Labor Market Reforms, Precautionary Savings, and Global Imbalances[†]

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Abstract

This paper establishes a link between labor market reforms and the increase in net foreign assets via a precautionary savings channel. We build a heterogeneous agent model of a small open economy with labor market frictions. We apply our model to evaluate a German unemployment benefits reform on Germany's current account. We find that the labor market reform contributes significantly to the increase of the reforming country's net foreign asset position. The core mechanism works via a precautionary savings channel. Consumers face uninsurable income risk in case of unemployment. In response to a reduction in the generosity of unemployment benefits, they want to insure against this risk. Agents start to accumulate domestic and foreign assets. Together with higher international competitiveness induced by lower wages, the net foreign asset position increases permanently. After the reform, all consumers are wealthier but the welfare effects are distributed unequally among agents.

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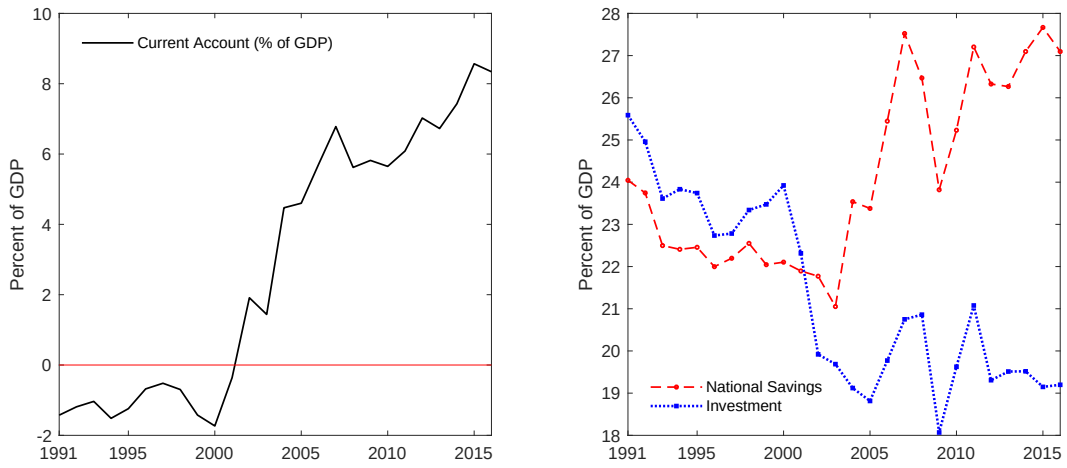
1 Introduction

Among economists and in public policy debates, the issue of global imbalances has returned to the agenda with momentum.[1] A prominent example often referred to in these discussions is the high and persistent current account surplus in Germany (see, for example, The Economist, 2017b). During the 1990s, the German current account fluctuated around -1% of GDP. At the turn of the millennium, it started improving and reached a record level of 8.6 % of GDP in 2016. By the definition of the current account (CA), this is connected to a divergence of aggregate savings and investment (see Figure 1). Potential reasons for the large CA surplus are the introduction of the euro, financial integration, economic growth in emerging markets, higher foreign demand for German goods, population aging, or labor market reforms. In this paper, we focus on the effect effects of labor market reforms on global imbalances. We build on the German experience and take a reduction in the generosity of unemployment benefits (the 'Hartz IV' reform) as an example. As an empirical motivation, Bertola and Lo Prete (2015) show in a cross-country study that countries with recent labor market deregulations tend to run current account surpluses.

Figure 1: Germany's Current Account, Savings and Investment



Notes: Savings refer to gross national savings and are defined as disposable income minus consumption and net transfers. Data sources: German National Statistical Office (2017) and Bundesbank (2017).

The idea for the present paper is that consumers can only partially insure against labor market earnings risk. Risk-averse agents want to smooth consumption over their lifetime. In response to a reduction in unemployment benefits, leading to an increase in income risk in case of unemployment, agents want to self insure against this risk. Under incomplete asset markets, they do so by accumulating precautionary savings. In an open-economy setting, households have access to international bonds, which increases the reforming country's net foreign asset position. In addition, a competitiveness channel is at work. Less generous unemployment benefits deteriorate workers' bargaining position and wages fall. Lower wages make production of domestic goods cheaper, which leads to higher competitiveness in the home country and boosts exports.[2]

[1] see the 'External Sector Report' by the International Monetary Fund (2020)

[2] In October 2014, Paul Krugman summarized the debate as follows: *"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."*

Therefore, in a setting with incomplete asset markets and uninsurable labor income risk, a reform of the unemployment benefit (UB) system can lead to surpluses of the reforming country's current account.

Existing theoretical contributions disagree on the existence and magnitude of such a relationship. Most modern open-economy models are capable of linking lower labor costs to higher international competitiveness. However, they do not find a link to the consequential – and notable – improvements in the current account and the net foreign asset position. This especially holds for the long run (see, among others, Busl and Seymen 2013, Dao, 2013, Cacciatore, Duval, Fiori, and Ghironi, 2016 and Gadatsch, Stähler, and Weigert, 2016). The first and foremost reason for this is that most of the relevant studies use the common open-economy representative agent model in the vein with Obstfeld and Rogoff (1995). This framework has two major limitations in the present context. First, all workers are perfectly insured against labor market risk as they are part of one representative family. As a result, there is no direct incentive to hold precautionary savings in steady state. We argue that allowing for an insurance motive is crucial if one is interested in changes in the current account, defined as savings minus investment. The second limitation is a technical one. As stressed by Ghironi (2006), this way of modeling is not able to pin down a unique, endogenously determined steady-state level of net foreign assets. The implied non-stationary dynamics of net foreign assets has led much of the literature to ignore the relevance of changes in the net foreign asset position as an important transmission mechanism. In general, modelers assume additional frictions on the international financial markets whenever holdings of net foreign assets exceed some exogenously fixed reference level (see Schmitt-Grohe and Uribe, 2003, Hunt and Rebucci, 2005, Lubik, 2007, and Benigno, 2009). That introduces a link between consumption and the net foreign asset position to achieve stationarity. But the reference level is set exogenously and independent of policy. Therefore, one can question the usefulness of these assumptions to study international macroeconomic issues when analyzing structural (policy) reforms (see also Ghironi, 2006, 2008, for a discussion).[3]

Against this background, we build a small-open economy heterogeneous agent model with search frictions. The labor market is characterized by frictions in line with Pissarides (2000) and features a two-pillar unemployment benefit. We apply the model to quantify the contribution of the far-reaching German labor market reform (Hartz IV) implemented in the years 2005 and 2006 on Germany's current account surplus.[4] In our model, risk-averse consumers face employment risk against which they can only insure partially by building precautionary savings.[5] As agents want to smooth consumption over their lifetime, they have an incentive to save more in response to the reduction in the generosity of unemployment benefits. From an open economy

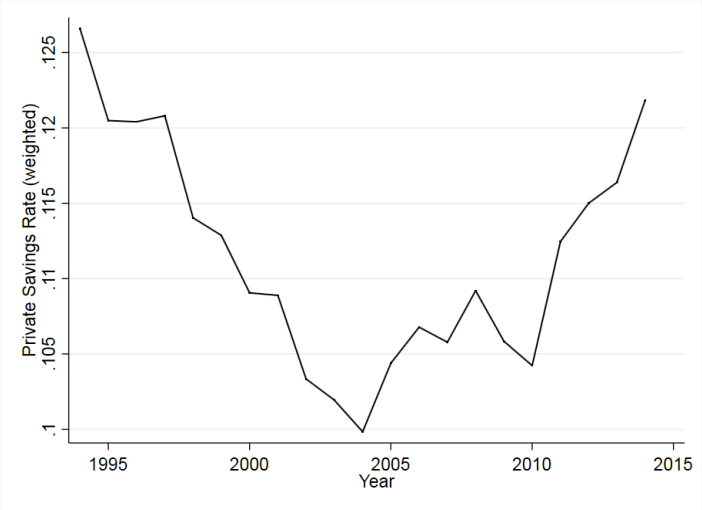
[3] To overcome this problem, an endogenous savings choice that pins down the level of net foreign assets in steady state is necessary. This can be done in an overlapping-generations framework (see Gale, 1971, Ferrero, 2010, Ghironi, 2006, 2008, Di Giorgio and Nisticò, 2013, or Di Giorgio and Traficante, 2018, for a discussion), in a framework with limited cross-sectional heterogeneity (in the spirit of Challe and Ragot (2016) and Hochmuth, Moyen, and Stähler (2019b) in a previous version of this paper), or in a heterogeneous agent framework (in the spirit of Krusell, Mukoyama, and Şahin, 2010).

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

[5] Our approach follows Krusell et al. (2010) who combine an Aiyagari (1994)-type incomplete asset market with labor market frictions.

perspective, our framework allows to establish a link between the labor market reform and the evolution of the German net foreign asset position via a precautionary savings channel.
Figure 2 highlights the empirical relevance of such a precautionary savings channel. It depicts the private savings rate for full-time employed household heads based on data of the German Socioeconomic Panel (SOEP). From the mid-1990s to 2004, the private savings rate showed a declining trend. By the year 2005, when the Hartz IV reform was implemented, we observe a reversal of this trend and an increase in the private savings rate.[6]

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



Notes: We calculate the private savings rate based on household-level survey data of the German Socioeconomic Panel (SOEP). The calculation follows Stein (2009), for details see Appendix B.

Consumer heterogeneity plays an important role in evaluating the macroeconomic consequences of the reform. If there is a sizable mass of consumers with low wealth, the response of aggregate consumption differs substantially to the response in the representative agent case (see Krueger, Mitman, and Perri, 2016a). An asset-poor consumer is less well insured against the earnings risk by the time the reform is implemented. She strongly reduces consumption to build up additional precautionary savings. Thus, the sign and magnitude of the aggregate consumption reaction depends on the underlying wealth distribution of consumers.
We further document the importance of taking into account 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, reducing wealth inequality in the economy. However, the welfare gains and losses are distributed unequally among agents. Why? Consider two types of agents, an asset-rich consumer, and an asset-poor consumer. The asset poor consumer has a high marginal propensity to consume (MPC) and depends heavily on labor income. This is not the case for a wealthy low MPC

[6] Clearly, this descriptive evidence does not allow statements on the underlying reasons for the increase in the private savings rate. For example, Ruppert and Stähler (2020) highlight the importance of retirement savings. Unfortunately, the SOEP data does not provide information on the amount of precautionary savings (e.g. due to labor market risk) for this period. Still, our model simulations suggest that at least part of the reversal in private savings was driven by the Hartz reforms. For a more detailed discussion and more information on the SOEP and the calculation of the savings rate, see Appendix B.

consumer. After the reform, all agents face a drop in their income in case of unemployment. However, the poor consumer faces a large contraction in consumption as she has low wealth and cannot smooth her consumption based on her savings. Therefore, the asset-poor consumer starts to build up savings, but suffers most in terms of foregone consumption. In addition, as the fall-back utility of workers declines, they accept lower wages in the short run. Again, this affects the asset-poor, high MPC consumer disproportionately as she depends more on labor income compared to wealthier agents. We find that along the transition to the post-reform equilibrium, all consumers are suffering from the reform. However, once the post-reform equilibrium is reached, employed consumers are in favor of the reform because labor market outcomes have improved. Evaluating the reform effects in a framework with a representative agent would yield a completely different result: Due to perfect consumption insurance and higher aggregate employment, there are welfare gains only.

We contribute to the existing literature in several dimension. First, we add search and matching frictions to a heterogeneous agent small open economy model. As such, we combine elements of de Ferra, Mitman, and Romei (2020)'s heterogeneous-agent small-open economy model with an incomplete-markets model featuring labor market frictions (as in Krusell et al., 2010). This modeling choice allows us to overcome the problem of steady-state indeterminacy of net foreign assets by including an endogenous savings choice, and, as such, a precautionary savings motive. Second, we use our model to evaluate the effects of structural labor market reforms the current account of the reforming country. In our quantitative exercise, we quantify the contribution of the German Hartz IV reform on its current account. We show that the existing literature underestimates the contribution of these reforms on global imbalances. Previous studies do not find a link between labor market reforms and increasing net foreign asset positions. Our model is capable to attribute, in the short run, on average 8% of the observed current account increase to the reforms. Third, we document the redistributive and welfare effects of a labor market reform in a small open economy. We find that all consumers are wealthier after the reform, but the welfare effects are distributed unequally among agents.

The reform leads to positive effects on the labor market as workers' willingness to accept lower wages fosters job creation and employment. This labor market effect slightly dampen the demand for precautionary savings. Nonetheless, demand for assets is high and cannot be supplied domestically. Consequently, agents buy international bonds. This increases the net foreign asset position. Besides the precautionary savings channel, higher competitiveness induced by lower wages in the reforming country further leads to an increase in the current account. Hence, contrary to most existing theoretical studies focusing on the effects of labor market reforms on global imbalances (among others, Busl and Seymen, 2013, Dao, 2013, Cacciatore et al., 2016 and Gadatsch et al., 2016), we find a quantitatively important and permanent effect on the German net foreign asset position and can explain a significant share of the increase in the German current account since the year 2005.

1.1 Related Literature

This paper is connected to multiple areas of the literature. First, it relates to studies discussing the link between labor market reforms and global imbalances. Second, it relates to the literature that addresses uninsurable labor market risk with precautionary savings in Bewley-Huggett-Aiyagari-type incomplete markets models.[7] And third, we contribute to the literature of precautionary savings and the linkages to international asset trade.

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 stands in contrast to Busl and Seymen (2013) and Gadatsch et al. (2016) who show in models with frictional labor markets that the Hartz reforms, now modeled as an actual decrease in unemployment benefit payments, had no effect on Germany's build-up of international assets. Going beyond the Hartz reforms, Cacciatore et al. (2016) study the effects of labor market deregulations in general and find quantitatively small effects on the current account. The studies discussed so far have in common that workers are perfectly insured within a family, and there is no precautionary savings motive. We argue that allowing for an endogenous savings motive (for example, via a precautionary savings channel) is crucial as this pins down the level of net foreign assets in steady state.

There are several other – also empirical – contributions, which focus on the general effect of labor market reforms on the current account. Kennedy and Slok (2005) provide empirical reduced-form evidence that a deregulation on the labor market (such as Hartz IV) 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. This effect counteracts the increase in net exports and 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 provide a theoretical model in which the link between a country's current account position and labor market institutions depends on financial market imperfections. Similar to our study, 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).

Our work is further related to theoretical papers analyzing the interactions between unemployment risk and precautionary savings in a heterogeneous-agent framework (see Challe, Matheron, Ragot, and Rubio-Ramirez, 2017, Challe and Ragot, 2016, Krusell et al., 2010, Heathcote and Perri, 2018, as well as McKay and Reis, 2016, McKay, 2017, McKay, Nakamura, and Steinsson, 2017, Ravn and Sterk, 2017, Ravn and Sterk, forthcoming).[8] These papers are based on a

[7] see Bewley (1986), Huggett (1993), and Aiyagari (1994)

[8] Further related are Krueger et al. (2016a) and Krueger, Mitman, and Perri (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) focus on the effects of income uncertainty on households' precautionary savings.

closed-economy framework and, therefore, are silent on the effects in an international dimension.

Our paper is further 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, Hartung, Jung, and Kuhn, 2018 and Hochmuth, Kohlbrecher, Merkl, and Gartner, 2019a). These papers evaluate the reform effects in a closed economy setting.

We see our paper complementary to those existing papers by providing insight on how much the far-reaching German unemployment benefits reform (Hartz IV) has contributed to the increase in the German current account position via a precautionary savings motive.

The rest of the paper is structured as follows. The next Section derives an open economy heterogeneous agent model with matching frictions. We explain the calibration in Section 3. Section 4 shows our results. We discuss the effects of consumer heterogeneity and welfare in Section 5. Section 6 concludes.

2 The Model

Time is discrete. There is a continuum of infinitely lived consumers of measure one. A consumer discounts the future with factor β and derives utility from consumption. 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 distinction between short- and long-term unemployed allows to replicate the German unemployment benefit system and to simulate the labor market reform realistically. The small-open economy is part of a currency union and takes the interest rate as given.

Every firm hires one worker and operates on a competitive product market. The firm uses capital and labor as production inputs. The firm's capital stock depreciates at rate δ.

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. The resulting worker-firm pairs are bilateral monopolies. Wages are determined via Nash bargaining between the firm and a labor union. 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.[9] All agents hold the same portfolio composition while they differ in the total value of their investment. Consumers face a borrowing constraint.

[9] Note that 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.

2.1 Labor Market Matching

All unemployed workers search on the same labor market. Each period, vacant jobs (V) and unemployed workers (U) are matched randomly via a Cobb-Douglas matching function which is specified as

$$M_t = \chi V_t^{1-\eta} U_t^{\eta}, \tag{2.1}$$

where χ denotes the matching efficiency and η the matching elasticity. The probability that a vacancy can be filled in the current period is

$$\lambda_t^f(\theta_t) = \frac{M_t(V_t, U_t)}{V_t} = \chi\Big(\frac{V_t}{U_t}\Big)^{-\eta} = \chi\,\theta_t^{-\eta}, \tag{2.2}$$

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

$$\lambda_t^w(\theta_t) = \frac{M_t(V_t, U_t)}{U_t} = \chi\Big(\frac{V_t}{U_t}\Big)^{1-\eta} = \chi\,\theta_t^{1-\eta}. \tag{2.3}$$

We assume that job destruction is exogenous and occurs with constant probability s. The aggregate law of motion for employment is given by

$$N_{t+1} = (1-s)N_t + M_t. \tag{2.4}$$

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 and long-term unemployment benefit recipients are:

$$U_{t+1}^S = (1-\pi^L)(1-\lambda_t^W)U_t^S + sN_t, \tag{2.5}$$
$$U_{t+1}^L = \pi^L(1-\lambda_t^W)U_t^S + (1-\lambda_t^W)U_t^L, \tag{2.6}$$

where π_L denotes the exogenous probability to switch from short-term into long-term unemployment. It follows that $U_t = U_t^S + U_t^L$.

2.2 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. We denote aggregate assets $\bar{a}$, which are given by integrating over all workers

with asset level 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

$$p_t = \frac{d_{t+1} + p_{t+1}}{1 + r - \delta}, \tag{2.7}$$

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:

$$q = \frac{1}{1 + r - \delta}. \tag{2.8}$$

We define the consumer's individual assets a

$$a_t \equiv (1 + r - \delta)(k_t + b_t + NFA_t) + (p_t + d_t)x_t. \tag{2.9}$$

The investment fund operates subject to the loanable funds constraint

$$k_{t+1} = \frac{\bar{a}_{t+1} - NFA_{t+1} - b_{t+1} - p_{t+1}}{1 + r - \delta}. \tag{2.10}$$

2.3 Consumers

All consumers have CRRA preferences over consumption

$$U = E_0 \sum_{t=0}^{\infty} \beta^t U(C_t) \quad \text{where} \quad U(C_t) = \frac{C_t^{1-\sigma}}{1-\sigma}. \tag{2.11}$$

where C_t is a CES aggregate of home and foreign consumption goods. In the small open economy, households 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

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

where $C_{H,t}$ denotes home goods consumed domestically and $C_{F,t}$ denotes goods produced in the Rest of the Eurozone 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 consumer has access to assets a including international assets. The consumers' individual state variable is a. Furthermore, the aggregate state is given by the asset distribution of consumers by employment status, Z.
Consumers takes prices and wages as given and choose consumption and asset holdings.
Employed Consumers: The recursive formulation of the employed consumer's problem ($i = E$) can be written

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

subject to

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

where P denotes the aggregate price level, C is the consumption of employed workers and the borrowing constraint $\underline{a}$.
Short-term Unemployed Consumer: A short-term unemployed consumer ($i = S$) receives unemployment benefits κ^S which depend the replacement rate for short-term unemployed b^S and on the equilibrium wage w, $\kappa^S = b^S(1-\tau)w$. 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

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

subject to

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

Long-term Unemployed Consumer: A long-term unemployed consumer ($i = L$) receives less generous unemployment benefits $\kappa^L = b^L(1-\tau)w$.[10] She either finds a job with probability λ_w in the next period or remains long-term unemployed. The problem is:

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

subject to

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

2.4 Firm

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

$$y_t = \tilde{k}_t^{\alpha}. \tag{2.12}$$

[10] This implies that $b^S > b^L$.

where $\tilde{k}_t$ is the amount of capital per worker and defined as the ratio of aggregate capital per employed worker $\tilde{k}_t = \frac{k_t}{N_t}$. The aggregate output is then given by $Y_t = y_t N_t$. The real per-period firm profit for a worker is defined as

$$\Pi_t = \frac{p_t^H}{P_t} \tilde{k}_t^{\alpha} - r\,\tilde{k}_t - w_t, \tag{2.13}$$

The dividends paid out are given by aggregate profits (per-worker firm profits Π_t times the number of employed workers N_t) minus vacancy posting costs:

$$d_t = \Pi_t N_t - \kappa^{\upsilon} V_t, \tag{2.14}$$

where κ^{υ} denote real vacancy posting costs. The firm maximizes the present value of the discounted stream of dividends. The firm's first-order conditions imply

$$r = \frac{p_t^H}{P_t} \alpha \tilde{k_t}^{\alpha-1}, \tag{2.15}$$

$$J_t = \frac{p_t^H}{P_t} \tilde{k_t}^{\alpha} - r\,\tilde{k}_t - w_t + E_t\left[q(1-s)J_{t+1}\right]. \tag{2.16}$$

Note that the real return to capital r is fixed on the international market in the setting of a small open economy. Equation (2.16) corresponds to the marginal value of an additional employed worker. The job-creation condition assuming free market entry is given by

$$\frac{\kappa^{\upsilon}}{\lambda_t^f} = q(1-s)\,E_t[J_{t+1}]. \tag{2.17}$$

2.5 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).[11]

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 value of a match for the union is

$$\begin{aligned} \mathscr{W}_t = w_t - \left[\frac{\kappa_t^S U_t^S}{U_t} + \frac{\kappa_t^L U_t^L}{U_t}\right] \\ + \beta\, E_t\left[(1-s)\mathscr{W}_{t+1}^E + s\left((1-\pi_L)\frac{U_{t+1}^S}{U_{t+1}}\mathscr{W}_{t+1}^S + \pi_L \frac{U_{t+1}^L}{U_{t+1}}\mathscr{W}_{t+1}^L\right)\right], \end{aligned} \tag{2.18}$$

[11] 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.

where the marginal values of working by employment state are defined in Appendix C. The firm's surplus of hiring one additional worker is given by J (Equation 2.16). Therefore, the wage is derived from solving

$$w_t = \max_{w_t} [\tilde{\mathscr{W}}_t]^{\zeta} [J_t]^{1-\zeta}. \tag{2.19}$$

The wage sharing rule is given by

$$\tilde{\mathscr{W}}_t = \frac{\zeta}{(1-\zeta)} J_t. \tag{2.20}$$

2.6 Fiscal Authority

The fiscal authority finances unemployment benefits for short and long-term unemployed workers ($\kappa_t^S U_t^S$ and $\kappa_t^L U_t^L$) as well as interest payments on outstanding government debt with a labor-income tax τ and by issuing new government bonds b_t:

$$\kappa_t^S U_t^S + \kappa_t^L U_t^L + b_{t-1} \frac{P_{t-1}}{P_t} = \tau_t w_t N_t + q b_t. \tag{2.21}$$

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

$$\frac{\tau_t}{\bar{\tau}} = \rho^{\tau} \frac{\tau_{t-1}}{\bar{\tau}} + \chi^b \frac{b_{t-1}}{\omega^B Y_{t-1}}, \tag{2.22}$$

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

2.7 Rest of the Eurozone

The small open economy is linked to the rest of the Eurozone 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 $\text{ToT}_t = \frac{p_{H,t}}{p_{F,t}}$. For convenience, we normalize the price of foreign goods p_t^F to unity.
The consumer price index (CPI) in the small open economy is given by

$$P_t = \left[\gamma p_{H,t}^{-\eta^C/(1-\eta^C)} + (1-\gamma) p_{F,t}^{-\eta^C/(1-\eta^C)}\right]^{-(1-\eta^C)/\eta^C}. \tag{2.23}$$

The demand for consumption goods produced in home of the Rest of the Eurozone C_H^* is a function of the terms of trade:

$$C_{H,t}^* = \text{ToT}_t^{-\theta_F} X \tag{2.24}$$

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).
Therefore, demand for home and foreign consumption goods can be expressed as

$$C_{H,t} = \left(\frac{\gamma}{(1-\gamma)}\right) \mathrm{RER}_t^{\frac{1}{1-\eta^C}} C_{F,t}. \tag{2.25}$$

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

$$q\mathrm{NFA}_{t+1} = \mathrm{NFA}_t \frac{P_t}{P_{t+1}} + NX_t, \tag{2.26}$$

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

$$NX_t = EX_t - IM_t = \frac{p_t^H}{P_t} C_{H,t}^* - \frac{p_t^F}{P_t} C_{F,t}. \tag{2.27}$$

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

2.8 Market Clearing

Total resources in the domestic economy equal aggregate domestic consumption, investment and resource costs arising from vacancy posting. Hence, the aggregate resource constraint in the domestic economy is given by

$$Y_t = C_t^H + \frac{p_{H,t}}{P_t} C_{H,t}^* + I_t + \frac{P_t}{p_{H,t}} \kappa^v V_t. \tag{2.28}$$

2.9 Equilibrium

Given the exogenous interest rate r, the equilibrium of the small open economy is characterized by a sequence of prices $\{w_t, p_t, P_t, p_t^H, p_t^F\}$ and allocations $\{Y_t, C_t, C_{H,t}, C_{H,t}^*, C_{F,t}, k_{t+1}, NFA_{t+1}, b_{t+1}, p_{t+1}, N_t, U_t, U_t^S, U_t^L, V_t\}$, and the distribution of employment and assets Z such that the following statements hold:

1. 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 (2.1). 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 (2.4).

4. The number of short-term unemployed and long-term unemployed consumers evolve according to 2.5 and 2.6.

5. The wage is a solution to the Nash bargaining game (2.19).

6. Given the wage, the labor income tax, and the share of short- and long-term unemployed consumers, the government budget constraint (2.21) holds and the labor tax rate follows the tax rule (2.22).

7. Asset markets clear and the loanable funds constraint (2.10) holds.

8. The aggregate resource constraint is satisfied.

3 Calibration and Reform Implementation

We build on the German example to assess the potential contribution of precautionary savings to the current account developments following labor market reforms. In this Section we thus describe first the calibration of our model and then discuss how we implement the German labor market reform.

3.1 Calibration

We calibrate the model to quarterly frequency and build on the calibration strategy of Moyen and Stähler (2014) and Christoffel, Kuester, and Linzert (2009). Table 1 shows our baseline parameter choice. As standard in the literature, we set the discount factor to $\beta = 0.99$ and the risk aversion parameter to $\sigma_c = 2$. Given that the parameter of relative risk aversion it may influence the degree of precautionary savings, we perform a robustness analysis of that value. 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, we set the share of capital in production α to the standard value of 0.33 and assume that capital depreciates at a quarterly rate of 2.5 percent.

Regarding the labor market, we set bargaining power of the union and the elasticity of matches with respect to unemployment to 0.5, which are standard values.[12] Furthermore, in accordance with IAB administrative data, we target a quarterly job-finding rate of 17.71 percent (see table 2). This value corresponds to the average job-finding rate in Germany between 1998 and 2004 (before the Hartz IV reform). Furthermore, we target an unemployment rate of 8.9 percent which corresponds to the average harmonized unemployment rate for Germany between 1995 and 2004 (quarterly averages, Data source: OECD, Main Economic Indicators, 2017). As in Christoffel et al. (2009), we target a job-filling rate of 0.7. This pins down the matching efficiency, vacancy posting costs, and the separation rate.

[12] 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 underaccumulation of capital which leads to constrained inefficiency. See also Krusell et al. (2010) for a discussion.

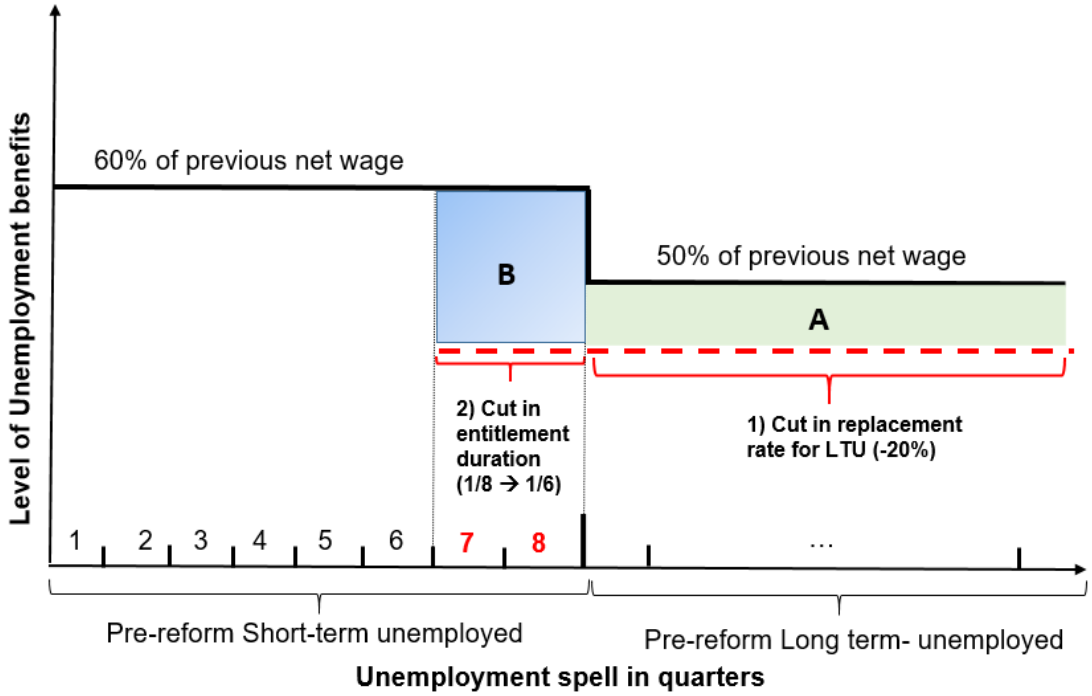
Table 1: Calibration

Parameter		Symbol	Value
Preferences			
	Discount factor	β	0.990
	Risk aversion	σ	2.000
	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			
	Capital share	α	0.330
	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	0.600
	Replacement rate for long-term unemployed	b^L	0.500
	Probability to switch to LTU benefit recipient	π^{LTU}	0.125
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

Table 2: Targets

Target	Symbol	Value
Price of foreign goods	p_F	1
Unemployment rate	U	8.9%
Job-filling rate	λ^f	70.0%
Job-finding rate	λ^w	17.7%

Figure 3: Reform Implementation (schematic plot)



For the policy parameters, we set the replacement rate for short-term unemployed to 0.6 and the initial replacement rate for long-term unemployed to 0.5. This corresponds to the legal value for single earners prior the reform. Furthermore, 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).

Table 2 shows the targets in our calibration. In the initial steady state, inflation is assumed to be zero. We normalize $p_{t,F} = 1$ for all t. 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.

3.2 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 half a year, more for elderly workers and less for younger workers.[13] Figure 3 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, LTU) by reducing the replacement rate b^L by 20 percent. Thus, we set $\kappa_t^{BL} = \bar{\kappa}^{BL} = b^{L'}(1-\tau)\bar{w}$, where $b^{L'}$ denotes the post-reform replacement rate of long-term un-

[13] 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.

employment benefit recipients. 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. Launov and Wälde (2013) use a decline of 7 percent, whereas Krebs and Scheffel (2013) implement a reduction of the replacement rate for long-term unemployed workers by 20 percent. Krause and Uhlig (2012) even assume a reduction of 67 percent for high-skilled workers and around 24 percent for low skilled workers. We chose a conservative reduction of the replacement rate in between plausible estimates which follows the approach of Krebs and Scheffel (2013). Given this disagreement in the literature, we provide robustness checks concerning the decline in the replacement rate.

The second reform step (cut in entitlement duration) is implemented 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. The exact cut in the entitlement duration for short-term unemployed was dependent on age. Our chosen reduction from 8 to 6 quarters 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 perform the simulation under perfect foresight.

4 Aggregate Effects of the Hartz IV Reform

In this Section, we discuss the aggregate results of our model simulation before we investigate the role of heterogeneity in 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. Next, we calculate the reform's contribution to the actual German current account surplus since the year 2005.

4.1 Steady State Comparison

We start our discussion of the reform effects by comparing the steady states before and after the reform.

Table 3 illustrates the percentage changes from the initial (pre-reform) steady state compared to the steady state when only considering the cut in the replacement rate ('rr cut only') and after the entire reform package (consisting of the reduction in the replacement rate and the entitlement cut). We observe that wages are higher in the post-reform steady state, which can be explained by the positive labor market developments as the increase in market tightness by 14% and decrease in unemployment by 5.84% induced by the reform and discussed in more detail below. Furthermore, prices of domestically produced goods decline by 0.36% which leads to an increase in the real exchange rate.

As already mentioned, the reform triggers positive labor market developments, and, as such, a higher job-finding rate and lower unemployment in the post-reform steady state. The number of short-term unemployment benefit (STUB) recipients declines considerably, whereas the number of long-term unemployment benefit (LTUB) recipients increases. Note that this is by definition of the second reform effect (the entitlement cut) which makes transitioning into the pool of LTUB 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 LTUB induced agents to increase their asset holdings considerably (+20.22%). This leads also to a higher capital stock and an increase in investment. Furthermore, exports are 0.91% higher after the entire reform and due to the increase in consumption, the domestic economy imports 2.7% more than before the reform.

Table 3: Long-run Effects of Hartz IV

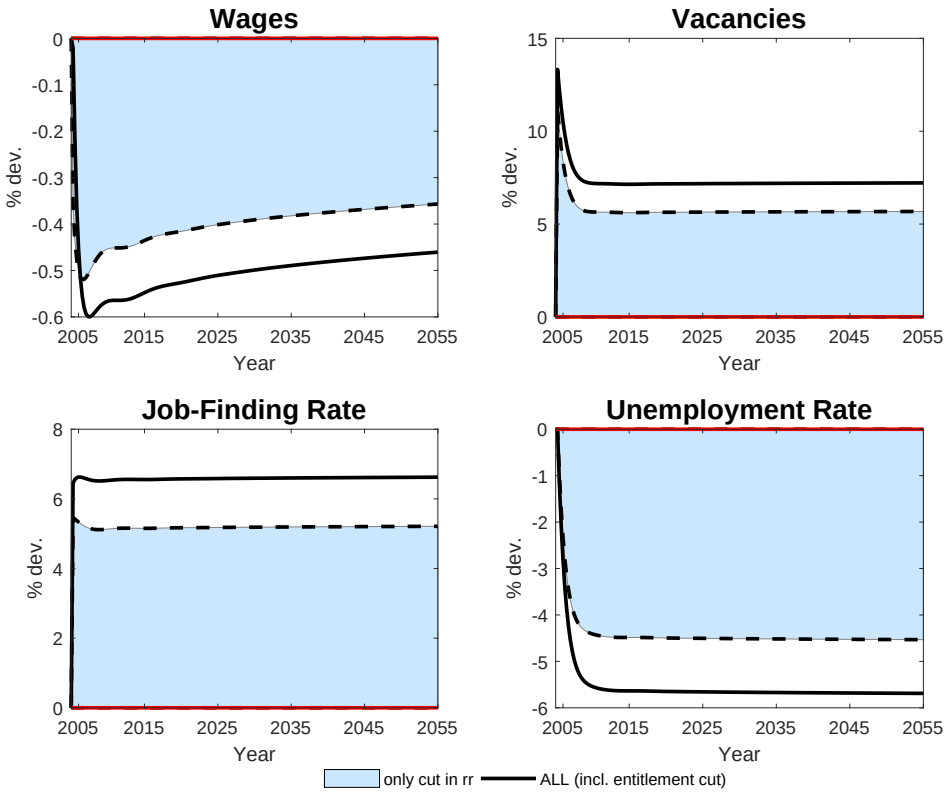
		Percent Deviation from Initial Steady State	
Variable		rr cut only	entire reform
Prices			
	Wage	-0.14%	-0.22%
	Price of home good	-0.32%	-0.36%
	CPI	-0.03%	-0.03%
	Real exchange rate	0.36%	0.42%
Labor Market			
	Market tightness	11.05%	14.09%
	Vacancies	5.86%	7.42%
	Unemployment	-4.67%	-5.84%
	Job-filling rate	-5.10%	-6.38%
	Job-finding rate	5.38%	6.81%
	Short-term unemployed	-2.45%	-13.18%
	Long-term unemployed	-8.50%	6.79%
Aggregates			
	Employment	0.46%	0.57%
	Consumption	2.56%	2.94%
	Assets	17.42%	20.22%
	Output	3.42%	3.97%
	Labor tax	-8.58%	-11.30%
	Dividends	5.86%	7.42%
	Capital	9.71%	11.24%
	Capital/worker	9.21%	10.60%
	Exports	0.80%	0.91%
	Imports	2.34%	2.70%

Notes: Total reform effects and effects only for the cut in replacement rate for long-term unemployment benefit recipients.

4.2 Transitional Dynamics

Figures 4 and 5 illustrate the transitional dynamics after the Hartz IV-reform in Germany. The reduction in the replacement rate ('rr') for long-term unemployed workers only (labeled 'only cut in rr') is depicted with blue shaded areas, the entire reform package (including the entitlement

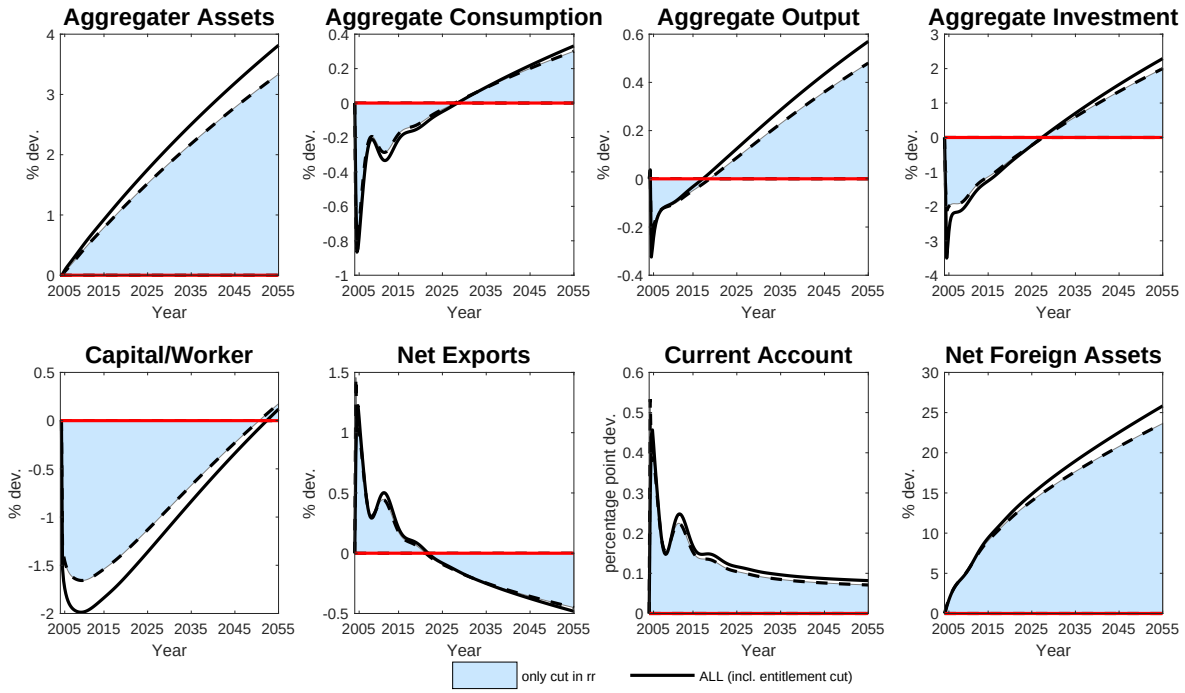
Figure 4: Effects of the Hartz IV-Reform Package on Labor Market Outcomes



cut) is depicted by the black solid line. The effects are presented in percent deviations (percentage points if indicated) from the initial steady state at the beginning of 2005 (before the reform). First, we consider the overall effects of the reform package on the labor market. The reduction in the generosity of the unemployment benefit scheme leads to a temporary decrease in wages because the workers' bargaining position worsens resulting from the reduced fall-back utility. 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 aggregate unemployment rate. On aggregate, unemployment falls by around 6 percent (see table 3). Due to the increase in the job-finding rate and the cut in the entitlement duration, the pool of STUB recipients declines much more (by 13.2 percent, see table 3). Considering only the reduction in the replacement rate (rr), we see that this reform component causes around two thirds of the overall labor market reaction. The cut in the entitlement period leads to a more pronounced drop of the wage (-0.6% instead of -0.5%). This additional wage effect translates to an increase in vacancies, a further boost in the job-finding rate and a further decrease in the aggregate unemployment rate of another two percent.

The aggregate effects are illustrated in Figure 5. For households the labor market effects induced by the reform lead to two opposing effects regarding precautionary savings: On the one hand, a better labor market situation reduces the incentive to save. On the other hand, higher income losses in case of unemployment increase the incentive to save. The latter effect clearly dominates and consumers in the domestic economy increase their asset holdings considerably. Because the

Figure 5: Aggregate Effects of the Hartz IV-Reform Package

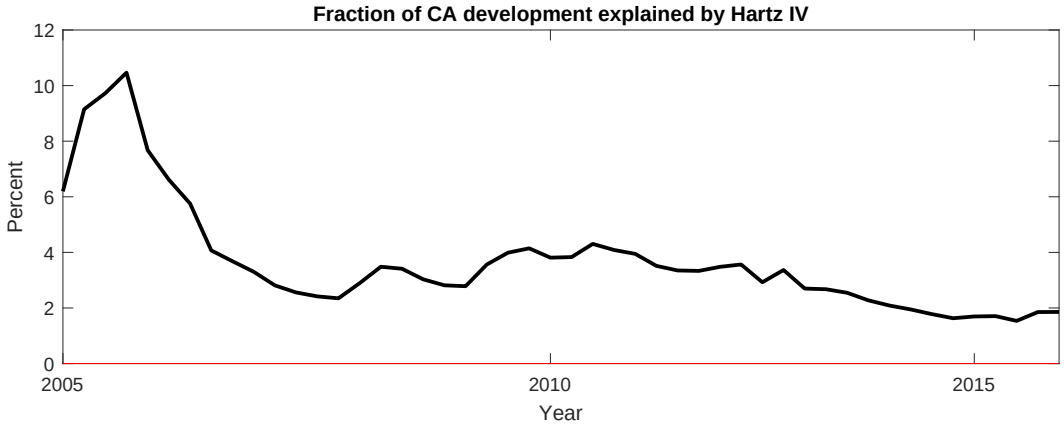


necessary assets are not fully provided domestically (being restricted by domestic government bonds, firm profits, and domestic capital), agents buy international bonds. Thus, the reforming country's net foreign asset position as well as the current account increase. A temporary lower wage income and 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), the real exchange rate increases in the long-run to a higher level.[14] This relative price reaction fosters German exports. Overall, the reactions of imports and exports lead to higher net exports in the short run. In addition, 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. 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.

If we compare the effects of the entire reform package to those when considering only the cut in the replacement rate for long-term unemployed workers (the blue-shaded areas), we note that the effects of the cut in the replacement rate dominate the effects on aggregate variables. The reason is that the probability to fall into the pool of long-term unemployment benefit recipients due to the cut in the entitlement duration is counteracted by the increase in the job-finding rate. This becomes clear from Figure 4. The entitlement cut leads to an additional increase in the job-finding rate, thus unemployment and wages decrease stronger. As a result, prices in the

[14] Remember, that we fix the price of foreign goods $p_F = 1$.

Figure 6: Contribution of Hartz IV to the German Current Account Surplus



Notes: Quarterly current account effects based on our model simulations as a share of Germany's quarterly current account developments in the data for the years 2005 to 2016. Data Source: Eurostat, seasonally adjusted.

reforming country drop strongly for several quarters (until consumption starts picking up again) which translates into a more pronounced reaction of the real exchange rate. This fosters exports and leads to a short-run spike in the current account.

4.3 Contribution of Hartz IV to Germany's Current Account Surplus

How much did the labor market reform contribute to the German current account surplus? The answer to this question is depicted in Figure 6. It illustrates the share of Germany's current account relative to GDP that can be attributed to the Hartz IV reform showing the current account effects based on our simulation as a share of the quarterly current account developments in the data for the years 2005 to 2016.[15] The German current account relative to GDP was 4.8 percent in the first quarter of 2005 and climbed to around 8 percent by the end of 2016. Shortly after the implementation of the reform, the highest contribution to the current account was in the third quarter after the reform (10.5 %) and decreased slowly in the subsequent quarters. Between the years 2005 and 2010, the average contribution to the German current account was around 5 percent of the actual current account developments. This result is robust to variations in the parameter of relative risk aversion (see Subsection 4.4).

4.4 Robustness

The parameter of relative risk aversion is crucial in determining the strength of agents' precautionary savings motive. To assess the robustness of our results to this parameter, we perform a sensitivity analysis. In our baseline scenario, we set the parameter of risk aversion σ to the standard value in the literature of 2. Lower risk aversion ($\sigma = 1.5$) leads to a slightly less pronounced savings reaction and, as a result, a smaller effect on Germany's net foreign asset position. On the other hand, if consumers are more risk averse ($\sigma = 2.5$), they increase their savings even more what leads to a stronger increase in net foreign assets. However, these differences are quantita-

[15] The data is retrieved from Eurostat. We seasonally adjusted the quarterly data using X12-Arima.

tively unimportant. The unemployment response is hardly affected by variations in σ.[16] Table 4 illustrates how the reforms' contribution to the German current account surplus varies with changes in the parameter of relative risk aversion. The overall contribution shows only little variation.

Second, as discussed in Section 3.2, existing literature has not yet reached an agreement on how much the replacement rate has declined due to the reform (see Hochmuth et al., 2019a for a discussion). For this reason, we perform a robustness analysis concerning the size in the decline of the replacement rate. For this exercise, we keep the cut in the entitlement period from 1/8 to 1/6 (as in our baseline simulation). Compared to our baseline cut in the replacement rate of 20%, we consider a more modest decline of only 10% as well as a stronger decline of 30%. Table 4 shows that the contribution of Hartz IV to the German current account is sensitive to the chosen shock size. The maximum contribution varies between 4.6% and more than 17.7%, whereas on average until 2016, the reforms' share varies between 1.6% and 6.3%.

Table 4: Robustness: The Reform's Contribution to the German Current Account Surplus

		Maximum	**Average 2005-2010**	**Average 2005-2016**
Baseline	(sigma=2, cut in rr=15%)	10.5%	4.6%	3.7%
Risk Aversion	sigma=1.5	9.1%	3.7%	3.1%
	sigma=2.5	10.5%	4.6%	3.7%
Shock Size	cut in rr=30%	17.7%	8.2%	6.3%
	cut in rr=10%	4.6%	1.7%	1.6%

5 The Role of Heterogeneity

Why is it important to take into account consumers' 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 MPCs along the asset distribution. In this Section, we first contrast the implications of our heterogeneous agent model to a representative agent model. Next, we analyze redistributive and welfare effects.

5.1 Comparison to the Representative Agent Framework

Due to uninsurable earnings risk, the reduction in the generosity of unemployment benefits changes agents' expectations of their future consumption path. On the one hand, the job-finding rate increases, reducing the likelihood to become a LTUB recipient. On the other hand, the entitlement cut augments the probability of a STUB recipient to transition into the pool of LTUB recipients (conditional on being short-term unemployed). The former effect reduces the need for precautionary savings, whereas the latter increases the incentive to increase individual asset holdings. Our quantitative exercise shows that the consumption risk effect outweighs the

[16] The corresponding model responses are illustrated in Appendix E and show that our results remain qualitatively robust to such variations.

increase in the job-finding rate. 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 same reform in a representative agent version of our model. In the representative agent version, all workers are perfectly insured against the idiosyncratic risk of becoming unemployment. Thus, their consumption and savings decision is independent of their employment status (as in Andolfatto, 1996 and Merz, 1995).[17] As a result, the Euler condition boils down to the conventional one:

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

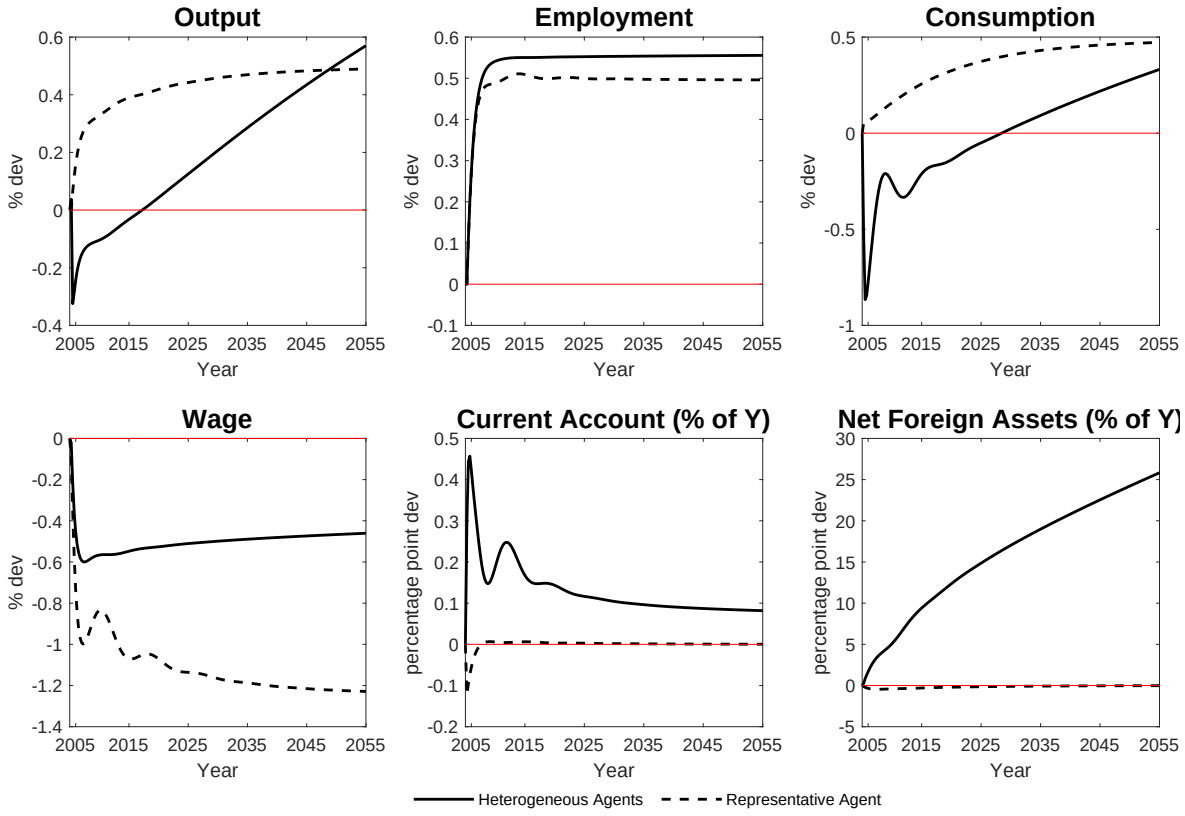
where λ_t denotes the marginal utility of savings, $\overline{NFA}$ denotes the steady state level of net foreign assets and ψ is an adjustment cost parameter.

To circumvent the problem of steady-state indeterminacy in the representative agent framework, we impose an exogenous level of net foreign assets. Following the literature, we assume that the level is zero in the initial steady state (see, for example, Gadatsch et al., 2016). We further follow the proposition of Schmitt-Grohe and Uribe (2003) and assume a risk premium on international bonds that increases with the country's net foreign asset position. This ensures stationarity of net foreign assets. More precisely, the interest rate paid or received by investors is now given by $R^{-\psi(NFA_t - \overline{NFA})}$, where we set ψ to 0.01.

The differences between these modeling choices become clear in Figure 7. It contrasts the simulation results from our heterogeneous agent model (solid line) with the representative agent case (dashed line). By construction, the incentive to hold precautionary savings is absent in the representative agent framework. Savings even decrease slightly in response to the reform. The reason is that the labor market reform generates expansionary effects due to the rise in employment caused by lower wages. In the representative agent case, wages remain permanently at a lower level. This is in contrast to the heterogeneous agent model, where wages rise after several quarters due to an equilibrium (market tightness) effect. The decline in savings leads to a hardly visible and short-lived fall in the current account balance and the net foreign asset position. Although the employment response is quite similar (slightly more pronounced in the heterogeneous agent version), the consumption and output responses differ strongly. In the heterogeneous agent version, both consumption and output decline in the short-run because agents start to accumulate savings. This consumption-savings trade-off is absent in the representative agent version and causes consumption and output to immediately increase to a higher steady state level. Thus, as long as households are perfectly insured against the risk of becoming unemployed, a drop in the replacement rate and a cut in the entitlement duration has hardly any (or even the contrary) effect on the current account.

[17] See Appendix C.1 for the household's problem in the representative agent case. As our baseline heterogenous agent model, we simulate the representative agent model in a non-linear fashion under perfect foresight.

Figure 7: Comparison to the Representative Agent Framework



5.2 Consumption along the Wealth Distribution

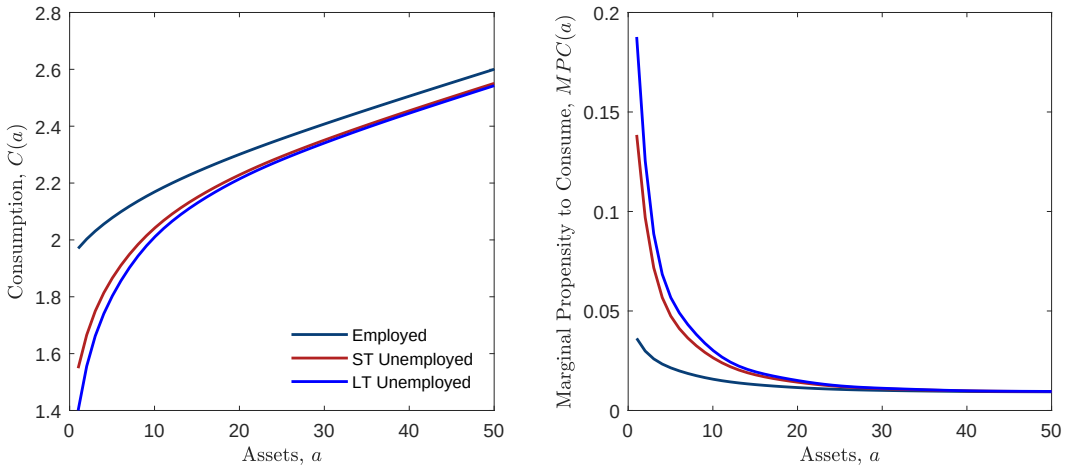
Figure 8 illustrates the pre-reform consumption policies and marginal propensities to consume (MPCs) by employment status and along the asset distribution.[18] Employed agents consume more than unemployed agents (see right panel of Figure 8). Consumers close to the borrowing constraint (asset-poor agents) have the highest MPC (i.e. the steepest increase in the consumption policy), whereas asset-rich agents have a low MPC (left panel). Also, the MPCs for employed asset-poor consumers are much lower than for long-term unemployed consumers. Next, we consider two consumers at the extremes of the asset distribution, an asset-rich and an asset-poor consumer.

In the case of (long-term) unemployment, the asset-poor consumer would face a severe drop in consumption. Therefore, the reform creates a strong incentive for her to self-insure against this risk. However, relative to her income, she has to give up the highest amount of consumption to increase her asset holdings. The asset-rich consumer, on the other hand, can, if she becomes unemployed, smooth consumption by reducing her savings. However, the higher risk to fall into the pool of LTUB recipients also induces wealthy consumers to accumulate more savings. In response to the reform, wages drop (in partial equilibrium) as worker's bargaining position worsens. The return on assets, however, is time invariant because the interest rate is exogenous to the reforming small-open economy.[19] The wage decline strongly affects asset-poor employed

[18] The MPC corresponds to the slope of the consumption policy function for an incremental increase ϵ in assets.

[19] The price for the domestic good and the CPI decrease as well making the nominal consumption bundle cheaper.

Figure 8: Consumption Policies and Marginal Propensities to Consume (MPCs) by Employment Status



Notes: Right-hand side: Consumption policies by employment status. Left-hand side: Marginal Propensities to Consume (MPCs) by employment status. We show the asset grid on the x-axis (cut at 50).

consumers whose share of wage income is larger compared to wealthy consumers who receive a fixed return on their high amount of assets.[20] Overall, the asset-poor, high MPC consumer has the highest need for precautionary savings but she has to give up the highest relative amount of consumption to accumulate wealth. On top of that, she suffers most by the wage reduction compared to the asset-rich, low MPC consumer. In the next Subsection, we discuss the resulting heterogeneous welfare effects of the reform.

5.3 Welfare and Redistributive Effects

In this subsection, we first analyze the (heterogeneous) welfare effects of the reform and discuss the consequences on the wealth distribution of the domestic economy.

5.3.1 Welfare Effects

Not all consumers in the economy are affected equally by the reform. Agents with low asset holdings rely stronger on labor income as the share of returns on their assets is small compared to asset-rich consumers. These asset-poor consumers might lose from the reform because they have to reduce their consumption considerably to self-insure against the unemployment risk. We quantify the relative welfare consequences of the Hartz IV reform for consumers in all three employment states along the wealth distribution. For this purpose, we calculate the welfare 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

However, in the short run, the drop in wages dominates the drop in goods prices.

[20] This is in contrast to the two-country RBC model with precautionary savings in Hochmuth et al. (2019b) where in response to an increase in aggregate asset supply, the world interest rate falls.

implementing the change in policy. 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. First, we calculate the welfare effects along the transition to the post-reform steady state and, second, we compare welfare changes in the pre- and post-reform steady state.[21]

Table 5 illustrates the consumption equivalents by wealth quintiles. On average, consumers in all employment states suffer a welfare loss along the transition. Employed consumers in the first wealth quintile require 0.205 % of lifetime consumption as a compensation for the reform, agents in the fifth wealth quintile suffer less from the reform. Furthermore, all short-term and long-term unemployed consumers suffer a loss from the reform although the rich unemployed agents suffer less compared to the poor. The economy-wide consumption equivalent which takes into account the corresponding shares of consumers in all employment states is negative and amounts to -0.167% along the transition.

If we compare the welfare effects between the steady states (neglecting the transition), employed consumers and short-term unemployed consumers are in favor of the reform. However, long-term unemployed workers suffer from the reduction in the generosity of unemployment benefits which cannot be compensated by the increase in the job-finding rate. As a result, they experience welfare losses after the reform.

What is the reason for the difference between the effects along the transition and the stationary welfare effects? Along the transition to the post-reform steady state, consumers have to reduce their consumption to build up savings. Low-asset, high MPC consumers have the highest forgone consumption relative to their income. In addition, they are strongly affected by the temporary decrease in wage (which is dampened by a reduction in the labor income tax). In the post-reform steady state, however, consumption and wages are higher. Furthermore, the job-finding rate has increased. This reduces the probability that they effectively experience long-term unemployment. Hence, employed consumers in the post-reform steady state favor the reform because they did not suffer any consumption losses along the transition. Instead, they benefit from the higher job-finding rate and consumption level in the new equilibrium. This is not the case for long-term unemployed workers who are indeed affected by the lower income due to the cut in the replacement rate.

Thus, along the transition, all agents suffer considerably due to consumption and wage losses. However, once the new equilibrium has been reached, employed agents benefit from the reform as wages, aggregate employment, and aggregate consumption are higher relative to the pre-reform steady state.

The importance of taking into account consumer heterogeneity in evaluation labor market reforms is further highlighted if we compare the welfare effects of our heterogeneous agent model

[21] For the effects along the transition path, we follow Bayer et al. (2019) and calculate 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.

Table 5: Welfare Effects: The Labor Market Reform in a Small Open Economy

	Incomplete Insurance							Complete Insurance
	Wealth Quintiles							
	1	2	3	4	5	Average	Economy	Economy
Effects along Transition (%)								
Employed	-0.208	-0.147	-0.131	-0.123	-0.117	-0.145		
Short-term Unemployed	-0.487	-0.296	-0.253	-0.230	-0.212	-0.294	-0.169	0.313
Long-term Unemployed	-1.172	-0.667	-0.549	-0.492	-0.446	-0.655		
Steady State Effects (%)								
Employed	0.276	0.326	0.336	0.339	0.336	0.323		
Short-term Unemployed	0.001	0.179	0.216	0.233	0.241	0.175	0.298	0.481
Long-term Unemployed	-0.678	-0.188	-0.077	-0.027	0.009	-0.183		

to the representative agent case. Under perfect consumption insurance, the welfare effects are always positive (as can be seen by the immediate rise in consumption).

5.3.2 Redistributive Effects

How did the unemployment benefit reform change the wealth distribution of consumers in the economy? To answer this question, we calculate the Gini coefficient and the coefficient of variation (CV) for consumption.[22] Table 6 illustrates the corresponding values for the wealth distributions before and after the reform for all three employment states.[23] The Gini coefficients for asset holdings of consumers in all three labor market states are lower after the reform indicating that the distribution got more equal. Also, the CV for consumption is lower which means that the percentage change in the standard deviation of consumption for the agents in the economy has decreased. Overall, we observe a decrease in wealth inequality due to the reform. Figure 13 in the appendix illustrates the corresponding wealth distributions by employment states and their shifts in response to the reform. In the post-reform steady state, all consumers hold more assets and are richer because they accumulated more precautionary savings. Initial asset-poor agents hold more wealth and moved away from the borrowing constraint.[24] 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 suffered heterogeneous welfare losses in the short and medium run.

[22] The coefficient of variation is the standard deviation divided by the mean.

[23] See Appendix B.2 for microeconomic evidence on wealth by employment state and by the duration of short-term unemployment.

[24] Our model's predictions on the redistributive reform effects are consistent with Krueger et al. (2016a) who find that in a model economy with a generous unemployment benefit system a larger mass of consumers holds little or no wealth due to the missing precautionary savings motive as compared to a less generous unemployment benefit system.

Table 6: Change in Inequality by Employment Status

	Pre-Reform	Post-Reform	Percentage Change
Gini Coefficient			
Employed	0.238	0.224	-5.94
Short-term Unemployed	0.254	0.233	-8.18
Long-term Unemployed	0.313	0.285	-9.00
Coefficient of Variation for Consumption			
Employed	1.387	1.265	-8.81
Short-term Unemployed	1.381	1.263	-8.52
Long-term Unemployed	1.363	1.226	-10.02

6 Concluding Remarks

This paper establishes 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. We investigate the role of consumer heterogeneity in the evaluation of the reform effects. 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 benefits reform in Germany (Hartz IV). We 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 invested domestically, the net foreign asset position and the current account increase, much more than what a representative agent model would generate. However, the magnitude of the contribution to the German current account surplus is not large enough to be the main driver. Thus, we conclude that other factors (such as savings for retirement and a tight fiscal stance) played an important role in the increase of the German net foreign asset position as well (see Ruppert and Stähler, 2020 for a discussion).

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 by the reform effects.

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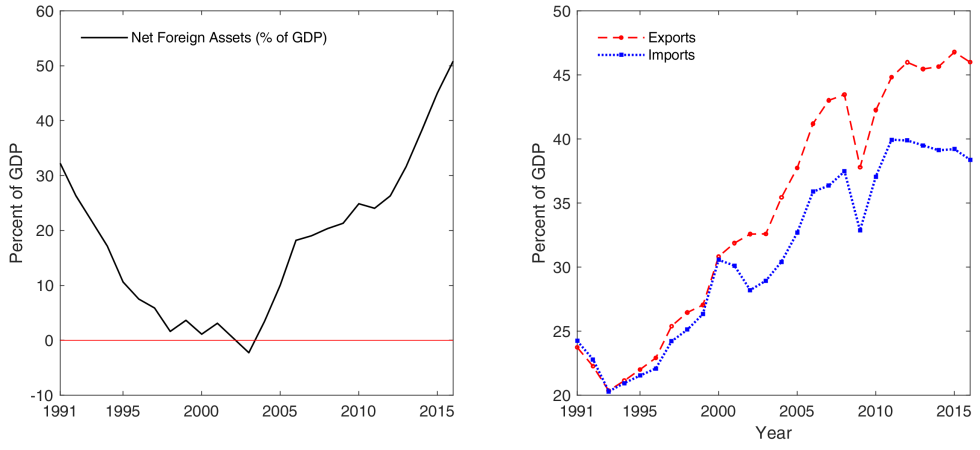
A Background

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

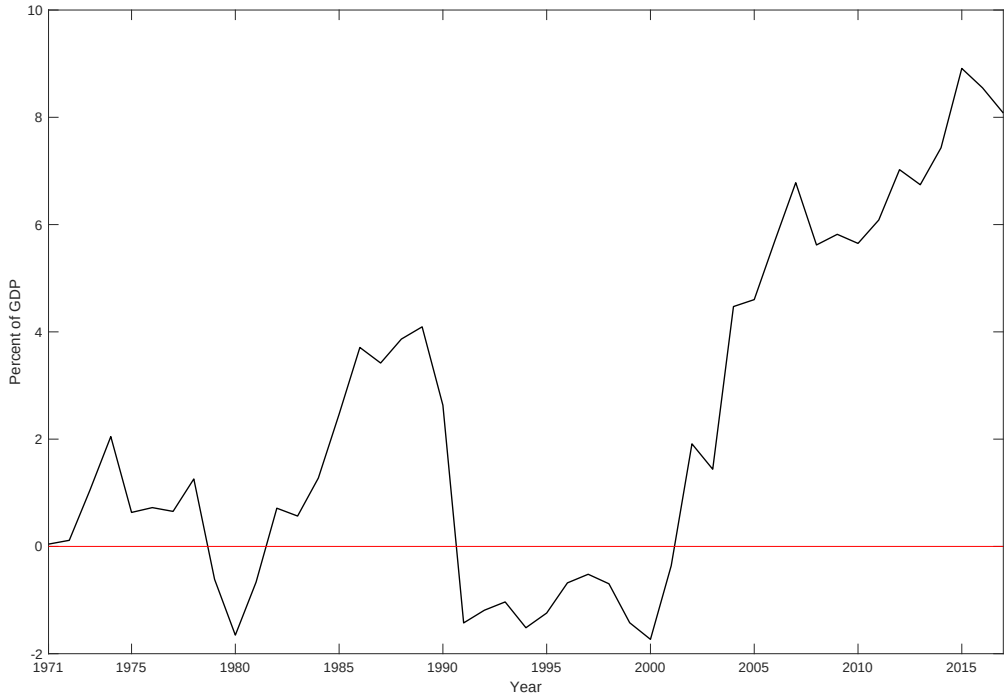
The current account is defined as a country's increase in domestic net claims on foreign incomes or outputs (see Obstfeld and Rogoff, 1995). Hence, the current account balance is given by the difference between national savings and domestic investment (see Figure 1 in the introduction). If savings exceed investment, residents hold claims on foreign goods or assets.
Figure 9 shows the German net foreign asset position (NFA) as well as exports (EX) and imports (IM) 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 (see Figure 10), 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 dramatically. 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).

Figure 9: The German Current Account, Exports and Imports



Notes: Exports and Imports refer to both goods and services. Data sources: German National Statistical Office (2017) and Bundesbank (2017).

Figure 10: The German Current Account, 1971-2016



Notes: Data Sources: The World Bank, World development indicators.

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).

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 (see Riphahn and Schrader, forthcoming for details). 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 Micro-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*). In addition, to be consistent with our modeling strategy, we restrict our sample to full-time employed household heads.

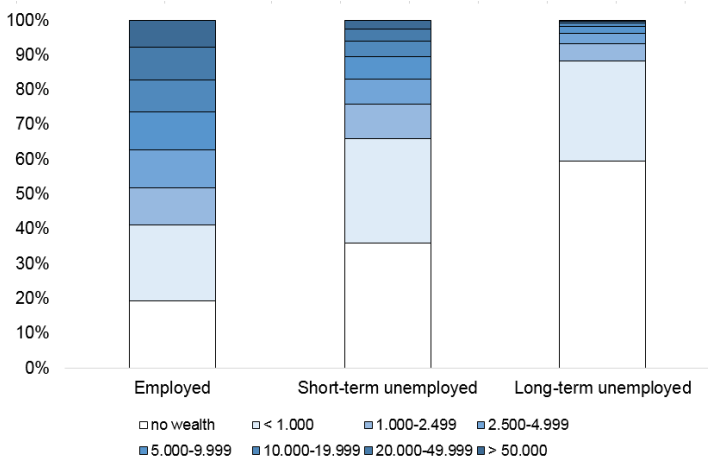
B.2 Wealth by Employment Status

We use data of the IAB Panel Study Labour Market and Social Security (PASS)[25] to answer the following questions: How much wealth do recently unemployed people have at the beginning of their unemployment spell? How does the level of wealth evolve during unemployment? For this purpose, we use the survey question on the amount of savings of a household.[26] Savings refer to wealth in the form of savings accounts, shares or life insurance, while housing is explicitly excluded. The descriptive statistics of household wealth by the employment status of the interviewed person (usually the main earner) are illustrated in Figure 11. Households with

[25] The IAB PASS survey was first carried out in 2007 and consists currently of ten waves. Each wave consists of approximately 10,000 households. Its focus lies on the circumstances and characteristics of recipients of Unemployment Benefit II (ALG II). For a detailed description of the IAB PASS survey, see Trappmann, Beste, Bethmann, and Müller (2013). Data access was provided via a Scientific Use File (project no.: 101900) supplied by the Research Data Center (FDZ) of the German Federal Employment Agency (BA) at the Institute for Employment Research (IAB).

[26] The answers can be one of the following categories: no wealth, less than 1.000 euros, 1.000-2.499 euros, 2.500-4.999 euros, 5.000-9.999 euros, 10.000-19.999 euros, 20.000-49.999 euros, and more than 50.000 euros.

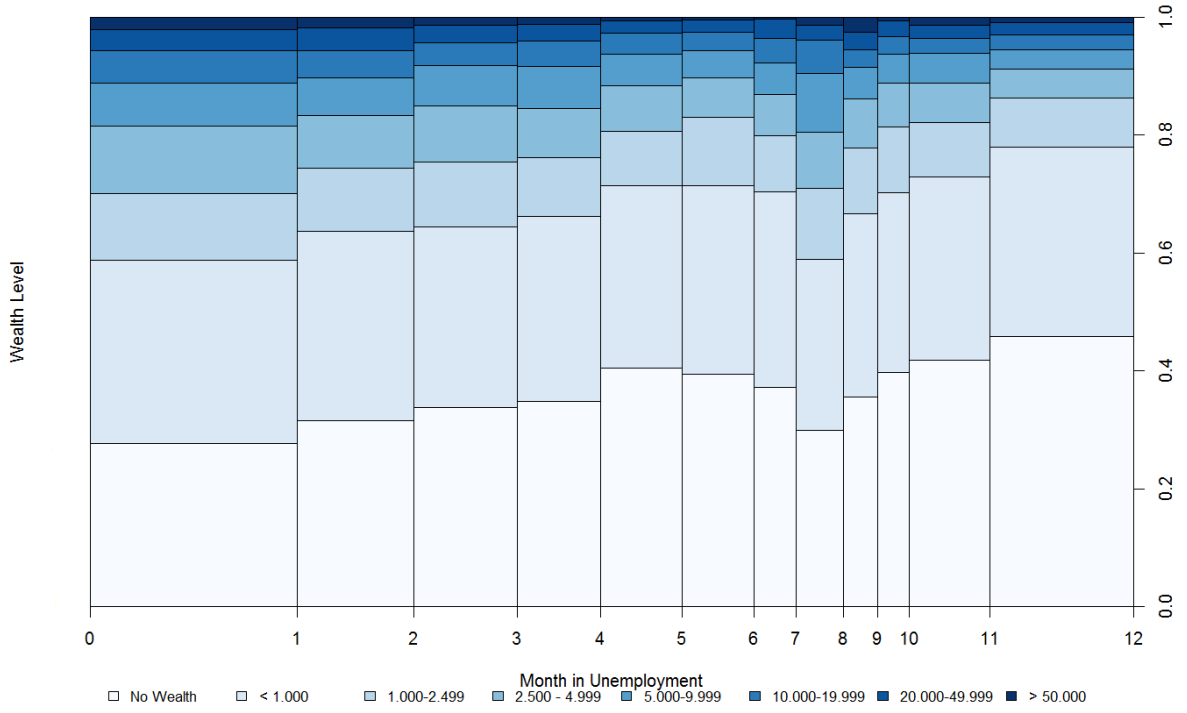
Figure 11: Wealth by Employment Status



Source: IAB PASS survey, own illustration.

an unemployed main earner have significantly less wealth compared to an average employed household. A closer look at the distribution of wealth by the duration of short-term unemployment (see Figure 12) reveals further insights: First, at the beginning of an unemployment spell, the wealth level is higher and decreases (almost) continuously over the short-term unemployment spell. Note that these descriptives are restricted to workers below the age of 50 who are eligible for at most twelve months of short-term unemployment benefits (older workers may receive ALG I for up to 24 months). However, there is a discontinuity (from the 6th to the 10th month) which is due to a composition effect of workers: In order to be eligible for the entire 12 months of ALG I, one must have had a job subject to social security contributions for at least 24 continuous months, otherwise the eligibility is reduced. Therefore, a fraction of workers can fall into the pool of long-term unemployed after six months already. Figure 12 shows that a worker at the beginning of the unemployment spell has more wealth than a worker after receiving 12 months of short-term unemployment benefits. Note that this picture is purely descriptive and we do not control for worker characteristics, therefore part of the picture is driven by composition effects: richer workers (who are most likely better educated) quicker find a job and return to the pool of employed workers.

Figure 12: Wealth by Duration of Unemployment



Source: IAB PASS survey, own illustration
Notes: Bar width shows the number of unemployed in the corresponding month of unemployment.

C Model Appendix

C.1 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:

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

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:

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

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

C.2 The Consumer's Marginal Utility of Working

The marginal value of working within an employment state is independent of the consumers asset level. The marginal value of working for employed consumers reads

$$\mathscr{W}_t^E = (1-\tau_t) w_t + \beta E_t [(1-s) \mathscr{W}_{t+1}^E + s \mathscr{W}_{t+1}^S]$$

For short-term unemployed consumers:

$$\mathscr{W}_t^S = \kappa_t^B + \beta E_t \left[\lambda_{t+1}^w \mathscr{W}_{t+1}^E + (1-\lambda_{t+1}^w) \left((1-\pi^L) \mathscr{W}_{t+1}^S + \pi^L \mathscr{W}_{t+1}^L \right) \right],$$

and long-term unemployed consumers

$$\mathscr{W}_t^L = \kappa_t^L + \beta E_t [\lambda_{t+1}^w \mathscr{W}_{t+1}^E + (1-\lambda_{t+1}^w) \mathscr{W}_{t+1}^L].$$

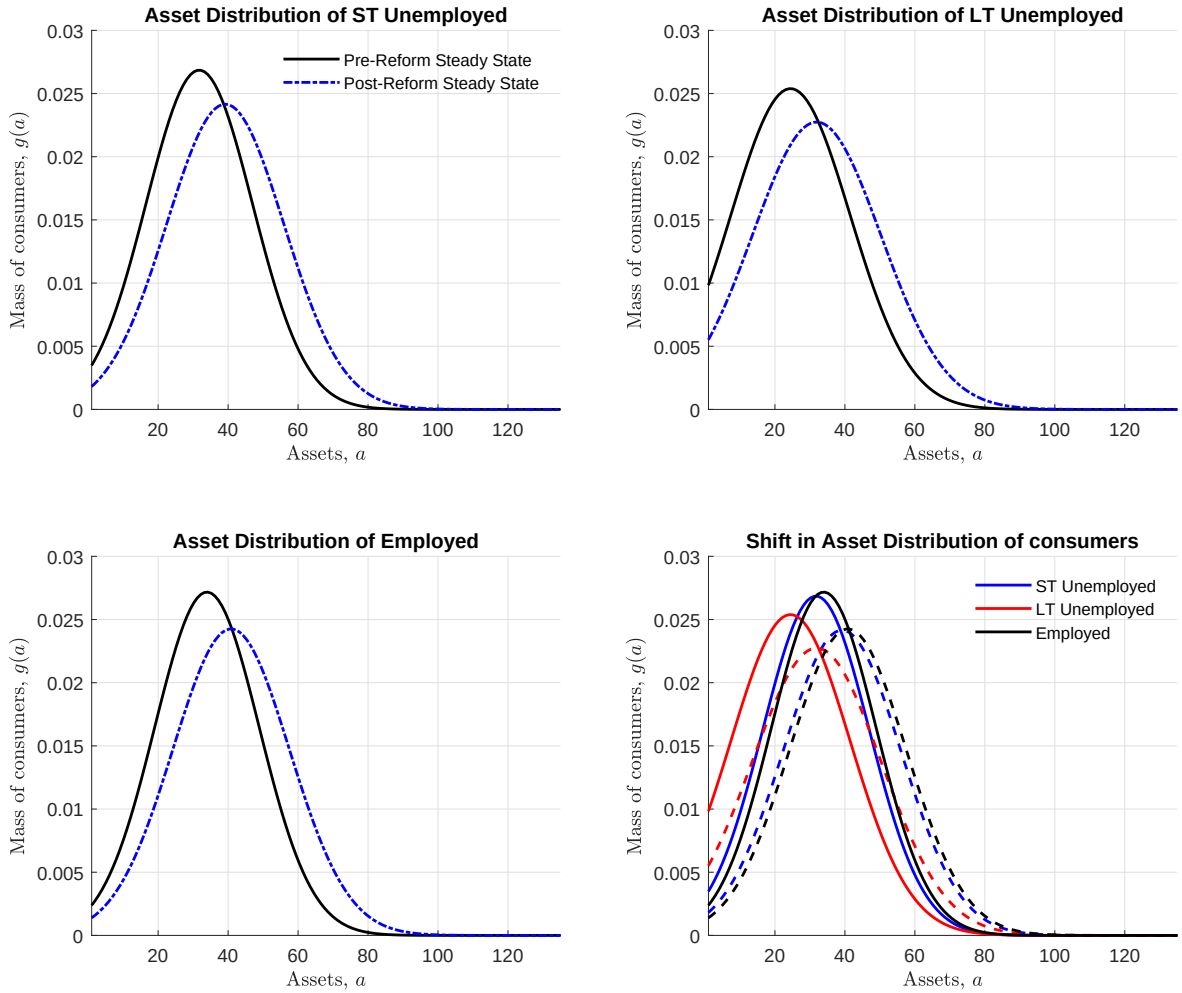
D Shifts in the Wealth Distribution

Figure 13 depicts the asset distribution by employment status in the pre-reform steady state (solid, black line) and in the post-reform steady state (dashed, blue line). The lower right panel plots all asset distributions in one figure. Employed consumers have the highest amount of average assets, short-term unemployed consumers have slightly less (5%) average wealth compared to employed consumers and the average amount of wealth of long-term unemployed consumers is twenty percent lower compared to employed workers. This relation is mirrored in the fraction of borrowing constrained consumers (the mass of consumers with zero asset holdings). In the pre-reform steady state, the mass of consumers at the borrowing constraint in long-term unemployment is more than twice as large compared to consumers in short-term unemployment.
In the post-reform steady state (after both the cut in the replacement rate as well as the reduction in the entitlement period), we observe that the asset distributions of consumers in all employment states shifts to the right, i.e. they hold more assets. In addition, the mass of consumers at the borrowing constraint is lower also indicating that agents are on average richer in the post-reform steady state.

E Sensitivity Analysis

F Open vs. Closed Economy

Figure 13: Shift in Stationary Asset Distribution by Employment Status



Notes: The mass of consumers in each employment state is normalized to one.

Figure 14: Variation in the Parameter of Risk Aversion

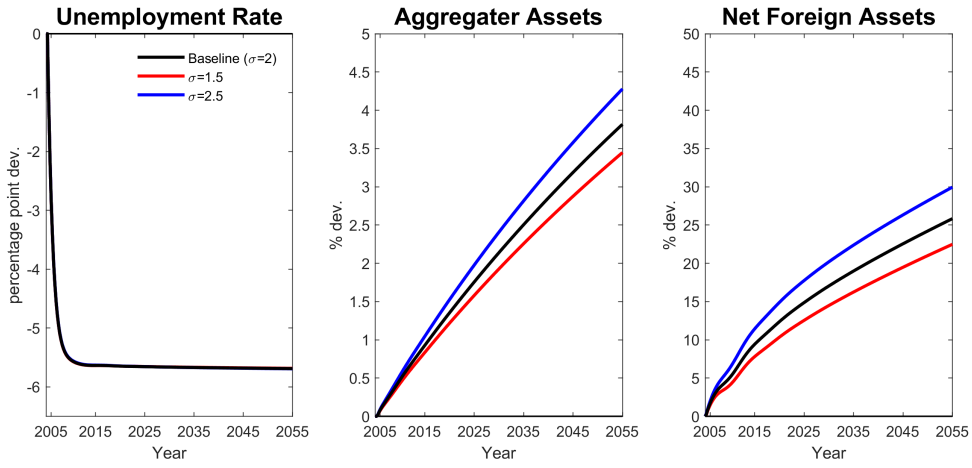


Figure 15: Sensitivity to the Contribution to the Current Account: Risk Aversion

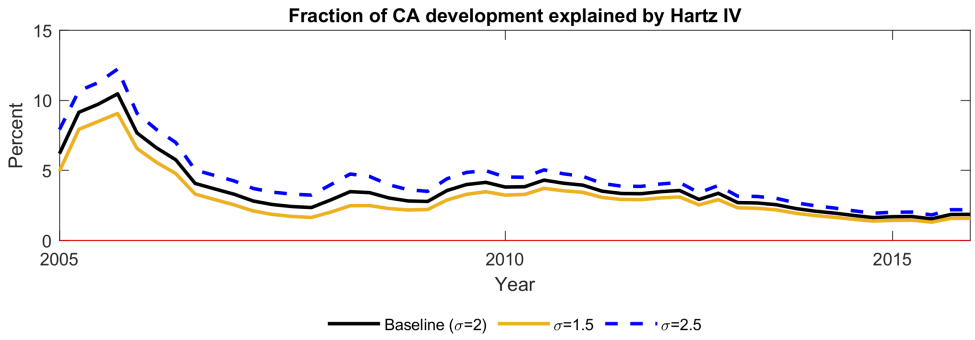


Figure 16: Variation in the Decline of the Replacement Rate for LTU

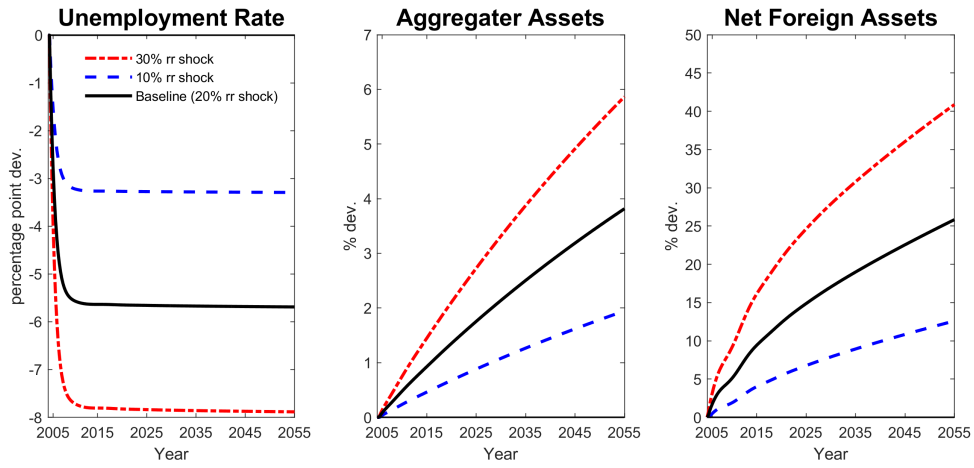


Figure 17: Sensitivity to the Contribution to the Current Account: Cut in the Replacement Rate