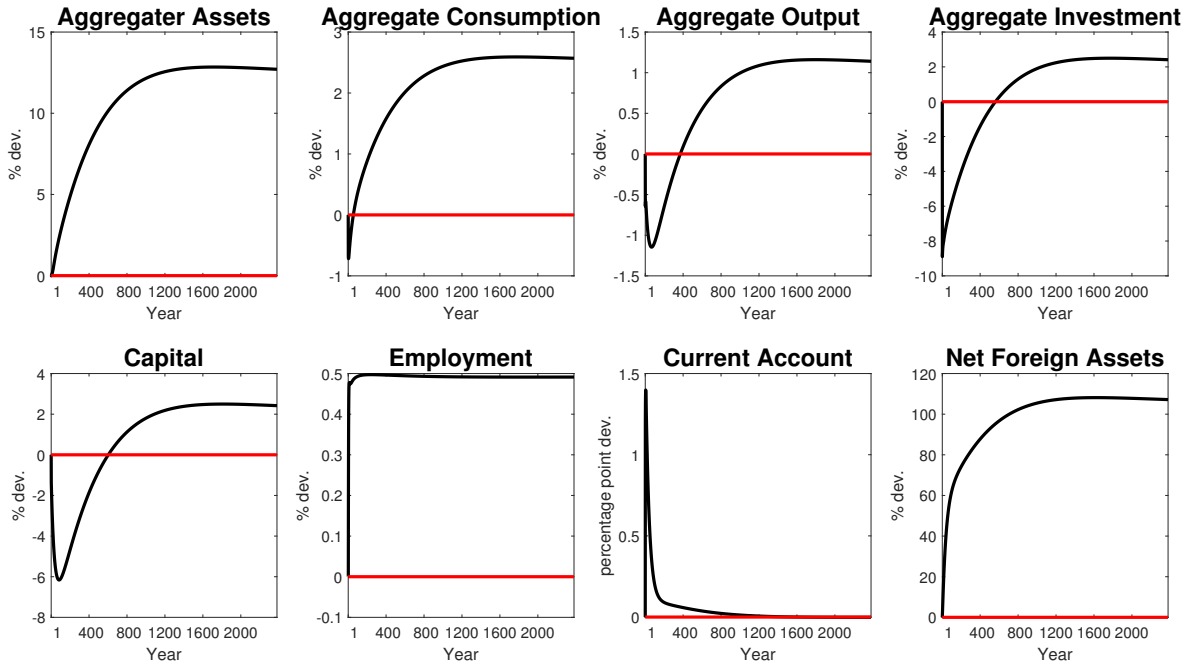
Domestic good market clearing:

$$Y_t = c_t^H + c_t^{H*} + I + \kappa^v V_t$$

Where we define the trade deficit in units of consumer prices:

$$TD_t \equiv C_t - \frac{p_t^H}{P_t}(Y_t - I_t - \kappa^V V_t), \tag{C.2}$$

Figure 18: Long-run Effects Reform Effects



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

From this we can see that:

$$TD_t = \frac{pH_t}{P_t} cH_t + \frac{p_t^F}{P_t} c_t^F - \frac{p_t^H}{P_t} c_t^H - \frac{p_t^H}{P_t} c_t^{H*} \tag{C.3}$$

$$= \underbrace{\frac{p_t^F}{P_t} c_t^F}_{Imports} - \underbrace{\frac{p_t^H}{P_t} c_t^{H*}}_{Exports} \tag{C.4}$$

The current account identity is:

$$CA \equiv nfa_t - nfa_{t-1} = (1 + r - \delta) nfa_{t-1} - TD_t$$

C.2 Long-run Model Responses

Figure 18 depicts the long-run aggregate reform effects. Note that aggregate investment decreases in the short run because of a capital-labor substitution effect: Lower wages make labor less costly relative to capital which is priced at the fixed interest rate. Thus, in the setting of a small open economy, where the world interest rate is exogenous, the aggregate capital stock declines initially and only increases gradually. Once wages pick up again, investment rises to a higher steady state level, which lies below the level of aggregate domestic savings. Furthermore, we observe an initial drop in aggregate output. This short-run contractionary effect can be explained by lower domestic demand and the drop in aggregate investment. As soon as domestic consumption recovers, output increases again and reaches a higher level in the post-reform steady state.

C.3 The Representative Agent

In the representative agent version of our model, all consumers are perfectly insured. The maximization problem of a consumer hence reads:

$$V_t^E = \max_{\{C_t, a_{t+1}\}} U(C_t) + \beta V_{t+1}^E$$

subject to the budget constraint

$$C_t + a_{t+1} = (1-\tau_t) w_t N_t + U_t^S \kappa_t^B + U_t^L \kappa_t^L + \frac{a_t}{1+\pi_t} + \frac{R \cdot \exp^{-\psi(NFA_{t-1} - \overline{NFA})} NFA_{t-1}}{1+\pi_t}$$

This results in the FOCs:

$$C_t : \lambda_t = C_t^{-\sigma}$$
$$a_t : \lambda_t = \beta E_t \left[\lambda_{t+1} \exp^{-\psi(NFA_{-1} - \overline{NFA})} \frac{R}{1+\pi_{t+1}} \right]$$

Rearranging gives the Euler equation for optimal asset holdings:

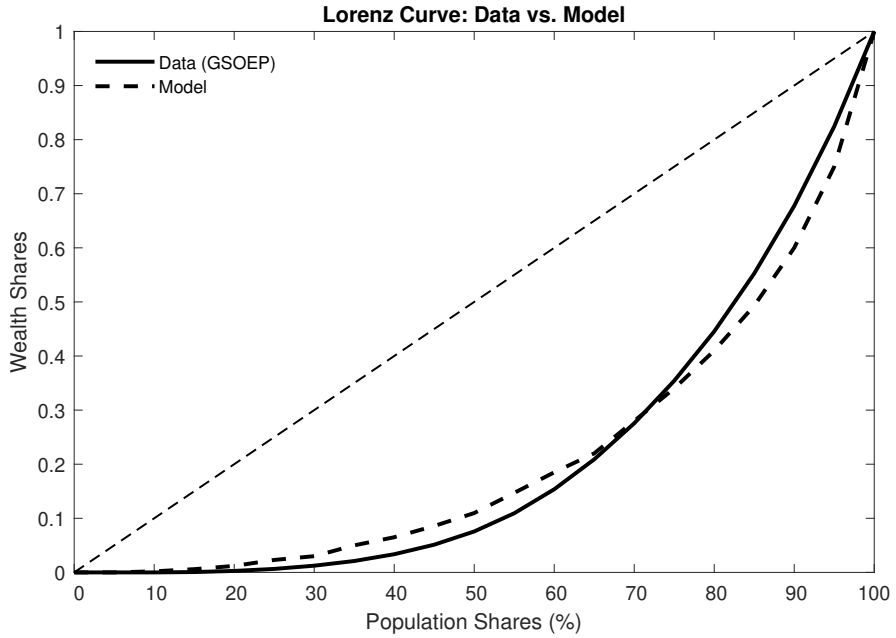
$$\frac{1}{R} = \beta E_t \left[\frac{\lambda_{t+1}^{-\psi(NFA_{-1} - \overline{NFA})}}{\lambda_t} \frac{1}{1+\pi_{t+1}} \right]$$

The risk premium on bond holdings also enter the equation for net foreign asset holding:

$$P_t NFA_t = R \cdot \exp^{-\psi(NFA_{t-1} - \bar{NFA})} P_{t-1} NFA_{t-1} + NX_t,$$

The rest of the representative agent version is identical to our heterogeneous agent model.

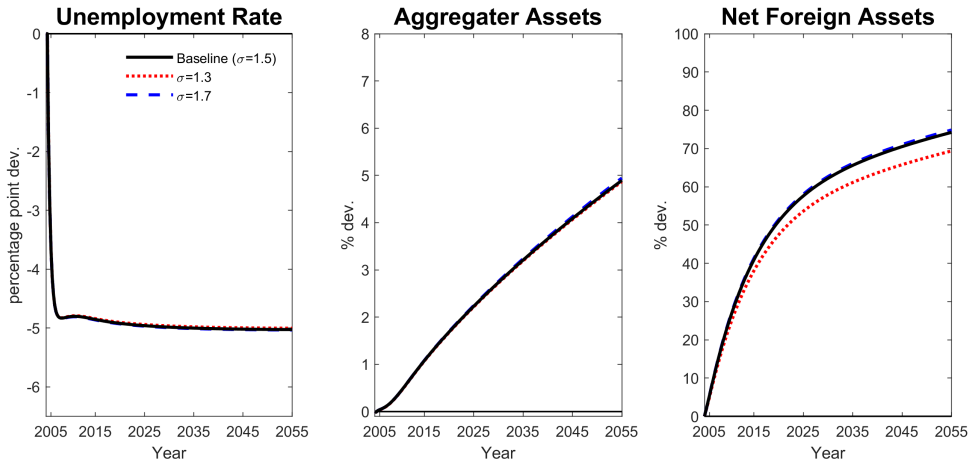
Figure 19: Lorenz Curve



Notes: The empirical Lorenz curve based on the German Socioeconomic Panel (GSOEP, wave of the year 2002) is depicted by the solid line. The Lorenz curve based on the pre-reform steady state aggregate wealth distribution is illustrated by the dashed line.

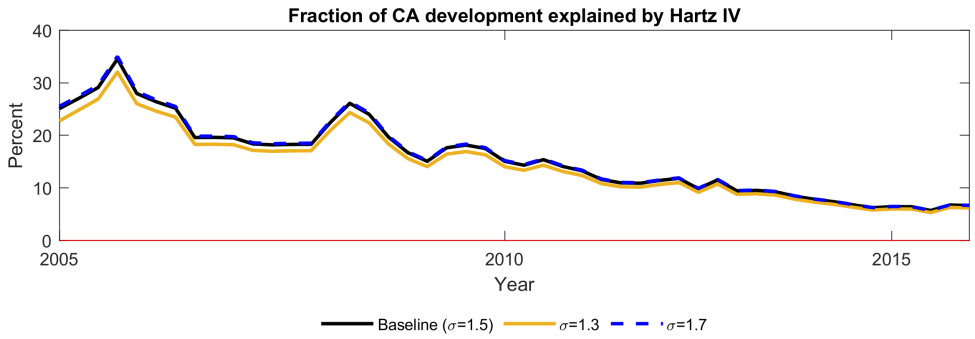
D Further Figures

Figure 20: Variation in the Parameter of Risk Aversion



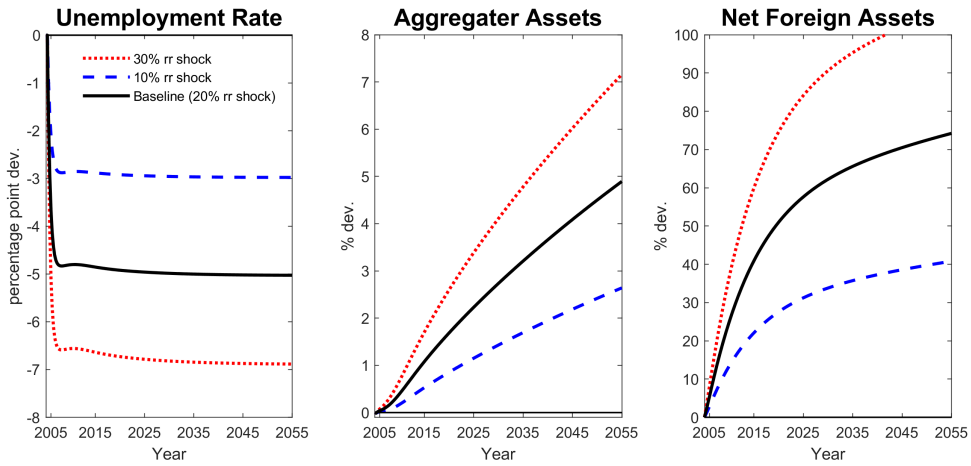
Notes: The solid black line depicts selected model responses to a simulation of the labor market reform for our baseline choice of the parameter of risk aversion $\sigma_c = 1.5$. The dotted red line illustrates model responses for $\sigma_c = 1.3$, the dashed blue line for $\sigma_c = 1.7$.

Figure 21: Current Account Dynamics: Variation in the Parameter of Risk Aversion



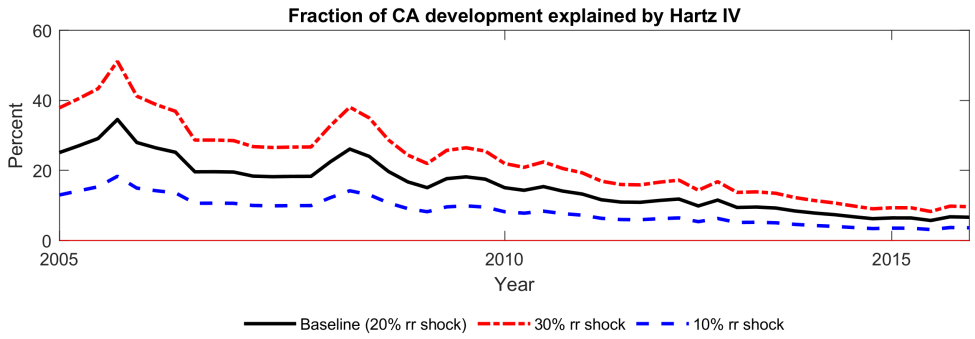
Notes: Reform contributions explained by our model as a share of the total CA/GDP developments in Germany. The solid black line depicts the contribution based on our baseline choice of the parameter of risk aversion $\sigma_c = 1.5$. The dotted red line illustrates reform contributions for $\sigma_c = 1.3$, the dashed blue line for $\sigma_c = 1.7$.

Figure 22: Variation in the Decline of the Replacement Rate for LTU



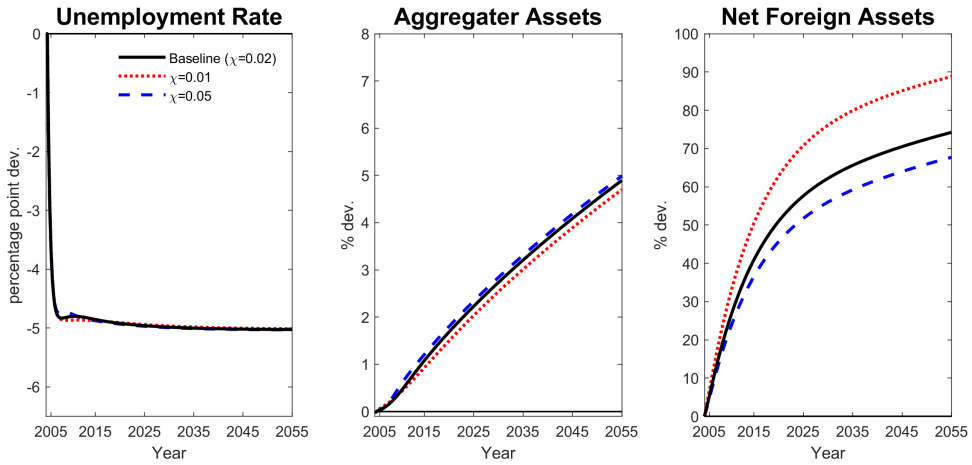
Notes: The solid black line depicts selected model responses to a simulation of the labor market reform for our baseline shock size regarding the decline in the replacement rate for long term unemployment benefit recipients of 20 percent. The dotted red line illustrates model responses for a shock size of 30 percent, the dashed blue line for 10 percent.

Figure 23: Current Account Dynamics: Variation in the Decline of the Replacement Rate for LTU



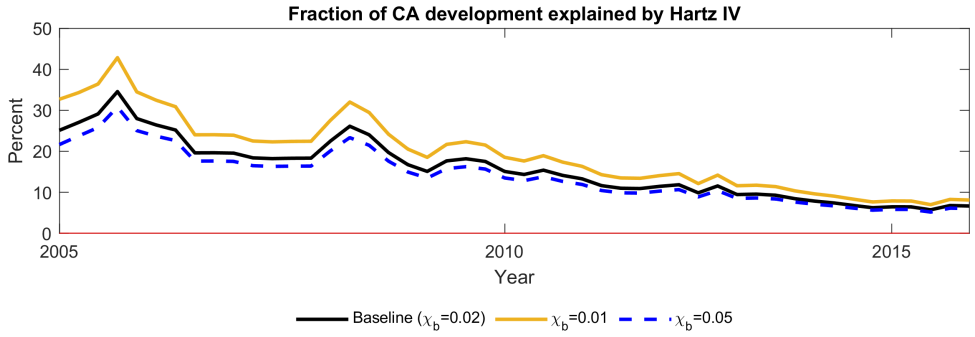
Notes: Reform contributions explained by our model as a share of the total CA/GDP developments in Germany. The solid black line depicts the contribution based on our baseline choice of the shock size regarding the decline in the replacement rate for long term unemployment benefit recipients of 20 percent. The dotted red line illustrates the reform contribution for a shock size of 30 percent, the dashed blue line for 10 percent.

Figure 24: Variation in the Elasticity of the Fiscal Rule



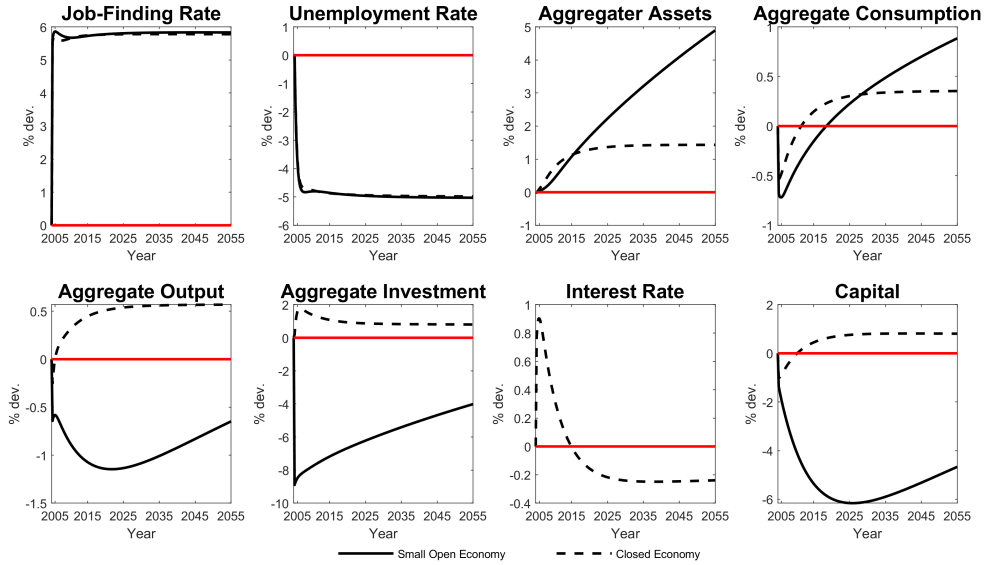
Notes: The solid black line depicts selected model responses to a simulation of the labor market reform for our baseline choice of the sensitivity of the fiscal rule to deviations from the debt-to-output ration of $\chi_b = 0.02$. The dotted red line illustrates model responses for $\chi_b = 0.01$, the dashed blue line for $\chi_b = 0.05$.

Figure 25: Current Account Dynamics: Variation in the Elasticity of the Fiscal Rule



Notes: Reform contributions explained by our model as a share of the total CA/GDP developments in Germany. The solid black line depicts the contribution based on our baseline choice of sensitivity of the fiscal rule to deviations from the debt-to-output ration of $\chi_b = 0.02$. The dotted red line illustrates reform contributions for $\chi_b = 0.01$, the dashed blue line for $\chi_b = 0.05$.

Figure 26: 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).