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# Incomplete Insurance and Open-Economy Spillovers of Labor Market Reforms[†]

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**Abstract**

This paper shows that less generous unemployment benefits in one country may generate substantial negative long-run consumption spillovers to non-reforming countries under incomplete consumption insurance. While lower benefits reduce unemployment in the reforming country, employed workers increase their precautionary savings to compensate for reduced government-provided insurance. A portion of these additional savings flows to the non-reforming country and depresses long-term consumption due to the negative net foreign asset position. To discipline our quantitative model, we estimate the increase of Germany's tradable sector in the aftermath of the Hartz unemployment insurance reform based on firm-level data. Our quantitative model matches a significant fraction of various macroeconomic trends after the reform, namely Germany's persistent increase of aggregate savings and net foreign assets, the increase of net exports, the real exchange rate depreciation within the Eurozone, and the decline in unemployment. Conversely, Germany's wage moderation before the reform appears to be unrelated to most of these phenomena.

**JEL classification**: E21, E24, F16, F41.
**Keywords**: Unemployment insurance reform, spillover effects, precautionary savings

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# 1 Introduction

While the macroeconomic impact of labor market reforms on unemployment, wages, and competitiveness has been extensively studied in the open-economy literature (e.g., Cacciatore, Duval, Fiori, and Ghironi, 2016a,b; Dao, 2013), little attention has been devoted to the role of households' incomplete insurance and savings behavior for international spillovers.[1] Estimated macroeconomic models identify an important role of private savings shocks for current account movements within the European Monetary Union (Kollmann, Ratto, Roeger, in 't Veld, and Vogel, 2015). These macroeconomic savings shocks may partly result from changed precautionary savings behavior induced by major structural reforms. Germany provides an interesting case due to its major reform of the unemployment benefit system in 2005 and 2006, which reduced government-provided insurance for long-term unemployed workers (Hartz IV-reform). Around the same time, Germany's aggregate savings increased, its real exchange rate within the Eurozone depreciated, the tradable sector was boosted, and net foreign assets increased substantially. Our paper analyzes the connection between the unemployment insurance reform and these phenomena.

We present a model framework that allows us to analyze the quantitative relationship between the German unemployment benefit reform and the described international macroeconomic facts. In our model, workers face incomplete consumption insurance against unemployment. When unemployment benefits are reduced, employed households accumulate more assets to self-insure against the risk of becoming unemployed. These larger precautionary savings increase the net foreign asset position, the current account surplus, and the size of the tradable relative to the nontradable sector in the reforming country. Furthermore, they trigger a short-run real exchange rate depreciation. Subsequently, in the two-country context of our model, the non-reforming economy increases short-run consumption due to lower interest rates. Thus, it runs current account deficits and accumulates negative net foreign assets relative to the reforming country. This leads to long-term indebtedness and generates permanent negative consumption spillover effects for the non-reforming country. To quantify the size of these macroeconomic effects, we estimate the quantitative increase in the tradable sector in Germany in the aftermath of the labor market reforms based on German administrative and survey data. We impose the estimated relative expansion of the tradable sector as a target in our quantitative model. We find that the German benefit reform can explain around 20 to 50 percent of the documented international macroeconomic facts. Furthermore, it triggered a permanent two percent consumption drop in the other Eurozone countries.

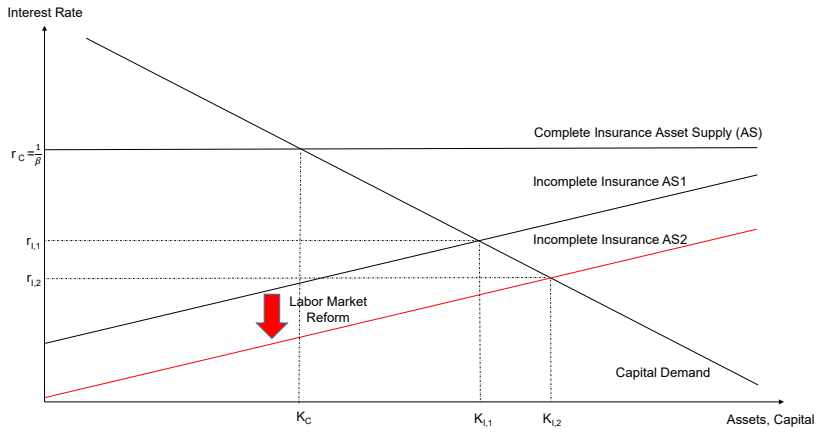
We address the general equilibrium insurance and incentive effects of an unemployment benefit reform in an open economy setting by incorporating incomplete insurance in a tractable way. Following Challe and Ragot (2016) and Challe, Matheron, Ragot, and Rubio-Ramirez (2017), we assume that all employed workers pool their income, but lose consumption insurance in case of unemployment. This generates a tractable precautionary savings motive that allows us to inves-

[1] Hochmuth, Moyen, Stähler, and Schröter (2024) analyze the role of precautionary savings for the accumulation of net foreign assets following an unemployment benefit reform. As they use a small open-economy model, they are silent on spillover effects.

tigate the interactions and spillovers in a two-country framework with endogenous interest rates. Our model further features a labor market with search and matching frictions (see Mortensen and Pissarides, 1994) with a rich deterministic unemployment duration structure to be able to analyze a benefit reform that was targeted at long-term unemployed. Finally, we assume that there are tradable and non-tradable goods. This distinction allows us to combine our macroeconomic model with estimation results on the movement between the tradable and non-tradable sectors, using administrative and survey firm-level data.

Deviations from complete insurance are key for our analysis and results. Figure 1 illustrates the underlying intuition. Asset supply is completely elastic in a complete insurance framework. In this case, the Euler equation of the representative agent pins down the steady-state interest rate, which is the inverse of the discount factor. By contrast, under incomplete insurance, there is an upward-sloping asset supply curve. In this case, higher interest rates make savings more attractive for incompletely insured agents. Figure 1 shows that a decline in unemployment benefits shifts the asset supply curve in the incomplete insurance setting to the right, as imperfectly insured employed workers want to save more once government-provided insurance is reduced. This reduces the steady-state equilibrium interest rate and increases the capital intensity of production in the two-country model. As we analyze the European Monetary Union case, we assume perfect capital mobility across countries.

**Figure 1:** Complete vs. Incomplete Insurance: Asset Market Effects




Notes: Stylized model reaction under complete insurance with complete insurance (leading to completely elastic asset supply) and incomplete insurance. In the latter case, a reduction of unemployment benefits triggers an increase in precautionary savings, which corresponds to a rightward shift of the asset supply curve. This leads to a lower monetary union interest rate and higher capital intensity.

To impose discipline on our quantitative exercise, we use administrative data to estimate the shift of the tradable relative to the non-tradable sector in Germany. Employed workers in the reforming country can only accumulate net foreign assets by running a current account surplus driven by the tradable sector in the economy. Therefore, we use the Administrative Wage and Labor Market Flow Panel (AWFP) and the IAB Establishment Panel to estimate the incremental reaction of the tradable relative to the non-tradable sector in Germany after the Hartz labor market reforms. The AWFP comprises the universe of German establishments (see Seth and Stüber,

2017 and Bachmann, Bayer, Merkl, Seth, Stüber, and Wellschmied, 2021) and allows us to control for time-invariant heterogeneity.[2] We find a statistically significant and economically meaningful increase in the tradable sector relative to the non-tradable sector for Germany. The estimated increase provides a calibration target for our quantitative model, since expanding the tradable sector is the only method to export savings, considering that the current account is the counterpart of the capital account.

Our calibrated quantitative model explains a significant fraction of the empirical macroeconomic open-economy facts. From 2005 to 2009, it explains around 40 percent of the decline in unemployment in Germany and more than thirty percent of the current account and unit labor cost movements relative to the other Eurozone countries.

In addition, we document that the increase in employed households' savings due to the unemployment insurance reform is in a similar order of magnitude as the increase in the data. Thus, if we calibrated to the average increase of observed (descriptive) increase of savings of employed workers, we would obtain similar results. However, we have chosen to calibrate to the estimated increase of the tradable sector, as we have much better data in this dimension that allows us to control for time-invariant heterogeneity at the microeconomic level.

We show that incomplete consumption insurance is key for the sign and size of spillover effects on the foreign economy. Under complete insurance, households in the domestic economy have no incentive to increase their savings, as there is no need for precautionary measures due to consumption pooling and the positive impact on the labor market. As a result, they do not accumulate net foreign assets, and the boost in the tradable sector, as well as the depreciation of the real exchange rate, are absent, which is inconsistent with empirical evidence.

Furthermore, we show that our key results are robust in various dimensions. Related to the debate on the wage effects of unemployment benefits (e.g., Jäger, Schoefer, Young, and Zweimüller, 2020), we change the bargaining power of workers. We also impose the decline of the separation rate in the aftermath on our model, as documented by Hartung, Jung, and Kuhn (2018). Although the quantitative results change in these scenarios, the key model mechanism remains important.

In addition to analyzing the open-economy effects of the Hartz labor market reforms, we analyze the German wage moderation that started in the 1990s. Several years before the Hartz labor market reforms, wages in the German labor market increased by less than aggregate productivity (Dustmann, Fitzenberger, Schönberg, and Spitz-Oener, 2014). This led to a decline in German unit labor costs relative to other European countries. Wage moderation may provide an alternative explanation for improving German competitiveness and increasing net foreign assets. Although wage moderation reduces unemployment in our quantitative model, it does not lead to an increase in net foreign assets. In contrast to the unemployment benefit reform, precautionary savings decline under wage moderation, as consumption risk falls due to higher job-finding rates, while unemployment benefits are unaffected in this scenario.

The rest of the paper is organized as follows. Section 2 puts our paper in perspective to the existing literature. Section 3 shows empirical macroeconomic facts for Germany and the Eurozone. In addition, it shows estimation results for the differential reaction of the tradable and non-tradable

[2] The IAB Establishment Panel survey allows us to determine the tradability of different sectors. In addition, we can analyze value-added shifts and control for intermediate inputs.

sectors in the aftermath of the Hartz reforms. Section 4 derives the macroeconomic model with search and matching and incomplete insurance. Section 5 explains our quantitative strategy and the matching strategy for the model and data. Section 6 shows and discusses the quantitative simulation results. Section 7 concludes.

## 2 Connection to the Literature

Our research contributes to several strands of the literature. First, we contribute to the effects of labor market reforms in the open economy. Several papers analyze these reforms in models with labor market frictions (see, for example, Cacciatore et al. (2016a), Cacciatore et al. (2016b), Dao (2013), and Poilly and Sahuc (2013)). This body of research finds that labor market reforms yield positive short-run labor market spillover effects. We complement this stream of the literature by incorporating an incomplete household consumption insurance mechanism into a two-country model with search and matching frictions. We demonstrate that less generous unemployment benefits in one country may lead to higher foreign debt in the other country and may thereby depress foreign consumption permanently.

Related to this stream of the literature, Duval, Furceri, and Tovar Jalles (2022) estimate the effects of labor market deregulation on the current account. They find that a loosening of employment protection legislation (EPL) is associated with current account improvements. Duval et al. (2022) argue that these EPL reforms affect precautionary savings, particularly in bad times.

In addition, there are papers that analyze the German Hartz labor market reforms in models without search and matching frictions. Kollmann et al. (2015) and Fadinger, Herkenhoff, and Schymik (2024) find that the Hartz-reforms, coupled with shocks to leisure in a frictionless labor market and shocks to private savings, were important in driving Germany's current account surplus. Fadinger et al. (2024) argue that the reforms improved German competitiveness, caused a boom in the German manufacturing sector, and led to the crowding out of manufacturing employment in other Eurozone countries. Our model framework with incomplete insurance provides a theoretical foundation for these facts. Due to more precautionary savings in the reforming country, we obtain a currency depreciation and a short-run boost of the tradable sector in the reforming economy. Furthermore, we analyze the quantitative importance of this channel for spillover effects in the context of the European Monetary Union.

Second, we contribute to the literature on the role of incomplete insurance in open economies[3] (for example, de Ferra, Mitman, and Romei, 2020, de Ferra, Mitman, and Romei, 2021, Auclert, Rognlie, Souchier, and Straub, 2021, Hochmuth et al., 2024, and Guo, Ottonello, and Perez, 2022). de Ferra et al. (2021) document that capital flows from equal to unequal countries due to private savings and higher borrowing of households in unequal countries.[4] Focusing on the Chinese current account surplus, İmrohoroğlu and Zhao (2020) find that incomplete insurance for the elderly led to large household savings and, thereby, to large current account surpluses. Comple-

[3] For an early contribution to the interaction of precautionary savings with search and matching in the closed-economy, see Krusell, Mukoyama, and Şahin (2010).

[4] Broer (2014) shows that a rise in income risk can depress the net foreign asset position if default leads to exclusion from financial markets.

mentary to these papers, we analyze the impact of a structural (labor market) reform on capital flows and long-run spillovers. The tractability of our framework allows us to study the spillover effects on the non-reforming country in a two-country setting with an endogenous interest rate.[5] Our paper is complementary to Hochmuth et al. (2024) who focus on the domestic effects of a labor market reform in a small-open economy model with full consumer heterogeneity. Compared to their paper, we find that domestic aggregate effects and the increase in the net asset position are of similar magnitude. Thereby, our tractable two-country open-economy model provides a valid representation of a more complex, fully heterogeneous model with a precautionary savings motive that allows us to analyze spillover effects.

Third, we contribute to the literature on the spillover effects of unemployment benefit reforms (see Felbermayr, Larch, and Lechthaler, 2013, Felbermayr, Impullitti, and Prat, 2018).[6] Eggertsson, Mehrotra, and Summers (2016b) and Eggertsson, Mehrotra, Singh, and Summers (2016a) show that under secular stagnation and the zero lower bound, unemployment benefit reforms can have beggar-thy-neighbor effects in a monetary union. Fadinger et al. (2024) stress the importance of downward nominal wage rigidities due to the introduction of the Euro for lower manufacturing employment in Eurozone countries in the aftermath of the German Hartz IV reforms. Complementary to them, we stress a novel channel that arises due to precautionary savings and in the absence of further frictions (such as the zero lower bound or downward nominal wage rigidities): The rest of the Eurozone experiences lower consumption in the long run due to the increase in their debt service. More generally, to our knowledge, we are the first paper that shows that under precautionary savings motive, there may be substantial (long-run) consumption spillover effects even in the absence of nominal frictions, zero lower bound considerations, or downward wage rigidity.

Finally, we contribute to the literature on the macroeconomic labor market effects of the Hartz IV labor market reform. Studies such as Hartung et al. (2018), Hochmuth, Kohlbrecher, Merkl, and Gartner (2021), Krause and Uhlig (2012), Krebs and Scheffel (2013), and Launov and Wälde (2013) have analyzed the reform effects within structural search and matching models in closed-economy settings. These studies commonly report a decline in unemployment due to the reforms, albeit with differences in the quantitative magnitude. Our research complements these findings by suggesting that lower benefits heighten precautionary savings under incomplete insurance, consequently increasing the capital intensity of production. Moreover, we draw attention to the significant open-economy repercussions stemming from these labor market reforms.

# 3 Institutional Reform and Empirical Facts

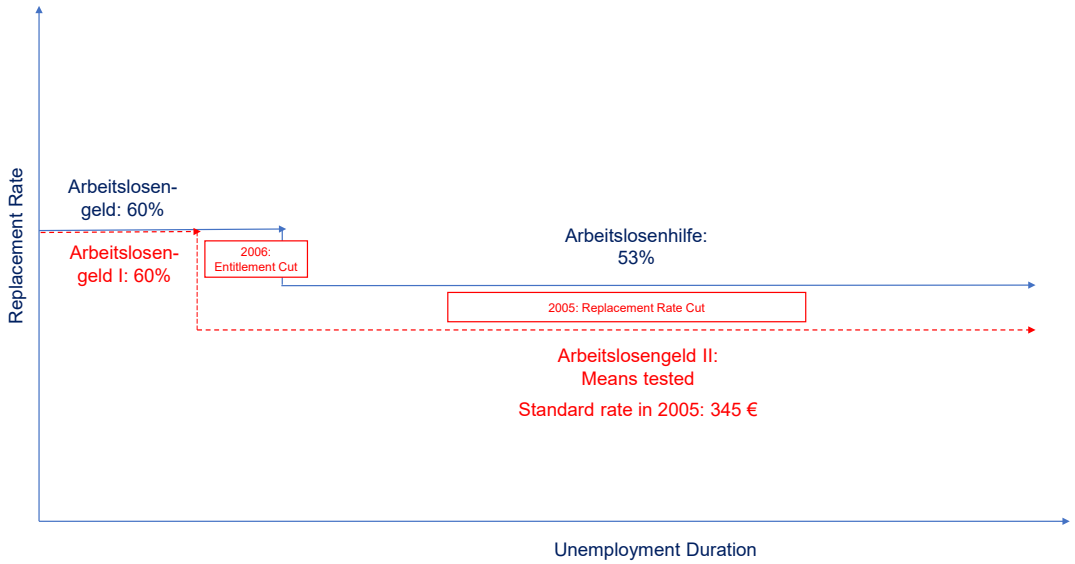
## 3.1 Institutional Reform

The German Hartz IV reform was the fourth part of a sequence of labor market reforms implemented between 2003 and 2006. The Hartz IV reform was introduced in two steps (see Appendix

[5] See Challe and Ragot (2016), Challe et al. (2017), Ravn and Sterk (2020), and Bilbiie (2008) for similar approaches to model consumer heterogeneity in a tractable framework.

[6] In addition, our paper is related to the literature on the effects of labor market institutions in a monetary union. See, for example, Abbritti and Mueller (2013) and Campolmi and Faia (2011).

**Figure 2:** Unemployment benefit changes due to Hartz IV labor market reform.




Notes: The horizontal axis shows the duration of unemployment, the vertical axis shows the replacement rate. The unemployment benefit system before 2005 is depicted in blue. The system from 2005 onward (Hartz IV) is depicted in red (dashed).

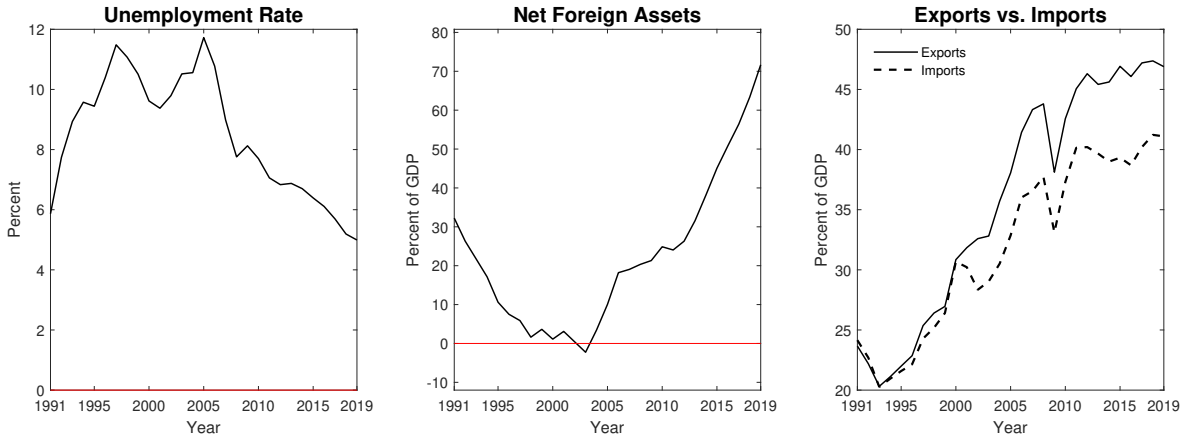
A for further details on the Hartz reforms, in particular, the fourth step). First, in 2005, the replacement rate for long-term unemployment was reduced: The formerly earnings-dependent transfers for long-term unemployed were transformed into fixed transfers with a strict means test. This meant a replacement rate cut for most groups, although the magnitude was heterogeneous (depending on earnings, wealth, etc.). 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.[7] See Figure 2 for a graphical illustration.

### 3.2 Macroeconomic Trends

In 2005, Germany's unemployment reached a peak level of roughly 12 percent. In the years after the Hartz IV reform, unemployment declined substantially (see the left panel of Figure 3).
Starting in the early 2000s, Germany's net foreign asset position started to increase, from zero to more than 70 percent of GDP in 2019 (see the middle panel in Figure 3). On the flip side, Germany started to run a large and persistent current account surplus, which reached a record level of 8.6 percent of GDP in 2015. The current account surplus was driven by a divergence of exports and imports (see the right panel in Figure 3).
Germany's aggregate unit labor costs (defined as labor compensation per worker to production per worker, depicted by the dotted line) relative to the rest of the Eurozone declined from the mid-1990s (see Figure 4). In other words, given the fixed nominal exchange rate within the Eurozone, Germany's labor compensation relative to production grew less than in other Eurozone

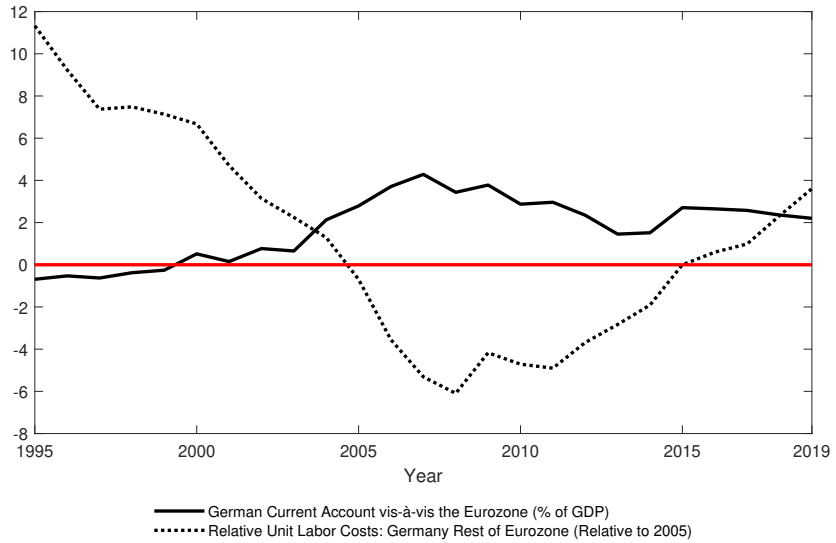
[7] The entitlement cut varied by age group and was strongest for elderly workers. For them, the entitlement duration was reduced from a maximum of 32 months to a maximum of 18 months.

**Figure 3:** German Unemployment Rate, Net Foreign Assets and Exports vs. Imports.



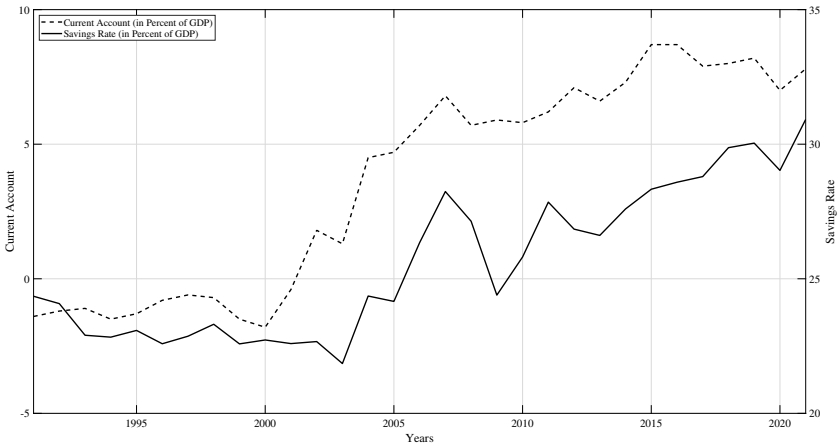

Sources: Deutsche Bundesbank and Destatis.

**Figure 4:** Germany's current account surplus relative to the rest of the Eurozone (in percent of GDP) and unit labor costs of Germany relative to the Eurozone (relative to 2005).




Notes: Germany's current account relative to Eurozone and relative unit labor costs (2005 normalized to 0). Sources: Deutsche Bundesbank and OECD.

**Figure 5:** Germany's current account and savings.



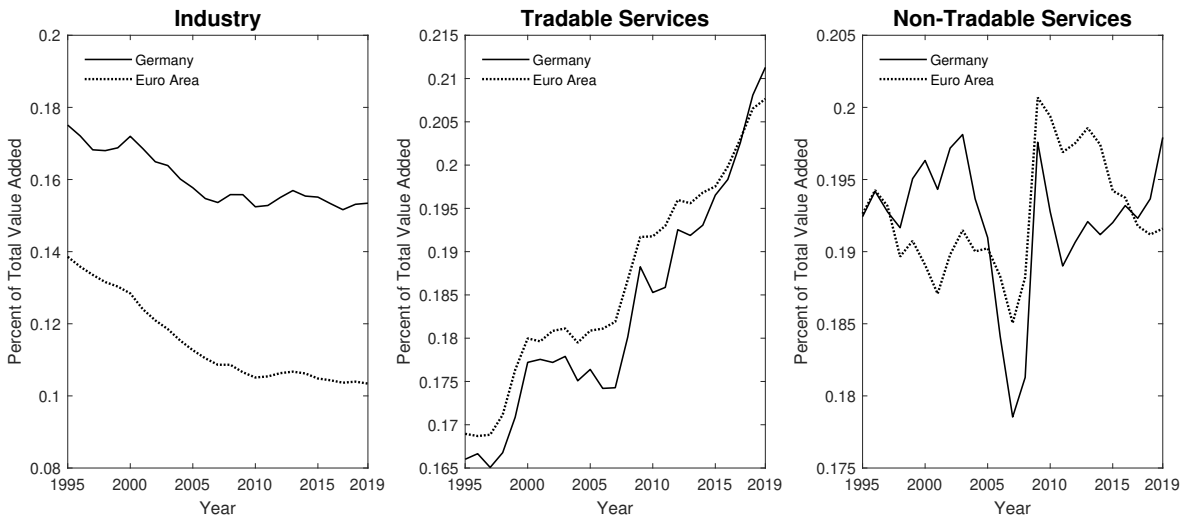

Notes: Germany's current account and savings rate (in percent of GDP). Sources: OECD and IMF.

countries. This phenomenon is often called the German "wage moderation" (see, e.g., Dustmann et al., 2014). However, despite these improvements in competitiveness compared to the rest of the Eurozone since the mid-1990s, Germany's current account surplus relative to the rest of the Eurozone only started accelerating from 2004 onward. As a flip side, Germany started to build up a large positive net investment position relative to other Eurozone countries at the same time (see, for example, Figure 7 in Hünnekes, Konradt, Schularick, Trebesch, and Wingenbach, 2019). Descriptively, the acceleration of the current account and net foreign investment position within the Eurozone corresponds to the point in time when the Hartz labor market reforms were implemented. In Section 6, we provide a model-based explanation for why wage moderation can be expected to have very different open-economy consequences compared to unemployment insurance reforms.

Furthermore, Figure 5 illustrates the strong comovement between Germany's current account surplus and the aggregate savings rate.[8] The aggregate savings rate and the current account show a correlation of 0.89 for Germany. It is also worth emphasizing that our model's relevant metric is the savings rate among employed households. Based on the German Socio-Economic Panel, Hochmuth et al. (2024) show that the private savings rate of employed workers reached its minimum in 2004 and started to increase in the aftermath of the Hartz reforms. They document a roughly 3 percentage point increase in the savings rate for employed households. Furthermore, they show that the groups that were most affected by the unemployment insurance reform in terms of entitlement cut, as defined in Hartung et al. (2018), show the largest increase in the savings rate. This will serve as a reference point for our quantitative simulations.

Figure 6 illustrates labor costs in terms of total compensation of employees by sector (industry, tradable services, and non-tradable services) divided by the economy-wide value added. Regarding the industry sector, we observe a similar declining trajectory of sector size in Germany and

[8] Non-financial corporations were also an important driver of the German current account surplus. However, this sector became a major contributor from the financial crisis onward. Savings of non-financial corporations increased from -0.49 percent of GDP in 2008 to 2.84 percent in 2009 (Source: Deutsche Bundesbank).




Notes: Total compensation of employees by sector (% of total value added). Industry excludes construction. Data Source: Eurostat (Gross value added and income by industry).

**Figure 6:** Germany vs. Euro Area: Labor Costs

the Eurozone. However, total labor costs relative to aggregate value added in the non-tradable service sector in Germany temporarily dropped by around 2 percentage points at the time of the Hartz IV reform. This fact was first pointed out by Klein and Schiman (2022). In Section 3.3, we will estimate the quantitative shift of the tradable relative to the non-tradable sector in Germany based on rich microeconomic data. Our quantitative model analysis will provide a theoretical explanation for this phenomenon.

In a nutshell, in the aftermath of the Hartz reforms, we find the following descriptive patterns: i) an increase in the aggregate savings rate, ii) a decline in unemployment, iii) an increase in Germany's net foreign assets, and an increase of exports relative to imports, iv) a depreciation of Germany within the Eurozone (expressed in terms of relative unit labor costs), v) a fall in labor costs in the non-tradable services relative to tradable services. These patterns will serve as a reference point for our aggregate model simulations.

### 3.3 Microeconometric Estimations

Precautionary savings can only flow to the neighboring country if the reforming country runs a current account surplus, as this is the flip side of the capital account. An improved current account requires a boost of the tradable sector in the reforming economy. We can measure the size of the increase in the tradable sector based on microeconomic data while controlling for composition effects.

To discipline the quantitative effects of the tradable vis-à-vis the non-tradable sector, we rely on microeconomic evidence based on the Administrative Wage and Labor Market Flow Panel (AWFP) and the IAB Establishment Panel from 1994-2018.[9] In contrast to aggregate data, this allows us to control for potential compositional effects. In all our specifications, we will use firm-fixed effects to control for unobserved time-invariant heterogeneity.

[9] See Appendices C.1 and C.2 for details on these two datasets.

We use the IAB Establishment Panel to classify sectors into tradable and non-tradable. To this end, we calculate the two-digit sector-specific export shares based on the share of sales abroad relative to total sales in the IAB Establishment Panel. Following Dustmann et al. (2014), we define a two-digit sector to be tradable if the export share exceeds the 25th percentile prior to 2005.[10] The definition of tradability at the sector level has two advantages. First, we believe that it is the economically more relevant definition compared to a definition at the firm level. Although a firm may only be selling a small fraction of its production to foreign countries (say, a supplier that mainly produces for a German producer of cars), it may be located in a sector that produces tradable goods (in our example, production of cars). Second, our tradability definition based on the sector-level can be imputed to the AWFP dataset. This dataset does not contain any information on tradability, but it has two major advantages relative to the IAB Establishment Panel: i) It is an administrative dataset from social security records. ii) It comprises the universe of all German establishments.[11]

We estimate the following fixed-effects model at the establishment level $i$:

$$\begin{aligned} log\,X_{i,t} = &\alpha_0 + \alpha_1 t_t + \alpha_2 t_t^2 + \beta_1 log(\text{GDP}_t^G) + \beta_2 log(\text{GDP}_t^W) + \\ &+ \gamma_1 \text{HartzIV}_t + \gamma_2 \text{HartzIV}_t \times \text{Tradable}_i + \mu_i + \epsilon_{i,t}, \end{aligned}$$

where $X_{i,t}$ is the dependent variable (either full-time employment, wage sum, or value added). Our coefficient of interest is $\gamma_2$, the interaction term of the Hartz IV-dummy and our dummy for tradability (*Tradable*, i.e. one above mean tradability). The Hartz IV dummy is a shift dummy that takes the value 1 from 2005 onwards. In interaction with our tradability dummy, this allows us to test whether the tradable sector behaved differently in the aftermath of the Hartz reforms. In all our specifications, we control for a linear and quadratic time trend, and business cycle effects (domestic $\text{GDP}_t^G$, and world $\text{GDP}_t^W$). In addition, we control for the share of intermediate inputs in a robustness check with the IAB Establishment Panel. It is well known that the intermediate input intensity has changed over time (e.g., due to outsourcing). This control variable allows us to see whether our results are robust to intermediate input changes. We restrict our sample to firms with at least ten employees on average over the entire sample period to prevent our results are driven by very small firms that only constitute a small fraction of aggregate employment.

The estimated coefficient for the interaction term (Hartz IV * Tradability) is positive and statistically significant in all specifications based on the AWFP (see left side of Table 1). According to our baseline specification, full-time employment increased by 2.7 percentage points more in the tradable sector than in the non-tradable sector in the aftermath of the Hartz reforms. The wage sum in the tradable sector even increased by 4.7 percentage points more than in the non-tradable sector. These results confirm the descriptives in Figure 6 that showed a relative decline of the non-tradable sector in the aftermath of the Hartz reforms.

[10] When we split establishments according to the mean export share, the key message that the tradable sector expanded more after the Hartz reforms remains robust. Results are available on request.

[11] Note that we use establishment and firm interchangeably in our paper. However, the IAB data universe refers to establishments, not firms.

**Table 1:** Estimation Results

| | AWFP | | IAB Establishment Panel | |
|---|---|---|---|---|
| *Dependent Variable* | log(Employment) | log(Wage Sum) | log(Value Added) | log(Value Added) |
| **Hartz IV*Tradability** | 0.027*** | 0.047*** | 0.085* | 0.118*** |
| Hartz IV | -0.006*** | -0.039*** | -0.066*** | -0.034** |
| log(GDP Germany) | 0.317*** | 0.534*** | 0.965*** | 1.438*** |
| log(GDP World) | 0.088*** | 0.028*** | 0.457*** | -0.048 |
| Time Trend | -0.057*** | -0.042*** | -0.121*** | 0.003 |
| Squared Time Trend | 0.001*** | 0.001*** | 0.002*** | 0.000 |
| Constant | -3.588*** | -1.313*** | -8.001*** | -0.348 |
| Establishment-Level Fixed Effects | Yes | Yes | Yes | Yes |
| Intermediate Inputs | No | No | No | Yes |
| $R^2$ | 0.770 | 0.806 | 0.875 | 0.934 |
| N | 7.622.574 | 7.622.574 | 68.225 | 68.225 |

Notes: Estimations include establishment-level fixed effects. Standard errors are clustered at the establishment level. The first two columns denote results based on the Administrative Wage and Flow Panel (AWFP), and the last two columns show results based on the IAB Establishment Panel. Regressions based on the IAB Establishment Panel include weights.

The estimations based on the IAB Establishment Panel confirm that the tradable sector expanded more than the non-tradable sector. Two major advantages of the IAB Establishment Panel are that we have information on value added (defined as sales minus intermediate inputs) and that we control for intermediate inputs.

The estimated coefficients for value added are even larger than for employment and the wage sum. Without including intermediate inputs, they are only significant at the 10 percent level. When including intermediate inputs, the interaction term is significant at the 1 percent level. What are the potential reasons for the differences in the employment and value added interaction terms? In addition to an increase in the size of the tradable sector, firms may have realized additional productivity gains. For our quantitative model exercise, we will target the most conservative estimate (namely, 0.027). Thus, our quantitative effects will constitute a lower bound on the reaction of the tradable vs. non-tradable sector and, thereby, the size of the negative consumption spillover effects.

# 4 The Model

We propose a model structure that is rich enough to be calibrated to our microeconomic estimations and to replicate key features of the labor market reform in Germany. At the same time, we require a model that can be solved within a two-country context with endogenous interest rates. This approach allows us to analyze the implications of the largest country implementing a major structural labor market reform within the Eurozone. We combine the following building blocks.[12]

First, we assume a two-country Real Business Cycle model to analyze international spillover effects. We abstain from modeling New Keynesian price adjustment costs (as for example in Galí and Monacelli, 2016), as we are interested in the long-run consequences of labor market reforms (for a discussion, see Section 2). Second, we assume a labor market with search frictions and

[12] The labor market structure builds on Hochmuth, Moyen, and Stähler (2019).

immediate rehiring (as in Blanchard and Galí, 2010) where random matching takes place via a Cobb-Douglas constant-returns matching function. We use a rich deterministic structure of different unemployment duration groups (short-term unemployed workers who differ in the length of their unemployment spell and long-term unemployed workers) that allows us to analyze the consequences of the Hartz IV labor market reform, which was targeted toward long-term unemployed. Third, we assume that there are tradable or non-tradable goods-producing firms. As all vacancies run through the same aggregate matching function, vacancies will be posted in the sector with the highest expected return. In equilibrium, this equalizes the prices for home-produced tradable and non-tradable goods.

Finally, following Challe and Ragot (2016) and Challe et al. (2017), we assume that all employed workers are members of a household with consumption pooling. However, once workers become unemployed, they have to leave the family and live on their own but obtain a share of the family's assets. As a result, workers face incomplete insurance against the consumption risk of becoming unemployed, which generates a tractable precautionary savings motive via the employed household head's intertemporal utility maximization.

The way we incorporate incomplete insurance, our model generates an upward-sloping asset supply curve. The equilibrium interest rate is pinned down endogenously by asset demand and asset supply in our framework (see Figure 1 in the Introduction for an illustration). In a model with complete insurance, the interest rate would be given exogenously by the inverse of the discount factor, which yields a horizontal asset supply curve. Due to our upward-sloping asset-supply curve, we do not have to assume frictions in the international capital market or portfolio adjustment costs as proposed by Schmitt-Grohe and Uribe (2003) to ensure steady-state determinacy and stationarity. In response to permanent policy changes (such as structural reforms), these frictions have long-run effects on the interest rate and net foreign asset position. Therefore, they are not innocuous in our context.[13]

In the presentation of the model in this section, we focus on the home country. The analogous equations hold also for the foreign economy, which is denoted with a subscript $F$.

### 4.1 Households

The economy consists of a continuum of agents normalized to measure one who differ in their employment status. All workers have CRRA preferences over consumption $c_t^i$. The expected discounted utility is:

$$U = E_0 \sum_{t=0}^{\infty} \beta^t u(c_t^i),$$

where $E_0$ are expectations in period 0, $i$ denotes different worker groups (defined below) and $\beta \in (0,1)$ denotes households' subjective discount factor.

We specify the following specific utility function:

[13] See also Ghironi (2006) for a discussion of this issue in terms of overlapping generation models, which also generate an endogenous savings motive.

$$u(c_t^i) = \frac{(c_t^i)^{(1-\sigma_c)}}{1-\sigma_c}, \tag{4.1}$$

where $\sigma_c$ is the relative risk aversion parameter.
Aggregate household consumption $C$ consists of tradable, $C_t^T$, and non-tradable, $C_t^N$. Bundling will be discussed in Section 4.2.

### 4.1.1 Employed Workers' Consumption

The family head chooses consumption and next period's asset holdings, $a_{t+1}$, for all members and redistributes consumption goods and assets equally among employed workers. In contrast, unemployed workers are not part of the family. When workers become unemployed, they move from employment to different unemployment states $i \in [e, e\,u_k, u\,u]$ with $e$ denoting employed, $e\,u_k$ short-term unemployed for $k$ periods, where $k \in K$, and $u\,u$ denotes long-term unemployed workers. $N_t, K_t$ are beginning of period employment (which consists of tradable and non-tradable employment), and capital, $\tilde{u}_t\left(u_{t-1}^i\right)$ is the beginning of period cross-sectional distribution of workers across labor market states $i \in [e, e\,u_k, u\,u]$ with $e$ denoting employed, $e\,u_k$ short-term unemployed for $k$ periods, where $k \in K$, and $u\,u$ denotes long-term unemployed workers.
The family head maximizes the utility of a member who is employed. Her maximization problem reads

$$\max_{c_t, a_{t+1}} V_t^e = \left\{ u(c_t^e) + \beta E_t\left[\left(1 - s(1-\rho_{t+1})\right)V_{t+1}^e + s(1-\rho_{t+1})V_{t+1}^{e\,u_1}\right]\right\}, \tag{4.2}$$

where $s$ is the exogenous separation rate, and $\rho$ is the endogenous job-finding rate. $N_t = N_t^T + N_t^N$ is aggregate employment, which consists of tradable and non-tradable employment.[14]
Utility is maximized subject to the budget constraint

$$\begin{aligned} c_t^e + a_{t+1} =& (1-\tau_t^w)w_t - t_t + \frac{\Pi_t}{N_t} + \left((1 - s(1-\tau^F)(1-\rho_t))\frac{N_{t-1}}{N_t}\right)R_t a_t \\ &+ \frac{\rho_t}{N_t}\sum_{k=1}^{K-1}\left(u_{t-1}^{e\,u_k} r_t^{e\,u_k} R_{t-k} a_{t-k}(1-\tau^F)\right), \end{aligned} \tag{4.3}$$

and the debt constraint

$$a_t \geq 0. \tag{4.4}$$

An employed worker's expenditures for current consumption and next period's assets are financed with labor income net of taxes given by $(1-\tau_t^w)w_t$, where $\tau_t^w$ is the tax rate on wages, and $w_t$ is the wage, $t_t$ are lump-sum transfers, and $\Pi_t$ are aggregate firm profits, which are distributed among employed workers. There are two types of real values of asset holdings (including

[14] As all workers are members of the same family, we do not have to distinguish types in the utility maximization.

their returns): First, the real value of assets $R_t a_t$ of those members who remain employed. Second, the real value of remaining assets $r_t^{e u_k}$ of newly-matched previously unemployed (denoted as $u_t^{e u_k, j}$ and defined below) who return to the family and lost their job $j$ periods ago (last term in equation 4.3).

The share of asset holdings for these returning members is given by $r_t^{e u_1} = (1 - \theta_{t-1}^1)$ and $r_t^{e u_k} = r_{t-1}^{e u_{k-1}}(1-\theta_{t-1}^k)$, where $\theta_t^k$ represents the proportion of assets consumed while in the unemployment state $k$.

Family members who separate from the family with an exogenous probability $s$ and are not rematched within the same period, with probability $1-\rho_t$, receive a portion of the family's assets. The family head deducts a fraction $\tau^F$ from this portion.

The maximization of the family's utility function (equation 4.2) subject to the budget constraint (equation 4.3) and the debt constraint (equation 4.4), results in the family member's marginal utility of consumption and asset choice:

$$\Omega_t R_t \leq 1 \tag{4.5}$$

with the marginal rate of intertemporal substitution of a worker defined as $\Omega_t$ (the employed workers' stochastic discount factor):

$$\Omega_t = \beta E_t \left[ \underbrace{(1-s(1-\tau^F)(1-\rho_{t+1}))\frac{\lambda_{t+1}^e}{\lambda_t^e}}_{\text{U' of employed worker}} \left( 1 + \sum_{k=1}^{K-1} \beta^{k-1} \underbrace{\frac{\lambda_{t+k}^e}{\lambda_t^e} \frac{\rho_{t+k}}{N_{t+k}} u_{t+k-1}^{e u_k} \cdot r_{t+k}^{e u_k}(1-\tau^F)}_{\text{U' of assets prev. unemp. bring back}} \right.\right.$$
$$\left.\left. + \underbrace{s(1-\rho_{t+1})\frac{\lambda_{t+1}^{e u_1}}{\lambda_t^e} \sum_{k=1}^{K} \tilde{r}_{t+k}^{e u_k}(1-\tau^F)}_{\text{U' of assets when unemployed}} \right) \right], \tag{4.6}$$

where $\tilde{r}_t^{e u_k} = \theta_{t+k}^k + \beta(1-\rho_{t+k})\lambda_{t+k}^{e u_{k+1}}/\lambda_t^e \tilde{r}_{t+1}^{e u_{k+1}}$ as long as $k < K$ and $\tilde{r}_t^{e u_K} = \theta_{t+K}^K$.

This is the Euler equation for asset holdings. The right-hand side of equation 4.6 can be split into three components: First, the marginal utility of asset holdings for employed workers. Second, the marginal utility of assets that are brought back by previously unemployed workers who find a job again and return to the family. The third term on the right-hand side denotes the marginal utility of assets derived during unemployment. This last term gives rise to the tractable precautionary savings motive.

Absent the precautionary savings motive, this condition would boil down to the standard asset Euler equation of the standard complete insurance model:

$$\frac{1}{R_t} = \beta E_t \frac{\lambda_{t+1}^e}{\lambda_t^e}. \tag{4.7}$$

We will use the latter equation (amending with Schmitt-Grohe and Uribe (2003)'s assumption to

close the open economy) when we contrast the quantitative results in our incomplete insurance framework with those in a complete insurance framework.

### 4.1.2 Unemployed Workers' Consumption

Short-term unemployed workers differ in their unemployment duration $k \in (1, K)$. When a worker does not match for $K$ periods on the labor market, she deterministically becomes long-term unemployed. Unemployed workers receive unemployment benefits $b_t^{BS_k,j}$ for short-term unemployed and $b_t^{BL,j}$ for long-term unemployed, respectively. More precisely,

$$b_t^{BS_k,j} = r r^s (1-\tau_{t-k}^w) w_{t-k,j} \tag{4.8}$$

$$b_t^{BL,j} = r r^l (1-\tau_{t-K}^w) w_{t-K,j}, \tag{4.9}$$

where $r r^s$ and $r r^l$ denote the net replacement rates for short-term and long-term unemployed respectively. This maps the institutional structure of the German labor market (and other OECD countries), where long-term benefits are typically less generous than short-term benefits. In addition, it allows us to analyze the Hartz IV labor market reform, which reduced long-term benefits and the duration of short-term benefits.

Once workers become unemployed, they receive a certain amount of assets, $1-\tau^F$, from the family head. Short-term unemployed consume a share $\theta_t^k$ of their wealth. They decide every period how much of their assets they want to consume, thus, $\theta_t^k$ is a choice variable. We assume that all assets have to be consumed during $K$ periods (the workers' short-term unemployment spell). Long-term unemployed workers have no asset holdings. This assumption is consistent with means-testing for receiving long-term unemployment benefits. If long-term unemployed owned assets above a certain threshold under Hartz IV, they were not eligible for these means-tested benefits.[15]

A short-term unemployed worker who is unemployed for $k > K$ periods chooses consumption $c_t^{eu,k}$ and the share of assets she wants to consume, $\theta_t^k \geq 0$. The maximization problem is:

$$V_t^{eu_k} = \max_{\{c_t^{eu_k}, \theta_t^k\}} \left\{ u(c_t^{eu_k}) + \beta E_t \left[ \rho_{t+1} V_{t+1}^e + (1-\rho_{t+1}) V_{t+1}^{eu_{k+1}} \right] \right\} \tag{4.10}$$

subject to the budget constraint for a $k$-period unemployed worker

$$c_t^{eu,k} + t_t = \kappa_t^{BS_k} + \theta_t^k R_{t-k} a_{t-k} (1-\tau^F). \tag{4.11}$$

In state K+1 an unemployed worker is considered a long-term unemployed worker. Long-term unemployed workers consume their contemporaneous income: $c_t^{uu} + t_t = \kappa_t^{BL}$.

It holds that $\sum_{k=1}^{K} \theta_{t-K+k}^k = 1$ and, $\theta_t^K$ is determined by previous choices. A short-term unem-

[15] We show in the Appendix that our assumption is in line with evidence from the IAB Pass Survey. The median long-term unemployed has zero wealth. And those who own some wealth mostly own very little (e.g., less than € 1000). Only around 10 percent of long-term unemployed had to live off their savings before receiving long-term unemployment benefits.

ployed worker in period $K$ only chooses consumption.
To ensure the existence of an equilibrium, it has to be the case that employed workers have a higher consumption level than unemployed workers ($c^e > c^{eu,1}$). This condition guarantees that employed workers have a precautionary savings motive and that previously unemployed workers have an incentive to find a job again, as remaining unemployed would result in a lower standard of living. A more detailed discussion of this issue can be found in Challe and Ragot (2016). In the numerical application, the family tax $\tau^F$ is set to make sure that this condition is satisfied.

### 4.2 Demand for Different Goods Types

Households consume a bundle of goods and services. This bundle consists of tradables and non-tradables, which are bundled according to a CES aggregator:

$$C_t = \left( \left(\alpha^T\right)^{\frac{1}{\phi^T}} \left(C_t^T\right)^{\frac{\phi^T-1}{\phi^T}} + \left(1-\alpha^T\right)^{\frac{1}{\phi^T}} \left(C_t^N\right)^{\frac{\phi^T-1}{\phi^T}} \right)^{\frac{\phi^T}{\phi^T-1}} \qquad 0<\alpha^T<1, \tag{4.12}$$

where $\alpha^T$ represents the share of tradables in the bundle and $\phi^T$ represent the elasticity of substitution between tradables and non-tradables.
The aggregate consumption price index is

$$P_t = \left( \alpha^T \left(P_t^T\right)^{1-\phi^T} + \left(1-\alpha^T\right)\left(P_t^N\right)^{1-\phi^T} \right)^{\frac{1}{1-\phi^T}}, \tag{4.13}$$

where $P_t^N$ denotes the price of non-tradables and $P_t^T$ is the price of the tradable consumption basket.
The domestic demand for tradables is

$$C_t^T = \alpha^T \left(P_t^T/P_t\right)^{-\phi^T} C_t, \tag{4.14}$$

and for non-tradables

$$C_t^N = \left(1-\alpha^T\right)\left(P_t^N/P_t\right)^{-\phi^T} C_t. \tag{4.15}$$

Thereby, the relative demand for tradables vs. non-tradables is a function of the relative prices:

$$\frac{C_t^T}{C_t^N} = \frac{\alpha^T}{1-\alpha^T}\left(P_t^T/P_t^N\right)^{-\phi^T}. \tag{4.16}$$

Tradable consumption consists of home produced tradables, $c_{t,H}$, and foreign produced tradables, $c_{t,F}$, which are aggregated according to a CES function:

$$C_t^T = \left( \left(\gamma^C\right)^{\frac{1}{\eta_C}} \left(c_{t,H}\right)^{\frac{\eta_C-1}{\eta_C}} + \left(1-\gamma^C\right)^{\frac{1}{\eta_C}} \left(c_{t,F}\right)^{\frac{\eta_C-1}{\eta_C}} \right)^{\frac{\eta_C}{\eta_C-1}} \qquad 0<\gamma^C<1, \tag{4.17}$$

where $\gamma^C$ denotes the consumption bias towards goods produced in the home country.

The aggregate price level for tradables is defined as:

$$P_t^T = \left(\gamma_C \left(p_{t,H}^T\right)^{1-\eta_C} + \left(1-\gamma_C^T\right)\left(p_{t,F}^T\right)^{1-\eta_C}\right)^{\frac{1}{1-\eta_C}}. \tag{4.18}$$

The demand for home and foreign tradables is:

$$c_{t,H} = \gamma^C \left(\frac{p_{t,H}^T}{P_t^T}\right)^{-\eta_C} C_t^T, \quad c_{t,F} = (1-\gamma^C)\left(\frac{p_{t,F}^T}{P_t^T}\right)^{-\eta_C} C_t^T. \tag{4.19}$$

Thus, relative demand for home and foreign tradables is a function of the real exchange rate:

$$\frac{c_{t,H}}{c_{t,F}} = \frac{\gamma^C}{1-\gamma^C} \left(\mathrm{RER}_t\right)^{\eta_c}, \tag{4.20}$$

with the real exchange rate defined as the relative price of home and foreign tradables, $\mathrm{RER}_t = p_{t,H}^T / p_{t,F}^T$.
We assume that investment goods are tradable (i.e. no non-tradable part as for consumption). Furthermore, tradable consumption goods and investment goods are perfect substitutes. Investment is aggregated in the same way as tradable consumption:

$$I_t = \left(\left(\gamma^C\right)^{\frac{1}{\eta_C}} \left(i_{t,H}\right)^{\frac{\eta_C-1}{\eta_C}} + \left(1-\gamma^C\right)^{\frac{1}{\eta_C}} \left(i_{t,F}\right)^{\frac{\eta_C-1}{\eta_C}}\right)^{\frac{\eta_C}{\eta_C-1}}. \tag{4.21}$$

In analogy with tradable consumption, the relative demand for home and foreign investment goods is a function of the real exchange rate:

$$\frac{i_{t,H}}{i_{t,F}} = \frac{\gamma^C}{1-\gamma^C} RER_t^{\eta_C}. \tag{4.22}$$

## 4.3 Production, Sector Choice, and Matching

In the previous section, we discussed the demand for tradables and non-tradables. In this section, we show how demand is satisfied by the free entry of vacancies in these two sectors.
We assume an aggregate Cobb-Douglas constant-returns production function:[16]

$$Y_t = e^z (K_t)^\alpha (N_t)^{1-\alpha} \tag{4.23}$$

Here, $Y_t$ denotes aggregate production at time $t$, which is a function of aggregate capital ($K_t$), labor ($N_t$), and aggregate productivity ($e^z$). Independently of whether firms produce in the tradable or non-tradable sector, aggregate production in real terms is described by this aggregate production function. Essentially, the production function determines the overall production in real terms. However, the allocation between the tradable and non-tradable sector is determined by vacancy postings in the tradable and non-tradable sector, as described below. As a result, the

[16] Due to constant returns to scale, this assumption delivers observationally equivalent results to a model economy with two identical production functions for the tradable and non-tradable sector.

economy's total capital and labor are divided between these sectors. This means that the sum of capital used in tradable and non-tradable sectors equals the total capital ($K_t = K_t^T + K_t^N$), and similarly, the sum of labor in both sectors equals the total labor ($N_t = N_t^T + N_t^N$).
Furthermore, we assume that aggregate matches in the economy are determined by a standard aggregate matching function, with searching workers and aggregate vacancies as inputs. This matching function is assumed to be a Cobb-Douglas and constant-returns:

$$M_t = \kappa^e S_t^{\eta} V_t^{1-\eta}, \tag{4.24}$$

where $\kappa^e$ denotes the matching efficiency, $\eta$ the matching elasticity, $S_t$ is the the total number of searching workers, and $V_t$ is the number of aggregate vacancies ($V_t = V_t^T + V_t^N$). As we assume search to be undirected, this allows us to define the probability of a firm to fill a vacancy

$$q_t = M_t / V_t = \kappa^e \theta_t^{-\eta}, \tag{4.25}$$

which is the same in the tradable and non-tradable sector. It is a function of aggregate market tightness, $\theta = V_t / S_t$.
Multi-worker firms either produce in the tradable or non-tradable sector, denoted by index $j$. They maximize the intertemporal discounted difference between revenues and costs (wage sum, vacancy costs, and capital costs[17]) in the respective sector:

$$\Pi_t^j = \max_{\{K_t, N_t, V_t\}} E_t \sum_{t=0}^{\infty} \Omega_t \left\{ \frac{p_{t,H}^j}{P_t} Y_t^j - w_t^j N_t^j - \kappa^{\upsilon} V_t^j - r_t^k K_t^j \right\} \tag{4.26}$$

subject to the employment dynamics equation:

$$N_t^j = (1-s) N_{t-1}^j + V_t^j q_t, \tag{4.27}$$

where $\kappa^{\upsilon}$ are vacancy posting costs.
Maximization of the profit equation and substitution yields the following first order conditions for labor and capital:

$$\frac{\kappa^{\upsilon}}{q_t} = \frac{p_{t,H}^j}{P_t} MPL_t - w_t^j + (1-s) E_t \left\{ \Omega_t \frac{\kappa^{\upsilon}}{q_{t+1}} \right\}, \tag{4.28}$$

where $MPL_t = e^z (1-\alpha) \left( \frac{K_t}{N_t} \right)^{\alpha}$ is the aggregate marginal product of labor that is determined by the aggregate capital intensity. When a firm increases its labor input by one unit ($\partial Y_t^j / \partial N_t^j$), this runs through the aggregate production function.[18] Therefore, what matters is the aggregate

[17] These firms rent out the capital stock, while the aggregate asset supply is determined by households.
[18] The first derivative of the production function with respect to the input factors is equal in the tradable and non-

marginal product of labor.

$$r_t^k = \frac{p_{t,H}^j}{P_t} MPK_t, \tag{4.29}$$

where $MPK_t = e^z \alpha \left(\frac{N_t}{K_t}\right)^{(1-\alpha)}$ is the aggregate marginal product of capital.
To understand the vacancy posting behavior in the tradable and non-tradable sectors, it is useful to look at the respective job-creation conditions:

$$\frac{\kappa^v}{q_t} = \frac{p_{t,H}^T}{P_t} MPL_t - w_t^T + (1-s)E_t \left\{ \Omega_t \frac{\kappa^v}{q_{t+1}} \right\}, \tag{4.30}$$

$$\frac{\kappa^v}{q_t} = \frac{p_t^N}{P_t} MPL_t - w_t^N + (1-s)E_t \left\{ \Omega_t \frac{\kappa^v}{q_{t+1}} \right\}, \tag{4.31}$$

Hiring costs in both sectors are the same ($\kappa^v/q_t$), as they are determined by aggregate market tightness. Thereby, the only differences that may arise are due to sector-specific prices (and wages, which are a function of these prices). If there is any price difference between the two sectors, firms in the sector with higher prices have an incentive to post more vacancies. This will increase sector-specific vacancies and, thereby, sector-specific production supply up to the point where production prices in the two sectors are equalized (in conjunction with downward-sloping demand, see Section 4.2). Therefore, in equilibrium, prices (and thereby wages) in the two sectors are the same due to free entry of vacancies: $p_{t,H}^T = P_t^N$.
Intuitively, the demand for home-produced tradables and non-tradables is a function of the CES aggregation and the respective demand function derived in the previous section. The supply of home-produced tradables and non-tradables is determined by the free-entry conditions of vacancies in these two sectors, which equalize the production costs of these two types. Thus, in case of a demand shift (e.g., because of the labor market reform that we will analyze), there will be more production of the good with more relative demand, as higher prices stimulate vacancy posting in this sector up to the point where prices are equalized.
Next, we define the matching market from the worker side. Workers do not direct their search to a sector, i.e., workers search for a job and are randomly matched. Thus, the job-finding rate ($\rho_t$) is a function of aggregate market tightness:

$$\rho_t = M_t / S_t = \kappa^e \theta^{1-\eta}. \tag{4.32}$$

tradable sectors, e.g.: $\frac{\partial Y_t}{\partial K_t^j} = e^z \alpha (K_t^T + K_t^N)^{(\alpha-1)} (N_t^T + N_t^N)^{1-\alpha}$. Using Euler's Theorem, the sector-specific production is defined as $Y_t^j = MPK_t K_t^j + MPL_t N_t^j$.

Searching workers are defined as

$$S_t = 1-(1-s)N_{t-1}. \tag{4.33}$$

Due to our random matching assumption, workers' job-finding probability is the same in all unemployment duration groups.
As we assume immediate matching (as in Blanchard and Galí, 2010), employment evolves according to

$$N_{t+1} = (1-s)N_t + M_t. \tag{4.34}$$

Unemployment is defined as

$$u_t = 1-N_t = \sum_{k=1}^{K} u_t^{eu_k} + u_t^{uu}, \tag{4.35}$$

where the number of unemployed workers in the first period ($k=1$) of their unemployment spell is

$$u_t^{eu,1} = s(1-\rho_t)N_{t-1}, \tag{4.36}$$

in subsequent periods $k \in (2,K)$ of short-term unemployment the number is given by:

$$u_t^{eu,k} = (1-\rho_t)u_t^{eu,k-1}. \tag{4.37}$$

Long-term unemployment evolves according to

$$u_t^{uu} = (1-\rho_t)[u_{t-1}^{uu} + u_{t-1}^{eu,K}]. \tag{4.38}$$

According to our model structure, searching workers are randomly matched in the tradable or non-tradable sector depending on the number of posted vacancies. The number of vacancies is a function of the respective demand, as defined in Section 4.2.
Thus, workers only switch sectors when they lose their job and transition to a new job in a different sector. While this assumption appears a bit extreme at first sight, it is in line with empirical evidence by Dauth, Findeisen, and Suedekum (2017).[19]

### 4.4 Wage Bargaining

We assume that wages are determined by Nash bargaining, where the family head bargains with the firm. Her bargaining power is $\zeta$. Given that all workers are homogeneous, the family head effectively represents individual workers' interests.

[19] Dauth et al. (2017) look at transitions between manufacturing and services. They find that direct sector switches among workers are rare. Instead, it is either young entrants that drive sector transitions or returnees out of non-employment.

In equilibrium, prices in the tradable and non-tradable sectors are equalized, leading to equal sector-specific marginal products of labor and, consequently, equal wages across these sectors. Moreover, the outside options for workers are identical. Unemployed workers are randomly matched to the tradable or non-tradable sector through the aggregate matching function. Although these sectors have different ex-post job-finding rates, the aggregate ex-ante job-finding rate is the same for all unemployed workers. This eliminates systematic wage discrepancies between the tradable and non-tradable sectors.
The surplus from working is given by $\tilde{\mathscr{W}}_t^j = \mathscr{W}_t^{e,j} - \mathscr{W}_t^{e\,u_1,j}$ (see Appendix D). The firm's surplus of hiring one additional worker is $J_t^j$. Therefore, the wage is derived from solving

$$w_t^j = \max_{w_t^j} [\tilde{\mathscr{W}}_t^j]^{\zeta} [J_t^j]^{1-\zeta}, \tag{4.39}$$

where $J_t^j$ is the firm's value of a match:

$$J_t^j = \frac{p_{t,H}^T}{P_t} MPL_t - w_t^T + E_t \Omega_t (1-s) J_{t+1}^j, \tag{4.40}$$

### 4.5 Investment fund

We assume that there is an investment fund. It is owned by the family and, thus, discounts the future with the stochastic discount factor $\Omega_t$. The investment fund purchases investment goods and bundles physical capital, $k_t$, government bonds, $b_t$, and international assets, $NFA_t$, to one single asset, which is held by the representative family of employed workers, $N_t a_t$:

$$N_t a_t = b_t + NFA_t + k_t. \tag{4.41}$$

Capital depreciates at rate $\delta$ and the capital stock evolves according to the law of motion given by

$$K_{t+1} = (1-\delta) K_t + I_t. \tag{4.42}$$

This yields the following condition:

$$R_t = r_t^k + (1-\delta). \tag{4.43}$$

where the gross interest rate is equal to the return on capital corrected for the deprecation rate.

### 4.6 Government

The government collects a labor-income tax $\tau_t^w$ and issues government bonds $b_t$ to finance interest payments on outstanding government debt, $R_{t-1} b_{t-1}$, and unemployment benefit payments.

$$\sum_{k=1}^{K} b_t^{BS_k} u_t^{e\,u_k} + b_t^{BL} u_t^{u\,u} + R_t b_t = \tau_t^w w_t N_t + t_t + b_{t+1}. \tag{4.44}$$

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

$$log(t_t/\bar{t}) = \rho^t log(t_{t-1}/\bar{t}) + \chi^b \left( \frac{b_{t-1}}{\omega^b Y_{t-1}} \right), \tag{4.45}$$

where $\rho^{\tau^w}$ denotes a smoothing parameter and $\chi^b$ the elasticity of the labor income tax rate to deviations from the long-run debt level that depends on aggregate output. The term $\left(b_{t-1}/(\omega^b Y_{t-1})\right)$ adjusts the lump-sum tax rate based on the deviation of last period's debt to its target with $\omega^b$ denoting the long-run debt-to-GDP ratio, and $\chi^b$ quantifies the government's responsiveness to this deviation. Note that potential fiscal gains due to labor market reforms are paid out via lump-sum taxes. This switches off potential second-round effects due to reduced distortions via the income tax and, thereby, constitutes a lower bound.

## 4.7 International Linkages

In our model, the two countries, Home and Foreign (denoted with $F$) are linked by trade in consumption and investment goods as well as international assets. We define the real exchange rate $RER_t$ as the ratio of producer prices in the tradable sector, $RER_t = p^T_{t,H}/p^T_{t,F}$.
Asset market clearing implies that total assets in the home economy, $N_t\, a_t$, have to equal government debt plus net foreign assets and capital, $b_t + NFA_t + k_t$. Hence, the loanable funds constraint, equation (4.41), must hold. As assets for the two countries must be in zero net supply, it must also hold that $rs\, NFA_t + (1-rs) RER_t NFA_{t,F} = 0$, where $rs$ is the relative size of the home country. A country's net foreign asset position is defined as the last period's assets plus current net exports, $NX_t$,

$$NFA_{t+1} = R_t NFA_t + NX_t, \tag{4.46}$$

and the current account is given by $CA_t = NFA_t - NFA_{t-1}$. Real per-capita net exports in Home are given by $NX_t = EX_t - IM_t$, with $EX_t = p^T_{t,H}/P_t \cdot (1-rs)/rs \cdot (c_{t,H} + i_{t,H})$, and $IM = p^T_{t,F}/P_t \cdot (c_{t,F} + i_{t,F})$. Households are assumed to consume goods produced at home and foreign goods.

## 4.8 Market Clearing

Equilibrium on the goods market implies that the economy-wide resource constraint must hold in the home economy and in the foreign economy:

$$\frac{p^T_t}{P_t} Y_t = C_t + I_t + NX_t + \sum_{j=T,N} \kappa^\upsilon V^j_t \tag{4.47}$$

$$\frac{p^T_{t,F}}{P_{t,F}} Y_{t,F} = C_{t,F} + I_{t,F} + NX_{t,F} + \sum_{j=T,N} \kappa^\upsilon V^j_{t,F} \tag{4.48}$$

For the last two equations, we use the equilibrium result that production prices in the home tradable sector are equal to production prices in the non-tradable sector.

# 5 Calibration

This section presents our calibration strategy and discusses how we implement the structural labor market reform in our tractable two-country incomplete insurance framework.

## 5.1 Calibration Strategy

Table 2 shows our baseline model calibration. The frequency is quarterly and the calibration of Home (Germany) and Foreign (Rest of Eurozone) is asymmetric. The two regions differ with respect to country size, the steady-state unemployment rate and productivity. The size of the Home country is 27.1 percent, which corresponds to the German share of GDP in the Eurozone in the year 2005. We set the subjective discount factor to $\beta = 0.97$, and the parameter of constant relative risk aversion $\sigma_c$ to 2. We further follow Cacciatore et al. (2016a) and set the elasticities of substitution between home and foreign goods to 6, which is in line with empirical evidence by Imbs and Mejean (2015). We set the elasticities of substitution between tradable and non-tradable goods to 0.5 (see Mendoza, 1991). Regarding the share of tradables on consumption, we target the tradable output value share in the year 2004 for tradable manufacturing and tradable services as calculated by Dustmann et al. (2014). Consistent with our definition of tradables, Dustmann et al. (2014) classify sectors as tradables if their export volume is above the 25th percentile of the distribution of export volumes.[20] We choose a home bias $\gamma^C$ of 0.66.[21]
Regarding the labor market, we set the elasticity of matches with respect to unemployment to 0.5 and workers' bargaining power $\zeta$ to 0.5, which are both standard values. Capital depreciates at a rate of 7 percent, and the weight of capital in production $\alpha$ amounts to 0.33.
For the policy parameters, in the pre-reform steady state, we set the replacement rate for short-term unemployed to 0.6 and the initial replacement rate for long-term unemployed to 0.5. These two values correspond to the legal value for single-earners without children (before the Hartz IV reform). Regarding the fiscal rule, we set the autocorrelation of the labor tax rate, $\rho^\tau$ to 0.8. Furthermore, we set the fiscal policy rule parameters to $\omega^b$=60% of GDP and $\chi^b = 0.05$ to ensure stationarity in government debt (see Kirsanova and Wren-Lewis, 2012).[22] The share of wealth kept by the family head is set to $\tau^F = 0.71$ to comply with the existence condition as discussed above.
Table 3 shows the targets in our calibration. We discipline the quantitative effects of our model by targeting the relative estimated reaction of the tradable to the non-tradable sector after the reform (see Table 1 of Section 3.3) in the first 40 periods (i.e., 10 years) after the reform.[23]

[20] See Table A1 in the Appendix of Dustmann et al. (2014).
[21] We further determine the foreign home bias endogenously by using equation 4.46 in order to hit the targets in Table 3.
[22] Performing an analogous simulation in which the lump-sum tax $\bar{t}$ takes care of debt stabilization does not alter our results much. The reason is that all households, also the unemployed workers, will be affected by that tax.
[23] The estimation period of our microeconomic model ranges from 1994-2014. The estimated shift dummy is set to 1 from 2005-2014. We choose the lower bound of 2.7%.

**Table 2:** Baseline Model Parameters

| | Parameter name | Symbol | Value | |
|---|---|---|---|---|
| | | | Home | Foreign |
| | Country size | $rs$ | 0.27 | 0.73 |
| Preferences | | | | |
| | Discount factor | $\beta$ | 0.97 | 0.97 |
| | Risk aversion | $\sigma_c$ | 2 | 2 |
| | EOS, home and foreign goods | $\eta^C$ | 6 | 6 |
| | EOS, tradable and non-tradable goods | $\phi^T$ | 0.5 | 0.5 |
| | Share of tradables in consumption | $\alpha^T$ | 0.79 | 0.79 |
| | Home bias | $\gamma^C$ | 0.66 | 0.87 |
| Labor Market and Production | | | | |
| | Matching elasticity | $\eta$ | 0.5 | 0.5 |
| | Workers' bargaining power | $\zeta$ | 0.5 | 0.5 |
| | Capital depreciation | $\delta$ | 0.07 | 0.07 |
| | Weight on capital in production | $\alpha$ | 0.33 | 0.33 |
| | Productivity (SS) | $e^z$ | 1 | 1 |
| Policy | | | | |
| | Replacement rate for short-term unemployed | rrs | 0.6 | 0.6 |
| | Replacement rate for long-term unemployed | rrl | 0.5 | 0.5 |
| | Autocorrelation tax rate | $\rho^\tau$ | 0.8 | 0.8 |
| | Elasticity of tax rate response to debt deviations | $\chi^b$ | 0.05 | 0.05 |
| | Target government debt-to-output ratio | $\omega^b$ | 0.6 | 0.6 |
| | Share of wealth kept by family head | $\tau^F$ | 0.71 | 0.71 |

**Table 3:** Targets

| Target | Symbol | Value | |
|---|---|---|---|
| | | Home | Foreign |
| Domestic Reaction of Tradable to Non-tradable Sector | | 0.027 | |
| Unemployment rate | $u$ | 0.089 | 0.096 |
| Job-filling rate | $q$ | 0.7 | 0.7 |
| Job-finding rate | $\rho$ | 0.116 | 0.108 |
| TPI | $p$ | 1 | 1 |
| CPI | $P$ | 1 | 1 |
| Real exchange rate | RER | 1 | 1 |
| Debt-to-GDP Ratio | b/Y | 0.6 | 0.6 |

In accordance with IAB administrative data, we target a quarterly job-finding rate to 11.6 percent for the domestic economy (Jung and Kuhn, 2014). This value corresponds to the average job-finding rate in Germany in 2004 (prior to the Hartz IV reform). Furthermore, as we target a slightly higher unemployment rate for the rest of the Euro Area, we correspondingly set a lower job-finding rate for Foreign.[24] Targeting a job-filling rate of 0.7 as in Christoffel, Kuester, and Linzert (2009) then pins down the matching efficiency, vacancy posting costs and the separation rate. In the initial steady state, inflation is assumed to be zero. We normalize $p_{t,H} = 1$ for all $t$ and target $\bar{p}_F = 1$ in the initial steady state. By construction, this implies the real exchange rate as well as the terms of trade to be equal to one in the initial steady state. The steady-state targets for unemployment rates are 8.9 percent in the home economy (Germany) and 9.6 percent in the rest of the Eurozone. These numbers refer to the harmonized unemployment rates from 1995 to 2004 (quarterly averages, Data source: OECD, Main Economic Indicators, 2017). Given these targets, we then derive the resulting interest rate and asset shares consumed by an unemployed worker in states $k \in K$ endogenously.

### 5.2 Reform Implementation

In our model simulation, we replicate the first reform step (cut in replacement rate for long-term unemployed workers, LTU, see Figure 2) by reducing the replacement rate $rr^l$ by 21 percent. This allows us to match our target concerning the expansion of the tradable sector based on our microeconometric estimation as discussed above. We further make long-term unemployment benefits time invariant: $b_t^{BL} = \bar{b}^{BL} = rr^{l,new}(1-\bar{\tau}^w)\bar{w}$. The magnitude of the decline in the replacement rate is within the range of plausible estimates.[25] See Section 5.2 for details on the labor market reform.

The second reform step (cut in entitlement duration) is implemented by assuming that workers who are unemployed for seven or eight quarters receive long-term benefits instead of short-term benefits. These workers were eligible for short-term unemployment benefits in the pre-reform scenario, but this duration is now cut by two quarters in the post-reform scenario.

Furthermore, we assume that, when simulating the full reform starting in 2005, households already anticipated the cut in entitlement duration scheduled for 2006. This implies that, at the time of the reduction in replacement rate for long-term unemployed workers, households know about the upcoming cut in entitlement duration already. We also 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.

[24] To be more precise, we assume the same inverse ratio $u^F/u^H$ which results in $\rho^F$=0.108.

[25] Note that the discussion on how much the replacement rate due to Hartz IV actually declined 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) assume a reduction of 67 percent for high-skilled workers and around 24 percent for low-skilled workers. We hence impose a conservative reduction of the replacement rate in between plausible estimates which is closest to the approach of Hochmuth et al. (2021).

# 6 Simulation Results

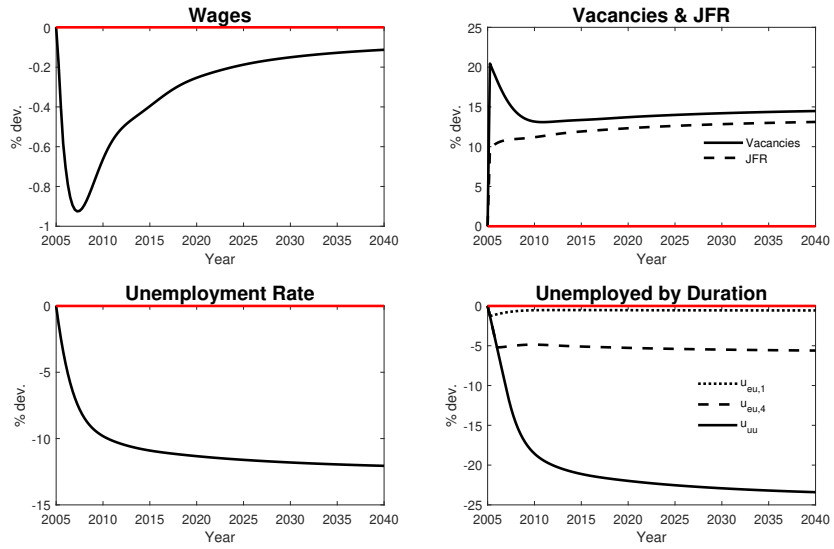
In this section, we describe the quantitative effects of the German benefit reform on the reforming economy and the spillover effects on the non-reforming economy. In addition, we show that the German wage moderation does not boost the tradable sector in our framework and, thereby, does not serve as a trigger for the open-economy patterns that can be found in aggregate data (see Section 3).

## 6.1 Effects of Benefit Reform

### 6.1.1 Effects in the Reforming Economy

The unemployment benefit reform triggers two effects in the reforming economy. First, as the value of (long-term) unemployment falls, this reduces the fallback option in wage bargaining and, thereby, wages. Figure 7 shows that lower wages stimulate vacancy posting, increase the job-finding rate and reduce unemployment in the reforming economy.[26] Burda and Seele (2020) document trends in the German labor market in the aftermath of the Hartz reforms in Germany and argue that the Hartz IV reform played a central role. Their documented trends are in line with our model predictions.

**Figure 7:** Consequences of Benefit Reform for Domestic Labor Market



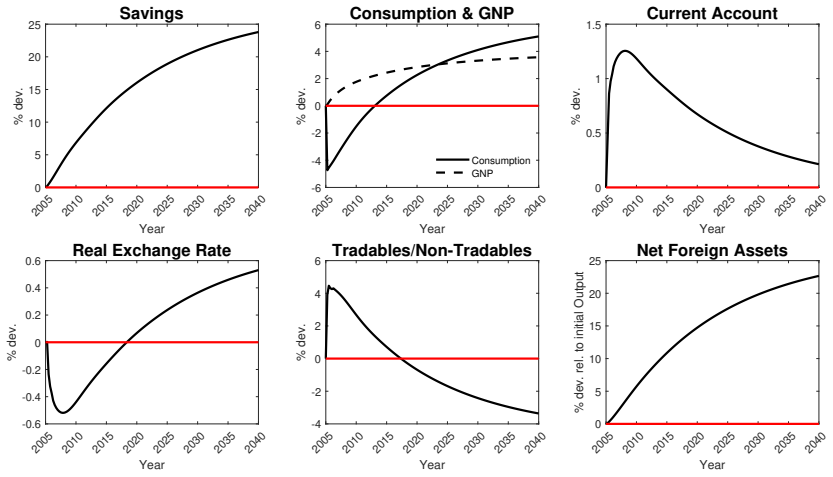

Notes: Model responses to the labor market reform in our baseline incomplete insurance framework. All adjustment paths are depicted as percent changes from the pre-reform steady state.

Second, as there is less government-provided insurance against long-term unemployment, employed households start accumulating assets to self-insure against the expected drop in consumption during long-term unemployment (see Figure 8).[27] The consumption-savings trade-off causes a decline in private consumption in the reforming economy.

[26] Note that the wage effect due to the lower outside option is quantitatively muted by the larger capital intensity due to the decline of the equilibrium interest rate.

[27] The private savings rate in Figure 8 is defined as the period-by-period change of employed households' assets divided by their disposable income.

**Figure 8:** Consequences of the Benefit Reform for Savings and Production




Notes: Model responses to the labor market reform in our baseline incomplete insurance framework. All adjustment paths are depicted as percent changes from the pre-reform steady state. Net foreign assets are defined in terms of annual output.

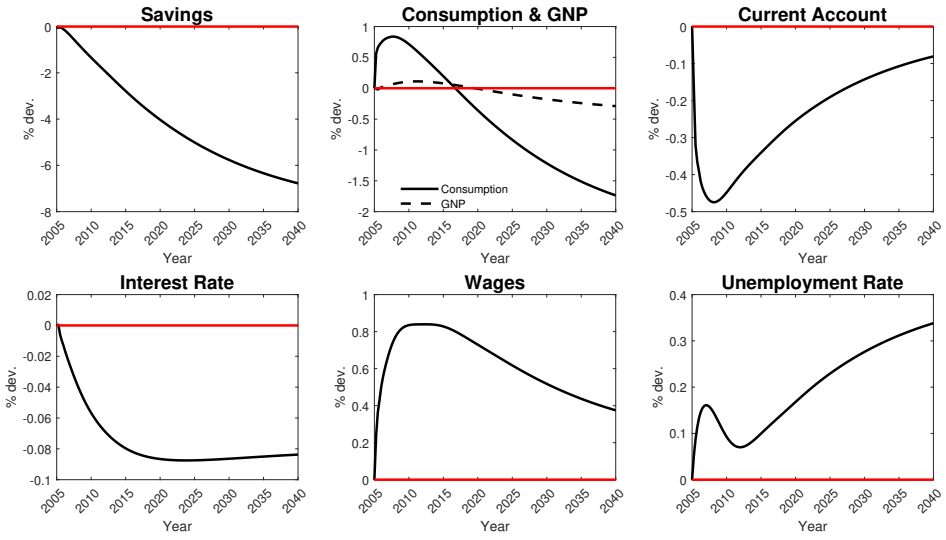
The increase in aggregate savings in the reforming economy and lower wages lead to a persistent decline of the real exchange rate in the short to medium run (see Figure 8). First, domestic consumption demand falls, which reduces the price of home-produced goods. Second, wages and thereby marginal costs for domestic goods fall.[28] Both effects increase the competitiveness of the home economy relative to the foreign economy. These two effects boost the tradable relative to the non-tradable sector in the home economy. In our quantitative exercise, we target the relative effect from 2005 to 2014 that we estimate based on the AWFP (see Section 3.3).
As households have access to international assets, the increase in domestic assets driven by their precautionary savings motive leads to a rise in net foreign assets and subsequently results in a current account surplus.

### 6.1.2 Short-Run Spillover Effects to the Non-Reforming Economy

As a result of the higher aggregate savings in the home economy, the two-country equilibrium interest rate falls (see Figure 9). This decline stimulates foreign consumption demand while reducing foreign savings. Consequently, the foreign economy begins to accumulate current account deficits and a net foreign liability position, which significantly impacts medium- and long-term consumption.
At the same time, the decline in the interest rate leads to higher capital intensity in both countries. A capital-labor substitution effect in the foreign economy causes unemployment in the non-reforming country to increase. The increase in wages and lower savings lead to short-run positive consumption spillover effects.
The increase in capital intensity is almost the same in both the domestic and foreign economies due to integrated capital mobility (differences are due to relative price shifts), as can be seen in Figure 17 in the Appendix. As the domestic net foreign asset position increases, the foreign economy becomes indebted abroad. Although wages in the non-reforming country rise, a significant

[28] In the first period, due to a spike in vacancy posting, marginal costs in the reforming economy increase.

**Figure 9:** Effects on the Foreign Economy




Notes: Model responses to the labor market reform in our baseline incomplete insurance framework. All adjustment paths are depicted as percent changes from the pre-reform steady state.

portion of the foreign capital stock (and other assets) is owned by households in the domestic economy in the new steady state.

## 6.2 Long-Run Effects

Due to the large negative net foreign asset position in the foreign economy in the long run, aggregate consumption in the non-reforming economy decreases permanently by 2.4 percent (see Table 4). In other words, there are significant long-run negative consumption spillovers. Although foreign GDP increases (i.e., more is produced in the foreign economy), part of the foreign capital stock is owned by economic agents in the reforming economy. Thus, GDP (i.e., produced goods and services in the non-reforming country) and GNP (i.e., goods and services produced by input factors from this economy) diverge in the non-reforming economy in the new steady state. Part of the capital stock in the non-reforming country is owned by the reforming country. Therefore, home-owned production factors produce less than before the labor market reform.[29]
Since we have disciplined our quantitative exercise by targeting the short- to medium-run reaction of tradables relative to non-tradables in the home economy based on the most conservative estimate of our microeconomic estimation in Section 3.3, we consider our quantitative implications as a lower bound. Based on this target, the home economy has consumption gains of more than 6 percent in the long run. By contrast, the foreign economy faces permanent consumption losses of approximately 2.4 percent. This means that there are substantial negative consumption spillover effects.

[29] In macroeconomic descriptive data, it is indeed visible that the GNP-GDP ratio fell in Southern European countries in the aftermath of the Hartz reforms.

**Table 4:** Long-run Reform Effects in Home and Foreign Economy (% dev. from steady state)

| | Home | Foreign |
|---|---|---|
| Output | 1.65 | 0.39 |
| GNP | 3.90 | -0.44 |
| **Aggr. Consumption** | **6.40** | **-2.43** |
| Unemployment | -12.39 | 0.42 |
| C: Tradable | 6.45 | -2.50 |
| C: Non-tradable | 6.19 | -2.18 |
| Tradeables/Non-Tradeables | -4.57 | 5.56 |
| CPI | 0.36 | 0.52 |
| TPI | 0.25 | 0.65 |
| Wage | -0.07 | 0.18 |
| Interest Rate | -0.08 | -0.08 |
| Real Exchange Rate | 0.75 | -0.75 |
| Capital-Labor Ratio | 1.58 | 1.61 |
| NFA/Output | 26.41 | -9.98 |

### 6.3 Model and Data

In Table 5, we compare our model economy's reaction to the actual development in the data five years after the implementation of the labor market reforms. Our baseline model simulation of the Hartz IV reform can explain a sizable share of the empirical international macroeconomic facts for Germany (see left column). Five years after the reform, our model explains between around 18 and 51 percent of the net foreign asset, current account, and unit labor cost movements in the data. Not surprisingly, the model simulation can explain a larger fraction of the within-Eurozone movements than of the overall movements.

Table 5 also compares the private savings rate reaction (of employment workers) in the model to the differential change of the private savings rate based on the German Socio-Economic Panel (SOEP), as calculated by Hochmuth et al. (2024). The private savings rate of employed workers increases by roughly three percentage points (from trough to peak) both in the data and in our model simulation. As the private savings rate reacts in the same order of magnitude in the model and the data, we consider this as a confirmation of our calibration strategy. Remember that we have chosen the long-term replacement rate decline to replicate the estimated relative increase of the tradable to the non-tradable sector in the data. An alternative would have been to target the differential savings rate reaction.[30] It turns out that such a strategy would yield similar quantitative results.

[30] Our chosen strategy benefits from the availability of high-quality data on tradables versus non-tradables. This allows us to better control for time-invariant heterogeneity and observable factors.

**Table 5:** Model Contribution to Empirical Time Series, 5 years after the reform

| Indicator | Baseline | Compl. Ins. | Low $\zeta$ | High $\zeta$ |
|---|---|---|---|---|
| Unemployment | 39.4% | 34.3% | 49.8% | 28.5% |
| Private Savings Rate | 111.8% | -221.1% | 119.4% | 92.5% |
| Net Foreign Assets/GDP | 17.9% | -2.8% | 19.3% | 13.9% |
| Current Account/GDP | 19.9% | -2.9% | 21.8% | 15.3% |
| Current Account vis-a-vis Eurozone /GDP | 31.7% | -4.7% | 34.6% | 24.3% |
| Unit Labor Costs relative to Eurozone | 51.1% | 168.6% | 37.1% | 72.9% |

Note: The model's contribution to the empirical facts, 5 years after the implementation of the Hartz IV-reform. Results are based on our baseline model simulation for the entire reform. Net foreign assets are defined in terms of annual output.

Furthermore, Table 5 shows that incomplete insurance is key for our results. Under complete insurance, the model simulation is unable to explain an important fraction of the open-economy movements within five years. In contrast, under complete insurance (i.e., complete consumption pooling among all workers), the private savings reaction and, thereby, the net foreign asset and current account reaction have the opposite sign as in the data. Households do not increase their private savings against unemployment when the unemployment benefit system becomes less generous. With lower unemployment benefits, the risk of unemployment falls, and this (lower) risk is spread equally across all workers due to consumption pooling.[31]

In more technical terms, under complete insurance, as illustrated by Figure 1, the asset supply curve is horizontal. Thereby, labor market reforms do not trigger any shifts in the asset supply curve. Therefore, spillover effects are much smaller (see Appendix E.1).

Finally, we test for the robustness of our results with different bargaining powers. This is connected to the debate on the effects of benefits on wages (see Jäger et al., 2020). Even in the baseline version of our simulation, the 21 percent decline in the net replacement rate only leads to a maximum wage decline of less than -0.8 percent, i.e. the aggregate sensitivity of wages with respect to benefits is relatively small.

In our robustness check, we change the bargaining power of workers to a lower value of 25 percent ("low $\zeta$") and to 75 percent ("high $\zeta$") instead of 50 percent. At the same time, we recalibrate the decline of the replacement rate to obtain the targeted movement of the tradable to the non-tradable sector (25 percent and 16.5 percent decline instead of 21 percent in the baseline).

Under a lower bargaining power of workers, the direct effect of benefits on wages is larger. Intuitively, there is a higher weight on the outside option in wage bargaining. Thereby, unemployment declines by more. As we require a larger decline of the replacement rate to hit our tradable to non-tradable target, employed workers start saving more and thereby generate larger net foreign assets and current account reaction.

Most importantly, the reaction of both net foreign assets and the current account continues to be sizable under different bargaining powers. This shows that our key quantitative conclusions are robust in this dimension.

[31] In Appendix E.1, we compare complete and incomplete insurance directly. Note that we use the assumptions by Schmitt-Grohe and Uribe (2007) to guarantee stationarity under complete insurance. For comparability, the Appendix shows the same scenario under incomplete insurance.

### 6.4 Further Robustness Checks

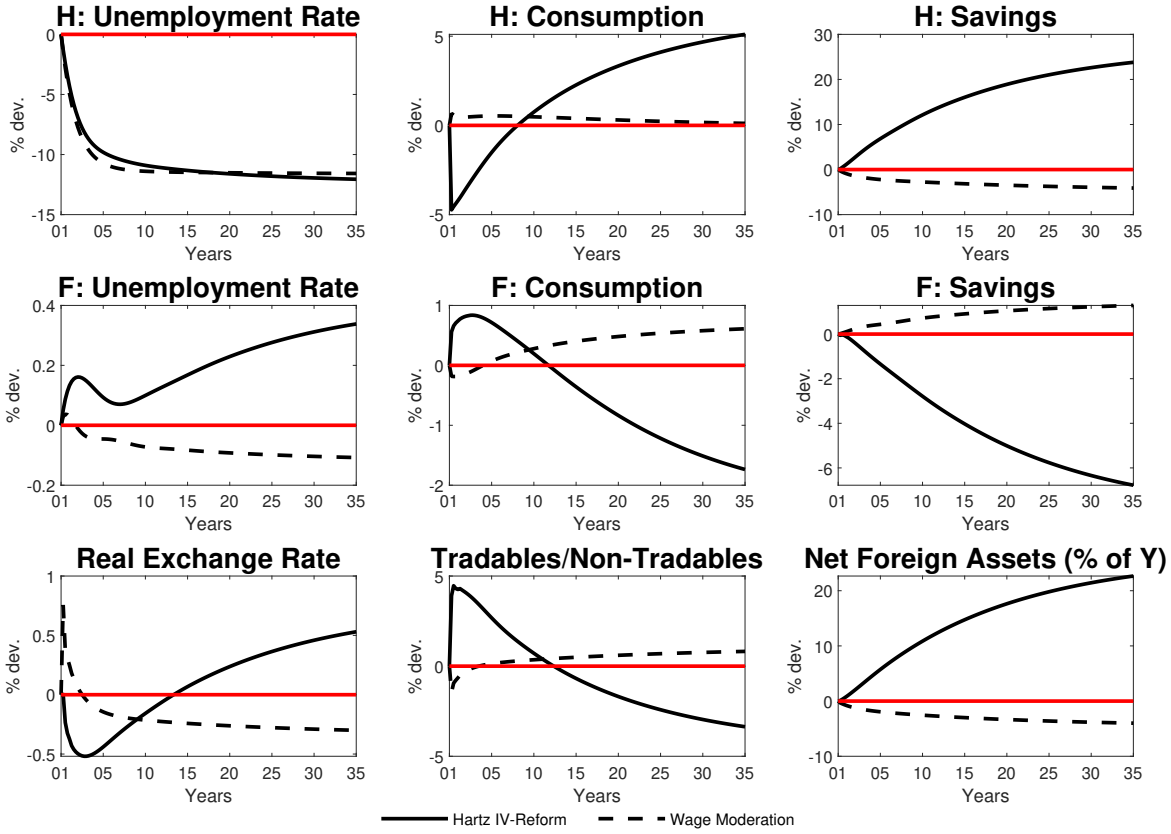
We conduct the following robustness checks (with additional details provided in the Appendix): First, we show and discuss the adjustment paths under complete consumption insurance in Appendix E.1. These were already briefly discussed in the previous section (based on Table 5). Most importantly, the long-run consumption spillover effects are absent under complete consumption insurance.
Second, we show how private and public savings interact (see Appendix E.2). Due to the unemployment insurance reform, public spending (unemployment benefits) decreases, and government revenues increase (taxes). Therefore, the Hartz reforms trigger an improved fiscal space. This is in line with the fact that household savings improved at the time of the reform, while the government sector was a key driver for savings shortly after the reforms.
Third, we show how the entitlement cut interacts with the replacement rate cut (see Figure 2 for an institutional illustration). In our quantitative exercise, the entitlement cut is very important. Employed households anticipate that they are not eligible for short-term benefits in quarters seven and eight anymore. Therefore, they bridge this gap with more private savings. When the replacement rate for long-term unemployed is cut on top of this, this savings effect is reinforced (see Appendix E.3 for details).
Fourth, we show that a realistic decline in separations as reaction to the UI reform does not switch off the precautionary savings channel (see Appendix E.4). Hartung et al. (2018) document a substantial decline in separation in the aftermath of the Hartz labor market reform. When we impose the full decline of the separation rate on our quantitative model, while keeping our target for the expansion of the tradable sector, the UI reform continues to trigger substantial precautionary savings and cross-country spillovers.

### 6.5 Effects of the German Wage Moderation

Dustmann et al. (2014) argue that the German wage moderation (i.e., lower wage than productivity growth) was a key driver for the German labor market upswing. We contrast a wage moderation with the labor market reform in our baseline calibration. We model such a scenario by reducing workers' bargaining power. We set the size of workers' bargaining power shock to obtain the same decline in unemployment as caused by the benefit reform.[32]
Figure 10 shows that a decline in the bargaining power leads to an immediate reduction in unemployment, as larger expected profits provide an incentive for firms to post additional vacancies.[33] As shown in Figure 10, wage moderation does not trigger any precautionary savings. In contrast to a cut of unemployment benefits, a permanent reduction of the bargaining power does not increase consumption risk. The opposite is the case: We observe a modest increase in consumption caused by the positive labor market effects as wage moderation increases the probability of finding a new job in case of job loss. This dampens the motive for precautionary savings,

[32] We reduce workers' bargaining power by 18%.
[33] Note that the timing of the decline of unemployment is not well in line with empirical evidence. Unit labor costs for end products in the manufacturing sector started to decline in the 1990s according to Dustmann et al. (2014). However, the German labor market only improved from 2005 onward.

**Figure 10:** Effects of the Hartz IV-Reform vs. the German Wage Moderation




Notes: Model responses to the labor market reform (solid line) and wage moderation (dashed line). All adjustment paths (except for net foreign assets) are depicted as percent changes from the pre-reform steady state.

whereas the benefits reform causes a pronounced drop in consumption. As a result, lower bargaining power reduces savings, the demand for foreign assets declines, and the real exchange rate in the home country appreciates.

In terms of open-economy effects, wage moderation triggers exactly the opposite effects of what we find in the data (see Section 3). In the home economy, the tradable vs. non-tradable sector shrinks in the short run. In addition, net foreign assets of the reforming country decline and its real exchange rate appreciates in the short run. Thus, through the lens of our model, wage moderation cannot be the driver for the increase of the current account surplus and the increase of net foreign assets in Germany.

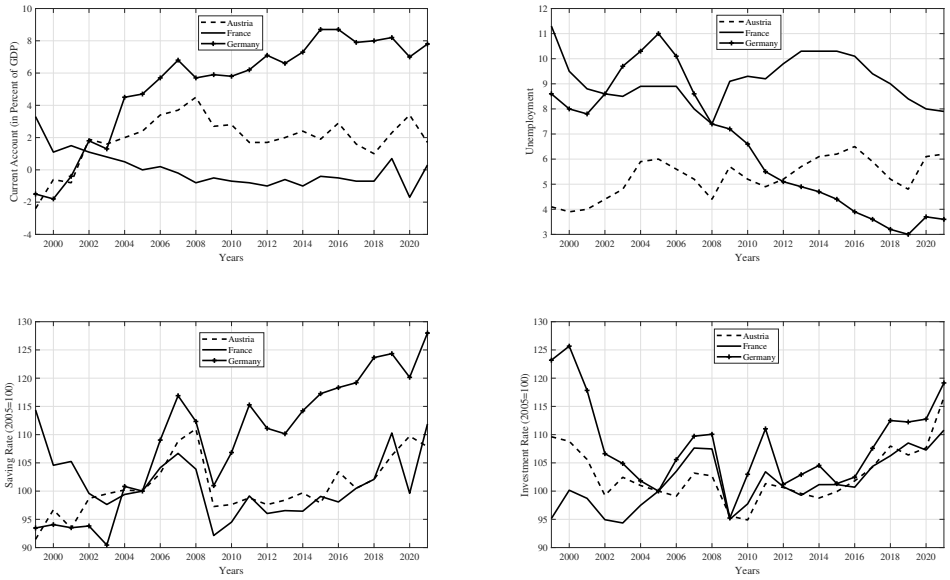
### 6.6 Comparison between Austria, Germany, and France

As a further plausibility check for the quantitative model mechanism in response to the unemployment insurance reform, we compare aggregate statistics from Germany to the two neighboring Eurozone countries, Austria and France.[34] Other than Germany, these two countries did not implement any major unemployment insurance reform around 2005.

[34] Austria is very similar to Germany in terms of the economic structure. In contrast, France shows more differences compared to Germany. It is the second-largest Eurozone economy after Germany. At the same time, aggregate statistics in France may be driven less by country-specific factors than in Spain or Ireland, where the real estate boom-bust cycle played an important role.

Figure 11 shows that Austria and Germany entered into the Eurozone with a negative current account balance, with very similar initial dynamics. However, around 2004 Germany and Austria started to decouple in terms of current account dynamics, with Germany's current account accelerating much more. This development is mirrored by a stronger increase in the aggregate saving rate in Germany around the time of the Hartz reforms, which was shortly interrupted by the Great Financial Crisis.

**Figure 11:** Austria, Germany, and France




Notes: The figure shows the current account in percent of GDP (Source: OECD), the savings rate indexed to 1999=100 (Source: IMF), unit labor costs indexed to 2005=100 (Source: OECD), and survey-based unemployment (Source: OECD).

Interestingly, France shows the opposite direction in terms of its current account and saving rate dynamics. While Germany decoupled from Austria and France in terms of the savings rate, the divergence is less pronounced in terms of the investment rate from 2005 onward.[35]
All these facts provide further anecdotal evidence in favor of our model mechanisms. Germany's and Austria's current accounts may also have been driven by other favorable developments. At the same time, Germany clearly decoupled from Austria in terms of the savings rate. Furthermore, only the German labor market saw a massive decline in unemployment. At the same time, France's descriptive statistics resemble the non-reforming economy in our quantitative model, with a declining current account.

## 6.7 Alternative Driving Forces

In this subsection, we discuss three possible alternative driving forces of European current account and net foreign asset movements beyond the German labor market reform. We discuss how these trends affect our quantitative strategy.

[35] The slump in investment at the beginning of the 2000s in Germany is largely driven transition dynamics in East Germany.

First, the import penetration with Chinese goods is often considered as a key driver for current account movements. However, Fadinger et al. (2024) show that German import penetration increased a lot more from 1995 to 2008 than Chinese import penetration. They also show that a one percentage-point increase in German Eurozone export-market competition leads to a significant reduction in manufacturing employment in other Eurozone economies, whereas the effect of Chinese import competition, though negative, is smaller in magnitude. This indicates that the expansion of the German tradable sector had a more substantial impact within the Eurozone compared to the China shock. As an additional robustness check, we include the trade balance with China in our estimation results, which leaves the estimated coefficient on the interaction term (our calibration target) unaffected.[36]

Second, the eastern enlargement of the European Union may have strengthened the German position within the Eurozone. However, keep in mind that we analyze the current account movements relative to other Eurozone countries, not those to eastern European countries. Furthermore, Germany opened its labor market to migrants only in 2011 (see Caliendo, Opromolla, Parro, and Sforza, 2021). However, as documented in Figure 6, the decline of the non-tradable service sector happened in the immediate aftermath of the Hartz labor market reforms.

Finally, the increasing trend of outsourcing in the production process could play a role for the movement of the tradable relative to the non-tradable sector. We address this by controlling for intermediate inputs in one empirical robustness check (see Table 1). When including the share of tradables, the estimated coefficient for the expansion of the tradable sector relative to the non-tradable sector is even larger than before. Thus, our calibration strategy is a lower bound in this dimension.

## 7 Conclusion

This paper shows that incomplete insurance alters the long-run effects of an asymmetric unemployment benefit reform in a two-country setting. Less generous unemployment insurance triggers more private savings in the reforming country. If households have access to international asset markets, they also invest in foreign assets. Consequently, this investment behavior leads to increased foreign indebtedness. Our analysis demonstrates that this mechanism ultimately results in long-term consumption losses for the non-reforming foreign economy.

We discipline our quantitative exercise by targeting the movement of the tradable to the non-tradable sector in the aftermath of the German Hartz labor market reforms (based on the universe of all German firms). Our estimations show an expansion of the tradable relative to the non-tradable sector. Based on our calibration, we find substantial negative long-run consumption spillovers due to the German Hartz reforms. Our counterfactual quantitative exercises can explain around one-third of the unit labor costs and current account movements between Germany and the rest of the Eurozone.

The unemployment benefit reform has significant positive labor market effects in the reforming country. Thus, it is a challenge for economic policy to design policy measures that increase firms'

[36] Results are available upon request.

incentives to post vacancies without triggering strong negative long-run effects for the neighboring country.

We further contrast the effects of the unemployment benefit reform with those of wage moderation. Our findings reveal that reduced bargaining power for workers generates open-economy effects opposite to those caused by decreased unemployment benefits. Specifically, we observe a short-term currency appreciation, a contraction of the tradable sector in the short term, and a permanent decline in net foreign assets. Thereby, through the lens of our model, wage moderation does not drive the observed open-economy trends between Germany and the rest of the Eurozone.

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# A Institutional Details on German Hartz Reforms

In response to rising unemployment in the early 2000s, the Hartz Commission, chaired by Peter Hartz (see Hochmuth et al. (2021) for more details), developed recommendations for the German labor market. These proposals were implemented gradually between 2003 (Hartz I and Hartz II) and 2005 (Hartz IV). According to Jacobi and Kluve (2006), the Hartz reforms had three main goals: (1) increasing the effectiveness and efficiency of labor market services, (2) activating the unemployed, and (3) boosting labor demand by deregulating labor markets. Under the concept of *"demanding and supporting,"* these four reforms restructured the German labor market:

**Hartz I** (in action since 2003): This reform facilitated the employment of temporary workers. Additionally, vouchers for on-the-job training were introduced.

**Hartz II** (in action since 2003): Introduction of new types of marginal employment with low income and subsidies for business start-ups.

**Hartz III** (in action since 2004): The core element of Hartz III was the restructuring of the Federal Employment Agency.

**Hartz IV** (in action since 2005): The last step was the most widely discussed reform since it caused a substantial cut in unemployment benefits for several groups. Unemployment benefits proportional to previous earnings were limited to one year, with exceptions for unemployed over 45 years old (*Arbeitslosengeld I*). After one year, unemployed shift to the much lower fixed unemployment benefits *Arbeitslosengeld (ALG) II*[37]. Hence, the unemployment assistance[38] and unconditional social assistance was abolished and replaced by *ALG II* which was independent of previous earnings. Eligibility for ALG II depends on personal wealth and the partner's income. In addition, a sanctioning system was introduced which allowed cuts in the fixed unemployment benefits if the unemployed person breaks an agreement with the Public Employment Agency (e.g., in terms of writing applications, reachability, responsible economic behavior).

# B Germany's Current Account: Sectors and Country Groups

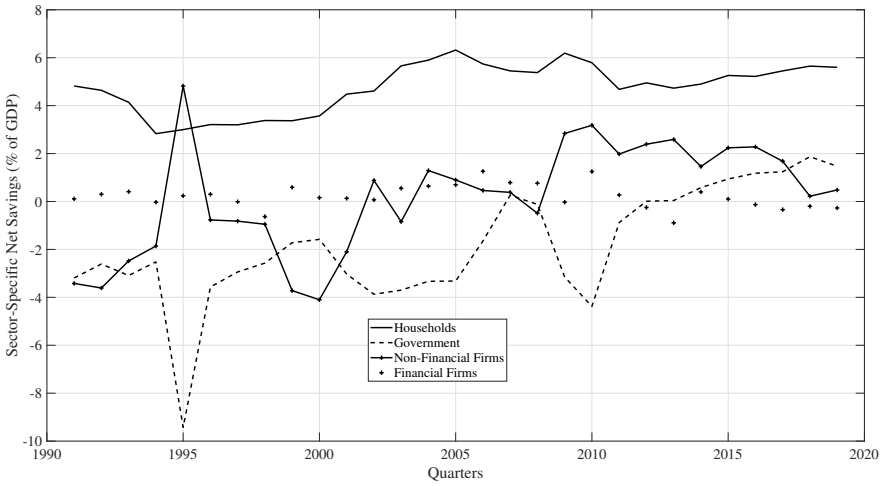
Figure 12 shows the net savings of different sectors in the German economy. Note that the behavior in 1995 was driven by special effects related to the privatization of formerly state-owned companies in East Germany. By definition, the sum of all four sectors adds up to the current account surplus.

Private households became a key contributor to net savings in 2005, i.e., the time when the Hartz reforms were implemented. This is in line with Hochmuth et al., 2024's finding based on the SOEP that employed workers' savings increased from 2005 onward. Keep in mind that these two savings concepts differ. Figure 12 shows the aggregate savings of private households (i.e., also (dis)savings from retired workers or unemployed are included). In contrast, Hochmuth et al., 2024's focus on employed workers' savings, which is the concept that corresponds to the savings motive in our model.

[37] The standard ALG II rate in 2017 is 409 euros.

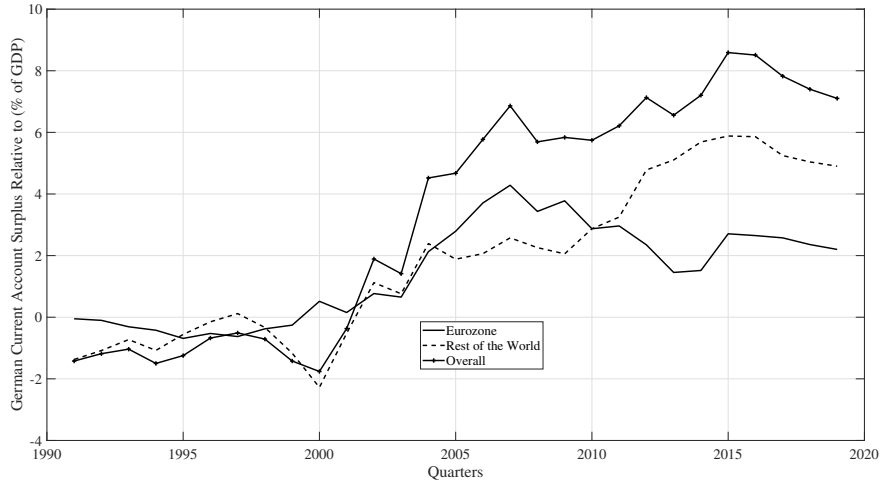
[38] Unemployment assistance (UA) amounted to 53% of previous net earnings (57% with children) and was subject to means tests. Hence, other income and assets reduced the claimable amount of UA.

**Figure 12:** Net Savings of Different Sectors




Net Savings of Household Sector, Government, Non-Financial and Financial Firms. Source: Deutsche Bundesbank.

**Figure 13:** Germany's Current Account Relative to Different Country Groups




Germany's current account relative to the Eurozone, relative to the rest of the world and overall. Source: Deutsche Bundesbank.

Figure 13 shows Germany's current account balance (in percent of GDP) relative to the Eurozone (solid line) and to the rest of the world (dashed line). It is visible that the current account surplus relative to the Eurozone was the key driver of overall the current account surplus acceleration from around 2005 onward. This development was interrupted by the Great Recession in 2008. In addition, net private household savings (see Figure 12) and the current account surpluses relative to the Eurozone have a correlation of 0.82.

# C Microeconomic Datasets

## C.1 The Administrative Wage and Labor Market Flow Panel

The Administrative Wage and Labor Market Flow Panel (AWFP) aggregates German administrative wage, labor market flow, and stock information to the establishment level for the years 1975–2014 (see Seth and Stüber (2017)). Before aggregating the data to the establishment level, several corrections and imputations were conducted at the micro level.

For coherency, we focus on wages and stocks for "regular workers."Wages are defined as the mean real daily wages of all employed full-time workers in a particular establishment. Daily wages include the base salary, all bonuses and special payments (such as performance bonuses, holiday pay, or Christmas allowance), fringe benefits, and other monetary compensations received throughout the year (or the duration of the employment spell). Therefore, daily wages correspond to a measure of total compensation rather than to a daily base wage. Workers' daily wages above the contribution assessment ceiling are imputed following Card, Heining, and Kline (2015) before aggregating the data to the establishment level.

For our baseline regressions, we restrict the AWFP data as follows. We consider only establishments with, on average, at least ten full-time workers.

## C.2 The IAB Establishment Panel

The IAB Establishment Panel is an annual survey of establishments located in Germany. The survey has been conducted since 1993 (Ellguth, Kohaut, and Möller, 2014). The survey information is collected mostly in face-to-face interviews. The survey aims for a representative sample of about 15,000 to 16,000 establishments each year.

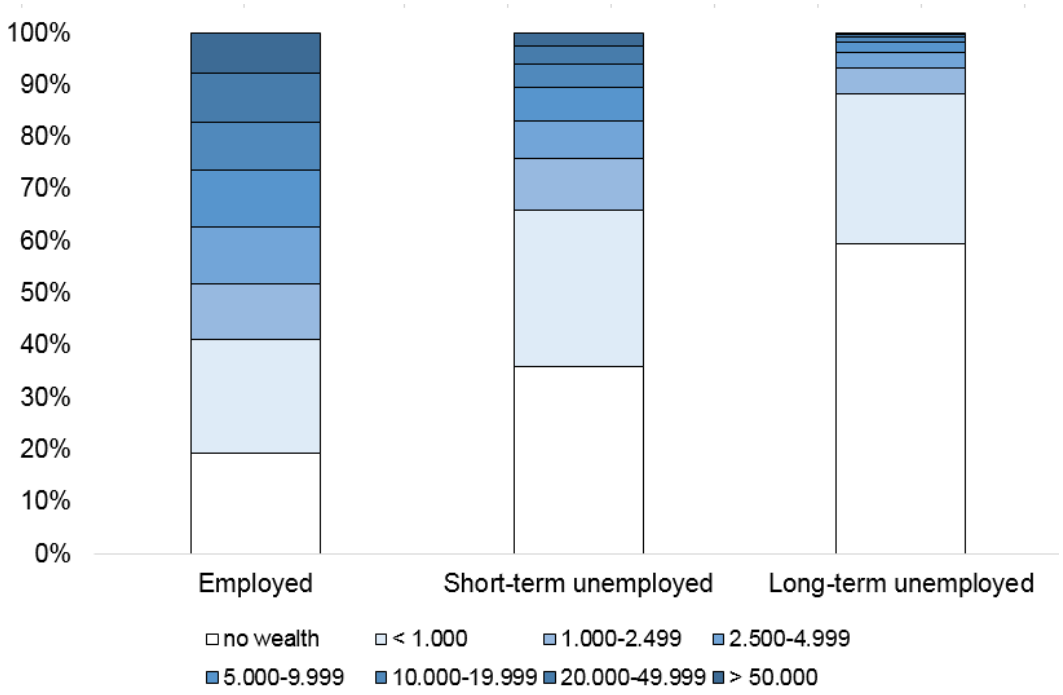
The IAB Establishment Panel contains survey information on the establishments that is not available in the administrative data (such as the AWFP). It covers various topics such as business performance and strategies, investment and innovation activities, vocational/further training, recruitment and layoff behaviour, working time issues, and structural information (e.g., works councils, collective agreements, ownership structure) among others.

The sampling frame of the IAB Establishment Panel comprises of all establishments in Germany with at least one employee who is fully liable to social security at June 30th of the previous year. Establishments that have exclusively workers in marginal part-time employment are excluded from the sampling frame. The survey sample is disproportionately stratified in three dimensions: First, the sample is stratified by 16 federal states. Second, the survey sample is stratified by ten establishment size classes as the population is very much skewed towards small establishments. Third, the survey sample stratifies by industries to allow for differentiated analyses in this respect.

## C.3 PASS

To illustrate wealth dynamics by employment and unemployment status, we use the Panel Study Labor Market and Social Security (PASS). This survey contains information on wealth for approximately 10,000 households.

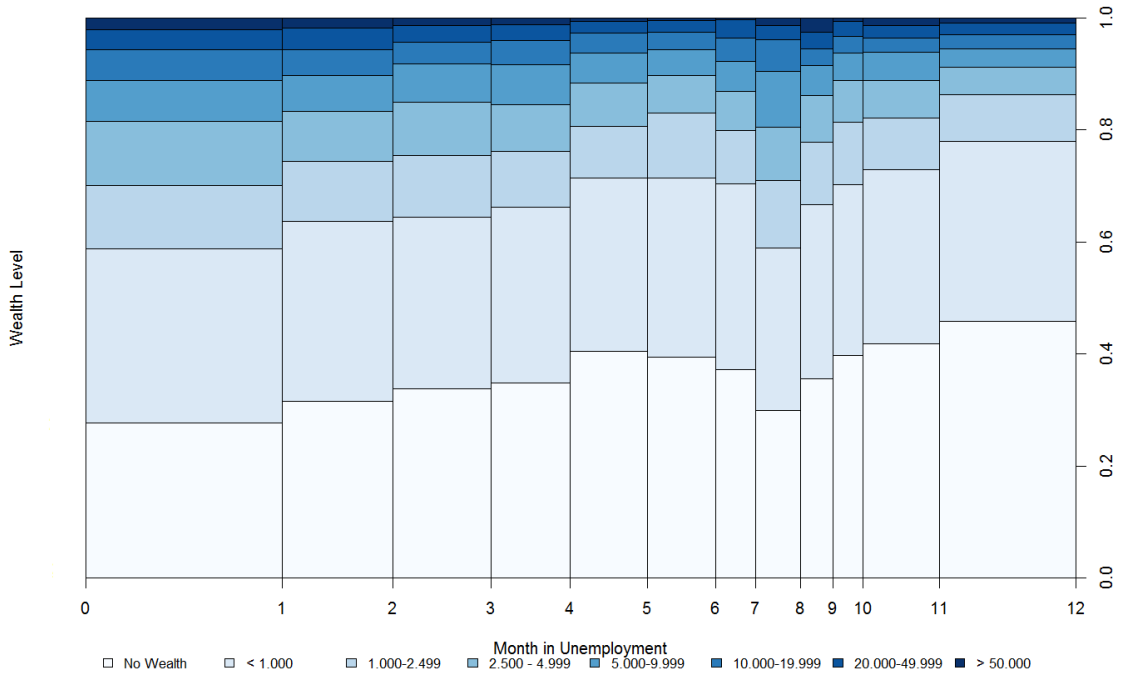
**Figure 14:** Wealth by Employment Status




Source: IAB PASS survey, own illustration.

Figure 14 shows wealth bins for employed workers, short-term unemployed, and long-term unemployed. It is clearly visible that employed have a higher wealth levels than unemployed. Furthermore, short-term unemployed have more wealth than long-term unemployed. Both aspects are in line with our model mechanisms, namely employed workers who save to insure their risk of unemployment and long-term unemployed that have run down their savings. The reduction of savings over months in unemployment can be seen in Figure 15.

**Figure 15:** Wealth by Duration of Unemployment




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

# D Derivations: Workers Marginal Value

In order to calculate the Nash-bargained wage, we derive the worker's marginal value of employment. The marginal value of an employed worker can be derived by taking the first-order condition of the family's value function subject to the family's budget constraint with respect to the level of employment $N_t$. This yields

$$\begin{aligned}\mathscr{W}_t^{e,j} = &\frac{u(c_{t,j}^e)}{\lambda_t^e} - [c_t^e + a_t + t_t - (1-\tau_t^w)w_t^T - (1-\tau_t^w)w_t^N \\ &- \beta E_t \left\{ \frac{\lambda_{t+1}^e}{\lambda_t^e} \left( \frac{N_t^T}{N_{t+1}} (1-s^j(1-\tau^F)(1-\rho_{t+1}^T)) + \frac{N_t^N}{N_{t+1}} (1-s^j(1-\tau^F)(1-\rho_{t+1}^N)) \right) R_t a_t \right\}] \\ &+ \beta E_t \left\{ \frac{\lambda_{t+1}^e}{\lambda_t^e} (1-s^j(1-\rho_{t+1}^j)) \mathscr{W}_{t+1}^{e,j} + \frac{\lambda_{t+1}^{eu_1,j}}{\lambda_t^e} s^j (1-\rho_{t+1}^j) \mathscr{W}_{t+1}^{eu_1,j} \right\}. \end{aligned} \tag{D.1}$$

Hence, every employed worker adds utility $\frac{u(c_t^e)}{\lambda_t^e}$ to the family. In addition, every family member contributes labor income and returns on assets to the family. Furthermore, every employed worker consumes, saves, and pays taxes. If the family member is still employed in the next period, the gain for the family is $\mathscr{W}_{t+1}^e$, however, with probability $s(1-\rho_{t+1})$, the member has to leave the family because she becomes unemployed. From the perspective of the family, who also cares about the utility of those who may become unemployed next period (because every member could be hit), this is taken into account by $\mathscr{W}_{t+1}^{eu_1}$.

The marginal values of short-term unemployment up to $k \in (1, ..., K-1)$ is given by

$$\mathscr{W}_t^{eu_k,j} = \frac{u(c_t^{eu_k,j})}{\lambda_t^{eu_k,j}} + \beta E_t \left\{ \frac{\lambda_{t+1}^{eu_{k+1,j}}}{\lambda_t^{eu_k,j}} (1-\rho_{t+1}^j) \mathscr{W}_{t+1}^{eu_{k+1,j}} + \frac{\lambda_{t+1}^e}{\lambda_t^{eu_k,j}} \rho_{t+1}^j \mathscr{W}_{t+1}^{e,j} \right\}, \tag{D.2}$$

while in period K it is

$$\mathscr{W}_t^{eu_K,j} = \frac{u(c_t^{eu_K,j})}{\lambda_t^{eu_K,j}} + \beta E_t \left\{ \frac{\lambda_{t+1}^{uu,j}}{\lambda_t^{eu_K,j}} (1-\rho_{t+1}^j) \mathscr{W}_{t+1}^{uu} + \frac{\lambda_{t+1}^e}{\lambda_t^{eu_K,j}} \rho_{t+1}^j \mathscr{W}_{t+1}^e \right\}. \tag{D.3}$$

For the long-term unemployed worker, the utility value is given by

$$\mathscr{W}_t^{uu,j} = \frac{u(c_t^{uu,j})}{\lambda_t^{uu,j}} + \beta E_t \left\{ \frac{\lambda_{t+1}^{uu,j}}{\lambda_t^{uu,j}} (1-\rho_{t+1}^j) \mathscr{W}_{t+1}^{uu,j} + \frac{\lambda_{t+1}^e}{\lambda_t^{uu,j}} \rho_{t+1}^j \mathscr{W}_{t+1}^{e,j} \right\}. \tag{D.4}$$

# E Quantitative Robustness Checks

## E.1 Incomplete vs. Complete Insurance and Spillovers

In contrast to a standard search and matching model, our model framework contains a precautionary savings motive (incomplete consumption insurance). In order to understand the role of incomplete insurance, we provide a comparison to a model with complete insurance. Under complete insurance, we have a perfectly elastic supply of capital (driven by the standard Euler consumption equation, see Figure 1). In the complete insurance case, we assume one representative household. In this case, unemployed workers remain in the family, and consumption is pooled among all households. Thus, there is no precautionary savings motive, and the Euler equation on asset holdings boils down to equation (4.7).

In order to guarantee stationarity of net foreign assets, we follow Schmitt-Grohe and Uribe (2003) to close open-economy models (SGU, henceforth). We assume that employed households have to pay portfolio adjustment costs on their net foreign assets (when they hold quantities that are different from the initial steady state): $-\frac{\psi}{2}(NFA_t - NFA)^2$.

Although we do not require these assumptions in our incomplete insurance framework (see Ghironi, 2006 for a discussion), we impose them for the simulations depicted in Figure 16 for comparability reasons.[39] For comparability, we simulate the complete insurance version of our model with the same parameters as the incomplete market version.[40]

As can be seen in the upper left panel of Figure 16, under complete consumption insurance, the benefit reform also leads to a labor market upswing in the reforming economy (due to lower wages). However, there are barely any spillover effects from the reforming to the non-reforming economy, neither in the short nor in the long run. The labor market reform does not trigger any savings effect (upper right panel) under complete insurance. Therefore, no net foreign asset accumulation takes place (lower right panel).

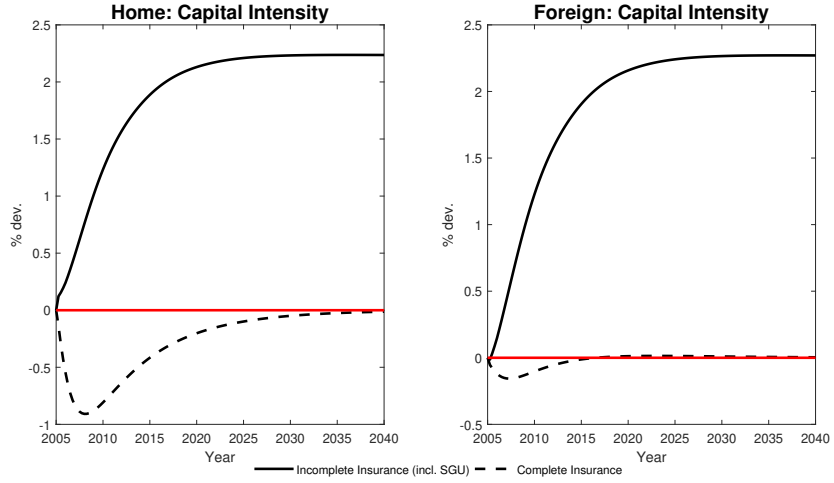
[39] Note that the spillover effects are smaller than in our baseline, as SGU impose a cost of holding net foreign assets.

[40] As we cannot reach the target in the complete insurance model, we keep all parameters the same as in the incomplete insurance economy.

**Figure 16:** Complete vs. Incomplete Insurance


Notes: Model responses to the labor market reform with incomplete insurance framework (solid line) and complete insurance framework (dashed line). Both with SGU assumptions. All adjustment paths are depicted as percent changes from the pre-reform steady state. H stands for Home and F stands for foreign.

**Figure 17:** Change in Capital Intensity: Reforming and Non-Reforming Country




Notes: Model responses to the labor market reform with incomplete insurance framework (solid line) and complete insurance framework (dashed line). Both with SGU assumptions. All adjustment paths are depicted as percent changes from the pre-reform steady state.

Under complete insurance, there are barely any meaningful open-economy effects.[41] The current account quickly balances. As the two-country interest rate remains unaffected in the long run in the complete insurance agent economy, the capital stock increases by much less than under precautionary savings.

It is worthwhile to contrast the time path of capital intensity under complete and incomplete insurance (see Figure 17). Under complete insurance, the long-run interest rate remains unaffected. Thereby, capital intensity in the pre- and after-reform steady state does not change. By contrast, under complete insurance, there is a substantial increase in capital intensity (due to the steady state interest rate decline).

### E.2 Fiscal Space

Finally, we analyze the interaction between private and public savings in the home economy. In our model, the decline in unemployment benefits triggered larger private savings and lower unemployment. This affects the government's budget position.

Therefore, we define a variable for the fiscal space of the government, $FS_t$, as the difference between government revenues at given tax rates (i.e., income taxes and fixed lump-sum taxes) and government spending (i.e., costs for the unemployment benefit system and interest payments on bonds):

$$FS_t = \tau_t^w w_t N_t + t - \sum_{k=1}^{K} \kappa_t^{BS_k} u_t^{eu_k} - \kappa_t^{BL} u_t^{uu} - (R_t - 1) b_t \tag{E.1}$$

Figure 18 shows that the Hartz IV labor market reform increased the fiscal space of the German government by 0.2 percent of GDP in the short run and around 0.6 percent of GDP in the long run. In our model, a fiscal rule redistributes this fiscal space back to households via lump-sum transfers.

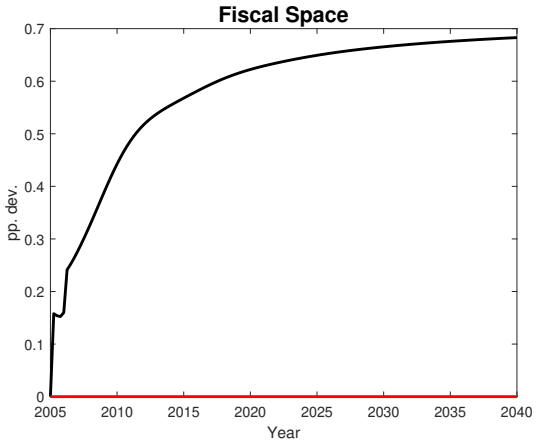
It is worthwhile to contrast this result with patterns in the data. Private savings increases from 4.1 percent of GDP between 1991 and 2004 to 5.4 percent of GDP from 2005 to 2019. In 2005, private households were the key contributor to the increase in aggregate savings in Germany (see Figure 19). By contrast, between 2006 and 2007, the government was the key contributor to the increase of aggregate savings. Aggregate government savings were −3 to −4 percent of GDP between 2001 and 2005. This number increased to −1.7 and +0.3 percent in 2006 and 2007, respectively.

The Hartz labor market reforms increased the fiscal space of the German government. In contrast to a simple fiscal rule, the government did not immediately reduce taxes. Social security contributions for unemployment insurance fell, for example, from 6.5 percent in 2005/06 to 4.2 percent in 2007 to 3.3 percent in 2008 and to 2.8 percent in 2009. Figure 19) shows the private households and government combined increased net savings substantially (for all sectors separately, see Figure 12 in the Appendix).

Finally, non-financial firms only became major contributors to aggregate savings in 2009 and

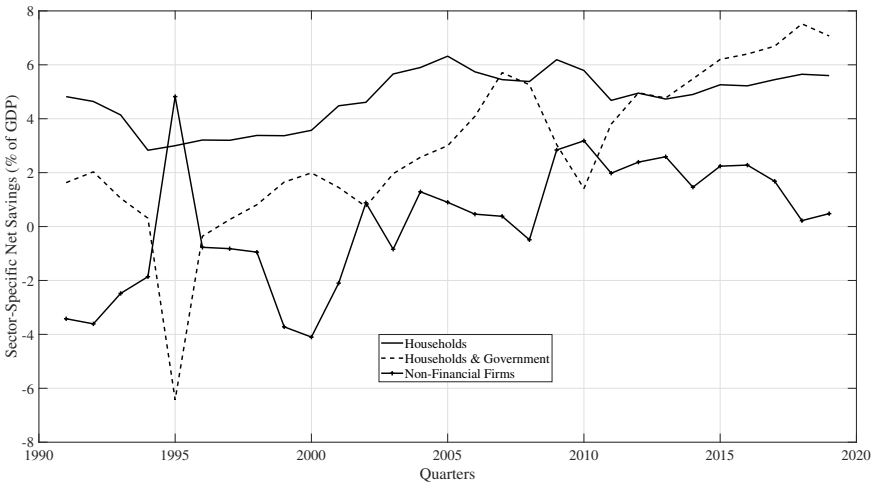
[41] Under incomplete insurance with SGU, the NFA position is now smaller than without SGU. Households have to trade off their precautionary savings motive against the portfolio adjustment costs.

**Figure 18:** Fiscal Space




Notes: Model response of the government budget (without adjustments of the lump-sum tax) in response to the labor market reform in our baseline incomplete insurance framework.

**Figure 19:** Net Savings of Different Sectors




Net Savings of Household Sector, Household and Government Sector Combined and Non-Financial Firms. Source: Deutsche Bundesbank.

2010 in Germany. They jumped from −0.5 percent in 2008 to 2.8 and 3.2 percent, respectively (see Figure 19).

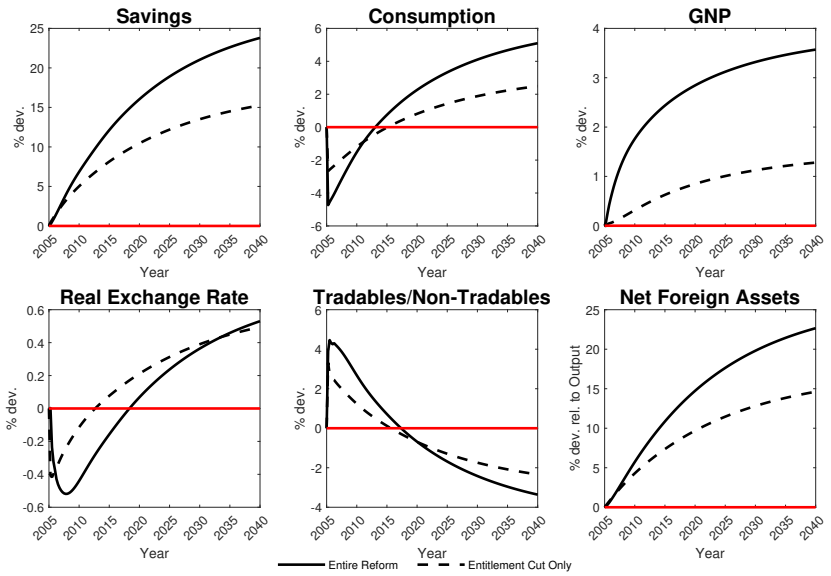
Figure 13 in the Appendix shows that the current account balance relative to the Eurozone was the key driver for the acceleration of the current account surplus around 2005. Thus, spillover effects to the rest of the Eurozone are important and will be analyzed next.

## E.3 Disentangling the Reform Effects

Figure 20 shows the entitlement cut as separate exercise. In this case, workers receive short-term unemployment benefits for a shorter time period (six instead of eight quarters). They increase their savings to self-insure against this scenario. We allow unemployed workers to use their sav-

ings for eight periods of unemployment.[42]

**Figure 20:** Entire Reform vs. Entitlement Cut Only




Notes: Model responses to the labor market reform with an incomplete insurance framework for the entire reform (solid line) and only the entitlement cut (dashed line). All adjustment paths are depicted as percent changes from the pre-reform steady state.

When the replacement rate for long-term unemployed is cut in addition to the entitlement cut, this amplifies the aggregate effects. Household savings increase for the transfer income in periods seven and eight falls. Therefore, workers save even more to self-insure for these periods with low income and high marginal utility of consumption.

## E.4 Decline in Separations

In our quantitative model, separations are exogenous. However, it is well known that separations declined in the aftermath of the Hartz reforms. Hartung et al. (2018) show that the separation rate was 22 percent lower in 2008-2018 compared to 1993-2002. This decline, partially driven by the Hartz IV labor market reform, reduced unemployment risk similarly to the increased job-finding rate.

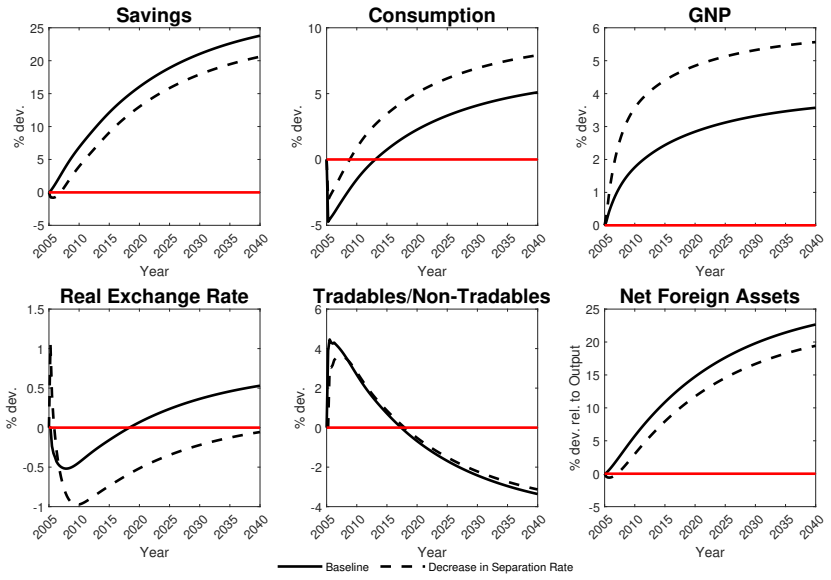
To evaluate whether a decline in the separation rate could deactivate the precautionary savings channel, we assume that separations immediately decreased by 22 percent with the implementation of the Hartz IV reform. This scenario constitutes an upper bound for the potential compensating effects of a decline in the separation rate. It imposes an immediate decline in the separation rate without adjustment lags and attributes the entire observed decline to the UI reform.

While assuming that the UI reform led to a 22 percent decline in the separation rate, we maintain our targeted expansion of the tradable sector relative to the non-tradable sector by 2.7 percent. We achieve this by adjusting the decline in the replacement rate accordingly, reducing it by 28 percent.

[42] Note that their remaining savings in periods seven and eight are very low. Thus, they would not run in conflict with the means test of long-term unemployment benefits.

Figure 21 shows that the immediate increase in savings is less pronounced as unemployment declines more significantly, leading to a less severe drop in consumption. Consequently, the immediate increase in net foreign assets is dampened compared to our baseline scenario. However, the long-run increase in net foreign assets is still substantial. The decline of separations does not switch off the precautionary savings channel.

**Figure 21:** Baseline vs. Separation Rate Decrease




Notes: Model responses to the labor market reform under the assumptions that separations decline by 22% (as in Hartung et al., 2018). All adjustment paths are depicted as percent changes from the pre-reform steady state.