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## The Hartz Reforms, the German Miracle, and the Reallocation Puzzle

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# 1 Introduction

Since the turn of the millennium, the German economy has experienced a remarkable sequence of events which have had a significant impact on the structure of its labor market, and which have led to some outcomes that have puzzled observers. Facing a high and rising unemployment rate (persistently above 10 percent) the German government instituted a series of labor market reforms, known as the Hartz reforms, phased in over the period of 2003 to 2005. These reforms were aimed at improving the flexibility of the market, the mobility of workers, and incentivizing workers to seek work more actively (Jacobi and Kluve, 2007)<sup>1</sup>. As shown in Figure 1, starting in 2005, the unemployment rate declined significantly, dipping below 10 percent for the first time in 2007.

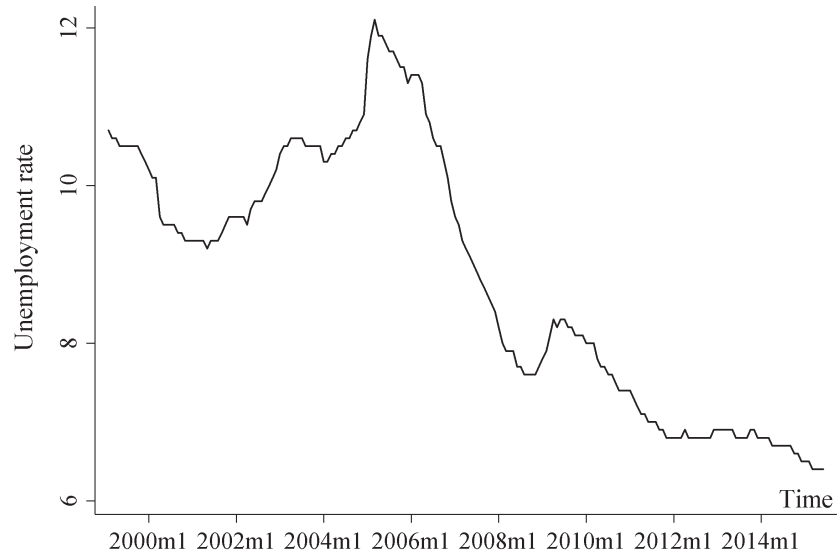


Figure 1: German unemployment rate from 2000-2015, seasonally adjusted

In 2008, like most other economies in the world, Germany was hit hard by the

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<sup>1</sup>In their classic study, Jacobi and Kluve (2007) identified three "cornerstones" of the Hartz reforms: "increasing effectiveness and efficiency of labour market services and policy measures", "activating the unemployed" and "fostering employment demand by labour market deregulation".

Global Financial Crisis and the Great Recession (GFC, for short). German GDP fell by 6.6 percent (Q1/2008 to Q1/2009) – a drop even more significant than the one experienced by the US at the time (Burda and Hunt, 2011). Productivity fell by a similar percentage – 6.3%, as shown in Figure 2.

However, unlike most countries (including the US) the German unemployment rate did not rise significantly at that time. As shown, once again, in Figure 1 it remained remarkably stable – leading some to call this "Germanys jobs miracle" (see, for example, Krugman (2009)). Viewing Figure 1, and considering the fall in unemployment since that time, it appears that the German unemployment rate was in a dramatic secular decline when the GFC hit, and this decline was temporarily suspended – leading to a relatively stable unemployment over the 2008-2010 period.

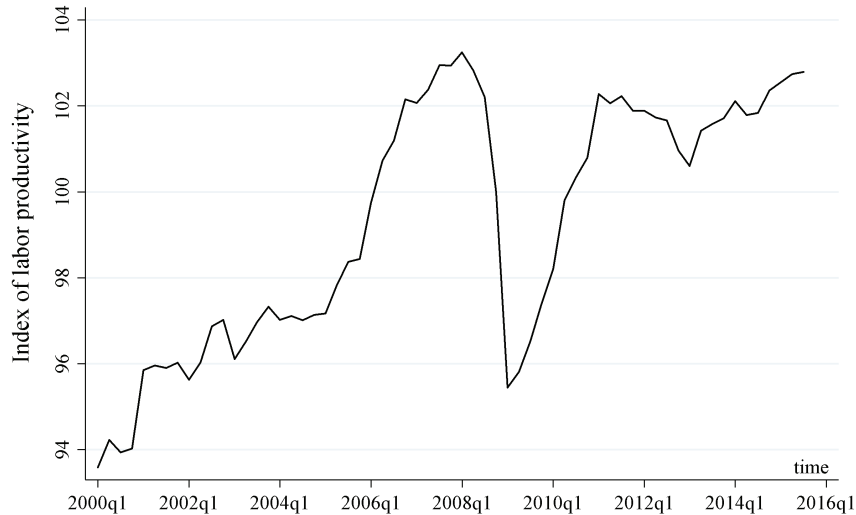


Figure 2: Labor Productivity, chain-index, base year 2010, seasonally adjusted

Interestingly, also, although the Hartz reforms were implemented to improve labor market outcomes through more flexibility and mobility, reallocation rates across occupations in Germany have been puzzlingly stable over the period (Bachmann and Burda, 2010; Bauer, 2013; Jung and Kuhn, 2014), as shown in Figure 3. This, we refer to as the "reallocation puzzle"<sup>2</sup>.

<sup>2</sup>In Appendix A an alternative measure based on Lilien (1982) is displayed which supports

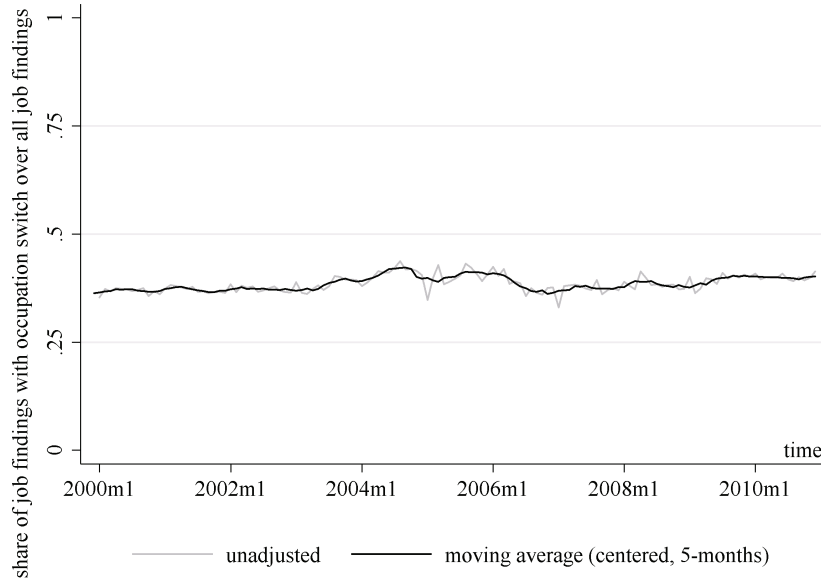


Figure 3: Share of job findings with occupational switch over all job findings

In this paper we explore the argument that, in effect, the Hartz reforms and the GFC offset each other in ways that led to the co-existence of both the German miracle and the reallocation puzzle. That is, the Hartz reforms offset the effects of the GFC on unemployment, and the GFC offset the effects of the Hartz reforms on reallocation. To examine this argument we analyze a labor reallocation model along the lines of Lucas and Prescott (1974), with some additional features that allow for the existence of unemployment benefits and rest unemployment, as in Jovanovic (1987), King (1990), Gouge and King (1997), and Alvarez and Shimer (2011). The model is rich enough to incorporate both of the offsetting channels described above, and provides simple formulas, based on its parameters, that allow for a quantitative assessment of the extent to which these two channels operated in Germany over the period.

We estimate the parameters of the model, using German data to make this assessment. The key parameters are: the changes in unemployment benefits, the changes in reallocation costs (i.e., the costs of moving from one occupation to another), the discount factor, the Markov switching probability between high and

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this view.

low productivity occupations, and changes in productivity levels in high and low productivity occupations.

The baseline parameterization of model implies that, for the GFC to perfectly offset the effects of the Hartz reforms on reallocation, a fall in productivity of 6.8 percent would have been required – very close to but slightly more than the 6.3 percent reduction. We also identify a critical condition in the model that allows for unemployment to fall over the entire period (the percentage fall in productivity must be less than the percentage fall in the unemployment benefits) and show that this is easily satisfied using the parameter estimates. We argue, then, that there is evidence that both of these offsetting channels did operate over the period, and they can explain, to some degree, both the German miracle and the reallocation puzzle.

The remainder of this paper is structured as follows. In Section 2 we introduce the model, identify its equilibrium allocations, and derive the key formulas. In Section 3 we discuss the empirical strategies for estimating the parameters of the model. In Section 4, we present the empirical results, followed by a robustness analysis in Section 5. In Section 6 we discuss our results with respect to the recent literature.

## 2 The Model

The economy has a large number of spatially distinct competitive local labor markets. We will refer to these local labor markets as *occupations*<sup>3</sup>. Time is discrete and the demand for labor, within any occupation, is subject to a local productivity shock  $\gamma$ , which can take on two values:  $\gamma \in \{\gamma_1, \gamma_2\}$ , where  $0 < \gamma_1 < \gamma_2$ . Occupations that draw  $\gamma_1$  and  $\gamma_2$  are said to experience "low productivity" and "high productivity", respectively. The shock is independent across occupations but, within each occupation, follows a symmetric Markov process, with persistence parameter  $\pi > 1/2$ . As is well known, the probability distribution over  $\gamma$  converges to the invariant distribution  $(1/2, 1/2)$ <sup>4</sup>. In the absence of any aggregate uncertainty, by the law of large numbers we know that, in any stationary equilib-

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<sup>3</sup>We prefer to interpret each labor market as an occupation although other interpretations are available, in particular: geographic locations, or sectors.

<sup>4</sup>See, for example, Stokey et al. (1989, p. 322).

rium, in each time period, equal proportions of the occupations draw productivities  $\gamma_1$  and  $\gamma_2$ .

For any wage  $w_t^i$ , in occupation  $i$  at time  $t$ , the demand for labor  $n_t^i$  is given implicitly by:

$$w_t^i = \gamma_t^i g(n_t^i) \quad (1)$$

Where  $g$  is an invertible and continuously differentiable function,  $g'(n) < 0$ ,  $\lim_{n \rightarrow \infty} g(n) = 0$ , and  $\lim_{n \rightarrow 0} g(n) = \infty$ .

A large number of infinitely-lived workers choose their occupation in each time period, to maximize the expected value of their income streams, using the discount factor  $\beta \in (0, 1)$ . Workers can work in only one occupation in any time period and, in any period, are identical except for the occupation that they start the period in. Let  $l_t^i$  denote the number of workers in occupation  $i$  at the beginning of period  $t$ .

The state of any occupation is summarized by the current value of the shock  $\gamma$  and the number of workers  $l$  that start the period there. Let  $S \equiv \{\gamma_1, \gamma_2\} \times [0, \infty)$ , so any  $s \in S$  indexes the state of an occupation. Also, let  $\bar{l} > 0$  denote the average number of workers per occupation. With all of the relevant information about any occupation summarized by its state, we can now drop the notation for any particular occupation and replace it with notation for all the occupations that have the same state. Hence, we can re-write (1) as<sup>5</sup>:

$$w(s) = \gamma g(n(s)) \quad (2)$$

Workers are able to observe all current information and have rational expectations. At the beginning of period, in any occupation, any worker can choose from the following three options: work (i.e., supply one unit of labor) in the current occupation, at the prevailing wage  $w(s)$ , stay in the current occupation but not work – and collect benefit  $b > 0$ , or pay  $\kappa > 0$  to move from the current occupation to a high productivity occupation. Following Alvarez and Shimer (2011), workers who choose the second option are said to experience "rest" unemployment and those who choose the third are said to experience "search" unemployment.

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<sup>5</sup>We focus on stationary equilibria of this model and hereafter, to minimize notation, we suppress time subscripts, except when needed for clarity.

Since all workers who choose to search are reallocated, search unemployment is synonymous with reallocation in this model.

Let  $m(s)$  denote the number of net migrants in occupations of type  $s$ <sup>6</sup>. In any occupation of type  $s$ , then, employment is constrained by:

$$n(s) \leq l + m(s) \quad (3)$$

The dynamics of labor supply in any occupation of type  $s$  are given by:

$$l_{t+1} = l_t + m(s_t) \quad (4)$$

Let  $l^*$  denote the value of  $l$  in each low productivity location when the value of  $\gamma g$  (which can be interpreted as the marginal product of labor) is equated across all occupations. Correspondingly, let  $w^*$  be defined by:

$$\gamma_1 g(l^*) = \gamma_2 g(2\bar{l} - l^*) = w^* \quad (5)$$

Thus,  $w^*$  represents the equilibrium wage that would prevail in the absence of any moving costs or benefits.

The co-existence of both rest unemployment and reallocation requires that certain restrictions be made on the values of benefits,  $b$ , and the cost of moving,  $\kappa$ . The value of  $w^*$  is a useful reference point in this context. If  $\kappa = 0$  then rest unemployment would not exist if and only if  $b \leq w^*$ . However, if  $\kappa$  is large enough, and  $b \leq w^*$ , then some workers would choose rest unemployment. We assume that  $b \leq w^*$  (so that benefits are no greater than the equilibrium wage with no moving costs) so we need to assume that  $\kappa$  is large enough. We also need to assume that  $\kappa$  is not too large to prevent search unemployment, or reallocation in equilibrium. Let  $n_1$  be defined by:

$$\gamma_1 g(n_1) = b \quad (6)$$

Thus,  $n_1$  is the value of the labor input at which the marginal product of labor in low productivity occupations equals the amount of the benefit payments. As will become clear below, it is useful to introduce the function  $h$  as the inverse function of  $g$ . From (6) we have:  $n_1 = g^{-1}(b/\gamma_1)$ , which we re-write as:

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<sup>6</sup>Note that  $m(s)$  can be either positive, negative, or zero.

$$n_1 = h(b/\gamma_1) \quad (7)$$

A sufficient condition for the co-existence of reallocation and rest unemployment is:

$$\gamma_2 g(2\bar{l} - n_1) < \kappa[1 + \beta(1 - 2\pi)] + b < \gamma_2 g(\bar{l}) \quad (8)$$

Workers choose their locations to maximize the expected present discounted value of their revenue streams. Let  $\tilde{v}(s)$  denote the equilibrium value of this stream, in an occupation of type  $s$  in the current period, and let  $v(s)$  denote the expected value of this stream if an occupation is in equilibrium for all future periods but keeps its beginning-of-period population in the current period. Also, let  $\lambda$  denote the payoff that any worker gets in any period if they choose to move. Individual workers in occupations of type  $s$  in the current period make the following decision:

$$\text{If } v(s) \leq \lambda - \kappa \quad \text{the worker is willing to move} \quad (9)$$

$$\text{If } v(s) > \lambda - \kappa \quad \text{the worker will stay} \quad (10)$$

This implies the following migration rule in any occupation of type  $s$ :

$$\text{If } v(s) \leq \lambda - \kappa \quad \text{then } m(s) \leq 0 \quad \text{so that } \tilde{v}(s) = \lambda - \kappa \quad (11)$$

$$\text{If } v(s) > \lambda \quad \text{then } m(s) > 0 \quad \text{so that } \tilde{v}(s) = \lambda \quad (12)$$

$$\text{If } \lambda - \kappa < v(s) \leq \lambda \quad \text{then } m(s) = 0 \quad \text{so that } \tilde{v}(s) = v(s) \quad (13)$$

## 2.1 The Stationary Equilibrium

King (1990) proves that a unique stationary equilibrium exists for this model, with the following properties:

1. Only low productivity occupations experience outflows.
2. Only high productivity occupations experience inflows.
3. In all high productivity occupations the level of employment  $n_2$  is determined by:

$$\gamma_2 g(n_2) = b + \kappa[1 + \beta(1 - 2\pi)] \quad (14)$$

4. Wages in all high and low productivity occupations are given by  $\gamma_2 g(n_2)$  and  $b$  respectively.
5. In equilibrium the average reallocation  $r$  is given by:

$$r = (n_2 - \bar{l})(1 - \pi) \quad (15)$$

where  $n_2$  is determined in (14).

6. "Rest" unemployment occurs only in low productivity occupations and the average number of workers experiencing rest unemployment in low productivity occupations is given by:

$$u_1 = 2\bar{l} - n_2 - n_1 \quad (16)$$

where  $n_1$  and  $n_2$  are determined in (6) and (14) respectively.

7. Total unemployment, defined by the sum of average reallocation and rest unemployment, is given by:

$$TU = r + u_1/2 \quad (17)$$

where  $r$  and  $u_1$  are determined in (15) and (16) respectively.

## 2.2 Comparative Statics

There are seven parameters in this model:  $\{b, \kappa, \beta, \pi, \gamma_1, \gamma_2, \bar{l}\}$ . To see the effects of these parameter changes on the equilibrium allocations, we start by examining their effects on employment levels in low productivity occupations,  $n_1$ . From (7) we have:

$$dn_1 = \frac{h'(b/\gamma_1)}{\gamma_1} db - \frac{bh'(b/\gamma_1)}{\gamma_1^2} d\gamma_1 \quad (18)$$

Clearly, from (18), only two of the parameters affect  $n_1$ : benefits  $b$  and productivity levels in low productivity occupations,  $\gamma_1$ . The independence of  $n_1$  from all of the other parameters comes from the maintained assumption that parameters are configured such that equilibrium wages in low productivity occupations

in the absence of benefits would be lower than benefit levels. This implies that, in the presence of benefits, wages in low productivity occupations are equal to those benefits. The value of  $n_1$  is determined, therefore, purely by the condition that the marginal product of labor in those occupations is equal to  $b$ , as in (6).

Considering the effects of  $b$  and  $\gamma_1$  on  $n_1$  separately we have, from (18):

$$\frac{\partial n_1}{\partial b} = \frac{h'(b/\gamma_1)}{\gamma_1} < 0 \quad (19)$$

$$\frac{\partial n_1}{\partial \gamma_1} = -\frac{bh'(b/\gamma_1)}{\gamma_1^2} > 0 \quad (20)$$

Intuitively, with diminishing marginal returns (i.e.  $h' < 0$ ), when the marginal product of labor is equal to benefit levels, an increase in benefit levels implies lower employment levels in low productivity occupations. Increases in the productivity level of low productivity occupations, however, allows for higher employment levels at the same marginal product.

To see the effects of parameter changes on employment levels in high productivity locations, we differentiate (14), the condition that determines the equilibrium value of  $n_2$ :

$$dn_2 = \frac{db + [1 + \beta(1 - 2\pi)]d\kappa + \kappa(1 - 2\pi)d\beta - 2\kappa\beta d\pi - g(n_2)d\gamma_2}{\gamma_2 g'(n_2)}. \quad (21)$$

Considering individual changes, from (21) we have:

$$\frac{\partial n_2}{\partial b} = \frac{1}{\gamma_2 g'(n_2)} < 0 \quad (22)$$

$$\frac{\partial n_2}{\partial \kappa} = \frac{1 + \beta(1 - 2\pi)}{\gamma_2 g'(n_2)} < 0 \quad (23)$$

$$\frac{\partial n_2}{\partial \beta} = \frac{\kappa(1 - 2\pi)}{\gamma_2 g'(n_2)} > 0 \quad (24)$$

$$\frac{\partial n_2}{\partial \pi} = -\frac{2\kappa\beta}{\gamma_2 g'(n_2)} > 0 \quad (25)$$

$$\frac{\partial n_2}{\partial \gamma_1} = 0 \quad (26)$$

$$\frac{\partial n_2}{\partial \gamma_2} = -\frac{g(n_2)}{\gamma_2 g'(n_2)} > 0 \quad (27)$$

$$\frac{\partial n_2}{\partial \bar{l}} = 0 \quad (28)$$

Intuitively, increases in benefits  $b$  make staying in one's current occupation, when it is experiencing low productivity, more attractive – so fewer workers choose to move to high productivity occupations. Similarly, increases in moving costs  $\kappa$  discourages movement to higher productivity occupations. Increases in the discount factor  $\beta$  make the investment in moving to high productivity occupations more lucrative in present value terms – inducing more movement. Increases in the persistence parameter  $\pi$  imply that low productivity occupations are more likely to stay low (and high productivity occupations are more likely to stay high) in the future, which makes movement to high productivity occupations more attractive. Increases in the productivity level of low productivity occupations  $\gamma_1$  have no effect on employment levels in high productivity occupations, as long as all workers in low productivity occupations earn the same amount as before the change, which they do in this equilibrium: each worker in each low productivity occupation earns the amount  $b$ . Increases in the productivity level of high productivity occupations  $\gamma_2$  increase wages, inframarginally, which induces movement into these occupations, to drive wages in those occupations down to their original levels. Finally, increases in average population levels have no effect on employment levels in high productivity occupations, in this stationary equilibrium, as long as they do not

affect the wages in low productivity occupations – which they do not in this equilibrium (they are equal to  $b$ ). In this equilibrium, higher population levels will affect the number of workers in low productivity occupations only.

To see how reallocation changes as the parameters change, we differentiate (15):

$$dr = (1-\pi) \left( \frac{\partial n_2}{\partial b} db + \frac{\partial n_2}{\partial \kappa} d\kappa + \frac{\partial n_2}{\partial \beta} d\beta + \frac{\partial n_2}{\partial \gamma_2} d\gamma_2 + \frac{\partial n_2}{\partial \pi} d\pi \right) - (n_2 - \bar{l}) d\pi - (1-\pi) d\bar{l} \quad (29)$$

Substitution of (22), (23), (24), (27), and (25) into the above expression gives us:

$$dr = \frac{1-\pi}{\gamma_2 g'(n_2)} \{ db + [1 + \beta(1-2\pi)] d\kappa + \kappa(1-2\pi) d\beta - g(n_2) d\gamma_2 - 2\kappa\beta d\pi \} - (n_2 - \bar{l}) d\pi - (1-\pi) d\bar{l} \quad (30)$$

Examining, now, the effects of these changes upon rest unemployment  $u_1$ , we differentiate (16):

$$du_1 = 2d\bar{l} - dn_2 - dn_1 \quad (31)$$

Now, using (18) and (21), we have:

$$du_1 = 2d\bar{l} - \frac{db + [1 + \beta(1-2\pi)] d\kappa + \kappa(1-2\pi) d\beta - 2\kappa\beta d\pi - g(n_2) d\gamma_2}{\gamma_2 g'(n_2)} - \frac{h'(b/\gamma_1)}{\gamma_1} db + \frac{bh'(b/\gamma_1)}{\gamma_1^2} d\gamma_1 \quad (32)$$

Finally, to find the effects on total unemployment, we differentiate (17)

$$dTU = dr + du_1/2 \quad (33)$$

Using (30) and (32) we find:

$$\begin{aligned}
dTU = & \frac{1 - \pi}{\gamma_2 g'(n_2)} \{ db + [1 + \beta(1 - 2\pi)] d\kappa + \kappa(1 - 2\pi) d\beta - g(n_2) d\gamma_2 - 2\kappa\beta d\pi \} \\
& - (n_2 - \bar{l}) d\pi + \pi d\bar{l} - \frac{h'(b/\gamma_1)}{2\gamma_1} db + \frac{bh'(b/\gamma_1)}{2\gamma_1^2} d\gamma_1 \\
& - \frac{db + [1 + \beta(1 - 2\pi)] d\kappa + \kappa(1 - 2\pi) d\beta - 2\kappa\beta d\pi - g(n_2) d\gamma_2}{2\gamma_2 g'(n_2)}
\end{aligned} \tag{34}$$

### 2.3 The Effects of the Hartz Reforms

Generally speaking, there were three major initiatives in the Hartz reforms. In the first initiative training measures provided by the FEA were realigned, because subsidized training in Germany was considered to be very costly but ineffective (Fitzenberger, 2008). This change included measures that orientate towards labor demand, where caseworkers carefully select people for training (cream-skimming, with a target reemployment rate of 70 percent of the participants) and where the average duration of the measures were shortened to prevent lock-in effects<sup>7</sup>. To sum up, training was improved by enhancing the quality of training, which should result in higher reallocation of workers. In the model, this is represented by a decrease in the cost of moving,  $\kappa$ . The second change was aimed at improving the efficiency of the placement process of the Federal Employment Agency (FEA). By reorganization of the responsibilities in the public employment services, a reduction in the number of unemployed workers per job adviser was achieved. Arguably, this helped workers receive more appropriate job offers. In the model, this means, once again,  $\kappa$  is reduced. The third initiative consolidated unemployment assistance for long-term unemployed and social assistance benefits to means-tested unemployment benefit (UB II), besides insurance-based unemployment benefit (UB I) which was mainly unchanged. Overall, that led to a reduction in the average level of unemployment benefits  $b$ .

We now consider each of these effects, in turn, using the model.

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<sup>7</sup>For a comprehensive outline see Kruppe and Lang (2014).

### 2.3.1 Training Subsidies and Improvements in the FEA

Both the change in training subsidies and the improvements in the placement process of the FEA reduce the cost of moving,  $\kappa$ , in this model. To see how these effects, together (but in isolation from other effects), change reallocation, rest unemployment, and total unemployment, we hold all of the parameters fixed, except for  $\kappa$  in (30), (32), and (34) respectively:

$$\frac{\partial r}{\partial \kappa} = \frac{(1 - \pi) [1 + \beta(1 - 2\pi)]}{\gamma_2 g'(n_2)} < 0 \quad (35)$$

$$\frac{\partial u_1}{\partial \kappa} = -\frac{[1 + \beta(1 - 2\pi)]}{\gamma_2 g'(n_2)} > 0 \quad (36)$$

$$\frac{\partial TU}{\partial \kappa} = \frac{(1/2 - \pi) [1 + \beta(1 - 2\pi)]}{\gamma_2 g'(n_2)} > 0 \quad (37)$$

Thus, the training subsidies and improvements in the placement process (by *reducing* moving costs) increase reallocation and reduce rest unemployment. These effects are both very intuitive: with moving costs reduced, more workers choose to move – reallocate – and, consequently, fewer workers choose to stay in their current occupations for rest unemployment, and collect benefits when times are bad for their current occupation. These effects work in opposite directions on total unemployment, but the downward pressure of rest unemployment outweighs the effect on reallocation, so total unemployment falls.

### 2.3.2 Reducing the Unemployment Benefits

To see the effects of a reduction in  $b$  upon reallocation, rest unemployment, and total unemployment, we hold all of the parameters fixed, except for  $b$ , in (30), (32), and (34) respectively:

$$\frac{\partial r}{\partial b} = \frac{1 - \pi}{\gamma_2 g'(n_2)} < 0 \quad (38)$$

$$\frac{\partial u_1}{\partial b} = -\frac{1}{\gamma_2 g'(n_2)} - \frac{h'(b/\gamma_1)}{\gamma_1} > 0 \quad (39)$$

$$\frac{\partial TU}{\partial b} = \frac{1/2 - \pi}{\gamma_2 g'(n_2)} - \frac{h'(b/\gamma_1)}{2\gamma_1} > 0 \quad (40)$$

Intuitively, a reduction in unemployment benefits makes rest unemployment less attractive in an occupation hit by hard times – so fewer workers stay and more workers choose to relocate themselves to more productive occupations. Once again, these effects work in opposite directions on total unemployment, but the downward pressure of rest unemployment outweighs the effect on reallocation, so total unemployment falls.

### 2.3.3 The Overall Effects of the Hartz Reforms

According to this theory the expected effects of all three of the major Hartz reform initiatives would be to *increase* reallocation and *decrease* both rest unemployment and total unemployment. Improved training subsidies, enhanced efficiency of the FEA, and reductions in unemployment benefits all have the same qualitative effects on these economic variables.

## 2.4 The Effects of the GFC

The GFC can be represented, in this model, by a reduction in both  $\gamma_1$  and  $\gamma_2$ . Examining their effects individually we find, from (30), (32), and (34):

$$\frac{\partial r}{\partial \gamma_1} = 0 \quad (41)$$

$$\frac{\partial r}{\partial \gamma_2} = -\frac{(1-\pi)g(n_2)}{\gamma_2 g'(n_2)} > 0 \quad (42)$$

$$\frac{\partial u_1}{\partial \gamma_1} = \frac{bh'(b/\gamma_1)}{\gamma_1^2} < 0 \quad (43)$$

$$\frac{\partial u_1}{\partial \gamma_2} = \frac{g(n_2)}{\gamma_2 g'(n_2)} < 0 \quad (44)$$

$$\frac{\partial TU}{\partial \gamma_1} = \frac{bh'(b/\gamma_1)}{2\gamma_1^2} < 0 \quad (45)$$

$$\frac{\partial TU}{\partial \gamma_2} = \frac{[1-2(1-\pi)]g(n_2)}{2\gamma_2 g'(n_2)} < 0 \quad (46)$$

Changes in  $\gamma_1$  play no role in the determination of reallocation because reallocation is driven by wage differentials, which are independent of  $\gamma_1$ . (In equilibrium the wage in low productivity occupations is equal to the benefit payment  $b$ , and the

wage in high productivity occupations is given by (14) which is also independent of  $\gamma_1$ .) The value of  $\gamma_2$ , however, does affect reallocation – any decrease in  $\gamma_2$  reduces the incentive to move to high productivity occupations and reduces reallocation levels. Rest unemployment is increased by any reduction in  $\gamma_1$  because, given the equilibrium wage  $b$  in low productivity occupations, a reduction in  $\gamma_1$  requires a lower level of employment in those occupation, to maintain the existing equilibrium wage. Thus, when  $\gamma_1$  falls, although the same number of workers remain in low productivity occupations, fewer of them are employed. A reduction in  $\gamma_2$  also increases rest unemployment, because it reduces the incentive for workers to move out of low productivity occupations and, given that the employment level in low productivity occupations is determined purely by (7), more workers experience rest unemployment. Total unemployment increases when  $\gamma_1$  falls, since reallocation is unchanged but rest unemployment increases. When  $\gamma_2$  falls, this reduces reallocation but increases rest unemployment. These two effects push total unemployment in opposite directions. However, given that  $\pi > 1/2$ , the second effect is stronger than the first, and total unemployment increases as  $\gamma_2$  falls.

## 2.5 The Reallocation Puzzle and the German Miracle

Let us now consider the conditions, in this model, under which the German miracle and the reallocation puzzle can exist and co-exist.

### 2.5.1 GFC Neutralization of the Hartz Reform Effects on Reallocation

When we compare the effects of changes in  $\gamma_2$  on reallocation, in (42), with the effects of changes in  $b$  and  $\kappa$  on reallocation, in (38) and (35) respectively, it is clear that, qualitatively, changes in  $\gamma_2$  move reallocation in precisely the opposite direction to those of changes in  $b$  and  $\kappa$ . Thus, in principle, it is possible for a drop in  $\gamma_2$  to offset, to some degree, the effects of the Hartz reforms on reallocation. Since, empirically, reallocation did not change significantly over the period, it is useful to identify the fall in  $\gamma_2$  that would exactly offset the effects of the reform.

To do this, we set  $dr = 0$  in (30), set  $d\beta = d\pi = d\bar{l} = 0$ , and solve for  $d\gamma_2$  in terms of  $db$  and  $d\kappa$ :

$$d\gamma_2 = \frac{db + [1 + \beta(1 - 2\pi)]d\kappa}{g(n_2)} \quad (47)$$

Re-writing this, and remembering that the wage in high productivity occupations  $w_2 = \gamma_2 g(n_2)$ , we get:

$$\frac{d\gamma_2}{\gamma_2} = \frac{db + [1 + \beta(1 - 2\pi)]d\kappa}{w_2} \quad (48)$$

This gives us the percentage reduction in  $\gamma_2$  required to exactly offset the Hartz reform effects on reallocation.

### 2.5.2 Hartz Reform Neutralization of GFC Effects on Unemployment

It is clear, from (37), (40), (45) and (46) that the Hartz reforms and the GFC also move total unemployment in opposite directions. Thus, it is possible in principle for the Hartz reforms to offset the effect of the GFC on total unemployment.

To consider what happens to total unemployment when the GFC is neutralizing the Hartz reform effects on reallocation, we can substitute (47) into (34), and set  $d\beta = d\pi = d\bar{l} = 0$ , to get:

$$dTU = \frac{h'(b/\gamma_1)[bd\gamma_1 - \gamma_1 db]}{2\gamma_1^2} \quad (49)$$

Thus:

$$dTU \leq 0 \quad \text{iff} \quad \frac{d\gamma_1}{\gamma_1} \geq \frac{db}{b} \quad (50)$$

That is, if the GFC neutralizes the effects of the Hartz reform on reallocation, then total unemployment will rise or fall, depending on the relative percentage declines in the productivity of low productivity occupations and unemployment benefits. In particular, if the percentage decline in benefits is *equal* to the percentage decline in the productivity of low productivity occupations, then total unemployment will not change when the GFC hits. In this case, the German miracle and the reallocation puzzle co-exist.

## 3 Parameterization

The key conditions in the analysis are (48) and (50). To assess whether or not (48) held in the German economy over the period, we must estimate the right

hand side of this equation, and compare its value with the observed fall in the productivity of high productivity occupations due to the GFC. To parameterize the equation, we need information on the change in unemployment benefits ( $db$ ), the change in moving costs ( $d\kappa$ ), the discount factor ( $\beta$ ), the persistence parameter of the Markov process ( $\pi$ ), the wage level of high productivity occupations ( $w_2$ ), and the percentage productivity fall of high productivity occupations ( $d\gamma_2/\gamma_2$ ). To assess (50) we need information on the percentage fall of the productivity of low productivity occupations ( $d\gamma_1/\gamma_1$ ) and the percentage fall of unemployment benefits ( $db/b$ ).

To measure the change in the level of unemployment benefits, we follow existing studies that evaluate the impact of the Hartz reforms. However there is more dissent than consensus in the calibration of this parameter and its impact in the reduction of the unemployment rate. While Krause and Uhlig (2012) find that the reduction of unemployment benefits account for a drop of 2.8 percentage points in unemployment, Krebs and Scheffel (2013) find that the effect amounts rather to 1.4 percentage points and Launov and Wälde (2013) find a very low impact of 0.3 percentage points. As pointed out by Launov and Wälde (2013), this range is caused by the calibration of the unemployment benefit cut: the stronger the cut, the higher the impact of the unemployment benefit reduction<sup>8</sup>. They conclude that "modest numbers of an average benefit reduction under 10 percent [...] appear empirically more convincing than the assumption of extreme cuts" (Krause and Uhlig, 2012, p. 26). Following this conclusion, we set the reduction in unemployment benefits to 0.10 which yields a reduction in the unemployment level of 2185 Euros (in real terms).

To proxy moving costs, we use data about the average training costs per participant spent by the FEA<sup>9</sup>. We use the costs spent on "further occupational training" as training measures within this category typically aim at providing unemployed workers with further skills or even a (new) vocational degree, and hence, have an impact on the workers' possibilities to reallocate across occupations. First of

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<sup>8</sup>Krebs and Scheffel (2013) assume a reduction about 11 percentage points from 0.57 to 0.46, Launov and Wälde (2013) find a reduction of 7 percentage points and Krause and Uhlig (2012) use cuts ranging between 70 and 30 percent.

<sup>9</sup>Thank you to Jan-Frederik Groth for providing us with the data on the expenditures for "further occupational training". The average number of participants in further occupational training is from the Statistic Service of the FEA.

all, we calculate the inverse of the average training costs per participant because we assume that the more money per participant is spent by the FEA, the lower the moving costs for the unemployed. Afterwards we calculate the change of this measure from peak to trough which implies that moving costs decreased about 30 percent. Afterwards we multiply the change in moving costs by the average amount of money spent per participant by the FEA<sup>10</sup>. This gives us the level change in moving costs  $d\kappa$ , which amounts to 1738 Euros (in real terms).

For the average wage in high productivity occupations, we use the Sample of Integrated Employment Biographies (SIAB, provided by the IAB) and calculate the average real wage of every 2-digit occupation (according to the German occupational classification KldB88). Because in the model, the wage in the low productivity occupation is defined to be equal to unemployment benefits, we use this feature and set the cutoff between high and low productivity regions according to the level of unemployment benefits. In detail, we use the unemployment benefit level and define an occupation to be low productivity if the average occupation wage is below the unemployment benefit level more than once during the observation period from 2000 to 2010. Occupations above that threshold are considered to be high productivity and the average wage over all of these high productivity occupations (35,518 Euros) is used to calibrate  $w_2$ .

The occupations which are found to be low productivity serve as an estimate for the switching probability in the Markov process. As most of the occupations are not below the threshold the whole time, we calculate how often we observe that an occupation switches between high and low and vice versa<sup>11</sup>. This share amounts to approximately 6.45 percent, such that we set  $\pi$  to  $1 - 0.0645 = 0.9355$ .

The discount factor is set to 0.9625 which corresponds to an average interest rate on long-term government bonds of 3.9 percent. For information on the data see Appendix B.

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<sup>10</sup>This indirectly assumes that an individual would pay the same amount of money as the FEA pays for a measure.

<sup>11</sup>For this exercise we use data that reach back to 1980.

## 4 Results

### 4.1 Explaining the Reallocation Puzzle

Using the above parameter estimates in (48) yields the following result:

$$\frac{d\gamma_2}{\gamma_2} = \frac{db + [1 + \beta(1 - 2\pi)]d\kappa}{w_2} \quad (51)$$

$$\frac{d\gamma_2}{\gamma_2} = \frac{-2.185 + [1 + 0.9625(1 - 2 \cdot 0.9355)] \cdot (-1738)}{35,518} \quad (52)$$

$$= -0.0684 \quad (53)$$

Thus, according to this model and data, in order to offset the effects of the Hartz reforms, a drop in the productivity (of high productivity occupations) of about 6.8 percent would be necessary. Empirically, the overall drop in productivity during the crises amounts to approximately 6.3 percent. This implies that under this parametrization, the GFC almost exactly offsets the effects of the Hartz reforms on reallocation.

Regarding the relative importance of the reduction in unemployment benefits vs. moving costs, it is clear that the main driver is the unemployment reduction. 90 percent of our result is induced by the reduction in unemployment benefits, while only 10 percent is induced by the reduction in moving costs. While the reduction in moving costs per se is not inconsiderable, the fact that the probability of switching from high to low productivity is fairly small, provides hardly any incentive for workers to move. Hence, moving is a rare event which relativizes the impact of a reduction in moving costs.

### 4.2 Explaining the German Miracle

One interpretation of the path of the unemployment rate in Figure 1 is that, post-2005, the Hartz reforms were reducing the rate along a steady secular path that was interrupted by the GFC in 2008. Thus, over the period of 2005-2010, the unemployment rate fell overall. The interpretation of the long secular decline is supported by the fact that the unemployment rate fell further after 2010, dropping below 7 percent by 2012. Arguably, then, if it were not for the ongoing effects of the Hartz reforms, the GFC would have increased the unemployment rate from

2008-2010. According to this view, the miracle itself was due to the long run effects of the reforms offsetting the short run rise due to the GFC.

Condition (50) identifies circumstances under which the overall effect on unemployment is negative, taking into account the fact that reallocation has not changed significantly over the period. Over the period 2005-2010, unemployment fell. According to (50), this can occur only if the percentage drop in the productivity of low productivity occupations is smaller than the percentage drop in the value of unemployment benefits. If we assume that the productivity of all occupations dropped by the same percentage (6.3 percent)<sup>12</sup>, then the observed 16.7 percent reduction in unemployment benefits meets this criterion. Thus, in percentage terms, unemployment benefits fell by approximately twice as much as needed to offset the effects of the GFC.

## 5 Robustness

### 5.1 Changes in Unemployment Benefits

As an alternative to the suggestion of Launov and Wälde (2013), we use data from the DICE (Database for Institutional Comparisons in Europe) (2013) that reports the average net unemployment benefit replacement rate in the period 2001 to 2010. The net replacement rate is defined as "the fraction of current or potential income which the social system provides to a person if he or she does not work. It varies according to the type of household, employee, sector of industry, wage and salary group and the reasons for not working." (CESifo, 2005, p. 81). Following this definition, the average net unemployment benefit replacement rate is calculated over different family types, wage levels etc.. According to this data, the average net unemployment benefit replacement rate in the period 2001 to 2010 dropped from about 60 to 44 percent. This was a drop of approximately 26.7 percent relative to the benefits and a 16.0 percent drop relative to the average wage. We multiply the drop of 16 percentage points with the average annual wage before 2005 to receive a measure for the drop in the level of unemployment benefits *db*. In real terms, the drop amounts to 3495 Euros on average per year. For our result, this implies that a reduction of 10.6 percent would have been necessary to

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<sup>12</sup>See Appendix C for more information regarding this assumption.

offset the effects of the Hartz reforms on reallocation and that the unemployment benefits fell by approximately four times as much as needed to offset the effects of the GFC on unemployment.

## 5.2 High vs. Low Productivity

Whether an occupation is considered as high or low productivity crucially depends on how the cutoff is set and on how often the average occupational wage falls below that threshold over time (here 1980-2010). In the last section, we set the cutoff such that it is equivalent to the level of unemployment benefits and considered all occupations to be low skilled that fall below this threshold more than once during the observation period.

Another possibility is to define an occupation to be low productivity whenever more than 50 percent of the observations are below the cutoff. Under this specification fewer occupations are low productivity and  $w_2$  is lower than before (34,673 compared to 35,518). According to that, the productivity drop amounts to  $-0.0711$ , which is more significant smaller than in the baseline specification.

Yet another possibility is to change the cutoff. For instance, we define occupations to have a high productivity when they show an average occupational wage that is twice as high as the unemployment benefit level. Assuming further, that occupations have to show an average occupational wage more than once during the observation period, we get that  $w_2 = 44,799$  Euros. Assuming that they have to be above this cutoff for at least more than 50 percent of the time, we get that  $w_2 = 54,416$  Euros. This results in a change for  $\gamma_2$  that amounts to  $-0.0550$  and  $-0.0453$ , which is less significant than in the baseline specification.

## 5.3 Moving Costs

In the model, the costs of moving summarize the direct and indirect costs of moving. Direct costs are, for instance, training fees or books, whereas the indirect cost can be interpreted as the additional time that the reallocation process adds to a period of unemployment. As unemployed workers in Germany get training subsidized by the FEA agency, one might argue that the costs, that are taken into account by workers refers to the indirect component. From Bauer (2015) we know that people that switch occupations through unemployment spend 27 to

50 percent longer in unemployment than people that return to same occupations and that workers who stay in their occupation are unemployed for about 148 days during the observation period. Using these two facts and multiplying by the average unemployment level before 2005, we get a measure for the change in indirect moving costs, which range from 1180 (27 percent longer) to 2185 (50 percent longer) Euros. Using the indirect instead of the direct costs of moving in our calculations, shows, that the percentage drop in productivity would need to be -6.69 and -7.15 percent, respectively.

## 5.4 Markov Switching Probability

We calculated the switching probability by using the occupations that are defined to have a low productivity. However this has some shortcomings. The probability also depends on the definition of a low productivity occupation, i.e. whether low productivity means being below the cutoff more than once during the observation period or being below the threshold for more than 50 percent of the time. Another possibility to set this parameter is to estimate an AR-process of the yearly average wage and set the probability  $\pi$  such that the variance and autocovariance of the Markov chain matches the empirical moments of the AR process (Kopecky and Suen, 2010).

$$\sigma_{AR}^2 = \frac{\sigma_\epsilon^2}{1 - \rho^2} = z^2 = \sigma_{MC}^2 \quad (54)$$

$$E_{AR}(\Delta w_t \Delta w_{t-1}) = \rho \frac{\sigma_\epsilon^2}{1 - \rho^2} = (2\pi - 1)z^2 = E_{MC}(\Delta w_t \Delta w_{t-1}) \quad (55)$$

The SIAB data allows us to construct a time series for yearly wages from 1980 to 2010. Estimation of an AR(1)-process with drift and controls for the reunion period (we use a dummy variable for the period from 1990-1993) yields a significant coefficient for the autocorrelation of 0.8781<sup>13</sup>. Hence, the persistence parameter is as follows:

$$\pi = \frac{1 + \rho}{2} \pi = \frac{1 + 0.8781}{2} = 0.9391 \quad (56)$$

This persistence parameter is very similar to what we used so far and leads to

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<sup>13</sup>Augmented Dickey-Fuller tests indicate that the series has a trend and a drift, which we control for in the regression.

slightly lower results for the drop in productivity (-0.0691).

## 6 Conclusion

While some papers about the "German labor market miracle" argue that the relatively mild reaction of unemployment is largely due to the flexibilities in the intensive margin that led to labor hoarding (e.g. Burda and Hunt (2011); Möller (2010)), other studies argue that wage moderation and the transition to a new (higher) employment level induced by the Hartz reforms were the main driver (Boysen-Hogrefe et al., 2010; Boysen-Hogrefe and Groll, 2010). Our findings are in line with the latter studies as we argue that the secular decline in unemployment was interrupted by the GFC. Our model abstracts from the relative role of the intensive margin during the GFC but does capture the role of wage moderation. The wage moderation leads to a relatively stable wage before and after the Hartz reforms. In our model, this implies that the shock in productivity that is necessary to offset the Hartz reforms is large and thus the reforms were not offset fully. Put differently, in the absence of wage moderation, a smaller shock would have been enough to offset the Hartz reforms, and the shock would not have just slowed down reallocation but probably had an increasing effect on unemployment<sup>14</sup>.

Studies that evaluate the impact of the Hartz reforms typically emphasize the role of the reduction in unemployment benefits (Krause and Uhlig, 2012) and the role of the improvement in the efficiency of the FEA (Launov and Wälde, 2013). Our model has similar implications, as the relative importance of the reduction in moving costs is rather limited compared to the reduction in unemployment benefits. In contrast to the existing literature, our study uses a Lucas and Prescott (1974) island model<sup>15</sup>. The model has the advantage that it explicitly addresses structural unemployment, which was the kind of unemployment the Hartz reforms aimed to reduce. To the best of our knowledge, this is the first study that argues that the link between the Hartz reforms and the GFC can be seen by less mobility

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<sup>14</sup>In the absence of wage moderation, the wage level in the economy would have been higher in the second half of the period under consideration, which increases the denominator in equation (48) and reduces the change in  $\gamma_2$ .

<sup>15</sup>Other studies use search models according to Ljungqvist and Sargent (1998) or search and matching models à la Diamond-Mortensen-Pissarides Diamond (1982a,b); Mortensen (1982a,b); Pissarides (1985); Mortensen and Pissarides (1994).

in the labor market across occupations.

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## References

- Alvarez, F. and Shimer, R. (2011). Search and rest unemployment. *Econometrica*, 79(1):75–122.
- Bachmann, R. and Burda, M. C. (2010). Sectoral transformation, turbulence and labor market dynamics in Germany. *German Economic Review*, 11(1):37–59.
- Bauer, A. (2013). Mismatch unemployment: Evidence from Germany, 2000-2010. *IAB-Discussion Paper*, 2013(10):35.
- Bauer, A. (2015). Reallocation patterns across occupations. *IAB-Discussion Paper*, 2015(26):38.
- Boysen-Hogrefe, J. and Groll, D. (2010). The German labour market miracle. *National Institute Economic Review*, 214(1):R38–R50.
- Boysen-Hogrefe, J., Groll, D., Lechthaler, W., and Merkl, C. (2010). The role of labor market institutions in the Great Recession. *Applied Economics Quarterly (formerly: Konjunkturpolitik)*, 61(Supplement):65–88.
- Bundesbank (2015). Time series BBK01.WT1010: Daily yield of the current 10 year federal bond.
- Burda, M. C. and Hunt, J. (2011). What explains the German labor market miracle in the Great Recession? *Brookings Papers on Economic Activity*, 2011(1):273–319.
- CESifo (2005). Net replacement rates. *DICE Report*, 3(1):81–82.
- Diamond, P. A. (1982a). Aggregate demand management in search equilibrium. *The Journal of Political Economy*, 90(5):881–894.
- Diamond, P. A. (1982b). Wage determination and efficiency in a search equilibrium. *The Review of Economic Studies*, 49(2):217–227.
- DICE (Database for Institutional Comparisons in Europe) (2013). Net replacement rates for different family types: Initial phase of unemployment, 2001 - 2011. Ifo Institute, Munich.

- Fitzenberger, B. (2008). Nach der Reform ist vor der Reform? Eine arbeitsökonomische Analyse ausgewählter Aspekte der Hartz-Reformen. *ZEW Discussion Papers*, 08-011(rev):34.
- Gouge, R. and King, I. (1997). A competitive theory of employment dynamics. *The Review of Economic Studies*, 64(1):1–122.
- Jacobi, L. and Kluve, J. (2007). Before and after the Hartz reforms: The performance of active labour market policy in Germany. *Journal for Labour Market Research*, 40(1):45–64.
- Jovanovic, B. (1987). Work, rest, and search: Unemployment, turnover, and the cycle. *Journal of Labor Economics*, 5(2):131–148.
- Jung, P. and Kuhn, M. (2014). Labour market institutions and worker flows: comparing Germany and the US. *The Economic Journal*, 124(581):1317–1342.
- King, I. P. (1990). A natural rate model of frictional and long-term unemployment. *Canadian Journal of Economics*, 23(3):523–545.
- Kopecky, K. A. and Suen, R. M. (2010). Finite state markov-chain approximations to highly persistent processes. *Review of Economic Dynamics*, 13(3):701–714.
- Krause, M. U. and Uhlig, H. (2012). Transitions in the German labor market: Structure and crisis. *Journal of Monetary Economics*, 59(1):64–79.
- Krebs, T. and Scheffel, M. (2013). Macroeconomic evaluation of labor market reform in Germany. *IMF Economic Review*, 61(4):664–701.
- Krugman, P. (2009). Free to lose. *The New York Times*, November 12th. Retrieved from [http://www.nytimes.com/2009/11/13/opinion/13krugman.html?\\_r=0](http://www.nytimes.com/2009/11/13/opinion/13krugman.html?_r=0).
- Kruppe, T. and Lang, J. (2014). Labour market effects of retraining for the unemployed: The role of occupations. *IAB Discussion Paper*, 2014(20):55.
- Launov, A. and Wälde, K. (2013). Thumbscrews for agencies or for individuals? How to reduce unemployment. *IZA Discussion Paper*, 7659:37.
- Lilien, D. M. (1982). Sectoral shifts and cyclical unemployment. *Journal of Political Economy*, 90(4):777–793.

- Ljungqvist, L. and Sargent, T. J. (1998). The European unemployment dilemma. *Journal of Political Economy*, 106(3):514–550.
- Lucas, R. E. and Prescott, E. C. (1974). Equilibrium search and unemployment. *Journal of Economic Theory*, 7(2):188–209.
- Möller, J. (2010). The German labor market response in the world recession – de-mystifying a miracle. *Zeitschrift für Arbeitsmarktforschung*, 42(4):325–336.
- Mortensen, D. T. (1982a). The matching process as a noncooperative bargaining game. In McCall, J. J., editor, *The economics of information and uncertainty*, chapter 7, pages 233–258. University of Chicago Press.
- Mortensen, D. T. (1982b). Property rights and efficiency in mating, racing, and related games. *The American Economic Review*, 72(5):968–979.
- Mortensen, D. T. and Pissarides, C. A. (1994). Job creation and job destruction in the theory of unemployment. *The Review of Economic Studies*, 61(3):397–415.
- Pissarides, C. A. (1985). Short-run equilibrium dynamics of unemployment, vacancies, and real wages. *The American Economic Review*, 75(4):676–690.
- Stokey, N. L., Lucas, R. E., and Prescott, E. C. (1989). *Recursive Methods in Economic Dynamics*. Harvard University Press.
- vom Berge, P., König, M., and Seth, S. (2013). Sample of Integrated Labour Market Biographies (SIAB) 1975-2010. *FDZ-Datenreport*, 1:65.

## A Alternative Reallocation Measure

To crosscheck whether the "reallocation puzzle" holds under another measure of reallocation, we constructed Lilien's (1982) employment dispersion index across 2-digit occupations. While the measure used in the body of the paper relies on gross flows across occupations, Lilien's (1982) measure relies on net flows. To be more precise, Lilien (1982) measures the weighted sum of employment growth deviations across occupations. As can be seen in Figure 4, the intuition of the "reallocation puzzle" remains under this alternative measure.

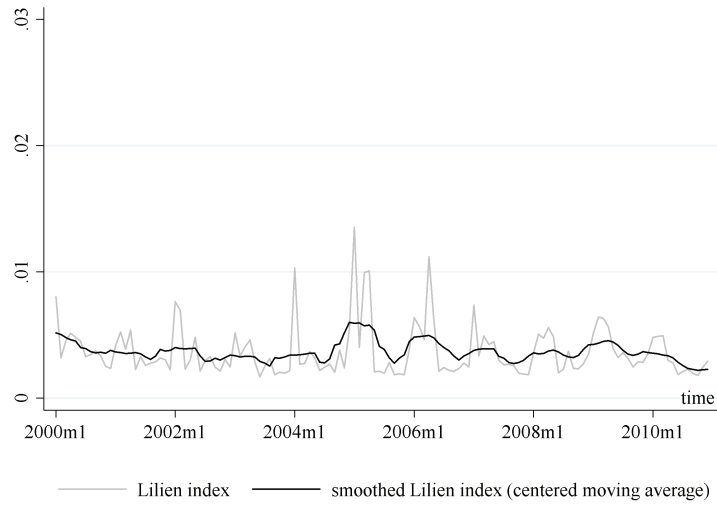


Figure 4: Alternative reallocation measure based on Lilien(1982)

## B Data Details

### Replacement Rate

The data from the the DICE (Database for Institutional Comparisons in Europe) (2013) provided by the CESifo Group Munich reports the average net unemployment benefit replacement rate in the period 2001 to 2010. In detail the measure is calculated as the average over 67 percent and 100 percent of the average worker's earnings level and for different family types (single, the only earner in

a married couple, or married to another earning person, with and without children ect.) (CESifo, 2005). The average worker corresponds to an adult full-time worker whose wage earnings are equal to the average wage earnings.

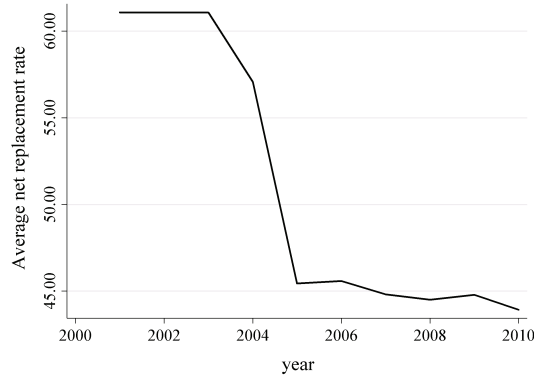


Figure 5: Average net replacement rate over time

The time series shows a decrease in the replacement rate over time from 60 to 44 percent with a substantial drop from 2003 to 2005 which reflects the effects of the Hartz reforms.

## Reallocation Costs

To measure the change in moving costs, we use the inverse of the average expenditures per participant on training measures that aim at "further occupational training" provided by the Federal Employment Agency. Afterwards we multiply this change by the average expenditure on further occupational training per participant. The measure is rather a proxy as it does not cover the expenditures of people that do training without funding of the Federal Employment Agency. Hence, the assumption behind is, that workers face the same costs the Federal Employment Agency for a training measure. As the training system was already changed in 2003, the data appears to be at odds with what we expected. The time series shows an increase in the reallocation costs around 2003/2004, and a decrease (what we would have expected) only after 2006. This might reflect that the change in the system took some time to be realized and that the instruments were not used instantaneously by the unemployed workers as supposed. Basically, the training system was reorganized by giving training vouchers to the unemployed.

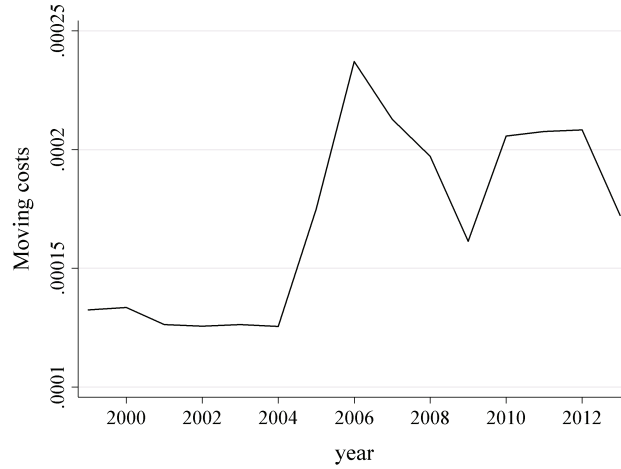


Figure 6: Reallocation costs 2000 - 2010

However, in the beginning not all of these vouchers were redeemed<sup>16</sup>. A second effect comes from the implementation of training measures with shorter durations. Typically, these measure are not as expensive but because they are shorter, more participants can do such a measure within a year. In sum, that led to a decrease in the expenditures per participant, which – given the inverse relation we employ – leads to an increase in reallocation costs.

## Wages and Occupations

We use a 2 percent sample of the social security records of the Federal Employment Agency, the so-called Sample of Integrated Employment Biographies (SIAB) to calculate wages from 1980 to 2010. See (vom Berge et al., 2013) for details on the data. We restrict the calculation to wages of full-time employees (excluding self-employed, family assistants, civil servants, regular students and trainees) and deflate them by the German consumer price index. As the wage information in these data is censored we impute wages using interval regressions that control for the workers' age and its square, firm tenure, occupational tenure, general labor market experience, education, and occupational status. We impute the wage separately for man and women, for East and West Germany, and by year. The

<sup>16</sup>Not all of the vouchers were redeemed, because e.g. workers were not sure which measure to choose or applied for measures that didn't reach a critical amount of participants (Fitzenberger, 2008, p. 15).

aggregate time series (monthly) given this procedure is as follows:

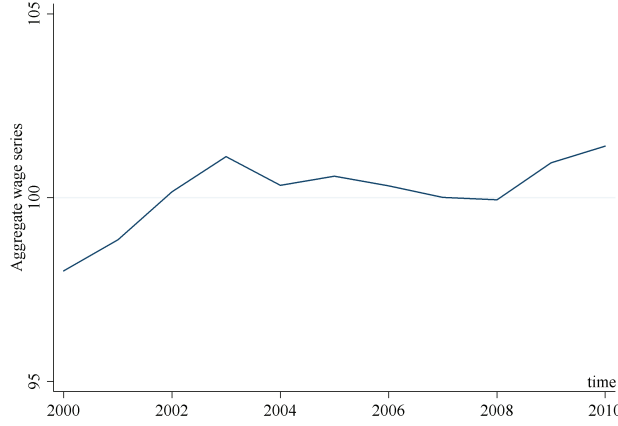


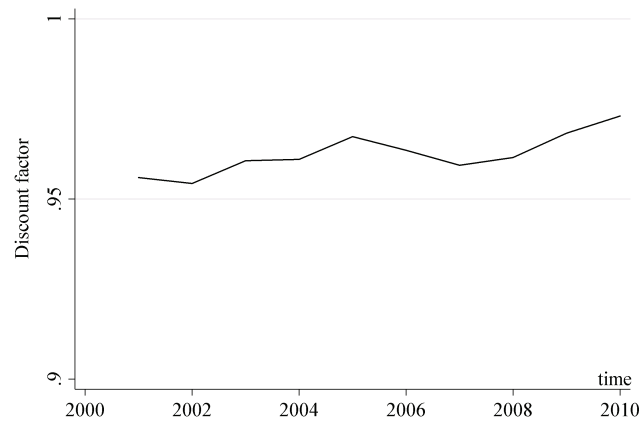
Figure 7: Wage series, 2000 - 2010, Euros, non-seasonally adjusted

Afterwards, we compress the wages by occupation and year from 1980 to 2010. An occupation refers to a 2-digit occupation according to the German occupation classification (KldB88) which covers almost 100 different occupations. We exclude occupations that show less than 20 observations on average over the period, which leaves us with 85 occupations. Under the definition that a low productivity occupation corresponds to an occupations where the average wage is below the unemployment benefit level more than once during the observation period, 5 occupations are low productivity. Under the definition that more than 50 percent of time lies underneath the threshold, only 2 occupations (namely agricultural workers and body carer) are low productivity. For the redefinition of high productivity occupations in the robustness section, it applies that 12 occupations are found to be high productivity, given that they have to be above the threshold more than once, and 27 occupation, given that they have to be above the threshold for more than 50 percent of time.

## Discount Factor

The discount factor is calculated as  $1/(1+r)$ , where  $r$  refers to the yield of the current 10 year federal bond (Bundesbank, 2015). This bond yield is available from October 2001 until recently on a daily basis. We averaged this yield to a yearly

measure which spans the period from 2001 to 2010. The average yield amounts to 3.9 percent and is decreasing over time.



Source: Bundesbank (2015), own illustration.

Figure 8: Discount factor 2001 - 2010

## C Skill Composition in Manufacturing

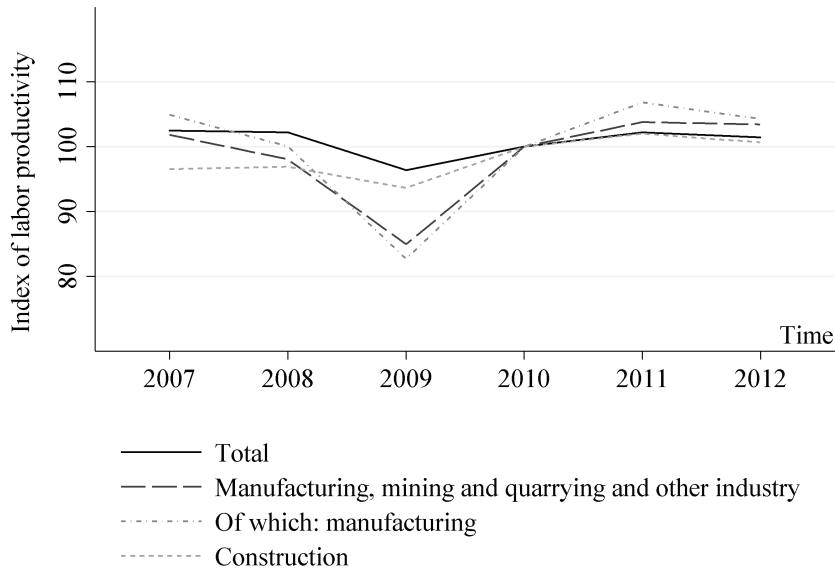


Figure 9: Labor productivity by selected sectors (NACE rev. 2 sections)

Though it is not possible with the data used so far to assess whether the assumption that the shock in high and low productivity occupations was about equal, we can shed some light on this issue by looking at sectors. A quite well-known fact is that in Germany exporting firms were hit the hardest by the GFC (Möller, 2010). Having a look at labor productivity for different sectors, it appears that manufacturing was hit the hardest (see Figure 9). However, the skill composition of the manufacturing sector is similar to the overall skill composition in Germany. The share of high skilled workers is slightly lower (one percent on average) as in the total economy, and the share of low skilled workers is slightly higher (0.7 percent on average) than in the total economy (see Figure 10 below).

Concluding, we do not find evidence against this assumption as the manufacturing industry, which was hit the hardest, is not the sector that employs a overproportionally large share of high skilled workers. The skill composition in manufacturing is similar to the skill composition in the aggregate economy. The share of high skilled workers is slightly lower and the share of low skilled workers

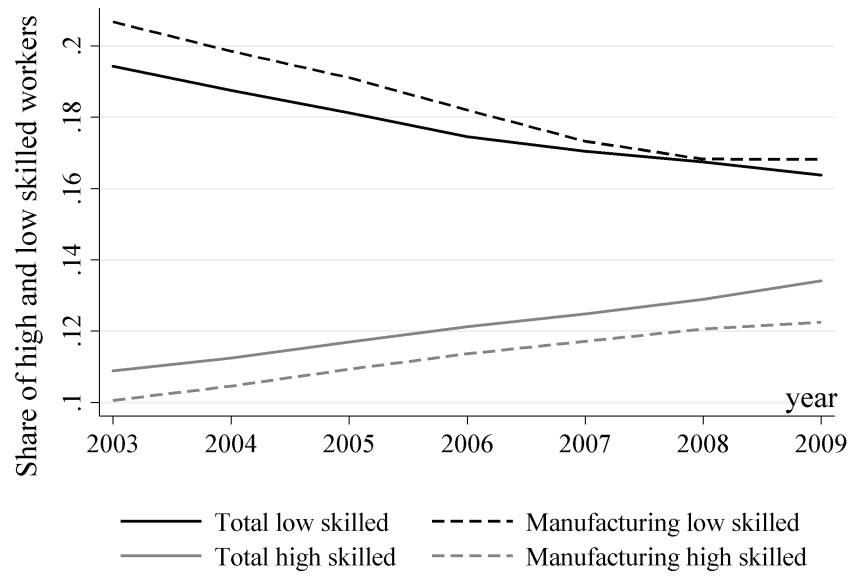


Figure 10: Share of high skilled and low skilled workers in the whole economy and the manufacturing sector

higher. However, the share of high skilled in manufacturing and the total economy track each other over time closely. The share of low skilled workers is decreasing a bit stronger during the crisis in manufacturing than in the total economy.